EPA KEY CONTACTS FORM

OMB Number: 2030-0020
Expiration Date: 06/30/2024

Authorized Representative: *Original awards and amendments will be sent to this individual for review and acceptance, unless otherwise indicated.*

Name: Prefix: First Name: Middle Name:
Last Name: Suffix:
Title:
Complete Address:
Street1:
Street2:
City: State:
Zip / Postal Code: Country:
Phone Number: **Fax Number:**
E-mail Address:

Payee: *Individual authorized to accept payments.*

Name: Prefix: First Name: Ed Middle Name:
Last Name: Willoughby Suffix:
Title: Federal Aid Coordinator
Complete Address:
Street1: P.O. Box 30473
Street2:
City: Lansing State: MI: Michigan
Zip / Postal Code: 48909-7973 Country: USA: UNITED STATES
Phone Number: 517-242-1285 **Fax Number:**
E-mail Address: willoughbye@michigan.gov

Administrative Contact: *Individual from Sponsored Programs Office to contact concerning administrative matters (i.e., indirect cost rate computation, rebudgeting requests etc).*

Name: Prefix: First Name: Lisa Middle Name:
Last Name: Root Suffix:
Title: Financial Manager
Complete Address:
Street1: P.O. Box 30473
Street2:
City: Lansing State: MI: Michigan
Zip / Postal Code: 48909-7973 Country: USA: UNITED STATES
Phone Number: 989-445-0127 **Fax Number:**
E-mail Address: rootl@michigan.gov

EPA Form 5700-54 (Rev 4-02)

EPA KEY CONTACTS FORM

Project Manager: *Individual responsible for the technical completion of the proposed work.*

Name: Prefix: | First Name: Cory | Middle Name:

Last Name: Connolly | Suffix:

Title: Climate and Energy Advisor

Complete Address:

Street1: P.O. Box 30473

Street2:

City: Lansing | State: MI: Michigan

Zip / Postal Code: 48909-7973 | Country: USA: UNITED STATES

Phone Number: 517-881-8972 | **Fax Number:**

E-mail Address: connollyc3@michigan.gov

OMB Number: 2030-0020
Expiration Date: 06/30/2024

Preaward Compliance Review Report for All Applicants and Recipients Requesting EPA Financial Assistance

Note: Read Instructions before completing form.

I. A. Applicant/Recipient (Name, Address, City, State, Zip Code)

Name: Michigan Department of Environment, Great Lakes, and Energy

Address: P.O. Box 30473

City: Lansing

State: MI: Michigan Zip Code: 48909-7973

B. Unique Entity Identifier (UEI): D1CZA6WQ2L85

C. Applicant/Recipient Point of Contact

Name: Ed Willoughby

Phone: 517-242-1285

Email: willoughbye@michigan.gov

Title: Federal Aid Coordinator

II. Is the applicant currently receiving EPA Assistance? ☒ Yes ☐ No

III. List all pending civil rights lawsuits and administrative complaints filed under federal law against the applicant/recipient that allege discrimination based on race, color, national origin, sex, age, or disability. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

EPA complaint #s 03DRr-22-R5; 01RNO-22-R5; 02RNO-22-R5; and 04R-21-R5. EGLE complaint #20-001-D

IV. List all civil rights lawsuits and administrative complaints decided against the applicant/recipient within the last year that alleged discrimination based on race, color, national origin, sex, age, or disability and enclose a copy of all decisions. Please describe all corrective actions taken. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

None

V. List all civil rights compliance reviews of the applicant/recipient conducted under federal nondiscrimination laws by any federal agency within the last two years and enclose a copy of the review and any decisions, orders, or agreements based on the review. Please describe any corrective action taken. (40 C.F.R. § 7.80(c)(3))

None

VI. Is the applicant requesting EPA assistance for new construction? If no, proceed to VII; if yes, answer (a) and/or (b) below.

☐ Yes ☒ No

a. If the grant is for new construction, will all new facilities or alterations to existing facilities be designed and constructed to be readily accessible to and usable by persons with disabilities? If yes, proceed to VII; if no, proceed to VI(b).

☐ Yes ☒ No

b. If the grant is for new construction and the new facilities or alterations to existing facilities will not be readily accessible to and usable by persons with disabilities, explain how a regulatory exception (40 C.F.R. 7.70) applies.

VII. **Does the applicant/recipient provide initial and continuing notice that it does not discriminate on the basis of race, color, national origin, sex, age, or disability in its program or activities? (40 C.F.R 5.140 and 7.95)** ☒ Yes ☐ No

a. **Do the methods of notice accommodate those with impaired vision or hearing?** ☒ Yes ☐ No

b. **Is the notice posted in a prominent place in the applicant's/recipient's website, in the offices or facilities or, for education programs and activities, in appropriate periodicals and other written communications?** ☒ Yes ☐ No

c. **Does the notice identify a designated civil rights coordinator?** ☒ Yes ☐ No

VIII. **Does the applicant/recipient maintain demographic data on the race, color, national origin, sex, age, or disability status of the population it serves? (40 C.F.R. 7.85(a))** ☒ Yes ☐ No

IX. **Does the applicant/recipient have a policy/procedure for providing meaningful access to services for persons with limited English proficiency? (Title VI, 40 C.F.R. Part 7, *Lau v Nichols* 414 U.S. (1974))** ☒ Yes ☐ No

X. **If the applicant is an education program or activity, or has 15 or more employees, has it designated an employee to coordinate its compliance with 40 C.F.R. Parts 5 and 7? Provide the name, title, position, mailing address, e-mail address, fax number, and telephone number of the designated coordinator.**

Katherine Lambeth, Nondiscrimination Compliance Coordinator
525 West Allegan St, PO Box 30473
Lansing, MI 48909
EGLE - NondiscriminationCC@michigan.gov
Phone: 517-249-0906

XI. **If the applicant is an education program or activity, or has 15 or more employees, has it adopted grievance procedures that assure the prompt and fair resolution of complaints that allege a violation of 40 C.F.R. Parts 5 and 7? Provide a legal citation or applicant's/recipient's website address for, or a copy of, the procedures.**

https://www.michigan.gov/-/media/project/Websites/egle/Documents/Policies-Procedures/Department/09-024-Nondiscrimination-EGLE-Programs.pdf

For the Applicant/Recipient

I certify that the statements I have made on this form and all attachments thereto are true, accurate and complete. I acknowledge that any knowingly false or misleading statement may be punishable by fine or imprisonment or both under applicable law. I assure that I will fully comply with all applicable civil rights statutes and EPA regulations.

A. Signature of Authorized Official	B. Title of Authorized Official	C. Date
James Garry	Federal Aid Coordinator	03/26/2024

For the U.S. Environmental Protection Agency

I have reviewed the information provided by the applicant/recipient and hereby certify that the applicant/recipient has submitted all preaward compliance information required by 40 C.F.R. Parts 5 and 7; that based on the information submitted, this application satisfies the preaward provisions of 40 C.F.R. Parts 5 and 7; and that the applicant has given assurance that it will fully comply with all applicable civil rights statures and EPA regulations.

A. *Signature of Authorized EPA Official	B. Title of Authorized Official	C. Date

Instructions for EPA FORM 4700-4 (Rev. 04/2021)

General. Recipients of Federal financial assistance from the U.S. Environmental Protection Agency must comply with the following statutes and regulations.
Title VI of the Civil Rights Acts of 1964 provides that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. The Act goes on to explain that the statute shall not be construed to authorize action with respect to any employment practice of any employer, employment agency, or labor organization (except where the primary objective of the Federal financial assistance is to provide employment). Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act provides that no person in the United States shall on the ground of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under the Federal Water Pollution Control Act, as amended. Employment discrimination on the basis of sex is prohibited in all such programs or activities. Section 504 of the Rehabilitation Act of 1973 provides that no otherwise qualified individual with a disability in the United States shall solely by reason of disability be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. Employment discrimination on the basis of disability is prohibited in all such programs or activities. The Age Discrimination Act of 1975 provides that no person on the basis of age shall be excluded from participation under any program or activity receiving Federal financial assistance. Employment discrimination is not covered. Age discrimination in employment is prohibited by the Age Discrimination in Employment Act administered by the Equal Employment Opportunity Commission. Title IX of the Education Amendments of 1972 provides that no person in the United States on the basis of sex shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance. Employment discrimination on the basis of sex is prohibited in all such education programs or activities. Note: an education program or activity is not limited to only those conducted by a formal institution. 40 C.F.R. Part 5 implements Title IX of the Education Amendments of 1972. 40 C.F.R. Part 7 implements Title VI of the Civil Rights Act of 1964, Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act, and Section 504 of The Rehabilitation Act of 1973.

Items "Applicant" means any entity that files an application or unsolicited proposal or otherwise requests EPA assistance. 40 C.F.R. §§ 5.105, 7.25. "Recipient" means any State or its political subdivision, any instrumentality of a State or its political subdivision, any public or private agency, institution, organizations, or other entity, or any person to which Federal financial assistance is extended directly or through another recipient, including any successor, assignee, or transferee of a recipient, but excluding the ultimate beneficiary of the assistance. 40 C.F.R. §§ 5.105, 7.25. "Civil rights lawsuits and administrative complaints" means any lawsuit or administrative complaint alleging discrimination on the basis of race, color, national origin, sex, age, or disability pending or decided against the applicant and/or entity which actually benefits from the grant, but excluding employment complaints not covered by 40 C.F.R. Parts 5 and 7. For example, if a city is the named applicant but the grant will actually benefit the Department of Sewage, civil rights lawsuits involving both the city and the Department of Sewage should be listed. "Civil rights compliance review" means: any federal agency-initiated investigation of a particular aspect of the applicant's and/or recipient's programs or activities to determine compliance with the federal non-discrimination laws. Submit this form with the original and required copies of applications, requests for extensions, requests for increase of funds, etc. Updates of information are all that are required after the initial application submission. If any item is not relevant to the project for which assistance is requested, write "NA" for "Not Applicable." In the event applicant is uncertain about how to answer any questions, EPA program officials should be contacted for clarification.

CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Statement for Loan Guarantees and Loan Insurance

The undersigned states, to the best of his or her knowledge and belief, that:

If any funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this commitment providing for the United States to insure or guarantee a loan, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions. Submission of this statement is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required statement shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

* APPLICANT'S ORGANIZATION

Michigan Department of Environment, Great Lakes, and Energy

* PRINTED NAME AND TITLE OF AUTHORIZED REPRESENTATIVE

Prefix: | * First Name: Ed | Middle Name:

* Last Name: Willoughby | Suffix:

* Title: Federal Aid Coordinator

* SIGNATURE: James Garry | * DATE: 03/26/2024

Other Attachment File(s)

*** Mandatory Other Attachment Filename:** 1234-ImplementingtheMIHealthyClimatePlan_StateofMi

Add Mandatory Other Attachment | Delete Mandatory Other Attachment | View Mandatory Other Attachment

To add more "Other Attachment" attachments, please use the attachment buttons below.

Add Optional Other Attachment | Delete Optional Other Attachment | View Optional Other Attachment

Project Narrative File(s)

*** Mandatory Project Narrative File Filename:** 1268-Workplan_StateofMichigan.pdf

Add Mandatory Project Narrative File | Delete Mandatory Project Narrative File | View Mandatory Project Narrative File

To add more Project Narrative File attachments, please use the attachment buttons below.

Add Optional Project Narrative File | Delete Optional Project Narrative File | View Optional Project Narrative File

OMB Number: 4040-0004
Expiration Date: 11/30/2025

Application for Federal Assistance SF-424

* 1. Type of Submission:
- [ ] Preapplication
- [x] Application
- [ ] Changed/Corrected Application

* 2. Type of Application:
- [x] New
- [ ] Continuation
- [ ] Revision

* If Revision, select appropriate letter(s):

* Other (Specify):

* 3. Date Received: 03/26/2024

4. Applicant Identifier:

5a. Federal Entity Identifier:

5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:

7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name: Michigan Department of Environment, Great Lakes, and Energy

* b. Employer/Taxpayer Identification Number (EIN/TIN): 38-6000134

* c. UEI: D1CZA6WQ2L85

d. Address:

* Street1: P.O. Box 30473
Street2:
* City: Lansing
County/Parish:
* State: MI: Michigan
Province:
* Country: USA: UNITED STATES
* Zip / Postal Code: 48909-7973

e. Organizational Unit:

Department Name:

Division Name:

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:
* First Name: Ed
Middle Name:
* Last Name: Willoughby
Suffix:

Title: Federal Aid Coordinator

Organizational Affiliation: Michigan Deptartment of Environment, Great Lakes, and Energy

* Telephone Number: 517-242-1285
Fax Number:

* Email: willoughbye@michigan.gov

Application for Federal Assistance SF-424

*** 9. Type of Applicant 1: Select Applicant Type:**

A: State Government

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

Environmental Protection Agency

11. Catalog of Federal Domestic Assistance Number:

66.046

CFDA Title:

Climate Pollution Reduction Grants

*** 12. Funding Opportunity Number:**

EPA-R-OAR-CPRGI-23-07

* Title:

Climate Pollution Reduction Grants Program: Implementation Grants (General Competition)

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

Add Attachment | Delete Attachment | View Attachment

*** 15. Descriptive Title of Applicant's Project:**

EGLE will accelerate the siting, zoning, and permitting of renewable energy through the establishment of the Renewables Ready Communities Program

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: MI-008 * b. Program/Project: MI-all

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 10/01/2024 * b. End Date: 09/30/2029

18. Estimated Funding ($):

* a. Federal	129,104,391.00
* b. Applicant	0.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	129,104,391.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

☐ a. This application was made available to the State under the Executive Order 12372 Process for review on .

☒ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

☐ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes," provide explanation in attachment.)**

☐ Yes ☒ No

If "Yes", provide explanation and attach

Add Attachment | Delete Attachment | View Attachment

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 18, Section 1001)**

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: * First Name: Ed

Middle Name:

* Last Name: Willoughby

Suffix:

* Title: Federal Aid Coordinator

* Telephone Number: 517-242-1285 Fax Number:

* Email: willoughbye@michigan.gov

* Signature of Authorized Representative: James Garry * Date Signed: 03/26/2024

BUDGET INFORMATION - Non-Construction Programs

OMB Number: 4040-0006
Expiration Date: 02/28/2025

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. Accelerating Siting, Zoning, and Permitting of 60% Renewable Energy in Michigan	66.046	$	$	$ 129,104,391.00	$	$ 129,104,391.00
2.						
3.						
4.						
5. Totals		$	$	$ 129,104,391.00	$	$ 129,104,391.00

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SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1)	(2)	(3)	(4)	Total (5)
	Accelerating Siting, Zoning, and Permitting of 60% Renewable Energy in Michigan				
a. Personnel	$ 3,302,050.00	$	$	$	$ 3,302,050.00
b. Fringe Benefits	1,768,579.00				1,768,579.00
c. Travel	82,800.00				82,800.00
d. Equipment	0.00				0.00
e. Supplies	208,171.00				208,171.00
f. Contractual	5,475,000.00				5,475,000.00
g. Construction	0.00				0.00
h. Other	117,423,531.00				117,423,531.00
i. Total Direct Charges (sum of 6a-6h)	128,260,131.00				$ 128,260,131.00
j. Indirect Charges	844,260.00				$ 844,260.00
k. TOTALS (sum of 6i and 6j)	$ 129,104,391.00	$	$	$	$ 129,104,391.00
7. Program Income	$	$	$	$	$

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SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8. Accelerating Siting, Zoning, and Permitting of 60% Renewable Energy in Michigan	$	$	$	$
9.				
10.				
11.				
12. TOTAL (sum of lines 8-11)	$	$	$	$

SECTION D - FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 43,710,494.00	$ 10,927,624.00	$ 10,927,624.00	$ 10,927,623.00	$ 10,927,623.00
14. Non-Federal	$				
15. TOTAL (sum of lines 13 and 14)	$ 43,710,494.00	$ 10,927,624.00	$ 10,927,624.00	$ 10,927,623.00	$ 10,927,623.00

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (YEARS)			
	(b)First	(c) Second	(d) Third	(e) Fourth
16. Accelerating Siting, Zoning, and Permitting of 60% Renewable Energy in Michigan	$ 42,825,620.00	$ 37,734,104.00	$ 2,644,359.00	$ 2,189,814.00
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$ 42,825,620.00	$ 37,734,104.00	$ 2,644,359.00	$ 2,189,814.00

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges:

22. Indirect Charges:

23. Remarks:

MI HEALTHY CLIMATE

Implementing the MI Healthy Climate Plan

MICHIGAN'S PRIORITY CLIMATE ACTION PLAN

EGLE MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

March 2024

MICHIGAN DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY

This report is available digitally at Michigan.gov/EGLE

EGLE promotes the equitable treatment and meaningful involvement of Michigan's residents regarding the development, implementation, and enforcement of laws, regulations, and policies. Equitable treatment means that no group of people bears a disproportionate share of the negative consequences resulting from governmental, industrial, or commercial operations and policies. Meaningful involvement means all people have an opportunity to participate in decisions that affect their environment and/or health.

To request this material in an alternative format, contact EGLE-Accessibility@Michigan.gov or call 800-662-9278.

This project has been funded wholly or in part by the United States Environmental Protection Agency (EPA) under assistance agreement 00E03462 to Michigan Department of Environment, Great Lakes, and Energy. The contents of this document do not necessarily reflect the views and policies of the EPA, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

CONTENTS

DEFINITIONS AND ACRONYMS

DEFINITIONS

Priority Climate Action Plan (PCAP): a narrative report that includes a focused list of near-term, high-priority, and implementation-ready measures to reduce GHG pollution and an analysis of GHG emissions reductions.

Comprehensive Climate Action Plan (CCAP): a narrative report that provides an overview of the grantees' significant GHG sources/sinks and sectors, establishes near-term and long-term GHG emission reduction goals, and provides strategies and identifies measures that address the highest priority sectors to help the grantees meet those goals.

Greenhouse Gas (GHG) Inventory: a list of emission sources and sinks and the associated emissions quantified using standard methods.

Low Income / Disadvantaged Communities (LIDACs): communities with residents that have low incomes, limited access to resources, and disproportionate exposure to environmental or climate burdens. Although the Inflation Reduction Act does not formally define LIDACs, EPA strongly recommends grantees use the Climate and Economic Justice Screening Tool and the Environmental Justice Screening and Mapping Tool to identify LIDACs in their communities. These tools identify LIDACs by assessing indicators for categories of burden: air quality, climate change, energy, environmental hazards, health, housing, legacy pollution, transportation, water and wastewater, and workforce development.

Metropolitan Statistical Area (MSA): A geographic entity delineated by the Office of Management and Budget for use by federal statistical agencies. Metropolitan statistical areas consist of the county or counties (or equivalent entities) associated with at least one urban area of at least 50,000 population, plus adjacent counties having a high degree of social and economic integration with the core as measured through commuting ties. Metropolitan statistical areas as defined by the U.S. Census 2020 MSA population.

State: One of the 50 U.S. states and the District of Columbia and Puerto Rico.

Acronyms

AVERT	AVoided Emissions and geneRation Tool
BEVs	Battery electric vehicles
BIL	Bipartisan Infrastructure Law
CCAP	Comprehensive Climate Action Plan
CEJST	Climate and Economic Justice Screening Tool
CH_4	Methane
CO_2	Carbon dioxide
CO_2FFC	Carbon dioxide from Fossil Fuel Combustion
CO	Carbon monoxide
CPRG	Climate Pollution Reduction Grant
CRS	Carbon Reduction Strategy
DOE	United States Department of Energy
DTMB	Michigan Department of Technology, Management & Budget
EAT	Energy Auditor Training
EGLE	Michigan Department of Environment, Great Lakes, and Energy
EJScreen	EPA's Environmental Justice Screening and Mapping Tool
EPA	Environmental Protection Agency
EPS	Energy Policy Simulator
ETIP	Energy Transition Impact Project
EVSE	Electric vehicle supply equipment
EWR	Energy Waste Reduction
F-gases	Fluorinated greenhouse gases
FPL	Federal Poverty Line
GHG	Greenhouse gas
GHGRP	Greenhouse Gas Reporting Program
GVMC	Grand Valley Metro Council
HVAC	Heating, ventilation, and air conditioning

ICEs	Internal combustion engines
IIJA	Infrastructure Investment and Jobs Acts
IRA	Inflation Reduction Act
LIDAC	Low-income and disadvantaged community
LEO	Michigan Department of Labor and Economic Opportunity
LPO	Loan Program Office
LULUCF	Land Use, Land Use Change, and Forestry
MAC-EJ	Michigan Advisory Council on Environmental Justice
MDARD	Michigan Department of Agriculture and Rural Development
MDHHS	Michigan Department of Health and Human Services
MDOT	Michigan Department of Transportation
MHCP	MI Healthy Climate Plan
MMTCO2E	Million metric tons of carbon dioxide equivalent
MiEJScreen	Michigan's Environmental Justice Screening and Mapping Tool
MTEG	Michigan Tribal Environmental Group
MW	Megawatt
NEVI	National Electric Vehicle Infrastructure
NF_3	Nitrogen trifluoride
NOx	Nitrogen oxides
N_2O	Nitrous Oxide
NREL	National Renewable Energy Laboratory
OCE	EGLE's Office of Climate and Energy
PACE	Powering Affordable Clean Energy
PCAP	Priority Climate Action Plan
PFC	Perfluorocarbon
PM2.5	Particulate matter
RAISE	Rebuilding American Infrastructure with Sustainability and Equity
RECI	Resilient and Efficient Codes Implementation

RFI	Request for Information
R-STEP	Renewable Energy Siting through Technical Engagement and Planning
SEMCOG	Southeast Michigan Council of Government
SF_6	Sulfur hexafluoride
SIT	EPA's State Inventory Tool
SMART	Strengthening Mobility and Revolutionizing Transportation
SOx	Sulfur oxides
TREC	Training for Residential Energy Contractors
UCPB	Utility Consumer Participation Board
UP	Michigan's Upper Peninsula
VOC	Volatile organic compound
WAP	Weatherization Assistance Program

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

This document outlines the State of Michigan's Priority Climate Action Plan (PCAP), developed as part of the EPA's Climate Pollution Reduction Grant Program. Michigan's PCAP closely follows the framework and key strategies laid out in the MI Healthy Climate Plan (MHCP). The PCAP involved statewide community engagement and development of a greenhouse gas (GHG) inventory to establish priority reduction measures, quantify potential GHG emission reductions, analyze benefits for low-income and disadvantaged communities (LIDACs), and provide commentary on the authority to implement the identified measures, intersection with other funding opportunities, and information about the workforce required to realize the measures.

Of these elements, the key outcomes include:

- **Community Engagement:** Extensive statewide community engagement efforts, including public meetings, surveys, and focus groups, identified key priorities and concerns including topics around environmental justice and all areas of Michigan's economy.
- **Michigan's GHG Emissions Inventory:** As of 2019, Michigan's net GHG emissions were 166.73 MMTCO2E, a 15% decrease from the baseline year of 2005. The Energy inventory sector remains the largest emitter, followed by Industrial Processes and Waste.
- **Priority Reduction Measures:** GHG reduction measures were evaluated and prioritized for the PCAP in the following sectors:
  - Electricity Generation
  - Commercial and Residential Buildings
  - Transportation
  - Industry

  The selected reduction measures identify several strategic priorities inclusive of renewable energy deployment, expansion of energy efficiency, electrification of the transportation and built environment, increased access to public transit, emphasis on methane reductions, and more.
- **LIDAC Benefits Analysis:** The PCAP prioritizes measures that benefit LIDACs by reducing emissions, improving air quality, and creating clean energy jobs. These communities often experience disproportionate negative impacts from climate change and pollution, and the PCAP aims to analyze and address these disparities through its priority reduction measures.
- **Next steps**: Refinement of several areas to build off PCAP learnings in development of the Comprehensive Climate Action Plan (CCAP) include deeper analysis in all areas of the PCAP, additional engagement with communities across the state, preparation for implementation grant applications, and more.

The PCAP represents a significant opportunity in Michigan's efforts to address climate change and create a more sustainable future for all residents through the implementation of the MI Healthy Climate Plan. It is important to note that achieving these ambitious goals will require sustained commitment, collaboration, and investment from all levels of government, businesses, and communities.

1. INTRODUCTION

1.1 Climate Pollution Reduction Grant (CPRG) Overview

The United States Environmental Protection Agency (EPA) issued planning grants under Phase I of the Climate Pollution Reduction Grant (CPRG) program to support interested states, metropolitan statistical areas (MSAs), tribes, and territories to develop and implement plans for reducing greenhouse gas (GHG) emissions and other harmful air pollutants. The State of Michigan's Department of Environment, Great Lakes, and Energy (EGLE) received a $3 million planning grant to write both a Priority and Comprehensive Climate Action Plan due in early 2024 and mid-2025, respectively. The Priority Climate Action Plan (PCAP) provides the State of Michigan with funds to, at a minimum, develop a GHG inventory, select and quantify priority near-term GHG reduction measures, perform a low-income and disadvantaged communities (LIDAC) benefits analysis, and review the authority to implement selected GHG reduction measures. A Comprehensive Climate Action Plan (CCAP) will be developed following the completion of this PCAP to build upon these elements and expand to include an updated GHG inventory, GHG emissions projections and reduction targets, a statewide community benefits analysis, additional community engagement, and comprehensive reduction measures.

EGLE is consistently searching for ways to bring sustainable solutions to Michigan to reduce greenhouse gas emissions, opening the opportunity to improve the lives of Michiganders through economic and health benefits. EPA's CPRG program is another opportunity for the State of Michigan to define near-term goals and spur action in implementing the MHCP key strategies. Developing a PCAP allows eligible entities to apply for CPRG Implementation Funds to implement the priority reduction measures with the main objective to reduce greenhouse gases through policies and programs that focus on near-term, high impact reductions.

NOTE: There are recommendations throughout this document that may help in guiding individual application processes for eligible entities applying to the CPRG implementation grant.

1.2 PCAP Overview and Definitions

The State of Michigan's PCAP covers all requirements as stipulated by the EPA in the following structure:

1. **Introduction:** Inclusive of PCAP document components, EGLE's high-level approach to the CPRG Program and the PCAP, the scope of this document, and methods used to develop each PCAP component.
2. **State Context:** Inclusive of details around the existing MI Healthy Climate Plan
3. **PCAP Elements:** Inclusive of the GHG inventory, an overview of statewide LIDACs, and each selected GHG reduction measure with its associated reduction measure description and quantification, LIDAC qualitative and quantitative community benefits analysis, a review of authority to implement, intersection with other funding availability, and a workforce planning analysis.
4. **Conclusion and Next Steps:** Inclusive of commentary on the strategy to develop the CCAP including a more detailed analysis on PCAP elements.

1.3 Scope of the PCAP

The geographic territory for EGLE's CPRG program covers the entire State of Michigan. Engagement sessions as part of the CPRG and the GHG inventory reached all regions of the state. In parallel, key sectors were identified for focus on the near-term PCAP requirements. These sectors represent the highest-emitting sectors in Michigan and oftentimes, the greatest ability to achieve near-term GHG reduction impact as emphasized by the EPA. The key sectors prioritized in the PCAP are as follows:

1. Electricity Generation
2. Commercial and Residential Buildings
3. Transportation
4. Industry

These sectors use language as suggested by the EPA[1], which align with key recommendations in the MHCP:

EPA Sector	MHCP Key Recommendation
Electricity Generation	Clean the Electric Grid
Commercial and Residential Buildings	Repair and Decarbonize Homes and Businesses
Transportation	Electrify Vehicles and Increase Public Transit
Industry	Drive Clean Innovation in Industry

[1] EPA Program Guidance

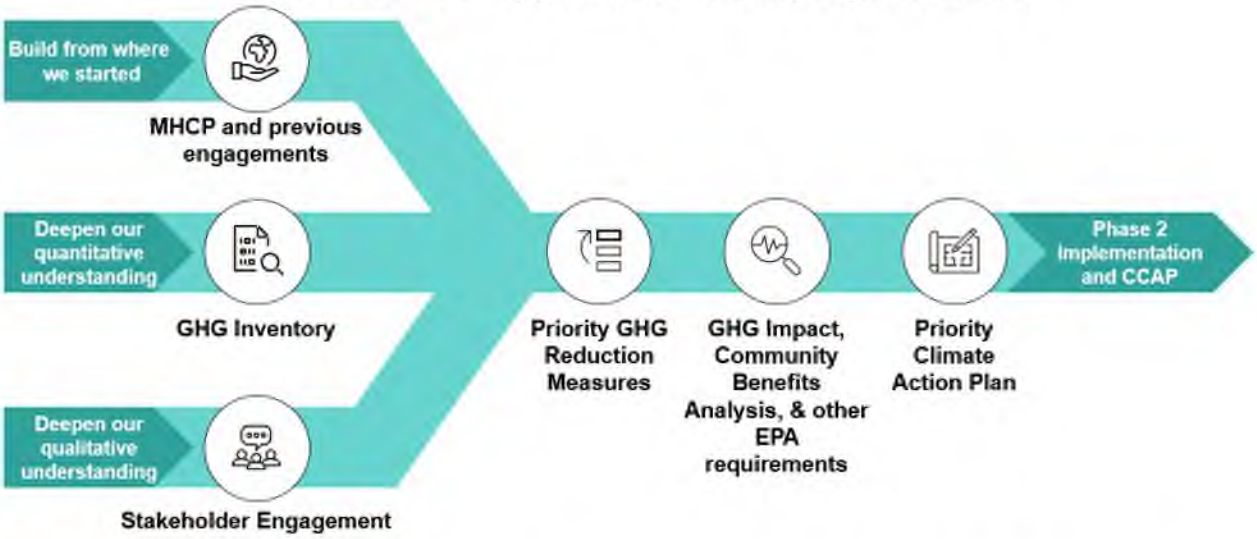
2. APPROACH TO DEVELOPING THE PCAP

The State of Michigan's approach to developing the PCAP is depicted in Figure 1: EGLE's approach to developing the PCAP. The PCAP is intended to help the State build upon and continue implementation of the MI Healthy Climate Plan released in 2022 while keeping the EPA strategic goals for the CPRG program top of mind. The MHCP is the state's roadmap with key actions to reach its goal of carbon neutrality by 2050, and is centered around the following six pillars:

1. Committing to Environmental Justice and Pursuing a Just Transition
2. Cleaning the Electric Grid
3. Electrifying Vehicles and Increasing Public Transit
4. Repairing and Decarbonizing Homes and Businesses
5. Driving Clean Innovation in Industry
6. Protecting Michigan's Land and Water

Several committees, plans, and follow-on commitments have been made to progress Michigan's journey towards carbon neutrality, illustrated more in depth in the following section. Michigan builds from the foundation established by the MHCP development process along with previous engagements to align CPRG requirements with existing initiatives, accelerating progress and amplifying impact.

Figure 1: EGLE's approach to developing the PCAP.



The CPRG program is an opportunity for Michigan to deepen both the qualitative and quantitative understanding of the impact of GHG emissions on the State with a focus on the priorities outlined in the MHCP. Qualitatively, Michigan was able to understand current barriers, needs, and solutions towards MHCP implementation through multiple novel and ongoing community engagement and a LIDAC benefits analysis. From a quantitative perspective, EGLE developed a GHG inventory to better understand the State's emissions profile and then, prioritize and quantify GHG reduction measures in addition to quantifying LIDAC benefits. The

culmination of these analyses, along with initial workforce and funding analyses, further enables the understanding of Michigan's needs in securing a sustainable future and realizing its long-term vision for individuals, families, and the State more broadly (described in **Figure 2**).

The CPRG program is an opportunity for Michigan to reach this long-term vision by augmenting existing actions and priorities within the state. Thus, EGLE carefully considered the EPA strategic goals and CPRG objectives and priorities while developing each action related to this PCAP. For example, upon prioritizing reduction measures, EGLE evaluated the durability, replicability, and near-term GHG reduction impact of potential measures. More details around the approach to collaboration, engagements, and analyses are described below.

Figure 2: The intended outcomes of the State's priority reduction measures exactly mirror those listed in the MHCP.

2.1 Collaboration and Community Engagement Methodology

Throughout the CPRG PCAP process, the State of Michigan has developed various ways to engage communities and maintain ongoing collaboration with the goal of creating a holistic, inclusive PCAP composed of Michigan's highest priority needs influenced by citizens and experts alike.

EGLE has long-standing collaborative relationships with several entities that continued and broadened to incorporate PCAP-specific discussions. For instance, as Southeast Michigan Council of Government (SEMCOG) and Grand Valley Metro Council (GVMC) were the two Michigan MSAs that received funding to develop their own PCAPs, EGLE met with SEMCOG and GVMC on a biweekly basis to share approach, status, and provide overall collaboration and

alignment throughout the process. Separately, Michigan met with all twelve of Michigan's federally recognized tribal governments regularly and bi-weekly with those tribes that received a CPRG planning grant. Some other entities with ongoing relationships that provided input on the PCAP whether directly or indirectly include the Michigan Advisory Council on Environmental Justice (MAC-EJ), Upper Peninsula (UP) Clean Energy Coalition, Catalyst Communities, Council on Climate Solutions, EGLE Climate Liaisons, interagency groups, community members, regional planning districts, municipalities, utilities, universities, students, labor unions and associations, and more.

EGLE organized additional engagement as part of the PCAP process with three main objectives:

1. Educate and excite communities about sustainability goals and progress occurring in the state
2. Inform priority reduction measure selection and understand barriers and solutions for the implementation of reduction measures across key sectors through the lived experiences of affected communities
3. Play a role to organize projects with near-term focus on prioritizing high GHG emissions reductions initiatives

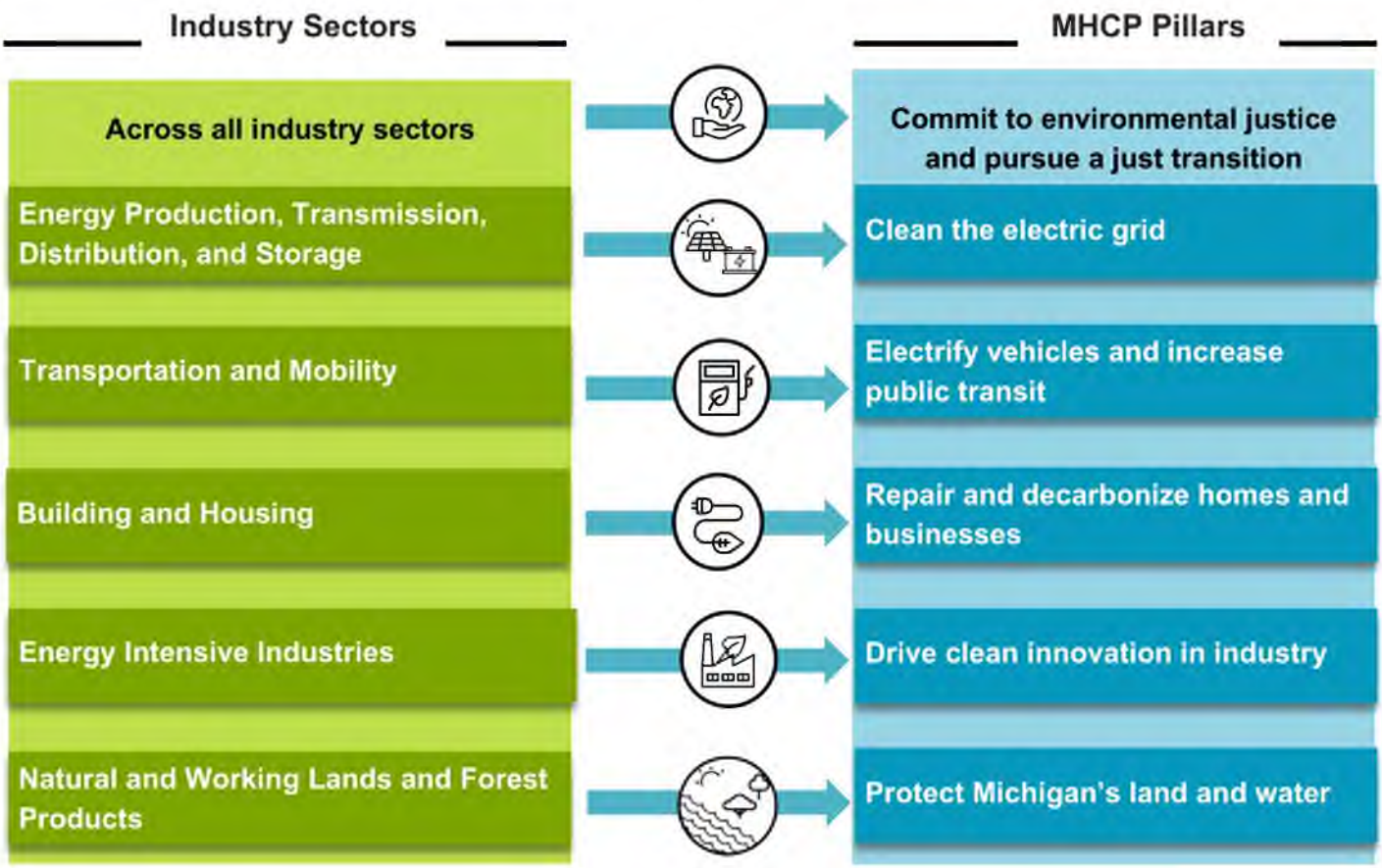
Community engagement content and activities were also developed with consideration of EGLE's core principles including empathy, equity, accessibility, transparency, continuous improvement, and place-based engagement for all engagement sessions. As part of ongoing collaboration and continuous improvement, EGLE released a Request for Information (RFI) to seek input from the public on topics related to community engagement and implementation of the MHCP. The feedback received from this RFI was used to develop the objectives and incorporated into the PCAP community engagement sessions.

The community engagement objectives and core principles were to be completed and incorporated within five in-person engagement sessions held for the public in different regions throughout the State (Detroit, Grand Rapids, Flint, Marquette, and Petoskey) and two virtual public listening sessions to capture ideas from as many people as possible while remaining aligned with EPA's PCAP deadline. One additional in-person session was held in Acme to gather specific input from Michigan's federally recognized tribes during a quarterly Michigan Tribal Environmental Group (MTEG) meeting. To accomplish these goals and principles, the in-person community engagement content and interactive exercises were iterated several times in preparation for facilitation and to achieve successful outcomes. EGLE made a deliberate effort to ensure that voices from low-income, disadvantaged, and historically underserved communities were included in these sessions.

To prioritize gaining community member feedback for each engagement session, events were held in the evening and locations were chosen with local partners, close to venues with public transit access in order to increase participation. Additionally, general locations were selected with low income and disadvantaged communities in mind. Of the six counties with the highest amount of census tracts identified as LIDACs, five of them are within close proximity to Detroit and Flint, comprising 55% of all census tracts identified by CEJST as LIDACs. The remaining county is Kent County, where the Grand Rapids engagement was held. Petoskey and Marquette also have identified LIDAC census tracts. Michigan's Upper Peninsula, where the Marquette engagement was held, is also identified by the DOE as a Priority Energy Community, meaning supplemental resources are provided to these communities as they are vulnerable to coal job loss impacts.[2]

EGLE focused most of each session on the group activity and discussion. As a result, about 25% of the time spent was used to educate and excite communities about Michigan's climate plans and progress and 75% of the time was spent on group activities. The sessions were organized around the MI Healthy Climate Plan pillars that correspond to key industry sectors as shown in Figure 3.

Figure 3: Industry sectors corresponding to the six pillars of the MHCP.



[2] energycommunities.gov/priority-energy-communities/

Prior to the group activity portion, the in-person sessions began with information on the MI Healthy Climate Plan, Climate Pollution Reduction Grant, other climate-related state programs, as well as other opportunities to get or stay involved. The interactive activities included the following:

Figure 4: In-person engagement session held in Detroit in November 2023.

1. **Breakout Group Activity**: Two rounds of participants selecting a key industry sector they want to discuss. As stated in the MI Healthy Climate Plan, each sector lists specific goals to achieve by 2030. Participants were tasked with discussing barriers, potential solutions, and benefits that may be realized by these solutions to achieve the goals set out in the MI Healthy Climate Plan.
2. **Gallery Walk**: Participants viewed the responses from the breakout group activity for all key sectors, added additional comments where they felt necessary, and uplifted any responses which they found most important, whether they be barriers, solutions, or benefits.
3. **Report-out**: All participants came together as one group to discuss key takeaways or popular topics discussed throughout the session.

Figure 5: In-person engagement session held in Petoskey in December 2023.

The sessions concluded with additional information and resources to stay up to date on progress. The in-person engagement sessions that occurred within the MSAs that received EPA CPRG planning grants were facilitated in collaboration with the lead agencies receiving the awards, SEMCOG and GVMC.

Virtual listening sessions were similar to an open-forum comment period for Michiganders to discuss any topic as it related to prioritization of measures for inclusion in the PCAP and broader MI Healthy Climate Plan implementation. To provide context and accomplish education around Michigan goals and progress in climate-related initiatives, each session began like the in-person sessions with a discussion of the MI Healthy Climate Plan, Climate Pollution Reduction Grant, other climate-related state programs, and other opportunities to get or stay involved prior to starting the open forum portion. The open forum portion consisted of participants raising their hand and taking turns to discuss any climate-related topic area they wish. Each participant had three minutes to speak to encourage feedback from all attendees on the call. Virtual listening sessions concluded by providing information and resources to stay involved with the MI Healthy Climate Plan.

2.2 GHG Inventory Methodology

The 2024 Michigan Greenhouse Gas Emissions Inventory was developed by EGLE to offer increased transparency and commitment to Michigan's sustainability goals. The purpose of the inventory is to provide the MI Healthy Climate Plan and other initiatives in pursuance of the Plan's goals with a quantifiable baseline of comparison for emissions reductions.[3]
The 2024 GHG Inventory is the second of two inventories developed for the State of Michigan, the first of which was developed in 2005 and compared emissions between 1990 and 2002.[4] Michigan's 2024 inventory examines 2005 and 2019 GHG emissions and overall trends from 1990 to 2019. The 2024 GHG Inventory was developed using the EPA's State Inventory Tool (SIT) (February 2023 version, with data updated through 2020) as a framework, while replacing and supplementing default emission data with state-specific data where appropriate. For more information on the methodology behind the greenhouse gas inventory, refer to the SIT Methodology which can be found via the module user guides available on the EPA's website.[5]

NOTE: For those applying for implementation grants within the State of Michigan under the EPA's CPRG program, please use 2019 as your reference year for emission data to ensure consistency between applications and comparability in emissions reduction calculations.

2.3 Priority Reduction Measure Selection and Quantification Methodology

Priority GHG Reduction Measures were selected and quantified based upon a rigorous process to vet and estimate the potential impact on Michigan's GHG emissions. To evaluate reduction measures, input was collected from numerous engagements with various groups including but not limited to:

- Catalyst Communities Initiative
- Request for Information on Community Engagement
- Public Call for Projects Form
- Council on Climate Solutions: Workgroup Recommendations[6]
- CPRG Engagement In-Person Engagement Sessions
- CPRG Engagement Virtual Listening Sessions
- Request for Information on the Implementation of the MI Healthy Climate Plan
- UP Energy Task Force Committee Recommendations
- Ad-hoc submittals to EGLE-OCE@Michigan.gov

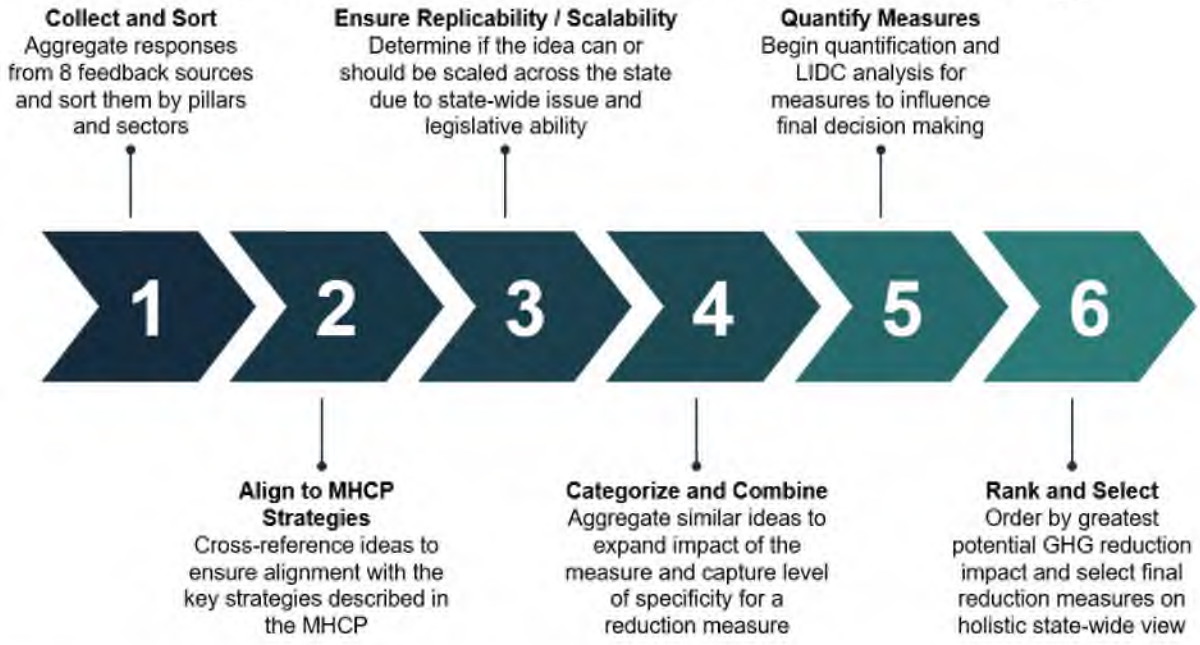
[3] mhcp-egle.hub.arcgis.com/
[4] css.umich.edu/publications/research-publications/michigan-greenhouse-gas-inventory-1990-and-2002
[5] epa.gov/statelocalenergy/state-inventory-and-projection-tool
[6] michigan.gov/egle/about/Groups/Council-on-Climate-Solutions/Workgroup-Recommendations

Selection and prioritization of GHG reduction measures considered approximately 800 ideas provided by feedback received across engagement sessions, recommendations, and individual submittals. These 800 ideas were then sorted into the 6 pillars described in the MHCP before being evaluated. They then moved through the prioritization framework as described in Figure 6 to best identify the measures that were aligned to the MHCP, replicable across the state, had the greatest GHG reduction impact potential, and aligned with other CPRG requirements as established by the EPA.

By following this framework, EGLE aimed to:

- Focus on Michigan's highest-emitting sectors with the goal of high-impact, near-term GHG emissions reductions
- Continue the momentum the MHCP started by aligning initiatives
- Abide and prioritize by EPA requirements to best position Michigan to receive CPRG implementation funds

Figure 6: EGLE's Priority Reduction Measure Selection Methodology



All received and ongoing feedback will be re-evaluated for the CCAP as changes in the legislative, economic, and technological environments occur upon development.

Quantifying priority reduction measures followed six steps to carry out the analyses:

1. Investigate emissions reduction source per reduction measure and best available quantification tool (whether federal, peer-reviewed, etc.)
2. Collect applicable data from reliable sources and existing MHCP goals, documenting assumptions related to data collection
3. Quantify emissions using the best identified tool

4. Validate emissions quantification with secondary tool as possible, documenting variances in quantification tool assumptions
5. Record the estimated annual emissions reduction, emissions reductions from 2024-2030, and emissions reductions from 2024-2050 for each priority reduction measure
6. Contextualize and include key assumptions in the write-up for each priority reduction measure

Quantification was completed across sectors, isolating emissions reductions across measures. Affected sectors for one reduction measure quantification were included where possible. Effects on one reduction measure were not compounded if another reduction measure were assumed to be implemented.

2.4 LIDAC Benefits Analysis Methodology

The LIDAC benefits analysis is composed of three primary sections:

1. Understanding of low-income and disadvantaged communities across the State of Michigan
2. Research and analysis around the hardest-hitting areas for LIDACs across the State of Michigan
3. Analysis of the specific quantitative and qualitative nature of effects on emissions reductions for each priority reduction measure

The tools used in the LIDAC analysis include the Climate and Economic Justice Screening Tool (CEJST), the EPA's Environmental Justice Screening and Mapping Tool (EJScreen), and MiEJScreen, the State of Michigan's environmental justice screening tool. Each census tract deemed low-income and/or disadvantaged by the following EPA definition according to posted CPRG guidance was included in the overall analysis. A list of all identified census tracts can be found in **Appendix C: CEJST Census Tracts**.

LIDAC Definition:

1. Any census tract that is included as disadvantaged in the CEJST
2. Any census block group that is at or above the 90th percentile for any of EJScreen's Supplemental Indexes when compared to the nation or relevant state
3. Any geographic area within tribal lands as included in EJScreen

Following the analysis and comparison of how these three tools interact, research and analysis were completed to understand the greatest potential benefits communities may realize from implementation of the reduction measures, and the MHCP as a whole. These areas include air quality and public health, energy burden, workforce, and climate resilience. The benefits analysis then talks about the components included within each reduction measure including co-pollutants, avoided deaths by race, avoided lost workdays, avoided respiratory symptoms and bronchitis, avoided hospital admissions, and avoided minor restricted activity days. All priority

reduction measures aimed to quantify each of these areas, though, due to the variety of tools used in emissions reduction quantification, this is not always the case.

2.5 Review of Authority Methodology

The Michigan PCAP is designed to identify implementation ready and high-priority actions that can be taken to reduce GHG emissions in the near-term. The focus is on measures that can be implemented using existing authority, without the need for significant legislative changes. The PCAP measures are drafted with replicability and scalability in mind, allowing for various implementation approaches involving different state agencies or local governments. Additional context on Michigan's authority to implement measures, while not exhaustive, are further described in Section 4.4 and in each priority measure in Section 5.

2.6 Intersection with Other Funding Availability

Each priority reduction measure includes a subsection describing any existing federal funding the State of Michigan has received to implement projects related to specific measures. This analysis was completed by researching an exhaustive list of available federal funding opportunities for each measure and categorizing their status with the State of Michigan into received funds, applying for funds, planning to apply, did not receive funds, or did not apply. Additional context on the coordinated efforts Michigan manages to receive funds and implement the MHCP are described in Section 4.6 and in each priority measure in Section 5.

2.7 Workforce Planning Analysis

Each priority reduction measure includes a subsection detailing current and changing workforce metrics. The existing number of jobs in broad categories (e.g., renewable energy, energy efficiency, etc.) are included in each measure along with the types of jobs to be created and the projected change in number of jobs by implementing the measure, where possible. All information was researched or analyzed using the Energy Policy Simulator. Additional context on the existing workforce planning activities occurring within Michigan, while not exhaustive, are briefly described in Section 4.6 and in each priority measure in Section 5.

3. STATE CONTEXT

Michigan's GHG emissions come from a wide variety of sources, including the burning of coal and natural gas to produce electricity; the use of diesel and gasoline for transportation; heating of homes and buildings; industrial processes in industry; methane and other emissions from waste; and agricultural processes.

The State of Michigan's Executive Directive 2020-10 spurred the development and creation of the MI Healthy Climate Plan. The MHCP was released in April 2022 and developed with input from hundreds of Michigan residents, including leaders and advocates in environmental justice, public transit, local food, climate action, business, labor, academia, government, and people of all political persuasions and walks of life.

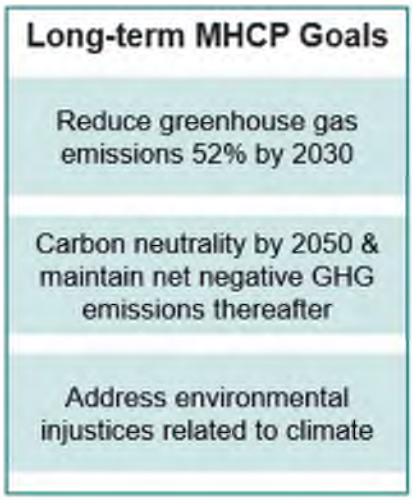
Figure 7: The seven objectives of the MHCP.

The MHCP lays out a pathway for Michigan to reach 100% carbon neutrality by 2050 to avert the worst impacts of the climate crisis, create good-paying jobs, and build a healthier, more prosperous, equitable, and sustainable Michigan for all Michiganders. It has seven objectives as listed in Figure 7.

The MHCP outlines key strategies across Michigan's economic sectors. It strongly emphasizes environmental justice to ensure Michigan's climate strategies uplift every portion of the State, including individuals and communities that have borne the brunt of climate impacts as well as associated criteria air pollutants and are at the greatest risk of being left behind in the transition ahead. Due to the robust research and development that went into the creation of the MHCP, all CPRG PCAP components use the data and information in the MHCP as a foundation for prioritizing and decision making on the State's near-term priorities. Executive Directive 2020-10 spurred several initiatives led by EGLE today such as the formation of councils, workgroups, opportunities for comment, and state grant programs which helped create the MHCP and now, they help progress the implementation of the MHCP. EGLE sees the EPA's CPRG program as an opportunity to bolster the MHCP and implement its key strategies. Therefore, the different components of this PCAP align with the goals set out in the MHCP.

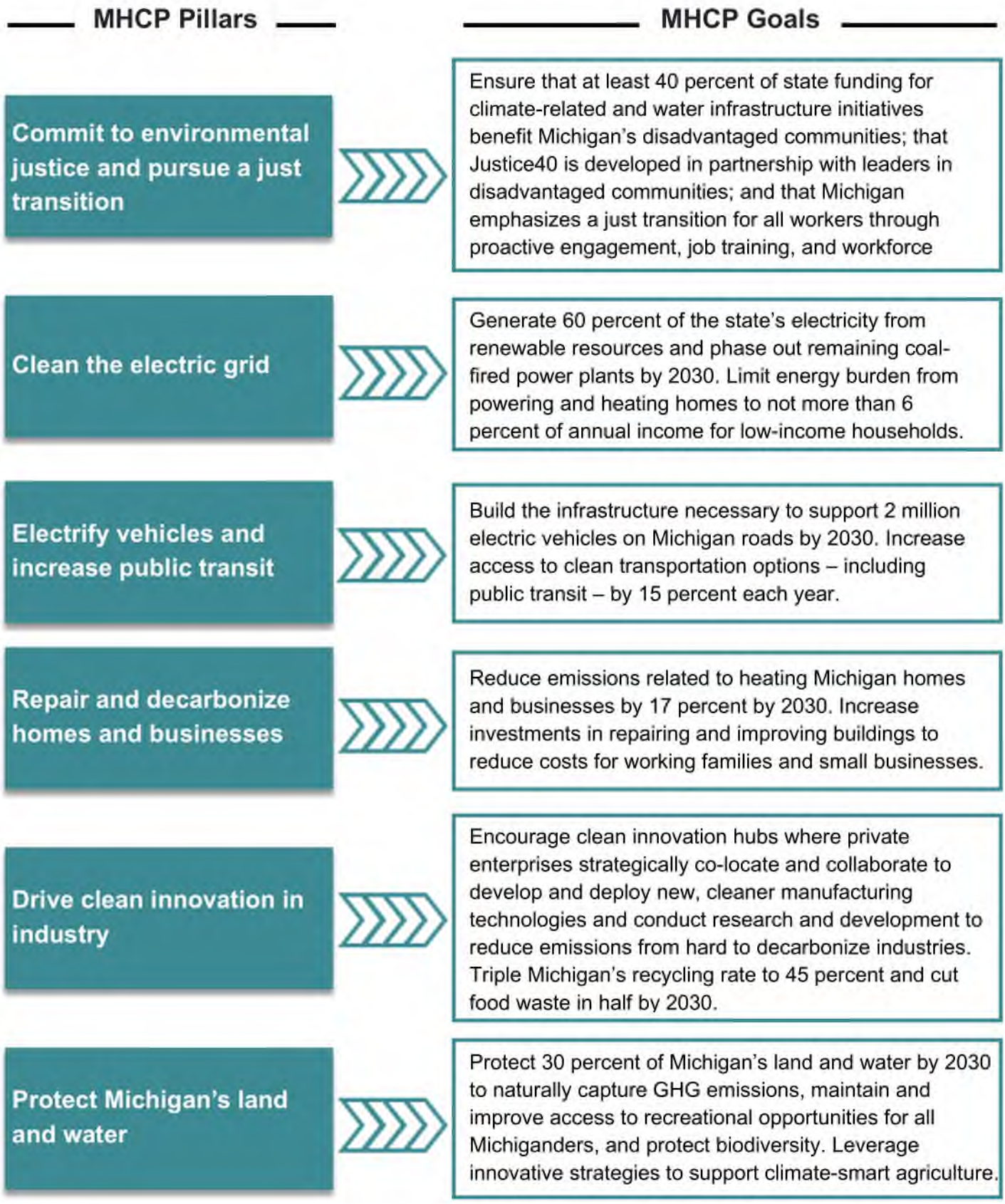
The MHCP identifies what needs to happen for Michigan to reach carbon neutrality by 2050, with a priority on actions from now until 2030. It focuses most heavily on the areas in Michigan where the biggest, most rapid gains in GHG reductions can be made, namely energy, transportation, and buildings. The CPRG offered an opportunity to refresh Michigan's GHG Inventory. The inventory shows that Michigan's net GHG emissions as of 2019 are 166.73 $MMTCO_2E$ which is an overall decrease of approximately 15% since the baseline year of 2005, as used in the MHCP. Electric utilities and transportation lead in CO_2 emissions from fossil fuel combustion, accounting for 35% and 32% of total CO_2 emitted, respectively. The MHCP groups the climate actions needed to achieve the State's goals into six categories, each with targeted sub-goals as shown in Figure 9.

Figure 8: MI Healthy Climate Plan's long-term goals



2023 marked a transformative year for Michigan in the ability to implement the MHCP and transition to a sustainable economy due to the passing of several legislative initiatives. A series of bills were passed to mandate implementation of key provisions in the MHCP. These legislative wins include commitments to clean energy standards, renewable energy goals, expanded options for rooftop solar, energy efficiency initiatives, and measures to address environmental justice and workforce development. The legislation signed by Governor Whitmer in July and November 2023 positions Michigan as a national clean energy leader, including advancing priorities including, increasing renewable energy deployment, lowering energy costs, prioritizing environmental justice, and securing living wages for clean energy workers. These efforts aim to meet ambitious climate goals while supporting economic growth and equity in Michigan's transition to a cleaner energy future. For more information about the recent legislation, please view MI Healthy Climate Plan 2023 Report.

Figure 9: MI Healthy Climate Plan's sector-specific goals organized by MHCP Pillar



4. PCAP ELEMENTS

This section discusses the results of:

1. Michigan's 2024 GHG Inventory
2. Community Engagement
3. LIDAC Benefits Analysis
4. Review of Authority to Implement Measures
5. Funding Opportunities in Michigan
6. Workforce Planning in Michigan

These findings directly aided in the selection of the priority reduction measures, further detailed in Section 5.

4.1 Greenhouse Gas Inventory

The State of Michigan completed its first GHG inventory in 2005 supported by the Center for Sustainable Systems at the University of Michigan.[7] The first inventory focused on profiling GHG emissions from 1990 and 2002 across the state. This subsequent inventory will contribute an updated methodology and corresponding calculations to the years previously covered and focus the analysis on GHG emissions across Michigan for the years of 2005 and 2019.

Since the original inventory was published, sustainability continues to be of ever-increasing importance given the threat of irreversible climate change and drastic weather events. In September 2020, Governor Whitmer signed Executive Directive 2020-10, which committed Michigan to achieve economy-wide carbon neutrality no later than 2050 and then maintain net-negative greenhouse gas emissions thereafter. The governor also reaffirmed the goals in Executive Directive 2019-12, which committed Michigan to pursue at least a 26-28% reduction below 2005 levels in GHG emissions by 2025. In addition to the goals set by these directives, Michigan joined 24 other states and Puerto Rico – under the umbrella of the U.S. Climate Alliance – in committing to an interim goal of a 52% GHG reduction by 2030.[8] In alignment with these goals, EGLE has developed this inventory to increase transparency surrounding the current state of GHG emissions, as well as provide a common and consistent baseline of comparison when analyzing potential emission reduction opportunities.[9]

Both iterations of the State of Michigan's GHG inventory use the EPA's State Inventory Tool (SIT) as a main source of data and modeling.[10] The SIT relies on data from both state and federal sources and consists of 11 modules, the makeup of which is shown in Table 1, to

[7] css.umich.edu/publications/research-publications/michigan-greenhouse-gas-inventory-1990-and-2002
[8] usclimatealliance.org/members/
[9] mhcp-egle.hub.arcgis.com/
[10] epa.gov/statelocalenergy/state-inventory-and-projection-tool

calculate state-wide GHG emissions. The SIT also includes a synthesis module to perform an inventory sector-based analysis of each module, and consequently organizes them into a single emission profile for a given state. The SIT provides default data from 1990 – 2020 which this inventory uses as the base for analysis, adding in state-specific data where default data is either unavailable or better represents Michigan's emissions activity. For detailed descriptions of data sources and other methodology, please refer to EPA's posted SIT documentation[11].

Table 1: Gases Emitted by Inventory Sector and Corresponding SIT Module

Inventory Sector	SIT Module	What gases are included?
Energy	CO_2 from Fossil Fuel Combustion Module	CO_2 from fossil fuel combustion for residential, commercial, industry, transportation, electric utilities economic sectors
	Stationary Combustion Module	CH_4 and N_2O emissions for residential, commercial, industrial, and electric utilities economic sectors
	Mobile Combustion Module	CH_4, N_2O for gasoline highway, diesel highway, non-highway, alternate fuel vehicles
	Coal Module	CH_4 for coal mining production *(not applicable to MI)*
	Natural Gas and Oil Module	CH_4 and N_2O for natural gas production, transmission, distribution, venting and flaring, and oil production, refining, and transportation
Industrial Processes	Industrial Processes Module	CO_2 for cement manufacturing, lime manufacturing, limestone and dolomite use, soda ash production, iron & steel production, and urea consumption
		N_2O for nitric acid production
		F-gases for ODS substitutes, semiconductor manufacturing, and distribution systems
Agriculture	Agriculture Module	CO_2 from liming
		CH_4 from enteric fermentation
		N_2O from manure management (direct and indirect soil management)
Waste	Solid Waste Module and Wastewater Module	CO_2 from waste combustion
		CH_4 from landfills
		N_2O from waste combustion
Land Use, Land Use Change, and Forestry	LULUCF Module	CO_2 sinks from net forest carbon flux, urban trees, and landfilled yard trimmings and food scraps
		N_2O from settlement soils

[11] epa.gov/statelocalenergy/download-state-inventory-and-projection-tool

The Energy sector comprises five modules including Carbon Dioxide (CO_2) from Fossil Fuel Combustion (across economic sectors including Residential, Commercial, Industrial, Transportation, Electric Power, and International Bunker Fuels), and additional modules which produce methane (CH_4), nitrous oxide (N_2O) and fluorinated greenhouse gases (F-Gases, consisting of hydrofluorocarbons (HFC), perfluorocarbons (PFC), nitrogen trifluoride (NF_3), and sulfur hexafluoride (SF_6)). These include Stationary Combustion (economic sectors which emit fossil fuels and wood including Residential, Commercial, Industrial, and Electric Power), Mobile Combustion (including Gasoline, Diesel, Non-Highway, and Alternative Fuel Types), Coal Mining, and Natural Gas & Oil. Additional analyses have been performed in the Electricity and Transportation sectors to translate the inventory sector approach to an economic sector approach. The State is committed to continued improvement and development of the inventory on an annual basis as new data and updated methodologies continue to become available.

NOTE: For those applying for implementation grants within the State of Michigan under the EPA's CPRG program, please use 2019 as your reference year for emission data to ensure consistency between applications and comparability in emissions reduction calculations.

4.1.1 Summary Results

Michigan's net GHG emissions as of 2019 equaled 166.73 $MMTCO_2E$, an overall decrease of approximately 15% since the baseline year of 2005 used in the MHCP. Figure 11 summarizes GHG emissions by inventory sector from 1990 to 2019. Energy, Industrial Processes, and Waste inventory sectors all experienced a reduction in emissions. Agriculture was the only inventory sector to experience an increase in emissions, with a 23% increase between 2005 and 2019. The Energy sector remains the largest emitting sector, making up 87% of Michigan's emissions in 2019 (see Figure 10). Refer to Refer to Appendix A: GHG Inventory Detailed Tables for a detailed look at GHG emissions by sector in 2005 and 2019.

Figure 10: Proportion of the State of Michigan's GHG emissions by inventory sector in 2019 as a percentage, demonstrating Energy as the highest emitting sector

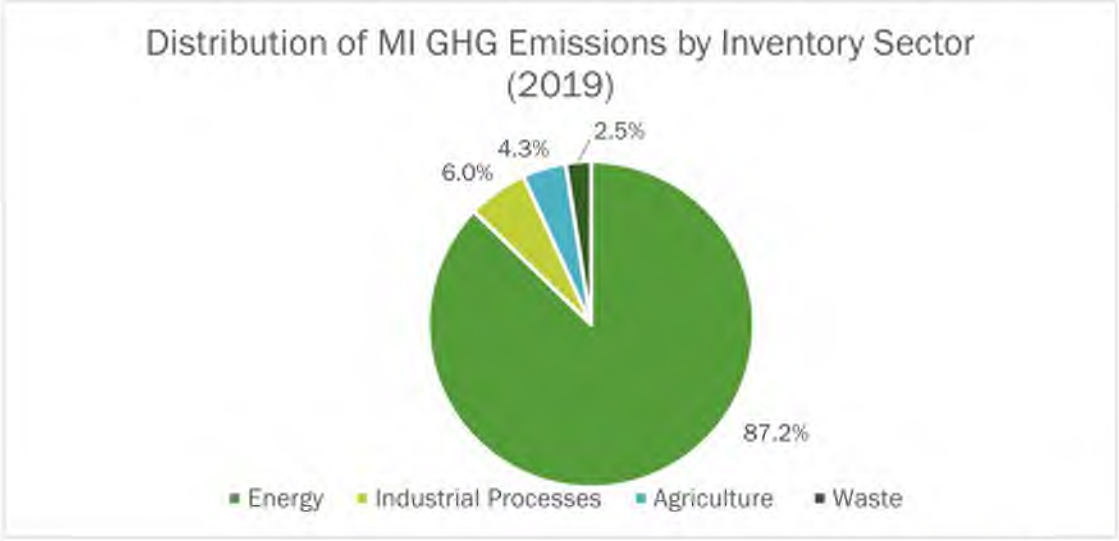
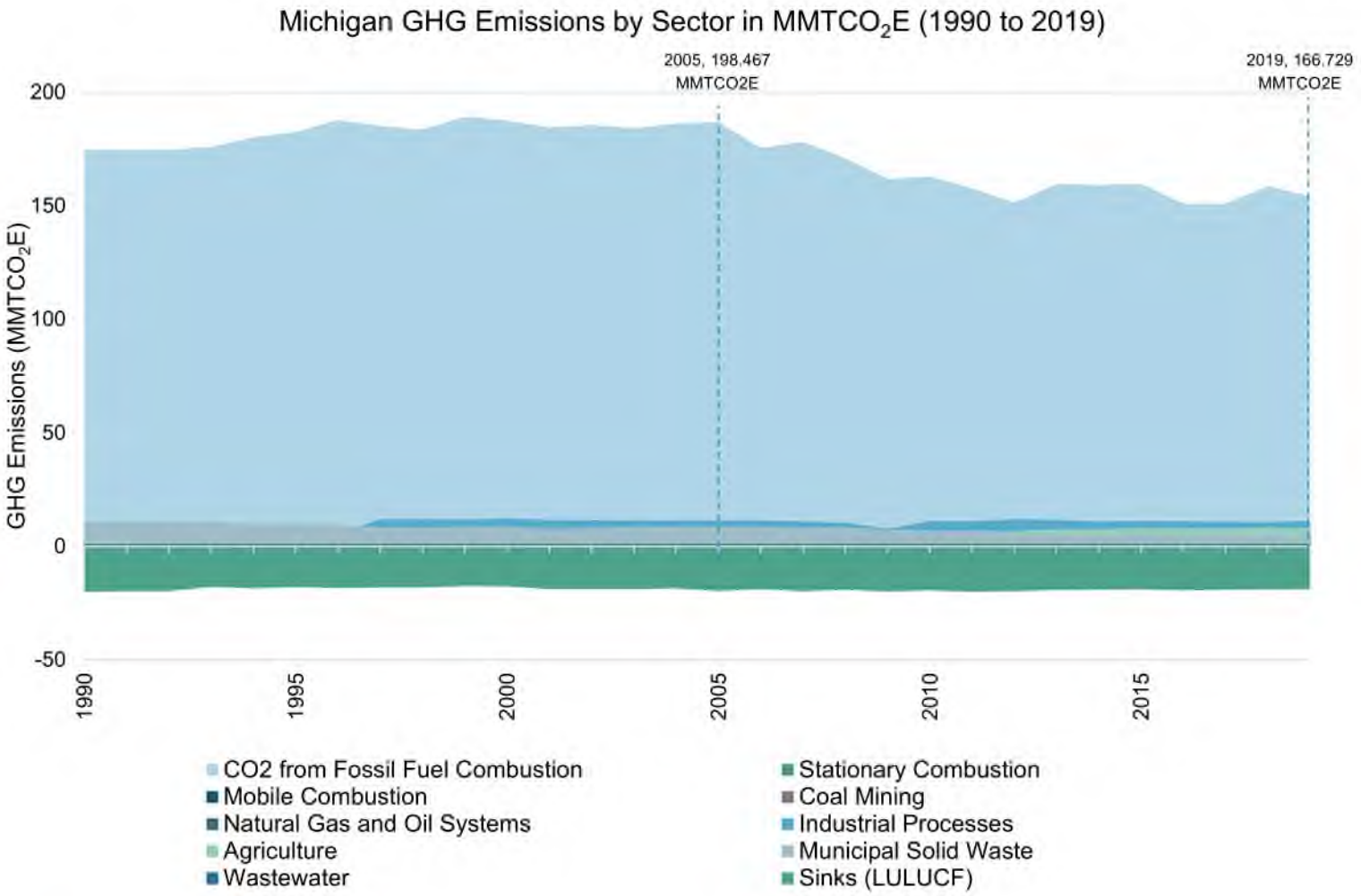


Figure 11: Michigan GHG Emissions by SIT Module in MMTCO2E (1990 to 2019)



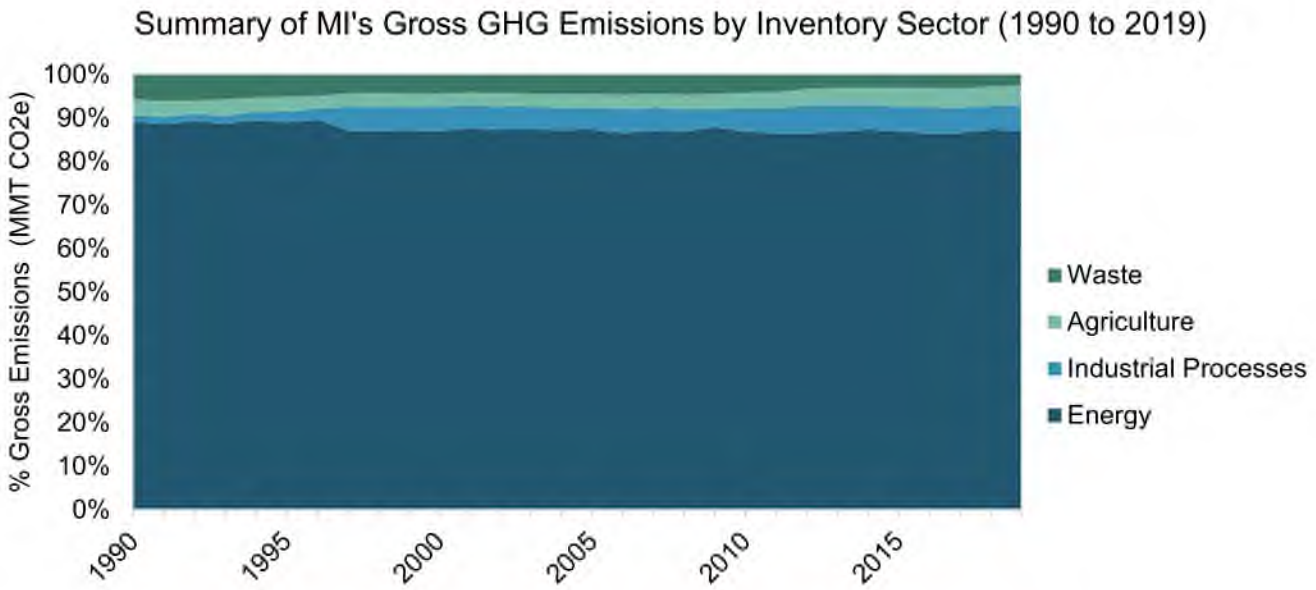
4.1.2 Detailed Results

GHG Emissions Trends

Quantifying and tracking annual GHG emissions as well as sector-based trends is critical to setting GHG reduction targets and developing a healthier, more equitable, and sustainable economy for Michiganders. Understanding where Michigan's emissions are most prevalent helps direct resources and efforts towards the largest emitting sectors as Michigan works in both the near- and long-term to prioritize deployment of sustainable technologies, policies, and programs.

Figure 12 shows the proportion of GHG emissions by inventory sector as a percentage of total GHG emissions from 1990 to 2019 for the State of Michigan. Inventory sectors include Waste, Agriculture, Industrial Processes, and Energy. As shown, Energy accounts for nearly 90% of Michigan's overall GHG emissions, and is made up from the following SIT modules:

Figure 12: The State of Michigan's GHG emissions by inventory sector between 1990 and 2019 as a percentage of overall emissions



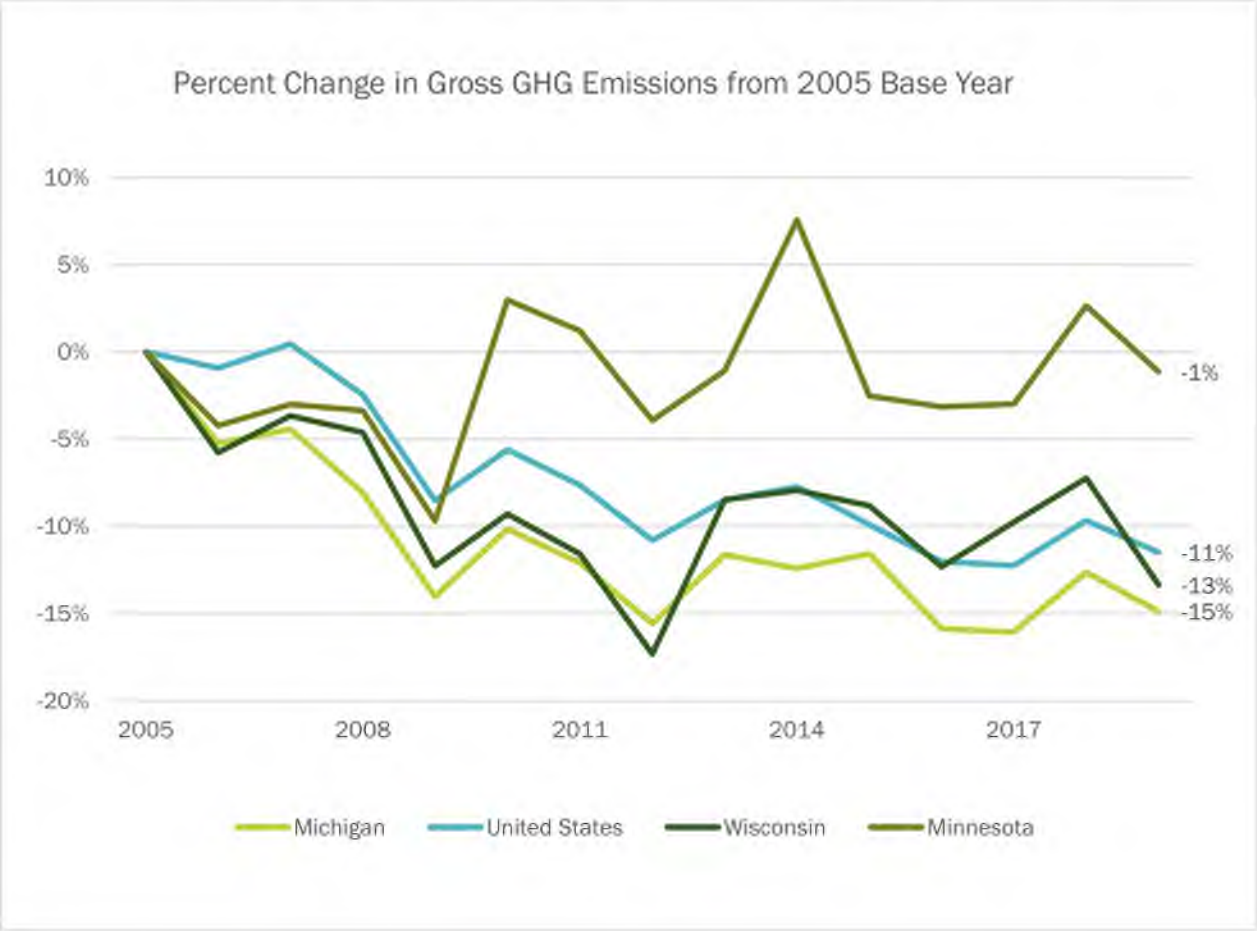
I. CO_2 from Fossil Fuel Combustion (CO_2FFC) (CO_2 emissions from fossil fuel combustion across economic sectors)
II. Stationary Combustion (CH_4 and N_2O)
III. Mobile Combustion (CH_4 and N_2O)
IV. Coal Mining (CH_4)
V. Natural Gas and Oil Systems (CH_4)

CO_2FFC makes up the vast majority of emissions (98.9% of emissions) from the Energy sector, followed by Natural Gas and Oil Systems which makes up 3.4%, and Stationary Combustion and Mobile Combustion with less than 1% of overall emissions in this sector.

Indirect CO_2 emissions from Electricity Consumption was excluded from total calculation values to avoid double counting emissions from the CO_2FFC module. The Land Use, Land Use Change, and Forestry (LULUCF) sector is not accounted for in net GHG emissions as they remove carbon dioxide from the atmosphere and thus, are not shown in Figure 12 as a percentage of total net emissions.

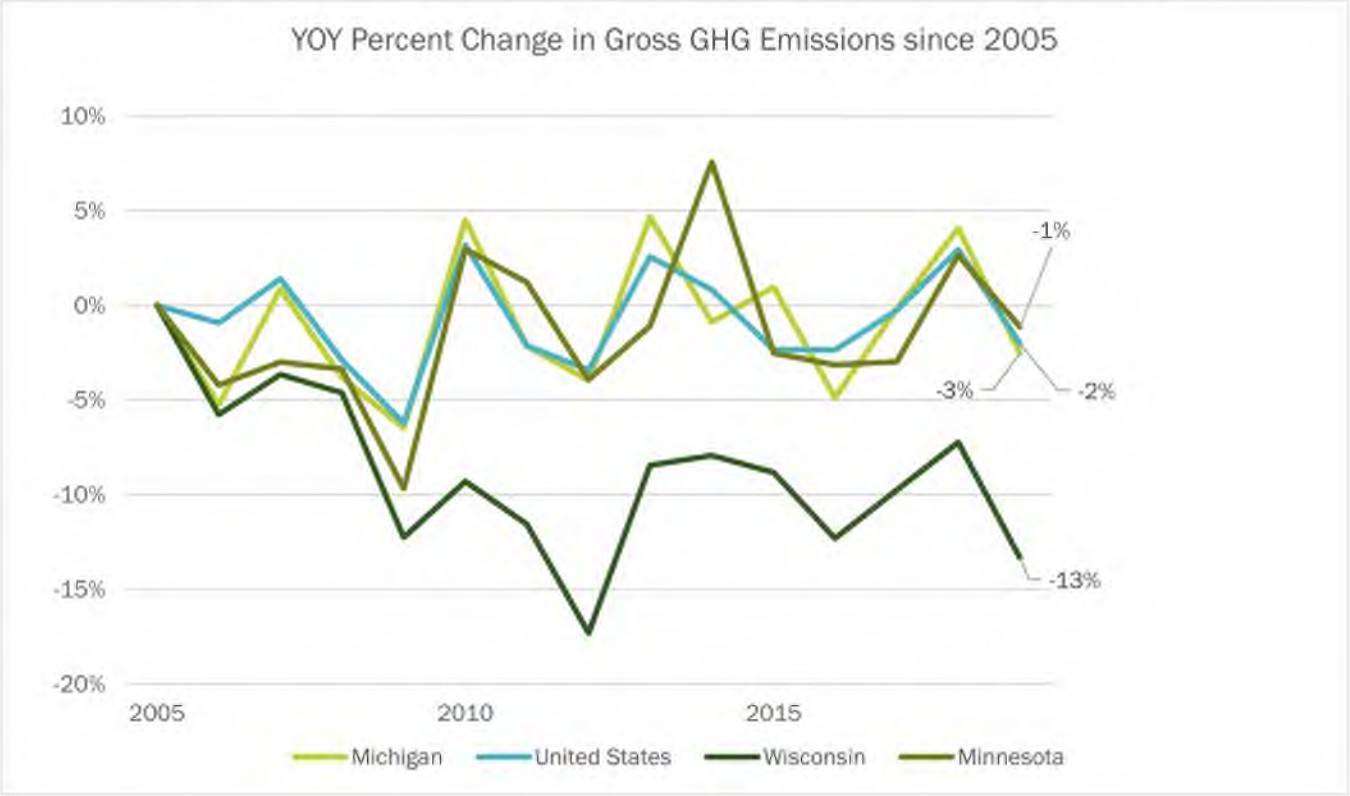
Figure 13 shows the change in gross GHG emissions from 2005 levels between the United States, Michigan, and other Midwest states. Despite some variability, a downward trend in Figure 13 shows a steady decline in Michigan's cumulative emissions since 2005. In 2019, Michigan's GHG emissions fell 15% below 2005 levels, compared to the U.S. 11% overall decline. Michigan's GHG emissions had a greater reduction than both Minnesota and Wisconsin as peer states based on 2005 levels.

Figure 13: Comparison of the percent change in Gross GHG Emissions across Michigan, the United States, and other Midwest States since 2005



Alternatively, Figure 14 shows variability demonstrated by a year-over-year percentage change in emissions rather than the ultimate downward trend shown in Figure 13. A year-over-year analysis demonstrates how emission levels change when compared to the previous year, as opposed to comparing each year individually to a standard baseline. For example, Michigan's year-over-year emissions decreased by 2% from 2018 to 2019, while emissions in 2019 were 15% lower than those in 2005. The United States, Michigan, and Minnesota trendlines show similar trends in variability, fluctuating between positive and negative emissions every two to three years. Wisconsin shows consistent reductions since 2005 year over year, though there is variability in the size of reduction. Both the U.S. and Michigan experienced a stagnation in emission changes from 2008-2009, and subsequently reached an 11% YOY increase the following year in 2010. This emphasizes that year over year emissions generally follow a volatile pattern, while trending downward overall.

Figure 14: Comparison of the year-over-year (YOY) percent change in Gross GHG Emissions across Michigan, the United States, and other Midwest states since 2005



GHG Emissions Distribution by Gas

This section will take a deep dive into the different GHGs most prevalent in Michigan, the proportion of each of them, and what inventory sectors contribute most to each gases' emissions. GHGs act as a blanket which cover the Earth's atmosphere and cause warming, however, each greenhouse gas warms the Earth at different rates. Differences in rates are expressed via Global Warming Potential (GWP) which are the result of a GHG's ability to absorb energy ("radiative efficiency") and how long they stay in the atmosphere ("lifetime"). To gain additional information on global warming potentials, please refer to the EPA's site: epa.gov/ghgemissions/understanding-global-warming-potentials.

The EPA primarily uses the 100-year GWPs from IPCC Fifth Assessment Report (AR5) per international reporting standards. 100-year GWP is based on energy absorbed by a gas over 100 years. Another common reference is the 20-year GWP which assesses the energy absorbed by a gas over 20 years and is prioritized for gases with shorter lifetimes. For gases with lifetimes shorter than that of CO_2, the 20-year GWP will be larger than a 100-year GWP. Using CH_4 as an example, which has a short lifetime, it's 100-year GWP is 28 (according to IPCC AR5) while it's 20-year GWP is around 81-83.

Below is a summary view of the GWP for relevant GHGs to show the potential warming consequences for each according to a 100-year GWP. Carbon dioxide has a GWP of 1 since it is the most prevalent GHG and is often used as a baseline of comparison to evaluate the impact of other GHGs.

Table 2: Global Warming Potential for GHGs discussed in the State of Michigan's GHG inventory[12]

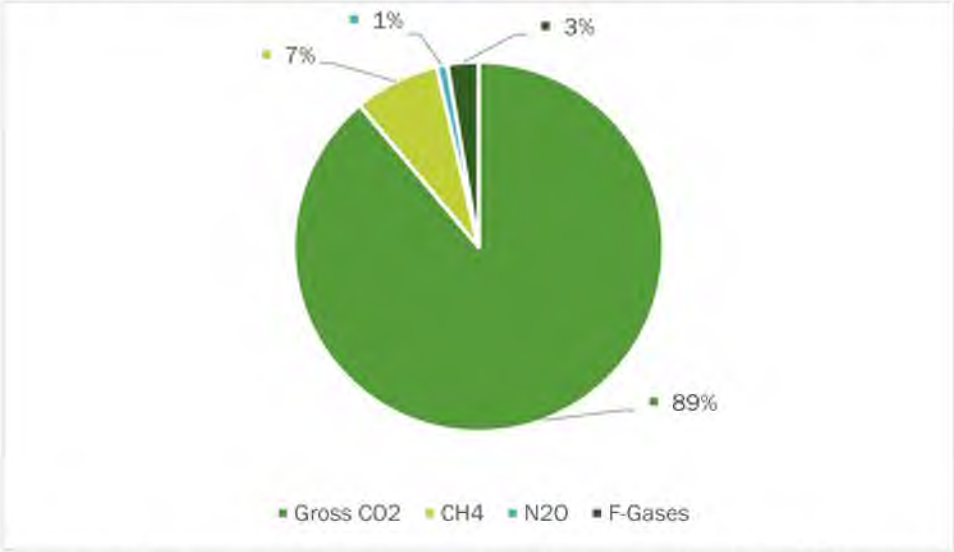
Greenhouse Gas	100-year Global Warming Potential
Carbon Dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous Oxide (N_20)	265
Hydrofluorocarbons (HFC)	4-12,400
Perfluorocarbons (PFC)	6,630 – 11,100
Sulfur hexafluoride (SF_6)	23,500
Nitrogen trifluoride (NF_3)	16,100

Despite CO_2 being the greatest source of GHG emissions in the state, the other GHGs assessed in this inventory have far greater GWP. Even with low proportions of the overall emissions, F-Gases (HFC, PFC, SF_6, and NF_3), often have GWPs over 1000, meaning they warm the Earth more than CO_2 over the same period of time. Emission reduction measures must pay attention to what GHGs they will impact and take special care to prioritize their reduction across the state.

Looking across the distribution of GHG emissions after adjusting all gases to a CO_2 equivalency (CO_2E) as shown in Figure 15, CO_2 emissions represent approximately 89% of overall GHG emissions in the State of Michigan. Methane is the second most present gas at 7%, followed by F-Gases (3%) and nitrous oxide (1%). Reference **Figure 16** for more details on the GHG emissions by gas in the State of Michigan.

[12] ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf

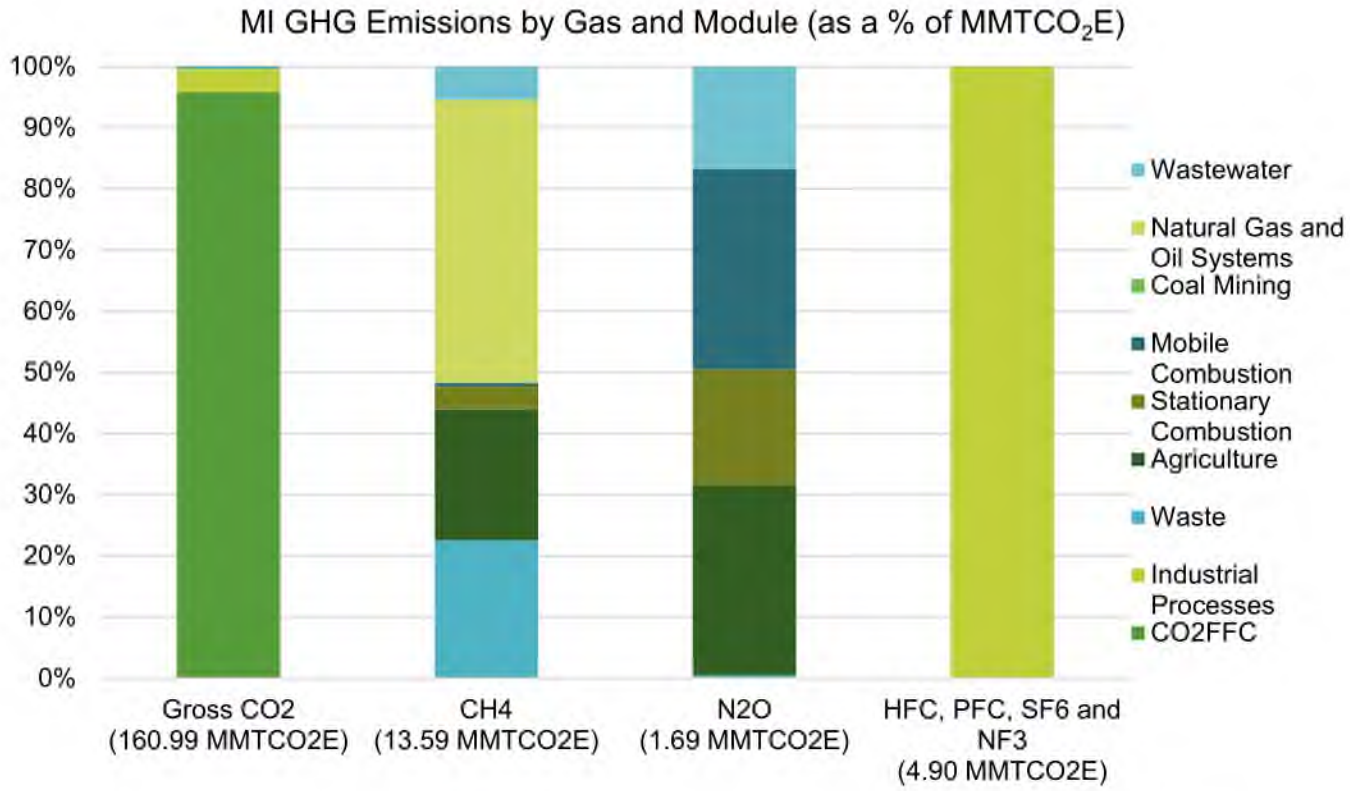
Figure 15: Distribution of GHG as a percentage of 2019 Gross Emissions



Around 90% of gross CO_2 emissions are accounted for within the CO_2FFC module within the Energy sector, while 10% come from industrial processes such as cement production, lime manufacturing, limestone and dolomite use, and iron & steel production.

The Natural Gas and Oil Systems module, Waste sector, and Agriculture sector contribute the most to CH_4 emissions, while N_2O is primarily attributed to the Mobile Combustion module and Agriculture sector. All F-Gases are attributed to the Industrial Processes sector as shown in Figure 16.

Figure 16: Distribution of Gas Types in Michigan by SIT Module in 2019



When exploring how these four GHG types have evolved between 2005 and 2019, CO_2 and N_2O decreased by 19% and 31%, respectively, while CH_4 and F-Gases increased by 4% and 14%, respectively. These emission profile changes may be due to lack of data prior to 2010 for certain modules such as Natural Gas & Oil, or simply due to a base increase in Agriculture and Industrial Processes, as some examples.

GHG Emissions by Inventory Sector

The Energy sector is by far the largest emitting inventory sector, representing 87.21% of Michigan's emissions profile in 2019, as shown in Figure 10. All sectors or modules are shown in **Table 3** and **Figure 17,** demonstrating their contribution to overall emissions in Michigan. The Energy sector is represented by five SIT modules – CO_2FFC, Stationary Combustion, Mobile Combustion, Coal Mining, and Natural Gas and Oil Systems – that will each be explored in the following sections. **Figure 18** displays the contribution of each SIT module towards overall Energy sector emissions.

Table 3: Impact Rank of GHG Emissions by Sector and Module in 2019

Sector or Module	Rank (in $MMTCO_2E$)
CO_2 from Fossil Fuel Combustion*	1
Industrial Processes	2
Agriculture	3
Natural Gas and Oil Systems*	4
Waste	5
Stationary Combustion*	6
Mobile Combustion*	7
Coal Mining*	8

**Specifies SIT modules part of the Energy inventory sector*

Figure 17: Proportion of GHG Emissions by Sector or Module in the State of Michigan in 2019

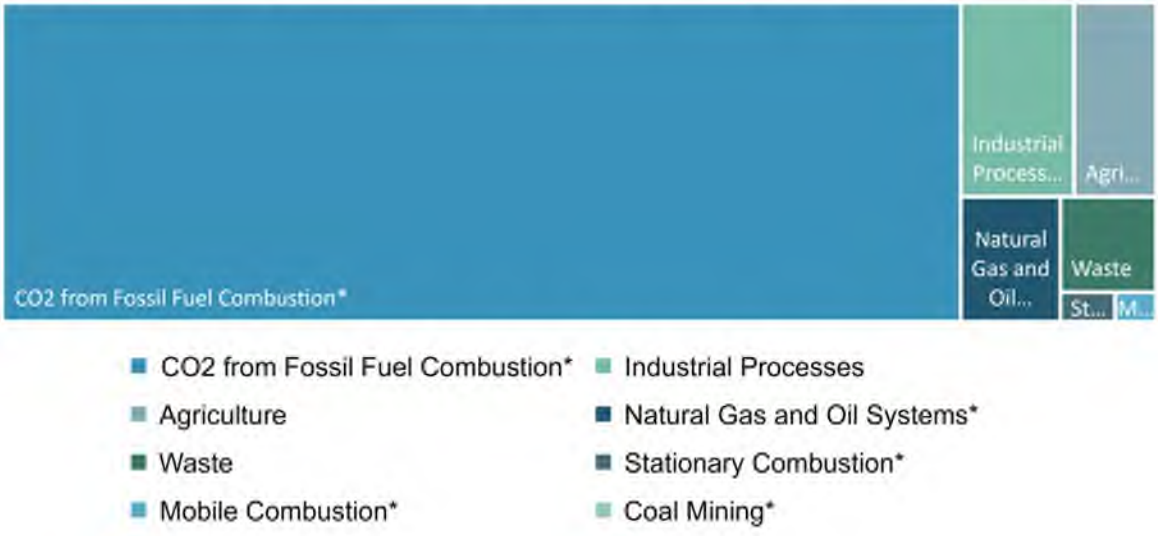
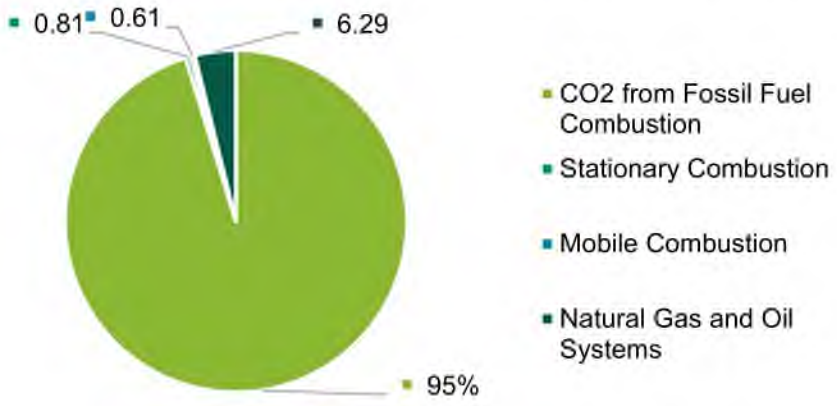


Figure 18: Breakdown of Energy Inventory Sector by SIT Module in 2019



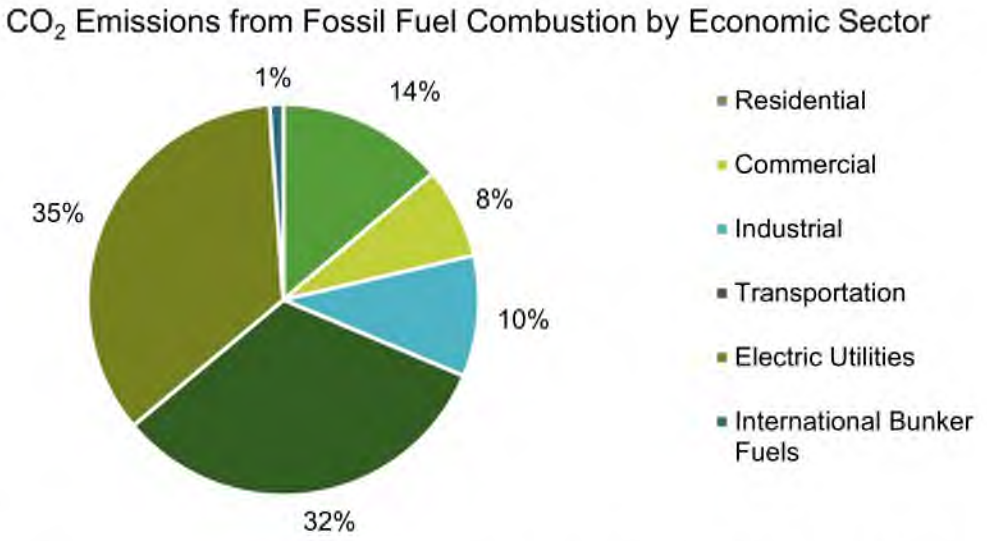
Energy

Carbon Dioxide Emissions from Direct Fossil Fuel Combustion

Carbon Dioxide Emissions from direct Fossil Fuel Combustion (CO_2FFC) is the largest emitting SIT module in Michigan for the GHG inventory and is included within the Energy inventory sector. CO_2 from Fossil Fuel Combustion is analyzed by economic sector, given its large contribution to the Energy emissions inventory sector. Economic sector analysis is pertinent to understand how the majority of GHG emissions are divided within the energy sector.

CO_2FFC emissions decreased by 17% overall from 2005 to 2019 with four of the six economic sectors (Residential, Commercial, Industrial, Transportation, Electric Utilities, and International Bunker Fuel) reducing emissions cumulatively across four different fuel types. Coal and petroleum CO_2 emissions decreased across all economic sectors from 2005 to 2019, whereas natural gas emissions increased. Table 4 shows 2005 and 2019 emissions data along with the percentage change between 2005 and 2019 across all six economic sectors and all three fuel types.

Figure 19: Proportion of CO2FFC emissions by Economic Sector in Michigan in 2019



Gross CO_2FFC emissions are heavily dependent on several factors from varying economic sectors, including overall energy demand, energy generation mix and capacity, and number of import/exports of energy demand in that year. Combustion from Electric Utilities was the highest emitting economic sector accounting for 35% of the overall CO_2 emissions from Fossil Fuel Combustion, closely followed by the Transportation sector at 32% (Figure 19).

Unsurprisingly, there has been a large decrease of carbon dioxide emissions from coal across all economic sectors, with a cumulative decrease of 46% between 2005 and 2019 (Table 4). Only the Electric Utilities and Industrial sectors generated emissions via coal combustion in 2019, with coal combustion decreasing by 45% between 2005 and 2019 in the Electric Utilities sector. Decrease of coal consumption is likely due to its increased cost, as compared to other energy sources such as natural gas which saw a cumulative increase of CO_2 emissions by 14% across economic sectors. Electric Utilities was observed to have the greatest increase in natural gas emissions between 2005 and 2019, likely due to its substitution for coal; however, the Residential economic sector remains the largest contributor of CO_2 emissions from natural gas at 18.58 $MMTCO_2E$, or 86.26% of all natural gas CO_2 emissions.

Petroleum fluctuates in its contribution to CO_2 emissions across all sectors, but overall saw a decrease in cumulative emissions by 9% from 2005 to 2019. A large increase in petroleum emissions occurred across the Commercial sector (83%), Electric Utilities sector (41%), and International Bunker Fuels sector (285%). The remaining economic sectors saw a decrease in petroleum emissions by 37% for Residential and 8% for both Industrial and Transportation. Despite the fluctuations, the cumulative decrease observed for petroleum is in in large part due to the 8% decrease in Transportation sector emissions, where petroleum makes up ~97% of CO_2 emissions in 2019.

Table 4: Total CO_2 Emissions from Fossil Fuel Combustion ($MMTCO_2E$) in Michigan

Emissions ($MMTCO_2E$)	2005	2019	% Change (2005 to 2019)
Residential	23.99	21.54	-10%
Coal	0.03	0.00	-100%
Petroleum	4.66	2.96	-37%
Natural Gas	19.30	18.58	-4%
Commercial	10.59	11.75	11%
Coal	0.33	0.00	-100%
Petroleum	0.86	1.58	83%
Natural Gas	9.40	10.17	8%
Industrial	20.62	15.63	-24%
Coal	4.42	1.82	-59%
Petroleum	4.97	4.56	-8%
Natural Gas	11.23	9.25	-18%
Transportation	55.20	50.74	-8%
Coal	0.00	0.00	-
Petroleum	53.70	49.14	-8%
Natural Gas	1.50	1.60	7%
Electric Utilities	76.50	54.57	-29%
Coal	68.69	38.04	-45%
Petroleum	0.78	1.10	41%
Natural Gas	7.03	15.42	119%
International Bunker Fuels	0.45	1.75	285%
Petroleum	0.45	1.75	285%
Total	**186.89**	**154.24**	**-17%**
Coal	73.46	39.87	-46%
Petroleum	64.98	59.34	-9%
Natural Gas	48.45	55.03	14%

Stationary Combustion

Stationary Combustion is the 3rd smallest module included in the energy inventory sector in Michigan, accounting for 0.43% of Michigan's overall GHG emissions in 2019. Between 2005 and 2019, emissions from this module decreased by 11%.

Across economic sectors, Electric Utilities and Industrial decreased in both CH_4 and N_2O emissions while the Residential and Commercial sectors increased both CH_4 and N_2O emissions. Emissions of N_2O and CH_4 decreased by 30% and increased by 19%, respectively (Table 5).

The Residential economic sector accounts for 50% of emissions from the Stationary Combustion module in 2019 as the primary emitter of CH_4, amounting to 0.36 $MMTCO_2E$ or 72% of CH_4 emissions from stationary combustion in 2019. Electric Utilities emit N_2O three times as much as any other economic sector within this module, leading to it being the second-highest emitting economic sector within Stationary Combustion in 2019. In comparison, the Commercial and Industrial sectors make up only a small portion of overall emissions from Stationary Combustion when accounting for methane and nitrous oxide (Table 5).

Table 5: Total CH_4 and N_2O Emissions from the Stationary Combustion Module in Michigan ($MMTCO_2E$)

Emissions ($MMTCO_2E$)	2005	2019	% Change (2005 to 2019)
Residential	0.32	0.41	28%
N_2O	0.05	0.05	16%
CH_4	0.27	0.36	30%
Commercial	0.07	0.09	19%
N_2O	0.01	0.01	14%
CH_4	0.06	0.07	20%
Industrial	0.12	0.10	-15%
N_2O	0.07	0.06	-15%
CH_4	0.05	0.04	-14%
Electric Utilities	0.34	0.21	-40%
N_2O	0.31	0.18	-42%
CH_4	0.04	0.03	-22%
Total	**0.85**	**0.81**	**-6%**
N_2O	0.43	0.30	-30%
CH_4	0.42	0.50	19%

Mobile Combustion

Mobile Combustion was the 2nd smallest emitting module of GHG emissions in Michigan in 2019, included under the Energy inventory sector at 0.33% of overall emissions in the state. The Mobile Combustion module measures CH_4 and N_2O across transportation. Between 2005 and 2019, CH_4 and N_2O emissions for Mobile Combustion decreased by 56%, equating to cumulative emissions decrease of ~0.076 $MMTCO_2E$. This value is equivalent to removing approximately 16,522 cars off the road. In large part this was due to a significant decrease in Gasoline Highway Passenger Car emissions, which decreased by 0.42 $MMTCO_2E$ or 55.38% of the total decrease in Mobile Combustion emissions from 2005 to 2019.

Michigan's Mobile Combustion accounting is separated into four categories: Gasoline Highway, Diesel Highway, Non-Highway, and Alternative Fuel Vehicles with subcategories of specific vehicle types for each.

Table 6 shows the emissions profile for each category and subcategory for 2005 and 2019.

Among the categories, Diesel Highway, Non-Highway, and Alternative Fuel Vehicles all increased in CH_4 and N_2O emissions, while Gasoline Highway was the only vehicle category to decrease in CH_4 and N_2O emissions from 2005 to 2019. The Non-Highway and Gasoline Highway categories claim the vast majority of CH_4 and N_2O emissions in the Mobile Combustion module.

The largest cumulative increase in CH_4 and N_2O emissions from Mobile Combustion came from Diesel Highway vehicles with over 0.08 $MMTCO_2E$, or 783% from 2005 to 2019. Heavy-Duty (HD) Vehicles are primarily responsible for this increase but all vehicle types under Diesel Highway CH_4 and N_2O emissions increased between these two reference years.

Under the Gasoline Highway category, Passenger Cars were responsible for the majority of CH_4 and N_2O emissions in 2019 as compared to other vehicle types, despite decreasing CH_4 and N_2O emissions by 72% since 2005 levels. All vehicle types included in Gasoline Highway vehicles have decreased their CH_4 and N_2O emissions since 2005.

Table 6: Total CH_4 and N_2O Emissions from Mobile Sources in Michigan ($MMTCO_2E$)

Fuel/Vehicle Type Emissions ($MMTCO_2E$)	2005	2019	% Change (2005 to 2019)
Gasoline Highway	1.130	0.248	-78%
Passenger Cars	0.586	0.166	-72%
Light-Duty Trucks	0.504	0.071	-86%
Heavy-Duty Vehicles	0.038	0.011	-72%
Motorcycles	0.001	0.000	-70%
Diesel Highway	0.011	0.094	783%
Passenger Cars	0.000	0.002	1713%
Light-Duty Trucks	0.000	0.004	777%
Heavy-Duty Vehicles	0.010	0.081	739%
Heavy-Duty Buses	0.001	0.008	1416%
Non-Highway	0.224	0.263	18%
Boats	0.011	0.032	177%
Locomotives	0.002	0.001	-43%
Farm Equipment	0.025	0.026	1%
Construction Equipment	0.057	0.075	32%
Aircraft	0.013	0.037	180%
Other*	0.114	0.092	-19%
Alternative Fuel Vehicles	0.001	0.001	82%
Light Duty Vehicles	0.000	0.000	18%
Heavy Duty Vehicles	0.000	0.000	67%
Buses	0.001	0.001	85%
Total	**1.365**	**0.607**	**-56%**

Natural Gas & Oil

The Natural Gas & Oil sector is the 4th largest emitting module in Michigan's 2024 GHG inventory, included under the Energy inventory sector. Between 2005 and 2019, CH_4 and N_2O emissions increased by 381% for a cumulative 6.29 $MMTCO_2E$ emitted in 2019. This large increase can be attributed to the addition of state-specific data since 2010. Oil emissions include CH_4 and N_2O emissions from production, refining, and transportation within the state of Michigan. CH_4 and N_2O emissions from the Natural Gas sector represent emissions from gathering, transmission and distribution. Table 7 demonstrates both CH_4 and N_2O emissions for Natural Gas and Oil in 2005 and 2019.

Table 7: Natural Gas and Oil CH_4 and N_2O Emissions in Michigan ($MMTCO_2E$)

Emissions ($MMTCO_2E$)	2005	2019	% Change (2005 to 2019)
Natural Gas	1.18	6.23	427%
Oil	0.12	0.06	-52%
Total	**1.31**	**6.29**	**381%**

Coal Mines

Michigan does not have any operational coal mines, with the last mine closing in 1952. Therefore, data is excluded for this module. An opportunity for further analysis may be done on residual emissions from abandoned coal mines, but no data has been found to support this analysis.

Industrial Processes

Industrial Processes emissions remained relatively flat from 2005 to 2019, decreasing by 2% overall. Industrial Processes cumulatively make up the 2nd largest emitting inventory sector in Michigan. They include non-direct combustion GHG emissions related to the handling and use of certain chemicals in processes such as cement production, lime manufacturing and iron & steel production. Industrial Processes account for 5.97% of Michigan's overall emissions in 2019. Table 8 demonstrates Industrial Processes emissions by type for 2005 and 2019.

Industrial Processes emissions are categorized across three greenhouse gas types:

a. Carbon Dioxide emissions
b. Nitrous Oxide emissions
c. HFC, PFC, SF_6 and NF_3 (F-Gases) emissions

Non-combustion related carbon dioxide emissions from industrial processes decreased by 13%, largely due to the decrease in cement manufacturing and iron & steel production that make up the majority of these emissions.

Emissions from F-Gases increased from 2005 to 2019 by 14% due to the replacement of Ozone Depleting Substances (ODS) with F-gas substitutes. F-gas substitutes for ODS are often found in refrigeration, air-conditioning, and aerosol applications. F-Gases have high global warming potentials as compared to other greenhouse gas types included in Industrial Processes, so though the amount of F-Gas emissions may not be large, their ability to retain heat in the atmosphere over their lifetime is what contributes to their large Global Warming Potential (refer to Table 2). Other processes including Semiconductor Manufacturing and Electric Power Transmission and Distribution Systems decreased in overall emissions but are comparatively low to ODS substitutes, clarifying the aggregate increase.

Nitric acid production data is not available for the State and therefore, is excluded in this Inventory. In addition, adipic acid is not produced in Michigan and thus, not included in the inventory.

Table 8: GHG Emissions related to Industrial Processes in Michigan ($MMTCO_2E$)

Emissions ($MMTCO_2E$)	2005	2019	% Change (2005 to 2019)
Non-Combustion Related Carbon Dioxide Emissions	7.072	6.182	-13%
Cement Manufacture	2.126	1.600	-25%
Lime Manufacture	-	0.341	-
Limestone and Dolomite Use	0.251	0.475	89%
Soda Ash**	0.087	0.060	-32%
Aluminum Production, CO2*	-	-	-
Iron & Steel Production	4.596	3.692	-20%
Ammonia Production*	-	-	-
Urea Consumption	0.011	0.014	27%
Nitrous Oxide Emissions	-	-	-
Nitric Acid Production*	-	-	-
Adipic Acid Production**	-	-	-
F-Gases	4.291	4.898	14%
ODS Substitutes	3.986	4.779	20%
Semiconductor Manufacturing	0.045	0.002	-95%
Magnesium Production*	-	-	-
Electric Power Transmission and Distribution Systems	0.260	0.116	-55%
HCFC-22 Production*	-	-	-
Aluminum Production, PFCs*	-	-	-
Total	**11.363**	**11.080**	**-2%**

*Data is unavailable via SIT, additional state-specific data is needed
**Adipic Acid Production and Soda Ash Manufacturing do not occur in the State of Michigan and therefore, no emissions are accounted for (Soda Ash Consumption is accounted for)

Transportation

The transportation sector makes up 32% of CO_2 emissions across the CO_2FFC module. To allow for a holistic view of the Transportation sector, inclusive of CH_4 and N_2O emissions related to Mobile Combustion, emissions data from both groups of emissions were combined and are represented in Table 9.

In 2019, non-highway vehicles made up 43% of transportation's GHG emissions. Gasoline Highway vehicles make up slightly less than half of the overall GHG emissions for Transportation at 41% of total emissions shown in Figure 20. Gasoline Passenger Cars had the greatest emissions contribution of any vehicle type, making up 27.4% of total Transportation emissions and 67% of Gasoline Highway vehicles overall, as shown in Table 9.

Non-Highway vehicle emissions are spread across construction equipment and the "other" category which includes Snowmobiles, Small Gasoline Powered Utility Equipment, and Heavy-Duty Diesel-Powered Utility Equipment, Aircrafts, Boats, and Farm Equipment. Construction equipment makes up 28% of Non-Highway Transportation emissions and 12% of total GHG emissions. Diesel Highway vehicles make up 16% of total emissions, mainly sourced from HD vehicles (vehicles greater than 8,500 lbs.).[13] Alternative Fuel vehicles remain the smallest percentage of GHG emissions, making up less than 0.05% the total.

Overall, most fuel and vehicle types have increased in GHG emissions from 2005 to 2019 – however, Gasoline Highway emissions have reduced by 55%, with the greatest reduction from light-duty (LD) trucks (<8,500 lbs.). 99% of total emissions for Transportation were from CO_2 emissions, while CH_4 and N_2O emissions made up 1% of overall emissions.

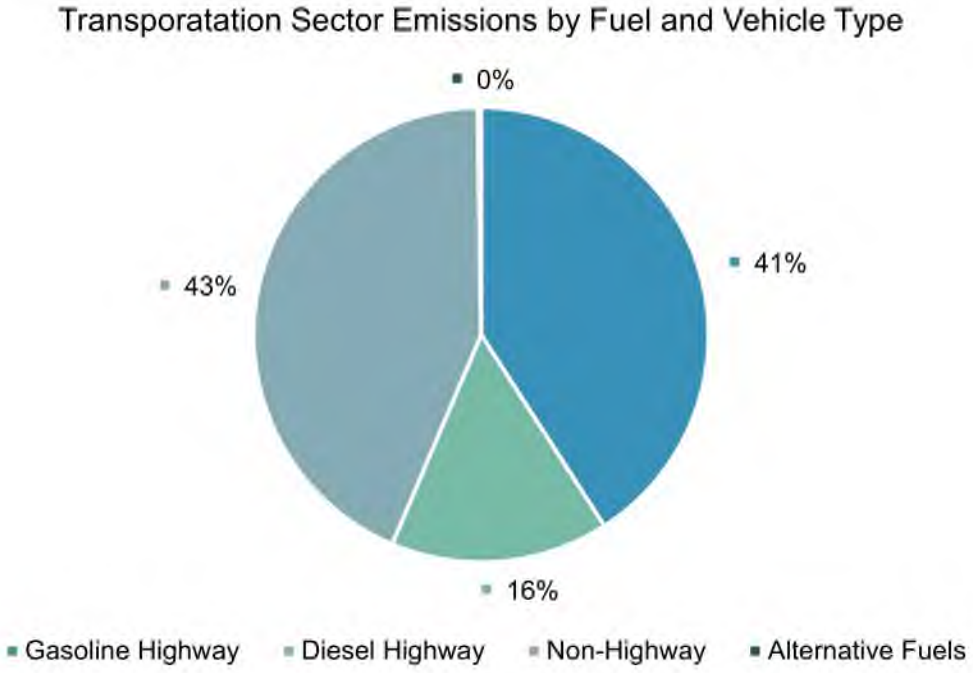
Table 9: Transportation Sector Emissions by Fuel and Vehicle Type in Michigan ($MMTCO_2E$)

Fuel Type/Vehicle Type ($MMTCO_2E$)	2005	2019	% of Total Emissions (2019)	% Change (2005 to 2019)
Gasoline Highway	46.824	20.994	41%	-55%
Passenger Cars	24.286	14.072	27%	-42%
Light-Duty Trucks	20.901	5.969	12%	-71%
Heavy-Duty Vehicles	1.580	0.918	2%	-42%
Motorcycles	0.057	0.035	0%	-38%
Diesel Highway	0.442	7.966	16%	1702%
Passenger Cars	0.004	0.147	0%	3601%
Light-Duty Trucks	0.018	0.321	1%	1690%
Heavy-Duty Vehicles	0.398	6.810	13%	1612%
Heavy-Duty Buses	0.022	0.688	1%	2994%
Non-Highway	9.264	22.269	43%	140%
Boats	0.473	2.672	5%	465%
Locomotives	0.100	0.117	0%	16%
Farm Equipment	1.050	2.167	4%	106%
Construction Equipment	2.364	6.376	12%	170%
Aircraft	0.552	3.155	6%	472%
Other*	4.726	7.783	15%	65%
Alternative Fuel Vehicles	0.032	0.121	0%	272%
Light Duty Vehicles	0.001	0.002	0%	141%
Heavy Duty Vehicles	0.001	0.003	0%	241%
Buses	0.031	0.116	0%	277%
Total	**56.563**	**51.350**	-	**-9%**

[13] afdc.energy.gov/data/10380

Figure 20: Total GHG Emissions for Transportation Sector (includes CO2FFC & Mobile Combustion modules) in Michigan in 2019

NOTE: 0% of total emissions signifies emissions less than 0.05%



Electricity Sector

The Electricity sector includes electricity generated and consumed within Michigan, as well as imports and exports (refer to Table 10 and

Figure ***21***). Though this inventory is primarily inventory sector-based, this section will aid in illustrating indirect CO_2 emissions from Electricity Combustion as well.

The Electricity sector is the greatest emitter of CO_2 from fossil fuel combustion in the State of Michigan, emitting 35% of total CO_2 from fossil fuel combustion, equivalent to 54.57 $MMTCO_2E$. To gather total direct electricity generation, this inventory collects electric power data from both stationary combustion activities and CO_2 from fossil fuel combustion. Stationary combustion makes up a small portion of overall direct electricity generation (.03%), making the total equal to 54.75 $MMTCO_2E$ in 2019. From 2005 to 2019, there was a 29% reduction in electricity generation GHG emissions.

The EIA's State Energy Data System (SEDS) provides detailed import and export data via the EIA's State Electricity Profiles.[14] Using these data, this inventory considers the net import and export of electricity into the State of Michigan both between states and internationally (international imports are typically from Canadian power plants). In 2005, an overall net export of interstate electricity trade resulted in a reduction of 1.99 $MMTCO_2E$ emissions based on

[14] eia.gov/electricity/state/Michigan/

negative net international and interstate imports. Conversely, in 2019, there was an overall net import of electricity resulting in 5.51 $MMTCO_2E$ increase in GHG emissions accounted for in the State (Table 10 and Figure 22). Please refer to EPA's posted SIT documentation[15] and the EIA's posted SEDS database documentation[16] for additional information on net imports.

The EPA's State Inventory Tool provides analysis of Indirect CO_2 emissions from Electricity Consumption by sector; however, it is important to note that end-use sector consumption is not reflected in total GHG emissions for the state due to overlap with electricity generation. Overall, the inventory reflects a 32% reduction in electricity consumption by end-use sector from 2005 to 2019. Specifically, the Industrial, Residential, and Commercial end-use sectors all reflected emissions reductions between 29% and 36% (See Table 11). The Commercial sector represented the greatest GHG emissions from electricity consumption with 18.34 $MMTCO_2E$. **Appendix A** details the specific end-use activities across Residential, Commercial, Industrial and Transportation sectors.

Despite electricity making up the largest portion of CO_2 emissions from fossil fuel combustion across the State, electricity generation and consumption have seen a decline in emissions for every year since 2008, while imports of electricity have been oscillating as certain years have net exports verses imports (see Figures 21 and 22).

Table 10: Electricity Sector Emissions by Generation, Imports, and End-Use Consumption ($MMTCO_2E$)

Electricity Sector Emissions ($MMTCO_2E$)	2005	2019	% Percent Change from 2005 to 2019
Total Direct Electricity Generation	76.84	54.77	-29%
Stationary Combustion from Electric Power (CH_4 and N_20)	0.34	0.21	-40%
CO_2 from FFC from Electric Power	76.50	54.57	-29%
Total Net Imports	-1.99	5.51	-377%
Net Interstate Trade	-0.80	4.36	-642%
Net International Imports	-1.18	1.15	-197%
Indirect CO_2 from Electricity Consumption	72.16	49.05	-32%

[15] epa.gov/statelocalenergy/download-state-inventory-and-projection-tool
[16] eia.gov/state/seds/

Table 11: Indirect CO_2 from Electricity Consumption by Sector*

Indirect CO2 from Electricity Consumption (MMTCO2E)	2005	2019	% Change (2005 to 2019)
Residential	23.582	16.226	-31%
Commercial	25.871	18.340	-29%
Industrial	22.699	14.477	-36%
Transportation	0.003	0.003	-4%
Total	**72.16**	**49.05**	**-32%**

*Refer to Appendix A - Table 3 for list of end-uses by sector

Figure 21: Total Electricity Generation, Interstate Trade, and End-Use Consumption in Michigan from 2005 to 2019

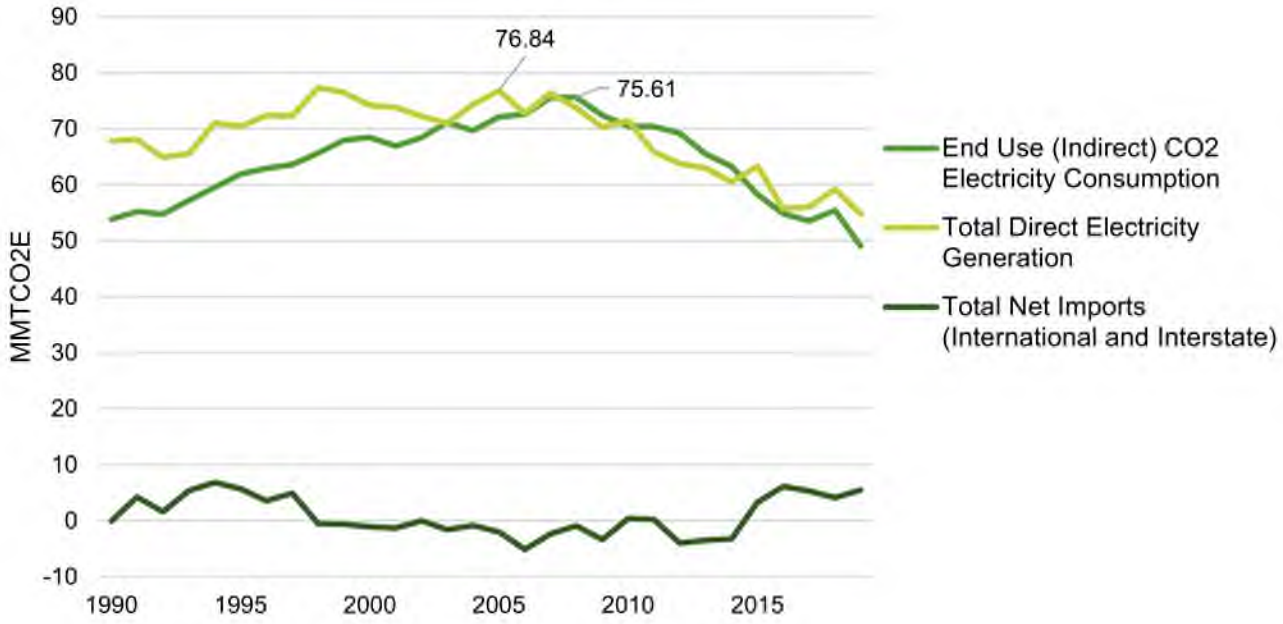


Figure 22: Net Total, Interstate, and International Electricity Imports in Michigan from 1990 – 2019

4.2 Community Engagement Outcomes

As a result of community engagement, EGLE facilitated five in-person public engagement sessions across the state and two virtual public listening sessions. All sessions were hosted in the evening between 6-8pm local time. The in-person sessions were held at the following venues in the respective towns:

1. Detroit – Zero Net Energy Center – International Brotherhood of Electrical Workers Local 58
2. Grand Rapids – Dan & Pamela DeVos Center for Interprofessional Health
3. Flint – Michigan State University College of Human Medicine
4. Marquette – Northern Michigan University
5. Petoskey – North Central Michigan College

One additional engagement session was held during the quarterly Michigan Tribal Environmental Group (MTEG) meeting in Acme at the Grand Traverse Resort.
Outcomes of the in-person and virtual sessions solicited approximately 400 attendees who provided ~1,500 comments. In addition, more than 600 pieces of feedback were received during the gallery walk exercise which helped to highlight the most important topics discussed during the sessions. 350 of the 1,500 comments received were in line with existing considerations for EGLE as part of the PCAP process, insinuating that Michiganders have a firm vision of what they want to see as part of MHCP implementation. The comments also provided 237 new

reduction measure ideas which were evaluated as part of the reduction measure prioritization framework. A feedback survey circulated to attendees following the sessions indicated:

90%
of attendees increased their understanding of the MHCP

90%
of attendees found the breakout group activities engaging

75% +
of attendees indicated they are interested in attending future EGLE events

Figure 23: Common topics discussed during engagement sessions held between November and December 2023

Engagements were facilitated by providing clear expectations of the intended outcomes of the session to demonstrate transparency and focused on place-based engagements to meet communities where they are. EGLE strives for continuous improvement, as demonstrated by requesting feedback via surveys to attendees. A subset of major themes that emerged across engagement sessions are depicted in Figure 23.

The last piece of engagement EGLE organized through its PCAP development in relation to the CPRG PCAP Phase was releasing a draft list of priority reduction measures for public comment prior to PCAP submission. EGLE received 66 responses from the open comment period. The feedback indicated that more explicit consideration should be given to LIDACs, and EGLE has incorporated this feedback into each reduction measure as a result. Additionally, there were several comments or clarification questions regarding what is and is not included in some of the measures. For instance, if rental properties apply to Reduction Measure #4 describing household decarbonization. To clarify these comments, the summary included within each reduction measure provides example entities or use-cases that may be implemented. However, these examples are not exhaustive and there are several other entities or infrastructure that may fall within reduction measures.

4.3 LIDAC Benefits Analysis

The State of Michigan has many areas that are identified as low income disadvantaged communities. Many of these communities are also disproportionally negatively impacted by injustices in categories including climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. To identify communities throughout the country facing especially negative impacts in these areas, the White House Council on Environmental Quality developed the Climate and Economic Justice Screening Tool (CEJST), a geospatial mapping tool which highlights disadvantaged census tracts across all 50 states, the District of Columbia, and the U.S. territories.

The CEJST screening tool methodology considers a census tract to be disadvantaged if it meets one of two requirements:

1. They are in census tracts that meet the thresholds for at least one of the tool's categories of burden
2. They are on land within the boundaries of Federally Recognized Tribes

Based on the CEJST screening tool, the State of Michigan has 996 census tracts that are identified as disadvantaged, making 35% of Michigan communities considered low income and disadvantaged. The map shown in Figure 24 provides an illustration of how widespread the identified disadvantaged communities are throughout the State of Michigan.

Within the 996 census tracts identified as disadvantaged, four of the census tracts were identified as disadvantaged due to tribal overlap. These tracts are located in Isabella County and at least 99% of the census tract is within Federally Recognized Tribal Areas.

In addition to the CEJST screening tool, the 996 identified disadvantaged census tracts were also analyzed using the EPA's Environmental Justice Screening and Mapping Tool (EJScreen). The EJScreen provides the EPA with a nationally consistent dataset and approach for combining environmental and demographic socioeconomic indicators. The EJScreen also includes information on supplemental indexes, which provides a combination of environmental and socioeconomic information based on thirteen specific environmental indicators, including: Particulate Matter 2.5 (PM2.5), Ozone, Diesel Particulate Matter, Air Toxics Cancer Risk, Air Toxics Respiratory Hazard Index, Toxic Releases to Air, Traffic Proximity, Lead Paint, RMP Facility Proximity, Hazardous Waste Proximity, Superfund Proximity, Underground Storage Tanks, and Wastewater Discharge. Based on the EJScreen tool, many of the 996 identified disadvantaged census tracts within the State of Michigan were also ranked in the 90th national percentile for seven out of the thirteen specific environmental indicators as described in Table 12.

Figure 24: Map of Michigan State showing the LIDACs among three different tools

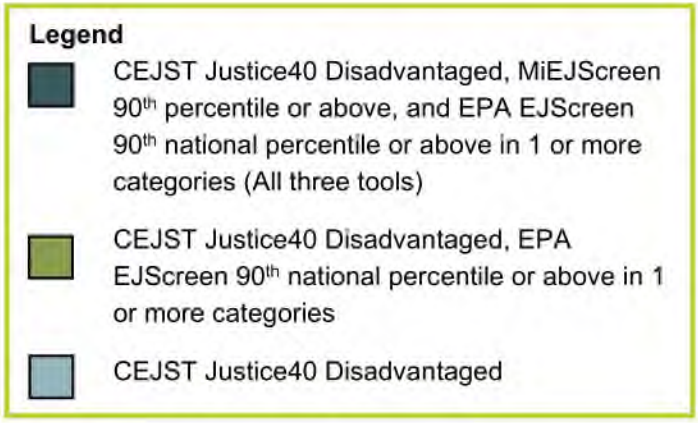
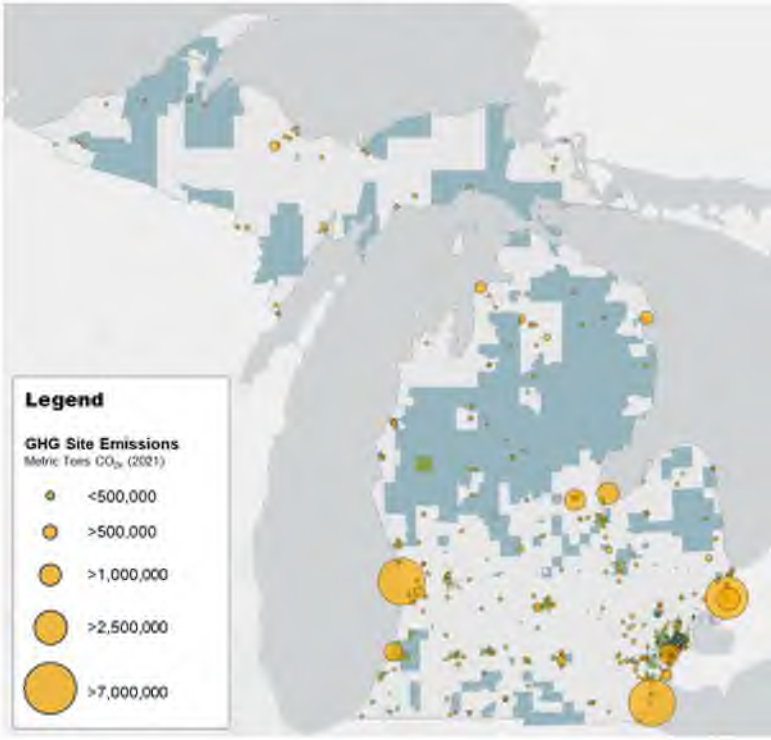


Table 12: Environmental and socioeconomic information from EPA's EJScreen corresponding to the number of census tracts in Michigan affected by those indicators.

Supplemental Indexes (EJScreen) 90TH National Percentile

Indicator	Number of Census Tracts
Traffic Proximity	226 census tracts
Lead Paint	366 census tracts
Hazardous Waste Proximity	16 census tracts
Superfund Proximity	125 census tracts
RMP Facility Proximity	107 census tracts
Wastewater Discharge	47 census tracts
Underground Storage Tanks	492 census tracts

Figure 25: Overlay of the State of Michigan's LIDACs with the highest emitting facilities in the state.



The majority of Michigan's GHG emissions are located in multiple clusters throughout the state. Figure 26 provides a representative view of GHG site emissions throughout the State of Michigan. The clusters represent the GHG site emissions based on metric tons emitted within the geographical area. As the maps show, many of the low income and disadvantaged communities throughout the State of Michigan are impacted by these clusters.[17]

The State of Michigan has engaged with community members and leaders throughout many of the identified disadvantaged communities. These engagements have included a variety of different methodologies, including surveys, questionnaires, in-person and virtual forums to ensure that the concerns and desired outcomes for the low income and disadvantaged communities throughout the state were identified. The in-person sessions held in the cities of Detroit, Grand Rapids, Flint, Marquette, Petoskey, and Acme collectively contain 505 of the 996 disadvantaged census tracts representing nearly 51% of the LIDACs within the state. Additionally, the two virtual sessions held were attended by individuals representing over 100 communities, and approximately 13% of those registered were from LIDACs based on zip codes provided.

4.3.1 Climate Impacts and Risks in LIDACs

Air Quality and Public Health

Residents in Michigan, especially in the southwest of Detroit, experience heavy pollution emitted from a variety of different sources. For example, the southwest and surrounding areas of Detroit are home to many factories, such as oil refineries and automobile manufacturing facilities. The emissions from these facilities, combined with daily automobile, truck traffic and other environmental stressors can adversely affect the health of those in the community. There are over 150 sites in southwest Detroit alone that release chemicals and particles which result in air pollution. These sites emit dangerous chemicals and particles such as PM2.5, sulfur dioxide, nitrous oxide and ozone. These air pollutants have caused increases in the asthma hospitalization rates in southwest Detroit and the surrounding areas, which are nearly triple the state average.[18]

Michigan anticipates that the investment in the priority climate action measures will provide benefits to LIDAC communities. Further, Michigan commits to involving and engaging LIDAC community members early and often throughout the planning process to influence decision-making. As a result, it is anticipated that the overall public health of residents will see improvements in these communities.

Based on available data from the CEJST screening tool, many of the identified LIDAC census tracts across the state also have adult residents with major health concerns that adversely impact their quality of life. Table 13 below shows the number of identified LIDAC census tracts

[17] epa.gov/ghgreporting
[18] iqair.com/us/usa/michigan

in which 90% or more of the adult residents have either asthma, diabetes, or coronary heart disease. The chart also provides information on the number of adults living with these serious health conditions across all identified LIDAC census tracts.

Table 13: Health conditions among low-income disadvantaged communities

Health Condition	# Census Tracts 90th National Percentile or Above	# of adults 18 or older in All LIDAC Census Tracts
Asthma	677	1,286,397
Diabetes	350	1,477,425
Heart Disease	324	800,560

Studies have shown that many of these health conditions can be linked to poor air quality, which is a consistent issue facing many communities located in LIDAC census tracts throughout the state. As these communities begin to engage and take part in projects and initiatives designed to improve overall air quality, the residents in many of the identified LIDAC areas should begin to realize tangible improvements in the overall health of the residents.

Energy Burden

Energy burden is a measure of the proportion of household income spent on energy costs, and in Michigan, this issue disproportionately affects economically vulnerable families. Michigan households with an income below the Federal Poverty Line (FPL) spend 18% of their income on energy, compared to an average of 3% for the overall population.[19] The financial impact is evident as these families allocate a substantial portion of their earnings to meet basic energy needs. Energy burden contributes to a cycle of poverty by limiting resources for other essential needs such as healthcare, education, and housing.

Recognizing the urgency of addressing energy burden, the State of Michigan has set ambitious goals to alleviate the strain on low-income families. EGLE has spearheaded initiatives to enhance energy efficiency, promote renewable energy sources, and provide financial assistance to vulnerable communities to limit energy burden from powering and heating homes to not more than 6% of annual income for low-income households. Programs such as the Weatherization Assistance Program (WAP) aim to improve energy efficiency in low-income homes, reducing energy consumption and subsequently lowering utility bills. Additionally, Michigan's Community Action Agencies collaborate to implement outreach and education programs to inform residents about available resources, energy-saving practices, and financial assistance options, fostering a comprehensive approach to alleviate energy burden. For every $1 invested in reducing energy waste in MI homes – through more efficient windows, lighting, and other energy-saving

[19] US DOE

technologies – homeowners save more than $3.20 in reduced future energy bills.[20] Energy efficiency also reduces energy burden by as much as 2%, translating into more than $400 in annual savings for households.[21]

In 2023, clean energy legislation in Michigan doubled funding for the Utility Consumer Participation Board (UCPB), which provides resources for organizations to advocate on behalf of ratepayers before the Michigan Public Service Commission, specifically for environmental justice and high energy burden communities. By funding more robust participation, these increased resources will continue to help mitigate energy burden among Michigan families, despite progress already trending in the right direction. The average energy burden between 2022 and 2023 decreased by 3% for households whose income is 0%-100% of the FPL. Although, the distribution of average annual energy cost and average energy burden across income categories as defined by the FPL remain relatively consistent between 2022 and 2023, accentuating the disproportionate impacts felt by LIDACs.

Addressing energy burden in low-income communities presents an opportunity to enhance overall well-being, with impacts on economic, social, and health. Weatherizing and repairing homes emerge as pivotal strategies, encompassing improvements such as insulation, air sealing, and energy-efficient appliance upgrades. Such measures not only result in immediate cost savings for families but also contribute to a more sustainable environment. Furthermore, investing in energy efficiency initiatives not only reduces energy bills but also enhances the comfort and health of homes, creating a positive ripple effect on the residents' overall quality of life. Getting access to these technologies and improvements for Michigan's low-income and disadvantaged communities continues to be a challenge and requires a concerted effort from government agencies, non-profit organizations, and private sector partners. By implementing these opportunities, Michigan can pave the way for a more equitable and sustainable energy landscape, fostering resilience and improved living conditions for its most vulnerable citizens.

Workforce

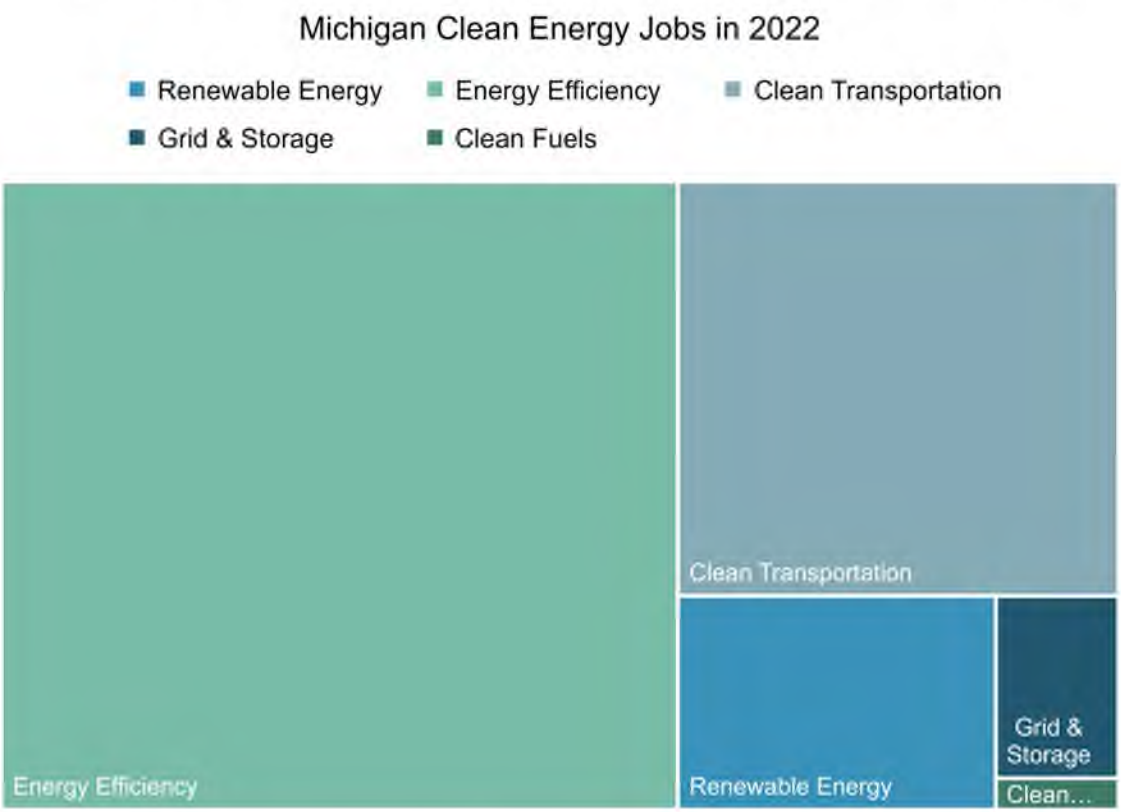
Michigan leads the Midwest states in clean energy jobs with nearly 124,000 Michigan residents employed by clean energy companies at the end of 2022. Michigan ranked 5th in the nation for clean energy jobs in 2022 after growing nearly 5% year-over-year, and the industry is poised for continued growth due to federal climate investments passed last year.

Table 14: Michigan Clean Energy Jobs in 2022, totaling 123,983 jobs

Clean Energy Job Categories	Number of Jobs in 2022
Renewable Energy	12,002
Energy Efficiency	75,085
Clean Transportation	32,271
Grid & Storage	3,944
Clean Fuels	682

[20] michigan.gov
[21] ACEEE

Figure 26: Michigan Clean Energy Jobs in 2022, totaling 123,983 jobs



Currently, clean energy jobs now account for over 40% of all energy workers in America[22], and it is anticipated that this upward trend will continue. As Michigan implements initiatives designed to promote renewable energy, energy efficiency, clean vehicles, grid modernizations and other pollution reduction initiatives, clean energy jobs are expected to continue to grow. The majority of the clean energy jobs in Michigan fall into the sector categories described in Table 14 and Figure 27[23].

The largest sector in Michigan's clean energy industry is energy efficiency, comprising over 60 percent of the state's clean energy workforce. Workers in Michigan's energy efficiency industry manufacture ENERGY STAR-rated appliances, install efficient lighting, heating, ventilation, and air conditioning (HVAC) systems, and install advanced building materials in homes and commercial buildings. Additionally, as more automakers and their suppliers continued to shift to electric vehicles, the clean transportation sector saw an increase in employment of over 14 percent in 2022 in Michigan[24].

Since August 2022, there has been more than $20 billion in investments for clean energy projects throughout the State of Michigan, which has resulted in the creation of more than 13,500 jobs[25]. As more communities in identified LIDAC census tracts continue to implement

[22] Clean Jobs America 2023
[23] Clean Jobs Midwest
[24] Clean Jobs Midwest
[25] Clean Jobs for MI

clean energy projects, it is anticipated that the number of clean jobs available to LIDAC members will continue to grow, especially with the prioritization of local hiring. Several bills passed in Michigan in 2023 consider environmental justice and workforce development holistically. For example, new laws stipulate strong labor standards for clean energy projects, prioritize worker benefits in long-term utility plans, and encourage diverse workforce hiring from environmental justice and low-income communities.

Climate Resilience

As global temperatures continue to rise, the State of Michigan, as well as other areas throughout the country, have experienced land, water, and atmospheric changes. These changes create an increasing risk to the livelihood of Michigan residents. Michigan communities have already been exposed to changing and intensifying weather patterns, and as shifts in climate, economics and technology continue to rapidly occur, it is imperative that local governments proactively and innovatively seek out ways to understand and address the anticipated challenges that these shifts will bring to communities and residents throughout the state to ensure community resiliency.

Climate concerns in Michigan include extreme heat, heavy precipitation and flooding, air pollution, impacts to the Great Lakes and natural ecosystems, and impacts to agriculture.[26] Communities in identified LIDAC areas are often more vulnerable to climate impacts due to several factors, including historic practices of redlining and land use decisions. Climate impacts can exacerbate existing health and social inequities. For example, extreme heat can exacerbate asthma symptoms and other pulmonary illnesses because it amplifies air pollutants and particulate matter. Heat also amplifies ground-level ozone levels, which are associated with higher hospitalization rates for asthma, more severe allergic reactions, and premature deaths for people with heart and lung disease. As previously discussed, many LIDAC areas have poor air quality and high rates of asthma. As heat indexes continue to reach record levels, this can increase the need for public health care services in LIDACs which may be ill-equipped to address these heightened healthcare needs, placing LIDAC residents at further risk.

Heavy rains and flooding are another area of concern for LIDAC areas, as they increase the likelihood of runoff, which can weaken public infrastructure, pollute bodies of water and spread water-borne illnesses and infections throughout the community. Water-borne diseases and poor drinking water quality are public health issues that can affect thousands of people in LIDAC areas prone to flooding. Flooded homes, if not properly and quickly cleaned up, can create unhealthy conditions for residents as they can lead to the development of mold and reduce indoor air quality.[27] Mental health problems can increase after people experience extreme weather events, such as floods.[28]

[26] What Climate Change Means for Michigan, EPA, August 2016
[27] Michigan Climate and Health Profile Report, 2015, MDHHS
[28] CDC.gov

As LIDAC community leaders continue to engage in conversations with the State of Michigan about resiliency strategies and initiatives, collaboratively the state can work to reduce climate change risks and improve overall resiliency for LIDAC residents.

Tribal Climate Impacts and Risks in Michigan

Michigan recognizes that tribal nations have also faced disproportionate burdens in our fossil fuel economy and are especially vulnerable to the impacts of climate change because of their deep ties to the land and reliance on hunting, fishing, and gathering. Oil spills and other such contamination have impacted significant resources like wild rice. The changing climate threatens the sustainability of the Great Lakes fishery which tribal fishers rely upon to earn a living and feed their families. Many cultural practices and traditions require access to species, like the maple tree, that are put at risk by climate change. Michigan's climate strategies and actions must honor, embrace, benefit, and not interfere with the cultural heritage and treaty rights of federally recognized tribal nations in Michigan and preserve the fragile balance of the Great Lakes ecosystem at the heart of that heritage and those rights.

In the implementation of the PCAP and CCAP, for programs and projects that are located near tribal lands, tribal governments should be included in robust outreach and communication efforts. As applicable, EGLE will follow the Department Policy and Procedure 09-031, "Consultation and Coordination with Indian Tribal Governments." Additionally, EGLE will continue to work with and coordinate efforts with tribes and tribal consortiums that are implementing their own PCAPs and CCAPs.

4.3.2 Analyzing LIDAC Quantitative Benefits

The implementation of the priority reduction measures will provide a crucial step towards environmental justice, mitigating the disproportionate impacts low income and disadvantaged communities often face. The impact measurements on the LIDACs were chosen due to their tangible benefit on the health, economic well-being, and overall quality of life of individuals within these communities. The following metrics are quantified in the discussion of the priority reduction measures in Section 5. Due to the statewide scope of this PCAP, these benefits can be reasonably expected to affect all census tracts listed in **Appendix C: CEJST Census Tracts** when considering the priority reduction measures emission reduction impact at an aggregated level.

> **Emissions by Pollutant (including co-pollutant)**: Tracking emissions by pollutant, including co-pollutants such as sulfur oxides (SOx), nitrogen oxides (NOx), particulate matter (PM2.5), volatile organic compounds (VOC), and carbon monoxide (CO), is crucial for environmental justice. Different pollutants have distinct health and environmental effects, and certain populations, especially those in lower-income and disadvantaged communities, may be disproportionately exposed to higher concentrations of specific pollutants. For example, PM2.5 and VOCs can trigger asthma and other respiratory

issues, while NOx and SOx contribute to acid rain and respiratory problems, which can disproportionately impact communities living near industrial facilities.

Avoided Deaths by Race: Avoidable deaths by race sheds light on the unequal environmental burdens faced by different communities. Different racial groups can have varying degrees of vulnerability to environmental hazards due to factors like housing quality and access to healthcare. By minimizing air pollution and improving overall air quality, the risk of respiratory diseases and cardiovascular issues decreases. By looking at preventable deaths linked to harmful pollution, we can pinpoint communities that bear a disproportionate burden. This approach allows policymakers to develop targeted interventions that address specific community needs.

Avoided Lost Workdays: Lower-income communities often bear the brunt of health-related challenges, leading to increased absenteeism from work. Lost workdays capture the immediate and ongoing economic harm caused by environmental issues, which is crucial for communities often dealing with financial insecurity. This metric captures the short-term health issues, respiratory problems, and mental health impacts that significantly disrupt lives and causes an economic toll on LIDACs. Implementation of GHG reduction measures should reduce the occurrences of respiratory illnesses, resulting in fewer lost workdays, impacting the economic well-being of individuals in these communities, and fostering greater productivity and financial stability.

Avoided Respiratory Symptoms and Bronchitis: Greenhouse gas reduction measures play a pivotal role in reducing air pollution, a major contributor to respiratory issues and bronchitis. Respiratory issues like coughs, wheezing, and shortness of breath are often early indicators of exposure to environmental pollutants. Tracking avoided cases of these symptoms provides an early warning system for potential long-term health problems like chronic respiratory diseases or asthma. Tracking avoided respiratory symptoms also captures the day-to-day burdens faced by communities living in polluted environments. Additionally, reducing the prevalence of respiratory symptoms not only enhances the overall health of individuals in lower-income communities but also alleviates the burden on healthcare systems, leading to a more equitable distribution of health resources.

Avoided Hospital Admissions: This metric highlights the significant burden of illness caused by environmental factors and encompasses a wide range of health problems from acute respiratory infections to chronic conditions exacerbated by pollution. Avoided hospital admissions provides a more comprehensive picture of environmental health impacts. In addition, hospital admissions are expensive, both for individuals and healthcare providers. Tracking avoided admissions reveals the substantial economic burden placed on communities disproportionately exposed to environmental hazards.

Avoided Minor Restricted Activity Days: Unlike more severe outcomes such as deaths and hospital admissions, this metric captures the subtler, everyday impacts of environmental hazards on people's lives. This includes days when individuals experience symptoms like headaches, fatigue, or mild respiratory issues that restrict their usual activities like exercise or outdoor time. Access to clean air promotes a healthier lifestyle and enhances the overall quality of life for community members. Tracking minor restricted activity days can highlight the cumulative burden of exposure to pollution. A single day of feeling unwell might seem minor, but the repeated occurrence can significantly impact mental well-being and quality of life, particularly for children and vulnerable populations.

4.4 Review of Authority to Implement Measures

The State of Michigan has the authority to implement the priority action GHG reduction measures identified in this document. In alignment with direction from the EPA, the PCAP prioritizes measures that have achievable, significant GHG reductions within the program period. To achieve this, the State of Michigan has current implementation authority, and many measures are voluntary and implementation ready, building on existing programs. In addition, the PCAP incorporates measures that have potential to be scaled up and positively impact Michigan communities state-wide, especially those in or adjacent to LIDACs as designated by the EPA.

The Michigan state constitution (Const. 1963, Art. V, § 2, Eff. Jan. 1, 1964) established the concept of 20 principal departments and gave the governor authority to reorganize. Governor Engler created the Department of Environmental Quality in EO 1995-18, which was one of the original 20 principal departments referenced in the state constitution and subsequently allocated by the legislature. Governor Whitmer's Executive Order 2019-06 renamed the Michigan Department of Environmental Quality (MDEQ) as the Michigan Department of Environment, Great Lakes, and Energy (EGLE) effective April 22, 2019. The mission of EGLE is to protect Michigan's environment and public health by managing air, water, land, and energy resources.

To implement many of these measures, additional financial support will be necessary. The State of Michigan has the authority to receive and accept "any grant, devise, bequest, donation, gift or assignment of money, bonds or choses in action, or of any property, real or personal" per MCL §§ 21.161. In addition, MCL §§ 18.1384 authorizes EGLE to follow state budget processes to apply for and receive, and appropriate federal funds.

4.5 Funding Opportunities in Michigan

Recent investments by the federal government through the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA) are an opportunity for Michigan to implement the key strategies of the MI Healthy Climate Plan and deliver outcomes that curb the worst impacts of climate change, improve public health, create economic opportunity, lower costs, shore up energy independence, protect our natural resources, and make investments to address historic, current, and future environmental injustices. These investments will also position Michigan's communities and Michiganders for leadership in the years and decades ahead.

Michigan has a highly coordinated effort to obtain funding for transitioning the state to a more sustainable future by implementing the key strategies described in the MHCP. The State coordinates across agencies pursuit of outcoming federal funding opportunities through the Michigan Infrastructure Office, with the Office of Climate and Energy leading coordination and pursuit of climate and clean energy related funding. This coordination includes weekly interagency meetings with agency principals, as well as frequent internal and external application collaborations. Opportunities relevant for entities across the state are also regularly shared out through a comprehensive network of contacts at universities, community-based organizations, tribal entities, and further. Several trackers and tools have been developed to find, coordinate, and keep track of the many funding opportunities flowing to entities from the aforementioned government legislation, as well as other recurring federal funding such as the State Energy Program. The State of Michigan regularly shares funding opportunities via public resources and invites public commentary around the use of federally pursued funds and programs via Requests for Information (RFIs) and other mediums. Further, state agencies regularly provide letters of support for applicants across the state. Cross-cutting to climate and energy, in late 2023 the state issued an RFI around the creation of a State Energy Finance Institution via the Energy Policy Act of 2005 Section 1703 managed by the U.S. Department of Energy's (DOE) Loan Program Office (LPO). Recent updates to this and other DOE LPO managed programs and IRS tax credits have expanded the opportunity for Michigan entities to receive funds and create impactful clean energy projects by decreasing the requirements for participation. The State of Michigan is in conversations with possible recipients and raising awareness across the state for these opportunities, and many more like the direct pay tax credits. EGLE's agile approach underscores the complex coordination and flexibility needed to secure maximum funding opportunities for the entire state.

Each priority reduction measure in Section 5 describes the relevant opportunities the State of Michigan has applied to, is evaluating as upcoming opportunities, and what funds have already been secured related to a particular measure.

4.6 Workforce Planning in Michigan

Clean Vehicles

Michigan's fastest-growing sector in 2022

+14.4% growth

The reduction measures described in the Priority Climate Action Plan, in tandem with the efforts being implemented by the MI Healthy Climate Plan, will require a skilled and prepared workforce to navigate the emerging changes across the economy. As described in the LIDAC Benefits Analysis section, Michigan leads the Midwest states in clean energy jobs at 123,983 jobs which saw 5% growth in 2022 across all sectors – twice as fast as the economy. Several projects under development in the state estimate the anticipated jobs that will be created from them such as the Midwest Alliance for Clean Hydrogen (MachH2) project projecting 13,600 direct jobs[29], and Ford Motor Company supporting 5,700 jobs in new electric vehicle manufacturing. Since the IRA, Michigan has secured a total of $21.3 billion in investment as of 2023. The projects funded by this amount and more anticipate the addition of 167,000 clean energy jobs[30] in total throughout the next decade.

The importance of bringing clean jobs to Michigan goes beyond the ability to implement the MHCP and reduce carbon emissions; it also brings an immense opportunity for economic growth for Michiganders. The clean energy legislation passed in 2023 had two callouts for growing a clean energy workforce:

1. Requires all projects approved in IRPs and renewable siting cases pay workers prevailing wage, enter into project labor agreements, and utilize Department of Labor certified apprenticeships.
2. Encourages diverse workforce development and hiring from environmental justice and low-income communities for EWR programs.

The distinction between growing the clean energy workforce and growing the clean energy workforce with an emphasis on diversity and inclusion has great impact on environmental justice. Below describes the current workforce planning activities in Michigan as of Q1 2024.

- Michigan has several robust apprenticeship programs that are growing both in number of completions and nontraditional programs. These apprenticeship programs also have increasing participation in underrepresented demographic groups and create high-paying jobs across the state. As the shift towards a sustainable economy continues, so will the need for clean energy jobs and the ability to train individuals for those jobs through new apprenticeship programs. Read more in the Registered Apprenticeships in Michigan 2022 report.

[29] michiganbusiness.org/news/2023/12/hydrogen/
[30] climatepower.us/wp-content/uploads/sites/23/2023/10/200k-Clean-Energy-Boom_Michigan.pdf

- Governor Whitmer and the Michigan Department of Labor and Economic Opportunity (LEO) launched a Michigan Electric Vehicle Jobs Academy in 2023 to connect industry and talent in automotive and electrification roles.
- Michigan launched a MI Healthy Climate Corps program to advance the goals of the MHCP by building capacity in governments and nonprofit organizations, guiding federal and state resources to communities, and fostering networking and professional development opportunities for Corps members, building Michigan's workforce in climate action. This aligns with existing climate-focused AmeriCorps programs in the state.
- Michigan is a leader in the country in customized workforce training lead by LEO. With a newly appointed Community and Worker Economic Transition Office, the state can use this strength to tailor innovative programs for future clean energy workforce needs.[31]
- Goodwill Detroit is launching a Clean Technology Accelerator to pilot in Quarter 2 of 2024 for electric vehicle technicians. The program has the opportunity to expand to different locations along with energy efficiency, solar and storage, and heat pump technicians following the pilot.
- Several partnerships throughout Michigan make the above-described programs a reality, including but not limited to MI Energy Workforce Development Consortium, MI Energy Innovation Business Council, MI Energy Efficiency Contractors Association, Michigan Works!, and Center for Energy Workforce Development each of which help grow and develop workforce programs in the state.

In Section 5, the estimated number of jobs to be created by the priority reduction measures along with the types of jobs that will be needed are discussed as analyses allowed.

5. PRIORITY REDUCTION MEASURES BY KEY SECTOR

This section discusses the individual greenhouse gas reduction measures identified as part of the prioritized framework. Each measure includes the following analyses and quantifications:

- Reduction measure description and quantification, including key implementing agency or agencies, implementation schedule and milestones, and metrics for tracking progress.
- LIDAC qualitative and quantitative benefits analysis
- Review of authority to implement
- Intersection with other funding availability
- Workforce planning analysis

[31] michigan.gov/leo/bureaus-agencies/economic-transition

Each measure is intended to be applicable statewide. They are organized by the following sectors:

1. Electricity Generation
2. Commercial and Residential Buildings
3. Transportation
4. Industry

The following is a summary list of the priority reduction measures organized by key sector.

ID	Key Sector	Priority Reduction Measure
1	Electricity Generation	Drive clean energy deployment including improving siting for renewable energy and energy storage across Michigan, including on brownfields and former industrial sites and emphasizing equitable access for Michigan's LIDACs.
2	Electricity Generation	Invest in energy storage and necessary electric grid investments to enable earlier coal plant retirements and better integrate renewable energy into the electric grid.
3	Commercial and Residential Buildings	Drive building electrification and fuel-switching in existing buildings including an emphasis on LIDACs and electrifying households that currently rely on delivered fuels such as propane and home heating oil.
4	Commercial and Residential Buildings	Reduce household fossil energy use through home repairs, electrical upgrades for building and vehicle electrification, weatherization, and other energy waste reduction investments with an emphasis on ensuring equitable access.
5	Commercial and Residential Buildings	Decarbonize government and nonprofit facilities and infrastructure, with an emphasis on LIDACs, by reducing energy waste, investing in decarbonization solutions, and reducing emissions from fossil fuel combustion.
6	Transportation	Electrify state government, municipal, tribal, and other public fleets, prioritizing equitable access for Michigan's LIDACs.
7	Transportation	Support just access to public transit and non-motorized transportation options by improving infrastructure, and by increasing routes, frequency, and reliability of available options.

ID	Key Sector	Priority Reduction Measure
8	Transportation	Encourage adoption of electric vehicles by increasing deployment of electric vehicle charging infrastructure, prioritizing equitable access for Michigan's LIDACs.
9	Industry	Encourage industrial innovation to advance energy efficiency, fuel-switching, and deployment of cleaner manufacturing technologies prioritizing facilities in LIDACs that may receive significant benefits from reduced industrial sector emissions.
10	Industry	Reduce methane emissions from various sources, including but not limited to food waste, organics diversion, and wastewater treatment facilities with a focus on methane reduction strategies that will bring significant benefits for LIDACs.

5.1 Electricity Generation Reduction Measures

Michigan's power sector emitted 58.2 $MMTCO_2E$ in 2019. Compared to 2005 levels, the energy sector has reduced overall emissions by 24%. Michigan's electric power sector is primarily driven by natural gas generation (34%), followed by coal (29%), nuclear (22%), and renewable energy (12%) as of 2022[32]. Decarbonizing the electric power sector is a vital part to decarbonizing Michigan's economy. As other sectors deploy electrification technologies such as electric vehicles and heat pumps, the faster electricity generation is decarbonized, the higher impact we will have through emissions reductions. Michigan has ambitious goals in this regard to decarbonize the power sector and reduce energy burden in LIDACs while maintaining grid security.

Reduction Measure #1 - Drive clean energy deployment including improving siting for renewable energy and energy storage across Michigan, including on brownfields and former industrial sites and emphasizing equitable access for Michigan's LIDACs.

Reduction Measure Description and Quantification

Deploying clean energy to Michigan's electric grid will create significant emission reductions across all sectors of the economy. The energy sector inventory is Michigan's largest emitting sector, with the burning of fossil fuels to produce electricity as a major contributor to energy-derived emissions. As other energy subsectors, such as transportation and heating for buildings,

[32] eia.gov/state/print.php?sid=MI

increasingly electrify, the resource mix for generating electricity will play a transformational role in meeting Michigan's decarbonization goals.

Through this measure, Michigan will drive clean energy deployment through initiatives like incentivizing siting of utility-scale and distributed renewable energy and storage. For example, in 2023, Governor Whitmer allocated $30 million of the Fiscal Year 2024 budget to EGLE to launch Renewables Ready Communities, a program that incentivizes communities to host utility-scale renewables. Providing additional resources to this program and expanding it to include siting on brownfields and former industrial sites can catalyze Michigan's clean energy deployment. In addition, technical assistance and educational resources can address potential barriers to implementation through providing incentives to municipalities and clean energy developers, increasing community capacity, sharing siting and permitting best practices, and streamlining the siting process for renewable energy systems.

While the MHCP set the goal to generate 60% of the state's electricity from renewable resources by 2030, including a call for a 50% renewable energy standard by 2030 and increased investments in customer-driven renewable energy such as voluntary green pricing programs and distributed solar. To codify parts of the MHCP, state legislation passed in 2023 which requires 50% of electricity to be sourced by renewable energy by 2030, maintained Michigan's voluntary green pricing programs, and made changes to increase access to distributed solar across Michigan. Currently, 15% of Michigan's electricity is generated from renewable energy, which means reaching the 50% renewable energy standard by 2030 requires a 200%+ increase in renewable energy generation in the state between 2024 and 2030, resulting in significant GHG emission reduction potential. Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. Meeting the goals of the 2023 legislation and the MI Healthy Climate Plan will need the rapid build out of renewable energy and energy storage, which will require improvements in siting and permitting to enable an additional 5-6% more renewable energy generation coming online each year between 2024 and 2030.

Entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to investor-owned utilities, public utilities, electric cooperatives, tribes, renewable energy developers, and others. Metrics that may be used to track this reduction measure include the amount of renewable energy generated in the state, the number and size of renewable energy projects approved by entities such as the Michigan Public Service Commission (MPSC), the number of brownfield and other industrial sites remediated with plans for renewable energy or storage development, and other metrics as identified.

Driving clean energy deployment was quantified using RMI's Energy Policy Simulator. Major assumptions include:

1. This reduction measure allows for the state to reach their renewable energy standard of 50% by 2030, 60% by 2035, and renewable energy goal of 100% by 2050.
2. Estimates include a range of renewable energy technologies being deployed, including nuclear as a clean energy.

Table 15: Estimated GHG emission reductions as a result of priority reduction measure #1

Estimated Emissions Reductions	Time Scale
1.640 $MMTCO_2e$	Annual near-term average
20.856 $MMTCO_2e$	Between 2024 – 2030
42.651 $MMTCO_2e$	Between 2024 – 2050

Validation of this quantification was performed using EPA's AVERT tool with estimates of year-over-year renewable energy deployment across onshore wind, utility-scale solar, and rooftop solar.

Note: This reduction measure was quantified under a large umbrella of implementation strategies. When applying for implementation grants for specific projects, ensure the appropriate emissions are calculated to result in reductions of the specific project.

LIDAC Qualitative and Quantitative Benefits Analysis

By accelerating clean energy deployment in Michigan, the analysis reveals that we can expect a range of positive outcomes for low income and disadvantaged communities. Cumulative emissions are projected to decrease significantly for SOx and NOx translating to cleaner air, especially for front line communities formerly near industrial sites and power plants. Emissions are expected to decrease for VOCs and CO as well, improving overall air quality and reducing the risk of chronic diseases. The cumulative decrease in pollutants will drive overall improvements in air quality leading to fewer respiratory issues, resulting in fewer hospitalizations and lost workdays, improving the physical, mental, and economic well-being for LIDAC residents.

Table 16: Change in co-pollutants as a result of priority reduction measure #1 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-7.619	-3.487
NOx	-8.163	-13.347
PM2.5	0.874	4.657
VOC	-2.576	-3.881
CO	-48.632	-150.443

Figure 28: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #1

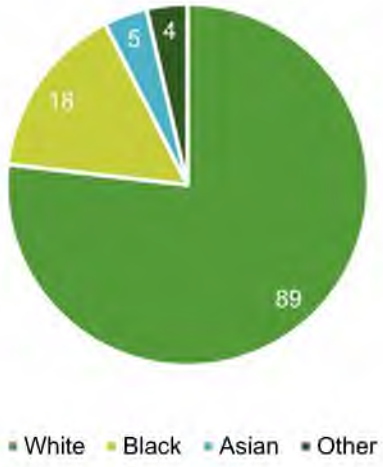


Figure 28: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #1

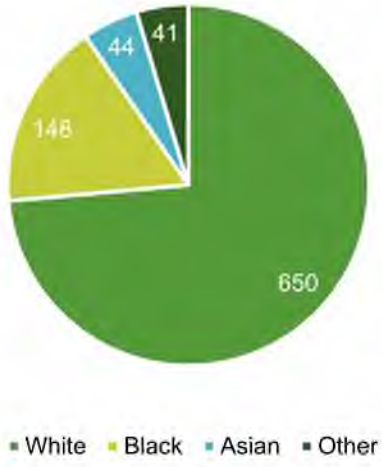


Table 17: Additional estimated community benefits in the near-term and long-term throughout Michigan as a result of priority reduction measure #1

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	7,156	54,854
Avoided Respiratory Symptoms and Bronchitis	2,500	19,203
Avoided Hospital Admissions	25	187
Avoided Minor Restricted Activity Days	42,516	325,763

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statutes in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" -- as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 -- which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan has both received and is waiting to hear back on multiple grant opportunities related to this reduction measure. The EPA awarded the State of Michigan $9.3 million in 2023 to cleanup brownfield sites[33], preparing the sites for reuse in the future. As part of the State and Tribal Response Program Grants, Michigan has also received funding from Brownfield categorical grants.[34] These funding opportunities are examples of efforts that will reduce barriers to siting renewable energy and energy storage on brownfields. Additionally, as a state program, EGLE currently offers grants and low-interest loans to promote the re-use of contaminated sites.

The State of Michigan is waiting to hear back on two other programs currently under review:

1. Solar for All through the Greenhouse Gas Reduction Fund
2. Renewable Energy Siting through Technical Engagement and Planning (R-STEP)

This measure also intends to leverage the complementary funding available through elective pay (sometimes called direct pay) of certain clean energy tax credits (§45Y, §48E). These tax credits only cover up to 30% of the projects contemplated under this measure, which may be insufficient for some projects to achieve a return on investment through cost-savings from energy bills. In addition to directly supporting projects through technical assistance and deployment of renewable energy and storage systems, this measure will also serve to educate Michiganders on the available tax credits and provide technical assistance to communities in designing such systems. As a result, this measure will catalyze widespread adoption of renewable energy and storage systems.

Workforce Planning Analysis

Currently in Michigan, there are approximately 12,000 renewable energy jobs across five different technologies[35]. By increasing renewable energy generation across the state, Michigan will create jobs across the value chain in manufacturing, professional services, maintenance, engineering, and more fields. This reduction measure is estimated to increase renewable energy jobs to around 22,000 (increase by about 10,000 jobs) by 2030[36].

[33] EPA
[34] java.epa.gov/acrespub/stvrp/
[35] Clean Jobs Midwest
[36] Energy Policy Simulator

Reduction Measure #2 - Invest in energy storage and necessary electric grid investments to enable earlier coal plant retirements and better integrate renewable energy into the electric grid.

Reduction Measure Description and Quantification

Investing in and implementing energy storage not only facilitates the integration of additional renewable energy sources but also enables phased retirement of remaining coal plants in the State of Michigan. It is necessary to widely deploy grid-scale energy storage to maintain energy security within the state and decarbonize the electric grid. The clean energy legislation passed in 2023 requires the study of long-duration storage and establishes a new energy storage standard of 2,500 megawatts (MW), making Michigan one of just a few states that require energy storage standards. Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. A major milestone to achieve this measure includes closing all coal-fired power plants by 2030 which would equate to interim milestones of removing about 1,050 MW of coal-fired capacity per year between 2024 and 2030.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to state government, local municipalities, tribes, utilities, battery energy storage developers, and others. Metrics that may be used to track this reduction measure include tracking the closure timeline of coal plants located within Michigan, the number, location, and size of battery storage projects approved by entities such as the Michigan Public Service Commission, localized air pollution surrounding corresponding coal plants, and other metrics as identified.

Table 18: Estimated GHG emission reductions as a result of priority reduction measure #2

Estimated Emissions Reductions	Time Scale
2.794 $MMTCO_2e$	Annual near-term average
16.762 $MMTCO_2e$	Between 2024 – 2030
23.593 $MMTCO_2e$	Between 2024 – 2050

This measure was quantified using EPS under the following assumptions:

1. The deployment of grid-scale energy storage at a rate of 1,050 MW per year allows for remaining coal-fired power plants to phase out by 2030
2. Phase-out is completed on a linear implementation schedule beginning in 2025
3. Grid-scale electricity storage was set to 30% of overall possible deployment by 2030 (though this policy scenario had no effect on emissions reductions)

Validation of this quantification occurred under manual calculation of displacing all coal-fired electricity generation with zero-emission electricity generation using 2022 generation data.

LIDAC Qualitative and Quantitative Benefits Analysis

Investing in grid-scale energy storage and necessary electric grid upgrades in Michigan will generate benefits for low-income and disadvantaged communities. By accelerating the retirement of coal plants and better integrating renewable energy sources, this measure can lead to substantial improvements in air quality, health, economic opportunities, and overall well-being. There is a projected decrease in pollutant emissions for SOx, NOx, and CO, translating to cleaner air. This will significantly reduce respiratory problems, asthma attacks, and cardiovascular diseases, leading to fewer hospital admissions and improved health outcomes for residents, especially those living near coal plants.

Table 19: Change in co-pollutants as a result of priority reduction measure #2 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-15.129	-7.810
NOx	-10.753	-10.396
PM2.5	0.910	5.426
VOC	-0.006	2.720
CO	-50.749	-149.636

Figure 30: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #2

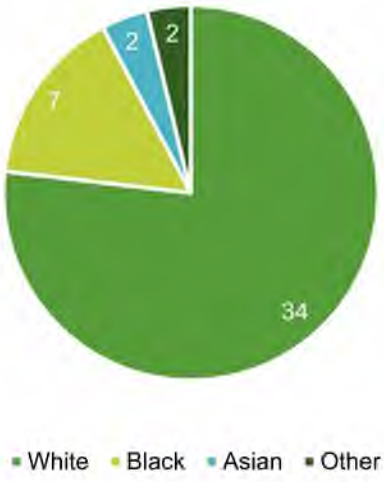


Figure 29: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #2

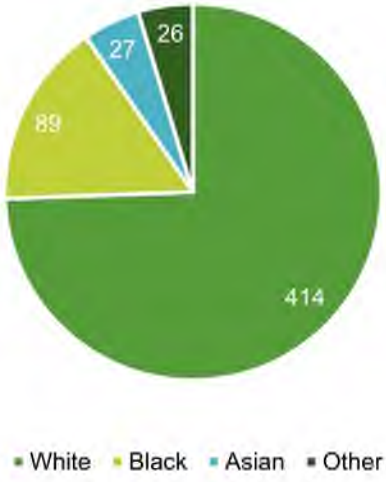


Table 20: Additional estimated community benefits in the near- and long-term throughout Michigan as a result of priority reduction measure #2

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	2,748	34,261
Avoided Respiratory Symptoms and Bronchitis	958	11,950
Avoided Hospital Admissions	10	118
Avoided Minor Restricted Activity Days	16,331	203,553

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statutes in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" – as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 – which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, Michigan was granted awards from three separate programs related to grid resilience and reliability fitting within Priority Reduction Measure #2. Recipients for these programs include the state, municipalities, and utilities and total over $100 million dollars. For example:

1. GRIP: Program Upgrading our Electric Grid and Ensuring Reliability and Resiliency / Grid Innovation Program (awarded to Consumers and DTE)
2. Powering Affordable Clean Energy (PACE) (awarded to municipalities)
3. Preventing Outages and Enhancing the Resilience of Electric Grid Grants (awarded to EGLE)

The State also pursued the Solar and Wind Grid Services and Reliability Demonstration opportunity but was not granted an award.

Workforce Planning Analysis

There are currently about 3,900 grid and storage jobs in Michigan. By driving renewable energy and energy storage integration into the electric grid, Michigan will create electrician, manufacturing, engineering, general and operations management, and construction jobs. This

reduction measure is estimated to increase energy storage jobs to a peak of approximately 11,400 in 2031[37]. Supporting coal plant workers with retraining programs and relocation assistance will be crucial to ensure a smooth transition to a clean energy future and avoid exacerbating existing economic disparities. Currently the Michigan Department of Treasury runs the Energy Transition Impact Project (ETIP), which helps communities impacted by the closure of energy facilities by developing strategies to assist in expanding job opportunities, remediating sites, and mitigating related economic and socio-economic dislocations. In 2023, Senate Bill 519 established the Office of Worker and Community Economic Transition within LEO to assist workers, communities, and employers during the transition to clean energy.

5.2 Commercial and Residential Buildings Reduction Measures

Michigan's built environment was the third highest-emitting sector in 2019. The 2024 GHG Inventory shows emissions from commercial and residential buildings contributed to 33.3 $MMTCO_2E$ to carbon dioxide emissions from fossil fuel combustion. Emissions related to the built environment are primarily due to use of heating fuels such as natural gas, propane, and oil. The best ways to decarbonize commercial and residential buildings is to electrify homes and implement energy efficient appliances and components. A major precursor to this, however, is ensuring the proper repair and weatherization of buildings and residences are incorporated to get the most out of energy-efficient equipment. Several other benefits result from having a strong and sustainable building stock including reduced energy bills, increased climate resilience, and increased health and well-being.

Reduction Measure #3 - Drive building electrification and fuel-switching in existing buildings including an emphasis on LIDACs and electrifying households that currently rely on delivered fuels such as propane and home heating oil.

Reduction Measure Description and Quantification

The MHCP aims to reduce emissions related to heating Michigan homes and businesses by 17% by 2030. According to research from Rewiring America, at least 39% of Michigan households—or 1.5 million households—could save a total of $710 million a year on energy bills if they were using modern heat pump space heaters and heat pump water heaters instead of their current appliances, which use electric resistance, fuel oil, or propane. That's an average savings per household of $460 each year. Half of the households with immediate savings potential are considered low- and moderate-income. The switch to electric heating and other appliances may also yield health benefits, as described in the LIDAC section of this reduction measure. Therefore, delivered fuels such as propane and home heating oil are two target areas to reduce emissions within this reduction measure. While the State of Michigan has several existing initiatives related to decarbonizing homes and buildings including the WAP, Sacred

[37] Energy Policy Simulator

Spaces Clean Energy Grants, Energy Waste Reduction (EWR) Programs, and more, these programs need additional assistance to reduce emissions in the built environment sector. Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. A major milestone to achieve this measure includes reducing emissions related to heating homes and buildings by 17% by 2030. This goal equates to reducing heating emissions in buildings by 2-3% each year between 2024 and 2030.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to investor-owned utilities, public utilities, electric cooperatives, Michigan residents, businesses, municipalities, tribes, and others. Metrics that may be used to track this reduction measure include the change in emissions from the residential sector related to fossil fuel combustion, the amount of electrified components sold (e.g., heat pumps) over time, the number of applications received by existing building electrification programs – especially those that focus on LIDACs, and other metrics as identified.

Table 21: Estimated GHG emission reductions as a result of priority reduction measure #3

Estimated Emissions Reductions	Time Scale
1.047 MMTCO$_2$e	Annual near-term average
6.280 MMTCO$_2$e	Between 2024 – 2030
25.808 MMTCO$_2$e	Between 2024 – 2050

Quantification of this reduction measure was calculated using EPS where four different policy levers were used to estimate the emissions reductions across commercial and residential buildings. The first policy lever includes retrofitting 37% of all existing commercial buildings and 25% of all existing residential buildings in Michigan between 2024 and 2030 for more efficient heating, cooling, and envelope components. The second policy lever is building component electrification which assumes a linear implementation between 2024 and 2050 where 25% of heating, appliance, and other building components that would normally be non-electric, be sold as electric. Two other policy levers were modeled, though they had no effect on the emissions quantification piece of the model. They included a rebate for efficient products and research and development in the near-term for fuel-use reduction.

Validation of this reduction measure is yet to be completed due to lack of quality data to both complete a second calculation and compare it accurately to the EPS model. Note, there is overlap in emissions reduction totals between reduction measure #3 and reduction measure #4.

LIDAC Qualitative and Quantitative Benefits Analysis

Driving building electrification and fuel-switching in existing buildings, particularly focusing on households reliant on delivered fuels like propane and home heating oil should positively impact low income and disadvantaged communities in Michigan. By transitioning from delivered fuels to clean electricity, households experience significant reductions in indoor and outdoor air pollution, The projected decrease in NOx, CO and VOCs results in fewer respiratory illnesses, asthma attacks, and cardiovascular problems. The improved health outcomes translate to fewer missed workdays, and other measures for a better quality of life for residents.

Table 22: Change in co-pollutants as a result of priority measure #3 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-0.512	6.606
NOx	-1.230	-12.628
PM2.5	-1.352	-1.493
VOC	-2.287	-6.007
CO	-56.851	-179.159

Figure 31: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #3

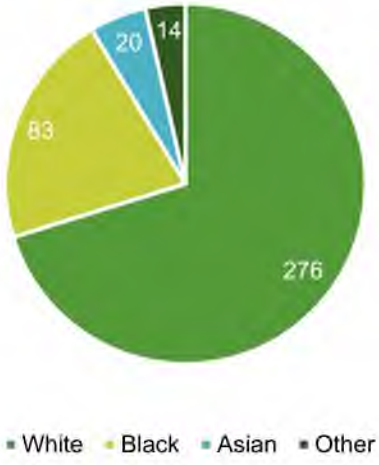


Figure 32: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #3

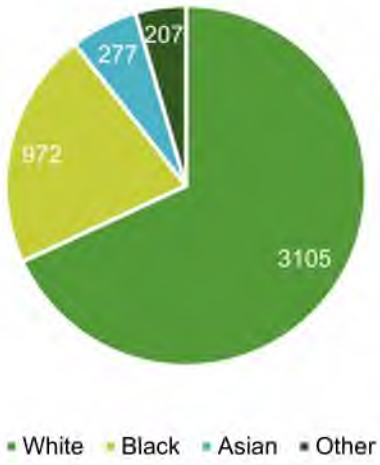


Table 23: Additional estimated community benefits in the near- and long-term throughout Michigan as a result of priority reduction measure #3

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	25,488	295,273
Avoided Respiratory Symptoms and Bronchitis	8,976	104,047
Avoided Hospital Admissions	80	928
Avoided Minor Restricted Activity Days	151,083	1,750,287

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statutes in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" – as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 – which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan has received funding for two different grant programs related to commercial and residential decarbonization including the Energy Efficiency Revolving Loan Fund Capitalization Grant Program (awarded $12.7 million) and Building Codes Implementation for Efficiency and Resiliency ($9.6 million) with partners. Additionally, two Michigan companies have received $22 million to scale up electric heat pump manufacturing from the U.S. DOE. There are currently two other opportunities pending an award decision:

1. Energy Auditor Training (EAT) Program (Section 40503)
2. Technical Assistance for the Adoption of Building Energy Codes

The State plans to apply for the Assistance for Latest and Zero Building Energy Code Adoption (Round 1) (Section 50131) program. The State applied for the Building Energy Codes: Resilient and Efficient Codes Implementation (RECI) program but was not granted funding.

Workforce Planning Analysis

Michigan's largest clean energy job sector is energy efficiency with over 75,000 jobs across Energy STAR and Efficient Lighting, HVAC, High Efficiency HVAC, Advanced Materials, and more sectors[38]. This reduction measure, related to driving building electrification and fuel-switching in existing commercial and residential buildings, will create jobs for electricians,

[38] Clean Jobs Midwest

engineers, technicians, customer service representatives, and more in the state. The estimated increase in jobs for this measure is set to peak in 2030 at around 103,000 newly created jobs.

Reduction Measure #4 - Reduce household fossil energy use through home repairs, electrical upgrades for building and vehicle electrification, weatherization, and other energy waste reduction investments with an emphasis on ensuring equitable access.

Reduction Measure Description and Quantification

This priority reduction measure solely focuses on residential building decarbonization given the higher proportion of GHG emissions from residential buildings and their reliance on fossil-fuel burning fuels compared to commercial buildings. The EPA shares, "Michigan is among the top five states in residential sector petroleum use and ranks first in residential sector consumption of propane"[39]. Decarbonizing Michigan buildings will require baseline investments in repairing Michigan's homes; stronger requirements, incentives, and financing options for energy efficiency and waste reduction; and evaluation and adoption of innovative home heating alternatives, including electrification. Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. A major milestone to achieve this measure includes reducing emissions related to heating homes and buildings by 17% by 2030. This goal equates to reducing heating emissions in buildings by 2-3% each year between 2024 and 2030.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to investor-owned utilities, public utilities, electric cooperatives, Michigan residents, third party installation and maintenance contractors, and others. Metrics that may be used to track this reduction measure include home repair and electrification components sold over a period of time, the number of applications received by existing electrification programs, electricity usage and demand over time, and other metrics as identified.

Table 24: Estimated GHG emission reductions as a result of priority reduction measure #4

Estimated Emissions Reductions	Time Scale
1.260 $MMTCO_2e$	Annual near-term average
7.562 $MMTCO_2e$	Between 2024 – 2030
24.463 $MMTCO_2e$	Between 2024 – 2050

[39] EIA

Quantifying this reduction measure was limited to residential properties in Michigan (i.e., excludes commercial buildings) but includes both rural and urban properties. Much like reduction measure #3, the emissions reductions were calculated using EPS with very similar policy levers. The first policy lever used was retrofitting 25% of all existing residential buildings in Michigan between 2024 and 2030 for more efficient heating, cooling, and envelope components. The second policy lever was building component electrification that assumes a linear implementation between 2024 and 2050 where 100% of heating, appliance, and other building components that would normally be non-electric, be sold as electric. The last policy lever modeled was a rebate for efficient projects which had no effect on the emissions change given it enables implementation of GHG reduction strategies but does not directly result in lowering emissions.

Validation of this reduction measure is yet to be completed due to lack of quality data to both complete a second calculation and compare it accurately to the EPS model. Note, there is overlap in emissions reduction totals between reduction measure #3 and reduction measure #4.

LIDAC Qualitative and Quantitative Benefits Analysis

Low income and disadvantaged communities benefit from targeted home repairs, electrical upgrades, weatherization, and other energy waste reduction investments. There is a projected reduction in emissions particularly in NOx, CO, and VOCs that will result in cleaner air and fewer respiratory illnesses like asthma and bronchitis, reduced hospital admissions, and overall improved health outcomes for LIDAC residents. An additional benefit that can be expected from weatherization and home repair investments is increased comfort by reducing summer heat stress and ensuring warmth in the winter, particularly helpful for vulnerable population segments like the elderly and young children. Energy efficient homes also translates to lower energy costs, alleviating a portion of the financial burden on low-income households and contributing to longer term economic stability. Efforts should be made to preserve existing affordable housing and tenant protections to ensure that home upgrades and electrification do not have adverse impacts on LIDAC households.

Table 25: Change in co-pollutants as a result of priority measure #4 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-1.000	6.569
NOx	-3.427	-11.837
PM2.5	-1.689	0.245
VOC	-3.628	-4.161
CO	-66.543	-168.706

Figure 33: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #4

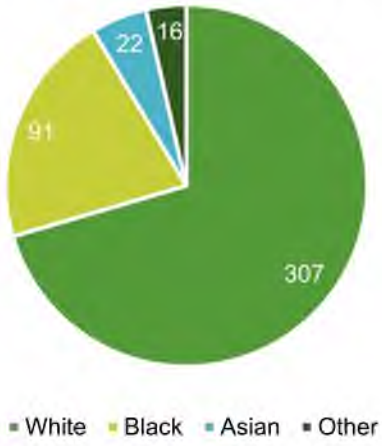


Figure 34: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #4

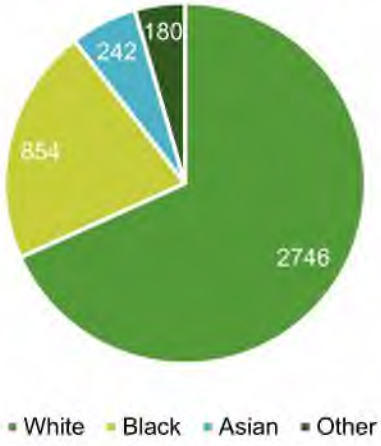


Table 26: Additional estimated community benefits in the near- and long-term throughout Michigan as a result of priority reduction measure #4

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	28,213	260,324
Avoided Respiratory Symptoms and Bronchitis	9,943	91,741
Avoided Hospital Admissions	89	819
Avoided Minor Restricted Activity Days	167,234	1,543,121

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statutes in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" -- as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 – which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan received $211 million in 2023 to carry out the Consumer Home Energy Rebate Program. Additionally, in 2023, the Michigan Department of Health and Human Services (MDHHS) received $183 million for the WAP, providing the opportunity for program expansion that will allow people living in multifamily units access to funds (in addition to others). EWR programs have also been a focus of electric and natural gas utilities in recent years. In 2022, utilities spent a combined $517 million on EWR programs that will lower emissions and save ratepayers money.

The State is awaiting an award decision on the Training for Residential Energy Contractors (TREC) (50123) program to expand the clean energy workforce.

Workforce Planning Analysis

Across the state of Michigan, there are currently over 100,000 jobs available across the clean energy sectors associated with this measure including energy efficiency, solar energy, and electric vehicles. Michigan is expected to see additional job creation in these areas across the value chain[40]. Examples include, solar panel and EV installers and technicians, electricians, green building retrofitter, engineers, and more. It is estimated that this reduction measure will result in an increase in jobs related to residential building decarbonization by approximately 21,000 by 2030[41].

Reduction Measure #5 - Decarbonize government and nonprofit facilities and infrastructure, with an emphasis on LIDACs, by reducing energy waste, investing in decarbonization solutions, and reducing emissions from fossil fuel combustion.

Table 27: Estimated GHG emission reductions as a result of priority reduction measure #5

Estimated Emissions Reductions	Time Scale
0.050 $MMTCO_2e$	Annual near-term average
0.251 $MMTCO_2e$	Between 2024 – 2030
0.502 $MMTCO_2e$	Between 2024 – 2050

Reduction Measure Description and Quantification

Decarbonizing government-owned and nonprofit facilities and infrastructure is an opportunity to pave the way for other commercial and residential buildings to reduce their carbon footprint. Supporting deployment of renewable energy and storage systems for local government buildings can reduce energy costs and provide resilience in case of an electric grid outage. This measure has several potential benefits to Michiganders such as:

- Sharing of best practices to business-owners and residents looking to decarbonize in the future
- Technology maturity for newer, expensive equipment (e.g., heat pumps) that result in potential cost savings for others who implement later on in maturity
- Potential reallocation of or reduced costs to constituents who indirectly fund operational costs of these facilities

[40] Clean Jobs Midwest
[41] Energy Policy Simulator

Specific implementation schedule and milestones will be determined by those implementing this measure. Implementing entities may track milestones by achieving a 2-3% reduction in emissions each year for buildings undergoing decarbonization initiatives as part of this reduction measure.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to state government, local municipalities, tribes, nonprofits, investor-owned utilities, public utilities, electric cooperatives, and others. Metrics that may be used to track this reduction measure include natural gas consumption and electricity use of government and nonprofit facilities over time, applications received by eligible electrification programs, the number of electrification components sold over time, and other metrics as identified.

Quantifying this reduction measure took a manual approach to collect data about energy use and operations from municipalities and apply it to cities and counties across Michigan. Using an average ratio of energy consumption among municipal buildings per capita, this factor was applied to the population throughout Michigan to model the estimated emissions. This approach was taken given the lack of actual building and energy data from Michigan government buildings. The calculations were made under the following assumptions:

1. Assumes a 20% improvement in building energy efficiency by 2030
2. Assumes a 40% improvement in building energy efficiency by 2050
3. Streetlight infrastructure was excluded
4. Nonprofit facilities were excluded

The National Renewable Energy Laboratory's (NREL's) ComStock Analysis Tool[42] was used to validate this reduction measure and shows a similarity in the order of magnitude of expected emission reductions. Differences in the data sets used and underlying assumptions prevent a direct comparison from being possible. Improvements to this quantification are possible with actual data from government-owned buildings in Michigan including but not limited to energy profile, building components such as square footage, and other data.

LIDAC Qualitative and Quantitative Benefits Analysis

Quantification of the LIDAC benefits was not possible for this reduction measure. It will likely result in similar benefits as reduction measures three and four such as improved air quality and a healthier environment for people using those facilities, though the quantity would alter based on the scale differences of each measure. Long-term energy savings from efficiency upgrades to public and nonprofit facilities will free-up resources for other community investments and potentially lead to lower costs for public services that benefit LIDAC residents.

[42] nrel.gov/buildings/comstock.html

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statutes in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" -- as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 -- which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan received $2.7 million in funding from the Energy Efficiency and Conservation Block Grant Program - State Formula program that directly aligns with this reduction measure to decarbonize government-owned buildings. In overlap with Priority Reduction Measure #3, the state plans to apply for the Assistance for Latest and Zero Building Energy Code Adoption (Round 1) (Section 50131) program. The EPA "Greenhouse Gas Reduction Fund" and the Federal Emergency Management Agency "Building Resilient Infrastructure and Communities" are two additional funding sources but are not believed to be duplicative due to different program foci.

Workforce Planning Analysis

The current jobs available and profiles to be created as a result of this reduction measure is similar to reduction measures #3 and #4. There is data lacking in the estimated increase of jobs in this reduction measure, however, it is estimated to be lower than the similar reduction measures in the built environment due to the smaller footprint of government-owned buildings in the state compared to the entirety of the residential and commercial sectors. There is likely overlap in the amount of jobs accounted for in the aforementioned reduction measures and with this one.

5.3 Transportation Reduction Measures

The transportation sector is the second highest emitting sector behind the energy sector in Michigan as of 2019 with a total of 51.4 $MMTCO_2E$. Transportation emissions are primarily due to the combustion of petroleum products such as gasoline and diesel in light-duty vehicles and freight trucks. In November 2023, the Michigan Department of Transportation (MDOT) released a statewide Carbon Reduction Strategy (CRS) report to explore initiatives to reduce statewide transportation sector carbon emissions that reflect the carbon reduction needs and preferences in the state. Several initiatives are underway to decarbonize different subsectors of the transportation sector, both funded by the CRS and separately. A zero-emission ferry conversion, development of EV battery manufacturing facilities, and multi-state EV charger deployment are examples of some ongoing projects.

Reduction Measure #6 - Electrify state government, municipal, tribal, and other public fleets, prioritizing equitable access for Michigan's LIDACs.

Reduction Measure Description and Quantification

As a step towards decarbonizing the transportation sector, Governor Whitmer recently called for a transition of the state government fleet to zero emission vehicles under Executive Directive No. 2023-5. The Governor called for the conversion of the state fleet to reach zero emissions by 2033 for light-duty vehicles and by 2040 for medium- and heavy-duty vehicles. This reduction measure aims to launch this Executive Directive to action while lowering emissions, growing demand for EV production, and reducing net costs. Including municipal, tribal, other public fleets, in addition to the electrification of school buses, in this measure is an opportunity for other large fleets to make the transition. It builds off existing plans to decarbonize fleets such as the BIL's Clean School Bus Program that will help transition school buses to zero emission vehicles. Thanks to the new Executive Directive, Michigan does not anticipate any major obstacles in the implementation schedule or milestones associated with this measure. The state government fleet currently has approximately 14,000 vehicles. In order to reach a zero-emission fleet by 2033, transiting approximately 1,500 vehicles per year to zero-emission vehicles could serve as interim milestones to achieve this reduction measure.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to state government, local municipalities, tribes, public schools, public universities, and others. Metrics that may be used to track this reduction measure include the number of electrified vehicles owned or leased by state government and other applicable entities, the number of EV chargers installed on government- and publicly-owned property, the number of entities engaging in bulk-buy programs, and other metrics as identified.

Table 28: Estimated GHG emission reductions as a result of priority reduction measure #6

Estimated Emissions Reductions	Time Scale
0.285 $MMTCO_2e$	Annual near-term average
1.519 $MMTCO_2e$	Between 2024 – 2030
7.571 $MMTCO_2e$	Between 2024 – 2050

Fleet electrification was quantified using EPA's AVERT tool. Major assumptions include:

1. Electrification of the State fleet is calculated using Michigan State Fleet Plans from DTMB
2. Municipal fleets and school buses are accounted for in the emission reduction calculation, tribal fleets or other major public fleets are not accounted for in this emission reduction
3. Focus is on emission reductions for light-duty vehicles and school buses across the State by 2030, medium and heavy duty vehicles are not quantified given lack of access to federal tools
4. Electric vehicles are added to displace new internal combustion engine (ICE) vehicles on the road
5. The manufacturing of EV batteries and recycling are not considered

Validation of these emissions reduction will be performed using comparable state data for fleet electrification.

Note: This reduction measure quantifies municipal fleets using representative fleet data for different population sizes across the State of Michigan. When applying for specific projects, ensure the appropriate emissions are calculated to result in reductions due to completion of the specific project.

LIDAC Qualitative and Quantitative Benefits Analysis

Transitioning from gasoline-powered vehicles to electric vehicles significantly reduces emissions of harmful pollutants like NOx and VOCs producing cleaner air for communities historically plagued by traffic-related pollution. This shift holds the potential to reduce respiratory illnesses like asthma and bronchitis and to improve overall health outcomes. In addition, the quieter operation of electric vehicles compared to gasoline-powered counterparts has a dual impact — minimizing noise pollution in neighborhoods and creating more peaceful environments for residents particularly those living near transit routes. This transition not only offers a quieter, less polluted urban landscape but also has the potential to transform public spaces, creating pedestrian-friendly areas that encourage outdoor activities, ultimately revitalizing community life. To ensure equity in the transition of the State fleet, the DTMB EV Plan should prioritize focus of fleet transition for fleet vehicles within Justice40 communities, high-density areas, and historically disadvantaged communities with higher pollution rates. In addition, to ensure that fleets are transitioned properly, siting electric vehicle supply equipment (EVSE) on state-controlled property in LIDACs will be a focus.[43]

[43] Executive Directive 2023-5

Table 29: Change in co-pollutants as a result of priority measure #6 in thousand metric tons of emissions

Pollutant*	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	0.064	0.332
NOx	-1.221	-6.076
PM2.5	0.009	0.043
VOC	-0.364	-1.966
CO	N/A	N/A

**Calculated via AVERT tool, does not include all co-pollutants from EPS*

Table 30: Additional estimated community benefits in the near- and long-term throughout Michigan as a result of priority reduction measure #6

Community Benefits	2024-2030 Cumulative Value*	2024-2050 Cumulative Value*
Avoided Lost Workdays	9,615	79,137
Avoided Respiratory Symptoms and Bronchitis	3,412	28,077
Avoided Hospital Admissions	31	149,984
Avoided Minor Restricted Activity Days	57,011	469,252

**Values are calculated in EPA's COBRA tool using the annual emissions for final implementation year of fleet transition (from AVERT). Additional analysis for year over year benefits given the implementation schedule is needed to show data change overtime.*

Review of Authority to Implement

In addition to the statutes in Section 4.4 and other relevant laws, the State of Michigan has existing legislative and regulatory authority to implement this measure without additional action.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, 55 school districts within the State of Michigan have received funds through the Clean School Bus Program to electrify their school bus fleets. Additionally, the State has applied for the 2023 Clean School Bus Rebate Program and is currently awaiting award decisions.

Other complementary funding sources include:

- Volkswagen settlement grants
- Federal and state-funded EV purchase rebates
- Federal Transit Administration's Low or No Emission and Grants for Buses and Bus Facilities Competitive Programs
- Diesel Emissions Reduction Act

- FEMA Congestion Mitigation and Air Quality Improvement Program
- Inflation Reduction Act Clean Ports
- Federal Highway Administration Charging and Fueling Infrastructure Discretionary Grant
- Inflation Reduction Act Alternative Fuel Vehicle Refueling Property Credit Direct Pay

Workforce Planning Analysis

Michigan currently has over 32,000 jobs in clean transportation. By electrifying government and other public fleets, this measure will create jobs as technicians, electricians, engineers, EV workers, infrastructure service jobs, transportation service jobs, and construction jobs.[44]

Reduction Measure #7 - Support just access to public transit and non-motorized transportation options by improving infrastructure, and by increasing routes, frequency, and reliability of available options.

Reduction Measure Description and Quantification

Michigan's current public transit system is comprised of 78 public transit agencies that transported 30 million passengers across the state in 2022[45]. Increasing the accessibility of public transit for both motorized and non-motorized modes was a very popular topic among the MHCP community engagement sessions held towards the end of 2023. In order to accomplish the expansion of Michigan's public transit network, upgrades and improvement to existing infrastructure is necessary. By improving and upgrading infrastructure, Michigan can increase routes, frequency, and reliability among public transit services for the Michigan public, who have experienced longer commute times in recent years[46]. Incentivizing the use of public transit can help displace individual passenger cars on the road and ultimately reduce emissions, commute time, and traffic on the roads.

Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. While an increase in public transit ridership and use of non-motorized transportation solutions will reduce emissions by displacing use of ICE vehicles, increased access to public transit will increase emissions from transit buses. Thus, this measure incorporates electrification of transit buses across the state to ensure a transition to clean infrastructure by 15% each year, as prioritized in the MHCP.

Example entities that may participate in implementing this reduction measure include but are not limited to state government, local municipalities, tribes, transit authorities, and others. Metrics that may be used to track this reduction measure include the number of registered vehicles within an area, ridership of public transit, the amount of money spent on developing infrastructure, sales data of vehicle batteries and public transit vehicles, and other metrics as identified.

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[44] Clean Jobs Midwest
[45] Michigan Transit
[46] U.S. Department of Transportation

Table 31: Estimated GHG emission reductions as a result of priority reduction measure #7

Estimated Emissions Reductions	Time Scale
1.162 $MMTCO_2e$	Annual near-term average
7.000 $MMTCO_2e$	Between 2024 – 2030
12.018 $MMTCO_2e$	Between 2024 – 2050

Quantification of increased access to public transit uses RMI's Energy Policy Simulator tool. Additional analysis of bus electrification uses AVERT tool. Major assumptions include:

1. Increased access of public transit is quantified using "mode shifting" policies which analyze emission reductions for passenger cars and SUVs who choose non-motorized and public transit options
2. MDOT's Michigan Ridership Reports were used to understand the total number of transit buses in the State of Michigan[47]

Validation of this measure used comparisons to similar frameworks such as the Carbon Reduction Strategy report by MDOT to replicate quantification given increased access to public transit.

Note: this reduction measure was quantified within the larger "mode shifting" which may include additional non-motorized factors in the emission reduction calculation. When applying for specific projects, ensure the appropriate emissions are calculated to result in reductions due to completion of the specific project.

LIDAC Qualitative and Quantitative Benefits Analysis

Michiganders who take public transportation spend an extra 67.7% of their time commuting and non-White households are 5.6 times more likely to commute via public transportation[48]. Improving infrastructure to enable more robust public transit and expanded non-motorized transportation options offers a cascade of benefits to low income and disadvantaged communities such as health, economic opportunity, and overall well-being. The projected reductions in harmful pollutants like NOx and CO translate to significant improvements in air quality, directly impacting residents' health particularly for people living near busy roads where there is expected to be major reductions in cases of respiratory symptoms and bronchitis. Improved transportation access fosters economic empowerment and social mobility. Expanded public transit networks, especially those in underserved areas, connect residents to job opportunities, educational institutions, healthcare facilities, and other essential services they may have previously lacked access to.

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[47] Michigan Department of Transportation
[48] transportation.gov/briefing-room/bipartisan-infrastructure-law-will-deliver-michigan

Table 32: Change in co-pollutants as a result of priority measure #7 in thousand metric tons of emissions

Pollutant*	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-1.031	7.368
NOx	-12.408	-27.762
PM2.5	1.366	5.492
VOC	-4.512	-1.474
CO	-96.832	-186.676

** Includes EPS and COBRA pollutants to account for increased access and electrification of transit*

Figure 35: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #7

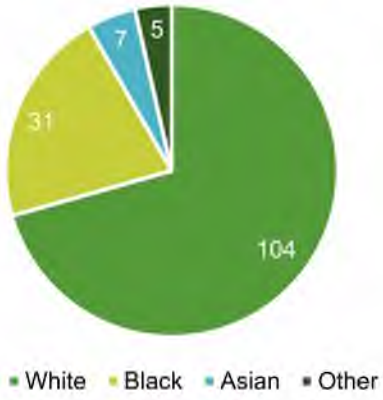
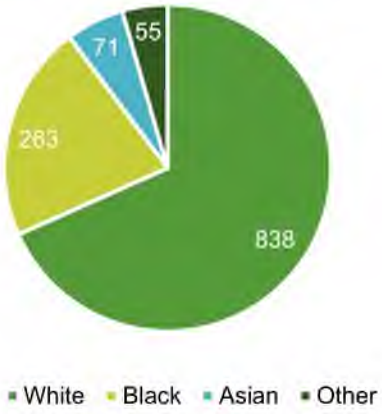


Figure 36: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #7



NOTE: Avoided deaths may be conservative estimate based on lack of data in one of the tools used in quantification

Table 33: Additional estimated community benefits in the near- and long-term throughout Michigan as a result of priority reduction measure #7

Community Benefits	2024-2030 Cumulative Value*	2024-2050 Cumulative Value*
Avoided Lost Workdays	9,458	78,457
Avoided Respiratory Symptoms and Bronchitis	3,357	27,841
Avoided Hospital Admissions	30	250
Avoided Minor Restricted Activity Days	56,079	465,212

** Values include both EPS (for updating infrastructure) and COBRA (for electrifying transit) benefits. COBRA outputs assume the benefits of the final implementation year, therefore, the benefits all buses have been transitioned for each year. Additional analysis is needed to understand the overtime benefits given a 15% MHCP implementation schedule.*

Review of Authority to Implement

In addition to the statutes in Section 4.4 and other relevant laws, the State of Michigan has existing legislative and regulatory authority to implement this measure without additional action and plans to orient implementation around existing areas of authority. Local governments and regional authorities also have significant authority to implement.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, Michigan has been awarded funds from three different federal grant programs to expand public transit:

1. Strengthening Mobility and Revolutionizing Transportation (SMART) Grant (awarded approximately $7 million to State and municipal entities (see FY 2022 awards below))
    a. Michigan Department of Transportation ($3.1 million)
    b. City of Detroit ($2 million)
    c. Oakland County
2. Rebuilding American Infrastructure with Sustainability and Equity (RAISE) (multiple awards received by the State and statewide entities over the course of the awards (see FY 2023 awards below))
    a. Michigan Department of Labor and Economic Opportunity ($8.5 million)
    b. City of Pontiac ($16.3 million)
    c. City of Jackson ($6.8 million)
3. Reconnecting Communities Pilot Program (awarded approximately $34 million to the State and City of Kalamazoo)

Workforce Planning Analysis

Currently, the State of Michigan has over 32,000 clean transportation jobs and the advanced transportation sector grew 21% from 2021 to 2022. By continuing to improve infrastructure and support access to public transit, Michigan will create jobs in transportation services, construction, and engineering, as well as for electricians, technicians, and EV workers[49]. Job growth for this measure is expected to increase to approximately 37,000 by 2030 with this reduction measure[50].

[49] Clean Jobs Midwest

[50] Energy Policy Simulator

Reduction Measure #8 - Encourage adoption of electric vehicles by increasing deployment of electric vehicle charging infrastructure, prioritizing equitable access for Michigan's LIDACs.

Reduction Measure Description and Quantification

Michigan currently has over 50,000 battery electric and hybrid vehicles registered in the state supported by just over 3,000 public charging ports. According to the MI Future Mobility Plan, another 100,000 chargers will need to be installed and supported to reach the MHCP goal of bringing 2 million electric vehicles on Michigan roads by 2030. While Michigan has several ongoing initiatives related to deploying charging infrastructure, such as the Charge Up Michigan Program, the rate at which chargers need to be deployed to reach MHCP 2030 goals is too high for existing programs as they stand today to accomplish. Increasing the access and security to those making the switch to electric vehicles is a vital way to reach successful deployment. In addition, addressing the charging infrastructure gaps along key commercial corridors can help support a region-wide transition to electric medium- and heavy-duty vehicles in Michigan and across the mid-west.

Table 34: Estimated GHG emission reductions as a result of priority reduction measure #8

Estimated Emissions Reductions	Time Scale
0.509 $MMTCO_2e$	Annual near-term average
3.052 $MMTCO_2e$	Between 2024 – 2030
13.489 $MMTCO_2e$	Between 2024 – 2050

Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. Interim milestones to achieving this measure could include deploying approximately 300,000 BEVs (inclusive of light-duty, medium-duty, and heavy-duty vehicles) per year between 2024 and 2030. Alternatively, deploying approximately 16,000 EV chargers per year between 2024-2030 within the state to help support the transition to electric vehicles could be used as milestones depending on the specific projects created out of this priority reduction measure.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to state government, local municipalities, tribes, electric vehicle charging infrastructure installers/contractors, Michigan residents, transportation agencies, and others. Metrics that may be used to track this reduction measure include the number of available public electric vehicle chargers, the number of electric vehicles registered in Michigan, gasoline and diesel sales data, air quality, and other metrics as identified.

Quantifying the emissions impact on deploying electric vehicle charging infrastructure was estimated using AVERT and was based on the following assumptions:

1. EV charging deployment will result in Michigan reaching their goal of bringing 2 million electric vehicles on Michigan roads by 2030 and all registered vehicles in MI as of 2022 transition to zero-emission vehicles by 2050
2. All remaining EVs deployed are assumed to be all-electric and light-duty vehicles to serve as a conservative estimate compared to a range of light-duty, medium-duty, and heavy-duty vehicles being deployed
3. There was no change in the existing electric power generation fuel mix in the state (i.e., initiatives related to clean energy deployment are not considered and the existing fuel mix is assumed to remain constant)
4. Omits emissions related to battery energy efficiency improvements and greenhouse gases outside of carbon dioxide

Validation of this reduction measure quantification was completed with manual calculation of displacing ~300,000 internal combustion engines (ICEs) per year with new battery electric vehicles (BEVs) and estimating the approximate GHGs emitted per typical ICE per year.

LIDAC Qualitative and Quantitative Benefits Analysis

Quantification of the avoided deaths by race was not possible for this reduction measure. It will likely result in similar benefits as reduction measures six and seven such as the significant reduction of harmful pollutants like NOx and SOx, leading to cleaner air and fewer respiratory illnesses, though the quantity would alter based on the scale differences between each measure.

Table 35: Change in co-pollutants as a result of priority measure #8 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-0.001	-0.004
NOx	-0.016	-0.070
PM2.5	-0.001	-0.006
VOC	-0.038	-0.164
CO	**N/A**	**N/A**

Table 36: Avoided estimated community benefits in the near-term and long-term as a result of priority reduction measure #8

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	7	39
Avoided Respiratory Symptoms and Bronchitis	2	13
Avoided Hospital Admissions	0	0
Avoided Minor Restricted Activity Days	39	235

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statues in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" – as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 – which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state to support the deployment of EV charging infrastructure.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan has received $110 million as part of the National Electric Vehicle Infrastructure (NEVI) Formula Program to deploy charging infrastructure across the state. The State is awaiting award decisions for the Electric Vehicle Charger Reliability and Accessibility Accelerator Program through the IIJA. There is an existing state program EGLE manages to advance strategic deployment of EV infrastructure along Lake Michigan.

Other complementary funding sources include:

- Volkswagen settlement grants
- Federal and state-funded EV purchase rebates
- EPA's Clean School Bus program
- Federal Transportation Administration's Low or No Emission and Grants for Buses and Bus Facilities Competitive Programs
- Diesel Emissions Reduction Act
- FEMA Congestion Mitigation and Air Quality Improvement Program
- Inflation Reduction Act Clean Ports
- Federal Highway Administration Charging and Fueling Infrastructure Discretionary Grant
- Inflation Reduction Act Alternative Fuel Vehicle Refueling Property Credit Direct Pay

Workforce Planning Analysis

Governor Whitmer has helped Michigan build on leadership in mobility. She worked to win big projects and create thousands of good-paying jobs, such as a historic $7B investment from GM, creating and retaining 5,000 jobs; a $1.7B investment from electric vehicle battery manufacturer LG Energy Solution, creating 1,200 jobs; and a $2B investment from Ford that will create more than 3,200 jobs. Michigan currently has approximately 32,000 jobs in the clean transportation space[51], with the largest hub in Detroit. As the state continues to increase deployment of electric vehicle charging infrastructure, the following jobs will be created: electricians, technicians, engineers, transportation services jobs, and grid specialists. Projected job creation was unable to be estimated for this reduction measure. In 2023, Senate Bill 519 established the Office of Worker and Community Economic Transition within LEO to assist workers, communities, and employers during the transition to clean energy, including internal combustion engine vehicle workers and workers in the supply chain for internal combustion engine vehicles. This Office can provide further support and analysis to understand and mitigate workforce impacts.[52]

5.4 Industry Reduction Measures

Michigan's industry sector accounted for 15% of overall GHG emissions in 2019. Emissions from industrial processes amounted to 11.1 $MMTCO_2E$ and energy related emissions from industrial processes was an additional 15.6 $MMTCO_2E$. The state's industrial sector is remarkably diverse, and makes critical products like iron, steel, cement, chemicals, and food using specific manufacturing processes that can cause on-site GHG emissions, often require a lot of power, and involve GHG emissions in their supply chains.

Reduction Measure #9 - Encourage industrial innovation to advance energy efficiency, fuel-switching, and deployment of cleaner manufacturing technologies prioritizing facilities in LIDACs that may receive significant benefits from reduced industrial sector emissions.

Reduction Measure Description and Quantification

Industrial decarbonization is a key area of focus for Michigan as one of the national leaders in manufacturing jobs and output[53]. Energy efficiency is a vital tool that can help Michigan's industrial sector reduce GHG emissions while keeping energy costs reasonable. Additionally, many industrial facilities have a high potential for process electrification, while other high-heat processes require fuel-switching to cleaner fuels (such as green hydrogen), and certain processes require deploying cleaner manufacturing technologies, including but not limited to carbon capture, utilization, and storage. The top ten highest GHG emitting industrial facilities

[51] Clean Jobs Midwest
[52] legislature.mi.gov/documents/2023-2024/billanalysis/Senate/htm/2023-SFA-0519-G.htm
[53] Business Facilities' 19th Annual Rankings Report: State Rankings

outside of power plants produced over 8 $MMTCO_2E$ in 2022, representing a major opportunity to reduce emissions from top emitting facilities as they pave the way for others to follow.

Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. In partnership with existing institutions, such as the Michigan State University Industrial Assessment Center, this measure would initially support site assessments and predevelopment costs for many of Michigan's industrial facilities. Decarbonization projects at facilities of varying sizes would be undertaken thereafter, prioritizing the projects that result in the greatest emission reductions.

Table 37: Estimated GHG emission reductions as a result of priority reduction measure #9

Estimated Emissions Reductions	Time Scale
0.597 $MMTCO_2e$	Annual near-term average
5.887 $MMTCO_2e$	Between 2024 – 2030
15.529 $MMTCO_2e$	Between 2024 – 2050

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to manufacturers, industrial plants, and others. Metrics that may be used to track this reduction measure include the change in natural gas and electricity usage of industrial facilities over time, emissions of various greenhouse gases via existing reporting programs, localized air pollution, and other metrics as identified.

Industrial decarbonization strategies such as fuel-switching, energy efficiency improvements, and investments in clean manufacturing technology were quantified using RMI's EPS tool. The following assumptions served as the base of the quantification:

1. Focus on industrial decarbonization outside of power plants to avoid double counting with other electricity specific reduction measures
2. The 10 highest emitting industrial users were distinguished using Greenhouse Gas Reporting Program (GHGRP) data and include minerals, metals, refineries, petroleum and natural gas systems, pulp and paper, and non-fluorinated chemicals industries[54]

Validation of this reduction measure quantification will be completed with manual calculation using comparative data for other similar sized industrial sites.

[54] EPA GHG Reporting

Note: The quantification included policies related to industrial energy efficiency, fuel-switching, and clean manufacturing for the top 10 industries (besides power plants). When applying for specific projects, ensure appropriate emissions are quantified.

LIDAC Qualitative and Quantitative Benefits Analysis

Cleaner manufacturing technologies and fuel-switching lead to significant reductions in emissions of harmful pollutants like NOx, SOx, and CO in traditionally overburdened communities located near industrial facilities. Transitioning to cleaner industrial processes will also generate demand for new skills and expertise that can create new workforce opportunities in areas like conducting energy audits and implementing the energy saving strategies they identify.

Table 38: Change in co-pollutants as a result of priority measure #9 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-1.433	5.805
NOx	-2.272	-4.160
PM2.5	1.305	5.199
VOC	-0.698	0.753
CO	-48.531	-149.659

Figure 37: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #9

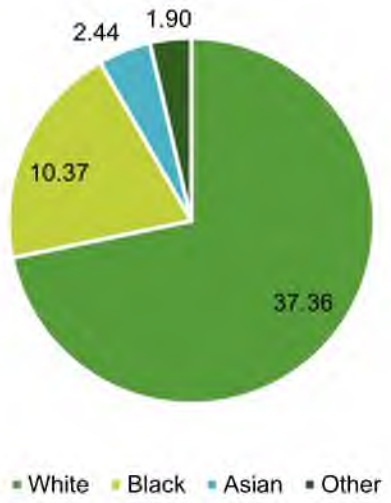


Figure 38: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #9

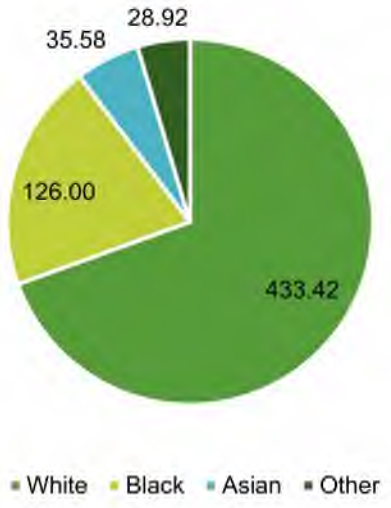


Table 39: Avoided estimated community benefits in the near-term and long-term as a result of priority reduction measure #9

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	3,335	39,897
Avoided Respiratory Symptoms and Bronchitis	1,180	14,107
Avoided Hospital Admissions	11	129
Avoided Minor Restricted Activity Days	19,767	236,484

Review of Authority to Implement

In addition to the statutes in Section 4.4 and other relevant laws, the State of Michigan has existing legislative and regulatory authority to implement this incentive-based measure without additional action.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan has received funding through the Regional Clean Hydrogen Hubs Program as part of the Midwest Hydrogen Hub to expand the production, processing, delivery, storage, and end-use of hydrogen which is applicable to the fuel-switching component of this priority reduction measure.

In addition, this measure intends to fill gaps in funding left after implementation of the federal 48C Clean Manufacturing Tax Credit. That program is currently funded at a $4 billion level, applications were due in December 2023, and winners of 48C credits are not yet known. The 48C program is expected to leave an abundance of unfunded projects to spur innovation and reduce emissions. This coalition grant program will build on the 48C grants and focus on projects that do not get 48C funding.

Workforce Planning Analysis

In Michigan, there are approximately 75,000 energy efficient jobs and almost 700 clean fuels jobs[55]. As the state strives to advance energy efficiency and fuel-switching in heavy industry, it will create jobs across the value chain in manufacturing, innovation consulting, business development, construction, engineering, and more. Job creation from this reduction measure can expect about 4,347 new jobs in the year 2050.

[55] Clean Jobs Midwest

Reduction Measure #10 - Reduce methane emissions from various sources, including but not limited to food waste, organics diversion, and wastewater treatment facilities with a focus on methane reduction strategies that will bring significant benefits for LIDACs.

Reduction Measure Description and Quantification

Methane emissions, while a relatively small portion of Michigan's GHG emissions, have a significantly higher warming potential compared to CO_2, stressing the importance of mitigating their release into the atmosphere. The inventory sectors that emit the highest amounts of CH_4 include Natural Gas and Oil Systems, Agriculture, and Waste. This reduction measure may focus on methane reductions from any emitting inventory sector with significant methane emissions, but for the purposes of quantification, prioritizes food waste, organics diversion, and wastewater.

Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. Michigan has a goal to reduce food waste by 50% from 2005 levels by 2030. Currently in development is a Michigan Food System Waste Reduction Road Map to inform decision makers of policies and programs related to reducing food waste.

Table 40: Estimated GHG emission reductions as a result of priority reduction measure #10

Estimated Emissions Reductions	Time Scale
0.858 $MMTCO_2e$	Annual near-term average
5.147 $MMTCO_2e$	Between 2024 – 2030
13.827 $MMTCO_2e$	Between 2024 – 2050

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to landfill owners, wastewater treatment facilities, compost companies, tribes, municipalities, universities, and others. Metrics that may be used to track this reduction measure include the change in reported methane emissions from industrial sites, the amount of methane vented and flared, the amount of food waste diverted from landfills, and other metrics as identified.

Quantification of this reduction measure was calculated using RMI's EPS tool and the EPA's recent report "Quantifying Methane Emissions from Landfilled Food Waste"[56]. The baseline assumptions include:

1. All food waste is calculated via municipal solid waste emissions from the EPA's SIT data and EPA's finding that 58% of fugitive methane emissions in municipal solid waste landfills are from food waste

[56] epa.gov/land-research/quantifying-methane-emissions-landfilled-food-waste

2. Wastewater baseline data are taken from the SIT
3. A 50% reduction in wastewater is also assumed (based on 2005 levels) in addition to reduction by 50% for food waste

Validation of this reduction measure was completed through addressing additional EPS policies and how they relate to emission goals, based on the SIT. Note, the SIT does not include state-specific data but uses EPA estimates and national proportions to calculate both waste and wastewater data.

LIDAC Qualitative and Quantitative Benefits Analysis

Reducing methane emissions from diverse sources – including food waste, organic waste diversion, and wastewater treatment facilities – has the potential to improve the lives of Michigan's LIDAC residents. Reducing methane emissions, even at a seemingly small scale within communities, leads to reduced pollutants, especially CO, and improves air quality and enhances overall health and well-being. Landfills and wastewater treatment facilities are often the source of unpleasant odors from the release of compounds that accompany methane such as hydrogen sulfide. Diverting organic waste to anaerobic digestion facilities minimizes the release of odorous compounds. Reducing these emissions creates a more pleasant environment in surrounding communities, which are often historically disadvantaged. In addition, implementing solutions like anaerobic digestion for food waste conversion requires infrastructure upgrades and operational staff, generating green jobs in local communities.

Table 41: Change in co-pollutants as a result of priority measure #9 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-0.891	7.429
NOx	-0.783	0.576
PM2.5	1.687	6.341
VOC	-0.178	2.269
CO	-45.358	-142.737

Figure 39: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #10

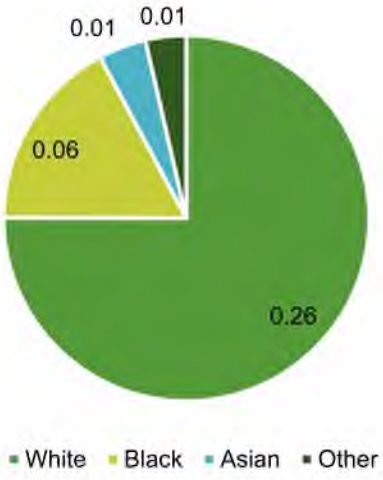


Figure 40: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #10

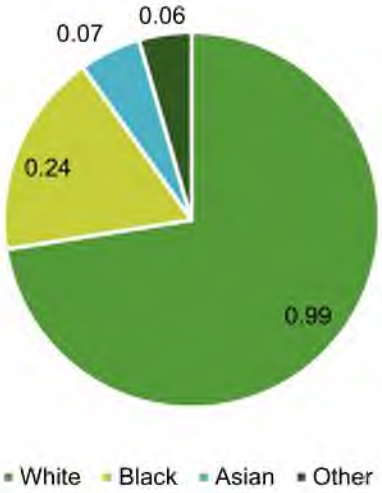


Table 42: Avoided estimated community benefits in the near-term and long-term as a result of priority reduction measure #9

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	22	87
Avoided Respiratory Symptoms and Bronchitis	8	30
Avoided Hospital Admissions	0	0
Avoided Minor Restricted Activity Days	128	516

Review of Authority to Implement

In addition to the statutes in Section 4.4 and other relevant laws, the State of Michigan has existing legislative and regulatory authority to implement this measure without additional action.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, EGLE was awarded $5 million as part of the Methane Emissions Reduction Program funded through the IRA that helps monitor air pollution, enhance climate resilience, and decrease adverse health effects in LIDACs.

Workforce Planning Analysis

This reduction measure relating to methane emissions reduction will have an effect on jobs in farming, food processing and manufacturing, grocery retail, food service, and more. This is the only reduction measure to estimate a decrease in net jobs by as low as 4,300 fewer jobs by 2050[57]. However, the aforementioned Community and Worker Economic Transition Office in LEO is meant to support workers from industries impacted by the clean energy transition and could provide analysis, planning, and support to mitigate adverse workforce impacts.

6. CONCLUSION AND NEXT STEPS

EGLE continues to oversee all components required to implement the strategies laid out in the MHCP. This requires complex management to obtain funds, incentivize progress, operate and promote programs, and much more. The potential outcome to establish Michigan as a clean energy leader in economic development, jobs, and overall well-being for citizens makes further progress an imperative.

As we look forward to making groundbreaking advancements in the areas discussed herein, EGLE will work to make the following additions or improvements both as part of the CPRG Program and upon MHCP implementation holistically.

- Incorporate natural and working lands sectors into relevant components of the CCAP.
- Increase meaningful engagement across the state by better incorporating equity and accessibility into future community engagements.
- Ensure tribes are included in outreach for PCAP and CCAP related programs and projects that are located near tribal lands. Outreach will include, but not be limited to:
    - Continuing to meet and collaborate with tribes and tribal consortiums on implementing PCAPs and CCAPs.
    - Continuing to include EGLE's MHCP and CPRG updates at quarterly MTEG meetings.
    - Ensuring tribes are notified of funding opportunities that could assist in implementing PCAP and CCAP strategies.
- Improve upon the data in the GHG inventory by:
    - Sorting data into an Economic Sector GHG inventory approach,
    - Engaging communities for Michigan specific data collection (e.g., utilities) (to replace default state-specific data sources) for the following SIT modules: agriculture, wastewater, municipal solid waste, electricity consumption, and,
    - Developing a dynamic, open-source data visualization dashboard, updated regularly.

[57] Energy Policy Simulator

- Perform a deeper analysis related to LIDAC and statewide community benefits, using local partnerships and experts to create a more robust assessment of the effects air pollution, energy burden, jobs, and climate resilience have on communities and incorporate learnings into decision-making.
- Continue to expand the funding opportunities assessment to holistically understand the streams of funding flowing to what industry sectors for what projects and programs.
- Further examine the existing and required workforce planning activities across the state beginning with overarching estimates in each industry sector, existing programs and planning activities, specific opportunities for LIDAC workers, and additional programs required to ensure a sufficient workforce is equipped to realize MHCP goals and a just transition.
- Perform a scenario analysis across reduction measures to estimate the complex nature of how initiatives interact with one another. Institute conservative, moderate, and aggressive estimates to deepen understanding of a range of possibilities along the timeline to 2050.

This Priority Climate Action Plan embodies Michigan's urgent response to the escalating challenges of climate change, echoing the urgent call to action outlined in the MI Healthy Climate Plan. As climate-related impacts increasingly affect Michiganders, failure to act decisively will exacerbate existing disparities and environmental injustices. However, by embracing the PCAP's strategic measures, including immediate actions to achieve a 52% reduction in greenhouse gas emissions by 2030 and laying the groundwork for full decarbonization by 2050, Michigan can seize a transformative opportunity. Oversight and implementation of the PCAP by the Office of Climate and Energy within EGLE, supported by advisory bodies and transparent reporting mechanisms, will ensure accountability and progress toward our shared goals. Through resolute leadership, inclusive participation, and collaboration among all parties involved, we can build a more equitable, healthy, prosperous, and sustainable future for all Michiganders.

APPENDIX A: GHG INVENTORY DETAILED TABLES

Appendix Table 1:
Summary of GHG Emissions for Michigan by Inventory Sector ($MMTCO_2E$)

Inventory Sector ($MMTCO_2E$)	2005	2019	% of Gross Emissions (2019)	% Change (2005 to 2019)
Energy	190.42	161.94	87.21%	-15%
CO_2 from Fossil Fuel Combustion	186.89	154.24	83.06%	-17%
Stationary Combustion	0.85	0.81	0.43%	-6%
Mobile Combustion	1.36	0.61	0.33%	-56%
Coal Mining	0.00	0.00	0.00%	-
Natural Gas and Oil Systems	1.31	6.29	3.39%	381%
Industrial Processes	11.36	11.08	5.97%	-2%
Agriculture	6.55	8.05	4.33%	23%
Waste	9.77	4.62	2.49%	-53%
Municipal Solid Waste	8.78	3.62	1.95%	-59%
Wastewater	0.99	1.01	0.54%	1%
Gross Emissions	218.10	185.69	-	-15%
Sinks (LULUCF)	-19.63	-18.96	10.21%	-3%
Net Emissions	**198.47**	**166.73**	-	**-16%**

Appendix Table 2:
Total GHG Emissions for Michigan by Greenhouse Gas in 2005 and 2019

Emissions ($MMTCO_2E$)	2005	2019	% of Gross Emissions (2019)	% Change (2005 to 2019)
Gross CO_2	194.61	160.99	88.86%	-17%
CO_2 from Fossil Fuel Combustion	186.89	154.24	85.14%	-17%
Industrial Processes	7.07	6.18	3.41%	-13%
Waste	0.61	0.54	0.30%	-12%
Agriculture	0.04	0.03	0.01%	-28%
Sinks (LULUCF)	-19.73	-19.05	-11%	-3%
Net CO_2*	*174.89*	*141.93*	*78%*	*-19%*
CH_4	13.07	13.59	7.50%	4%
Stationary Combustion	0.42	0.50	0.28%	19%
Mobile Combustion	0.13	0.09	0.05%	-33%
Coal Mining	0.00	0.00	0.00%	-
Natural Gas and Oil Systems	1.31	6.29	3.47%	381%
Agriculture	2.34	2.91	1.61%	24%
Waste	8.15	3.07	1.69%	-62%
Wastewater	0.72	0.74	0.41%	3%
N_2O	2.46	1.69	0.93%	-31%
Stationary Combustion	0.43	0.30	0.17%	-30%
Mobile Combustion	1.24	0.52	0.29%	-58%
Industrial Processes	0.00	0.00	0.00%	-
Agriculture	0.42	0.49	0.27%	18%
Waste	0.01	0.01	0.00%	-27%
Wastewater	0.27	0.27	0.15%	-2%
F-Gases	4.29	4.90	2.70%	14%
Industrial Processes	4.29	4.90	2.70%	14%
Gross Emissions	**214.44**	**181.16**	**-**	**-16%**
Net Emissions (Sources and Sinks)	**194.71**	**162.11**	**-**	**-17%**

** Carbon dioxide sinks in the environment are categorized under land-use, land-use change and forestry thus, are subtracted from Gross CO_2 emissions. Net CO_2 = gross CO_2 emissions - sinks. NOTE: Dashes signify that the value is not counted. Coal mining production in the State of Michigan stopped by 1952, therefore, no emissions are accounted for.*

Appendix Table 3: Indirect CO2 from Electricity Consumption by End-Use Sector with Detailed Uses ($MMTCO_2E$)

End-Use Sector	2005	2019	% Change (2005 to 2019)
Residential	23.58	16.23	-31%
Space Heating	1.28	2.51	96%
Air-conditioning	3.59	1.80	-50%
Water Heating	1.88	1.93	3%
Refrigeration	3.16	1.29	-59%
Other Appliances and Lighting	13.67	8.69	-36%
Commercial	25.87	18.34	-29%
Space Heating	1.45	0.52	-64%
Cooling	2.10	2.06	-2%
Ventilation	3.69	3.02	-18%
Water Heating	0.37	0.07	-80%
Lighting	8.94	3.39	-62%
Cooking	0.33	0.52	55%
Refrigeration	3.17	2.73	-14%
Office Equipment	0.66	0.74	12%
Computers	1.47	1.69	15%
Other	3.70	3.61	-2%
Industrial	22.70	14.48	-36%
Indirect Uses-Boiler Fuel	0.22	0.22	3%
Conventional Boiler Use	0.21	0.22	7%
CHP and/or Cogeneration Process	0.01	0.00	-100%
Direct Uses-Total Process	17.87	11.57	-35%
Process Heating	3.08	1.63	-47%
Process Cooling and Refrigeration	1.56	1.19	-24%
Machine Drive	11.93	7.42	-38%
Electro-Chemical Processes	1.05	0.98	-6%
Other Process Use	0.25	0.35	39%
Direct Uses-Total Nonprocess	4.36	2.51	-42%
Facility HVAC	2.03	1.18	-42%
Facility Lighting	1.77	0.95	-46%
Other Facility Support	0.47	0.26	-45%
Onsite Transportation	0.06	0.09	48%
Other Nonprocess Use	0.03	0.03	-11%
Other	0.25	0.17	-32%
Transportation	0.003	0.003	-4%

End-Use Sector	2005	2019	% Change (2005 to 2019)
Automated Guideway	0.003	0.002	-39%
Bus (charged batteries)	0	0	-
Cable Car	0	0	-
Commuter Rail	0	0	-
Heavy Rail	0	0	-
Inclined Plane	0	0	-
Light Rail	0	0	-
Trolleybus	0	0	-
Other	0	0.001	-
TOTAL	**72.16**	**49.05**	-32%
Residential	23.58	16.23	-31%
Commercial	25.87	18.34	-29%
Industrial	22.70	14.48	-36%
Transportation	0.003	0.003	-4%

Comparison of Michigan's 2024 Inventory using EPA's SIT and the EPA's annual Inventory of U.S. Greenhouse Gas Emissions and Sinks and the Inventory of U.S. Greenhouse Gas Emissions and Sinks by State

Appendix Table 4:
Difference between Michigan's 2024 Inventory and EPA's Annual Inventories*

Inventory Sector ($MMTCO_2E$)	2005 (SIT)	2005 (EPA Annual Inventories)	Difference between SIT and EPA Annual Inventories (2005)	2019 (SIT)	2019 (EPA Annual Inventories)	Difference between SIT and EPA Annual Inventories (2019)
Energy	190.418	196.408	-5.991	161.935	158.805	3.131
Industrial Processes	11.363	12.988	-1.626	11.080	14.055	-2.975
Agriculture	6.548	8.523	-1.975	8.047	10.769	-2.722
Waste	9.771	9.974	-0.203	4.624	7.005	-2.381
Gross Emissions	218.100	227.166	-9.067	185.687	190.549	-4.862
Sinks (LULUCF)	-19.633	-15.785	-3.848	-18.958	-15.263	-3.695
Net Emissions	198.467	212.109	-13.643	166.729	175.371	-8.642

**2024 Inventory uses EPA's SIT and EPA's Annual Inventories include the Inventory of U.S. Greenhouse Gas Emissions and Sinks and the Inventory of U.S. Greenhouse Gas Emissions and Sinks by State*[1]

[1] EPA Greenhouse Gas Inventory Data Explorer

APPENDIX B: SUMMARY TABLE OF PRIORITY REDUCTION MEASURES

The below table describes the associated emission reduction quantification and review of authority to implement for each priority reduction measure described in Section 5. Priority Reduction Measures by Key Sector.

ID	Key Sector	Priority Reduction Measure	Estimated Emissions Reductions		
			Annual near-term average	Between 2024 – 2030	Between 2024 – 2030
1	Electricity Generation	Drive clean energy deployment including improving siting for renewable energy and energy storage across Michigan, including on brownfields and former industrial sites and emphasizing equitable access for Michigan's LIDACs.	1.640	20.856	42.651
2	Electricity Generation	Invest in energy storage and necessary electric grid investments to enable earlier coal plant retirements and better integrate renewable energy into the electric grid.	2.794	16.762	23.593
3	Commercial and Residential Buildings	Drive building electrification and fuel-switching in existing buildings including an emphasis on LIDACs and electrifying households that currently rely on delivered fuels such as propane and home heating oil.	1.047	6.280	25.808
4	Commercial and Residential Buildings	Reduce household fossil energy use through home repairs, electrical upgrades for building and vehicle electrification, weatherization, and other energy waste reduction investments with an emphasis on ensuring equitable access.	1.260	7.562	24.463

ID	Key Sector	Priority Reduction Measure	Estimated Emissions Reductions		
			Annual near-term average	Between 2024 – 2030	Between 2024 – 2030
5	Commercial and Residential Buildings	Decarbonize government and nonprofit facilities and infrastructure, with an emphasis on LIDACs, by reducing energy waste, investing in decarbonization solutions, and reducing emissions from fossil fuel combustion.	0.050	0.251	0.502
6	Transportation	Electrify state government, municipal, tribal, and other public fleets, prioritizing equitable access for Michigan's LIDACs.	0.285	1.519	7.571
7	Transportation	Support just access to public transit and non-motorized transportation options by improving infrastructure, and by increasing routes, frequency, and reliability of available options.	1.162	7.000	12.018
8	Transportation	Encourage adoption of electric vehicles by increasing deployment of electric vehicle charging infrastructure, prioritizing equitable access for Michigan's LIDACs.	0.509	3.052	12.646
9	Industry	Encourage industrial innovation to advance energy efficiency, fuel-switching, and deployment of cleaner manufacturing technologies prioritizing facilities in LIDACs that may receive significant benefits from reduced industrial sector emissions.	0.597	5.887	15.529
10	Industry	Reduce methane emissions from various sources, including but not limited to food waste, organics diversion, and wastewater treatment facilities with a focus on methane reduction strategies that will bring significant benefits for LIDACs.	0.858	5.147	13.827

APPENDIX C: CEJST CENSUS TRACTS

According to the EPA, low income and disadvantaged communities includes census tracts included in the Climate and Economic Justice Screening Tool (CEJST), census blocks above 90th national percentile in EJScreen Supplemental Indexes, or geographic areas within tribal lands (as included in EJScreen). Below are the **996 census tracts** which fall under one, or all, of these definitions as of 2010 Census.

County Name	Census tract 2010 ID
Alcona County	26001970100
Alcona County	26001970400
Alcona County	26001970500
Alcona County	26001970600
Alger County	26003000100
Allegan County	26005031000
Allegan County	26005031200
Alpena County	26007000100
Alpena County	26007000400
Alpena County	26007000500
Alpena County	26007000700
Alpena County	26007000800
Antrim County	26009960200
Antrim County	26009960700
Arenac County	26011970100
Arenac County	26011970200
Arenac County	26011970300
Arenac County	26011970400
Arenac County	26011970500
Baraga County	26013000100
Baraga County	26013000200
Bay County	26017280300
Bay County	26017280400
Bay County	26017280600
Bay County	26017280700
Bay County	26017280900
Bay County	26017281300
Bay County	26017285202
Bay County	26017285800
Bay County	26017286500
Bay County	26017286600

County Name	Census tract 2010 ID
Berrien County	26021000300
Berrien County	26021000400
Berrien County	26021000500
Berrien County	26021000600
Berrien County	26021002000
Berrien County	26021002100
Berrien County	26021002200
Berrien County	26021002300
Berrien County	26021002500
Berrien County	26021020200
Berrien County	26021020500
Berrien County	26021020600
Berrien County	26021020700
Berrien County	26021020900
Branch County	26023950200
Branch County	26023950800
Branch County	26023951200
Branch County	26023951400
Branch County	26023951600
Calhoun County	26025000200
Calhoun County	26025000300
Calhoun County	26025000500
Calhoun County	26025000600
Calhoun County	26025000700
Calhoun County	26025000800
Calhoun County	26025001000
Calhoun County	26025001100
Calhoun County	26025001300
Calhoun County	26025001400
Calhoun County	26025002100
Calhoun County	26025002600

County Name	Census tract 2010 ID
Calhoun County	26025002800
Calhoun County	26025003100
Calhoun County	26025003300
Calhoun County	26025003600
Calhoun County	26025004000
Calhoun County	26025004100
Cass County	26027002000
Cass County	26027002100
Charlevoix County	26029000200
Charlevoix County	26029001500
Cheboygan County	26031960200
Cheboygan County	26031960300
Cheboygan County	26031960700
Cheboygan County	26031960800
Chippewa County	26033970200
Chippewa County	26033970400
Chippewa County	26033970500
Chippewa County	26033970700
Chippewa County	26033970900
Chippewa County	26033980200
Chippewa County	26033980300
Clare County	26035000100
Clare County	26035000200
Clare County	26035000300
Clare County	26035000400
Clare County	26035000500
Clare County	26035000600
Clare County	26035000800
Clare County	26035000900
Clare County	26035001000
Clare County	26035001300
Clinton County	26037010203
Clinton County	26037010702
Clinton County	26037010901
Crawford County	26039960300
Crawford County	26039960400
Crawford County	26039960500
Delta County	26041970100

County Name	Census tract 2010 ID
Delta County	26041970800
Delta County	26041971000
Dickinson County	26043950500
Eaton County	26045020202
Eaton County	26045020901
Emmet County	26047970100
Emmet County	26047970800
Genesee County	26049000100
Genesee County	26049000200
Genesee County	26049000300
Genesee County	26049000400
Genesee County	26049000500
Genesee County	26049000600
Genesee County	26049000700
Genesee County	26049000800
Genesee County	26049000900
Genesee County	26049001000
Genesee County	26049001100
Genesee County	26049001200
Genesee County	26049001300
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Genesee County	26049001500
Genesee County	26049001600
Genesee County	26049001700
Genesee County	26049001800
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Genesee County	26049002000
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Genesee County	26049002300
Genesee County	26049002400
Genesee County	26049002600
Genesee County	26049002700
Genesee County	26049002800
Genesee County	26049002900
Genesee County	26049003100
Genesee County	26049003200
Genesee County	26049003300
Genesee County	26049003400

County Name	Census tract 2010 ID
Genesee County	26049003500
Genesee County	26049003600
Genesee County	26049003700
Genesee County	26049003800
Genesee County	26049004000
Genesee County	26049010110
Genesee County	26049010113
Genesee County	26049010115
Genesee County	26049010304
Genesee County	26049010305
Genesee County	26049010501
Genesee County	26049010502
Genesee County	26049010504
Genesee County	26049010811
Genesee County	26049010812
Genesee County	26049010910
Genesee County	26049010911
Genesee County	26049010912
Genesee County	26049011301
Genesee County	26049011302
Genesee County	26049011401
Genesee County	26049011508
Genesee County	26049011901
Genesee County	26049012003
Genesee County	26049012006
Genesee County	26049012007
Genesee County	26049012008
Genesee County	26049012100
Genesee County	26049012201
Genesee County	26049012202
Genesee County	26049012310
Genesee County	26049012311
Genesee County	26049012501
Genesee County	26049012503
Genesee County	26049012601
Genesee County	26049012602
Genesee County	26049013500
Genesee County	26049013600

County Name	Census tract 2010 ID
Gladwin County	26051000100
Gladwin County	26051000300
Gladwin County	26051000400
Gladwin County	26051000500
Gladwin County	26051000600
Gladwin County	26051000700
Gladwin County	26051000800
Gogebic County	26053950100
Gogebic County	26053950200
Gogebic County	26053950500
Gogebic County	26053950600
Gratiot County	26057000300
Gratiot County	26057000400
Gratiot County	26057000700
Gratiot County	26057001000
Hillsdale County	26059050200
Hillsdale County	26059050400
Hillsdale County	26059050600
Hillsdale County	26059050700
Hillsdale County	26059050800
Hillsdale County	26059051100
Hillsdale County	26059051200
Houghton County	26061000100
Houghton County	26061000200
Houghton County	26061000300
Houghton County	26061000400
Houghton County	26061000700
Huron County	26063950300
Huron County	26063950600
Huron County	26063951000
Huron County	26063951200
Ingham County	26065000100
Ingham County	26065000600
Ingham County	26065000700
Ingham County	26065000800
Ingham County	26065001200
Ingham County	26065001703
Ingham County	26065002000

County Name	Census tract 2010 ID
Ingham County	26065002101
Ingham County	26065002600
Ingham County	26065002800
Ingham County	26065003200
Ingham County	26065003301
Ingham County	26065003500
Ingham County	26065003602
Ingham County	26065003700
Ingham County	26065004302
Ingham County	26065005100
Ingham County	26065005201
Ingham County	26065005304
Ingham County	26065005402
Ingham County	26065006500
Ingham County	26065006600
Ingham County	26065006700
Ingham County	26065006800
Ionia County	26067030200
Ionia County	26067030300
Ionia County	26067031700
Ionia County	26067032100
Iosco County	26069000100
Iosco County	26069000300
Iosco County	26069000400
Iosco County	26069000500
Iosco County	26069000600
Iosco County	26069000700
Iosco County	26069000800
Iosco County	26069000900
Iron County	26071000300
Iron County	26071000400
Iron County	26071000500
Isabella County	26073000100
Isabella County	26073940100
Isabella County	26073940200
Isabella County	26073940400
Isabella County	26073940500
Isabella County	26073940600

County Name	Census tract 2010 ID
Jackson County	26075000100
Jackson County	26075000200
Jackson County	26075000400
Jackson County	26075000500
Jackson County	26075000600
Jackson County	26075000900
Jackson County	26075001000
Jackson County	26075001100
Jackson County	26075001200
Jackson County	26075001300
Jackson County	26075005000
Jackson County	26075005100
Jackson County	26075005500
Jackson County	26075005800
Jackson County	26075005900
Jackson County	26075006000
Jackson County	26075006900
Kalamazoo County	26077000100
Kalamazoo County	26077000201
Kalamazoo County	26077000202
Kalamazoo County	26077000300
Kalamazoo County	26077000600
Kalamazoo County	26077000900
Kalamazoo County	26077001000
Kalamazoo County	26077001100
Kalamazoo County	26077001504
Kalamazoo County	26077001507
Kalamazoo County	26077001702
Kalamazoo County	26077001803
Kalamazoo County	26077002201
Kalamazoo County	26077002903
Kalamazoo County	26077005501
Kalkaska County	26079950200
Kalkaska County	26079950400
Kalkaska County	26079950601
Kalkaska County	26079950602
Kent County	26081000800
Kent County	26081000900

County Name	Census tract 2010 ID
Kent County	26081001000
Kent County	26081001101
Kent County	26081001300
Kent County	26081001500
Kent County	26081001600
Kent County	26081001900
Kent County	26081002000
Kent County	26081002200
Kent County	26081002600
Kent County	26081002800
Kent County	26081003000
Kent County	26081003100
Kent County	26081003200
Kent County	26081003500
Kent County	26081003600
Kent County	26081003700
Kent County	26081003800
Kent County	26081003900
Kent County	26081004000
Kent County	26081004200
Kent County	26081004600
Kent County	26081010301
Kent County	26081010402
Kent County	26081011406
Kent County	26081012606
Kent County	26081012607
Kent County	26081012701
Kent County	26081012901
Kent County	26081013300
Kent County	26081013400
Kent County	26081013500
Kent County	26081013600
Kent County	26081013802
Kent County	26081014000
Kent County	26081014100
Kent County	26081014200
Kent County	26081014300
Kent County	26081014701

County Name	Census tract 2010 ID
Lake County	26085960100
Lake County	26085961100
Lake County	26085961200
Lake County	26085961300
Lapeer County	26087331000
Lapeer County	26087336500
Lapeer County	26087337500
Lapeer County	26087339500
Lenawee County	26091061301
Lenawee County	26091061302
Lenawee County	26091061400
Lenawee County	26091061600
Lenawee County	26091061800
Lenawee County	26091061900
Livingston County	26093722300
Livingston County	26093725100
Livingston County	26093742202
Mackinac County	26097950200
Mackinac County	26097950300
Mackinac County	26097950400
Mackinac County	26097950500
Macomb County	26099206700
Macomb County	26099222101
Macomb County	26099228100
Macomb County	26099230500
Macomb County	26099231400
Macomb County	26099231500
Macomb County	26099231600
Macomb County	26099231900
Macomb County	26099232300
Macomb County	26099232400
Macomb County	26099240000
Macomb County	26099241000
Macomb County	26099241200
Macomb County	26099241600
Macomb County	26099241700
Macomb County	26099245000
Macomb County	26099245100

County Name	Census tract 2010 ID
Macomb County	26099245200
Macomb County	26099245400
Macomb County	26099247100
Macomb County	26099247601
Macomb County	26099255300
Macomb County	26099255800
Macomb County	26099255900
Macomb County	26099256100
Macomb County	26099256500
Macomb County	26099256600
Macomb County	26099256700
Macomb County	26099256800
Macomb County	26099258200
Macomb County	26099258400
Macomb County	26099258600
Macomb County	26099258700
Macomb County	26099258800
Macomb County	26099258900
Macomb County	26099260100
Macomb County	26099260600
Macomb County	26099260800
Macomb County	26099262100
Macomb County	26099262300
Macomb County	26099262400
Macomb County	26099262500
Macomb County	26099262800
Macomb County	26099262900
Macomb County	26099263200
Macomb County	26099263400
Macomb County	26099263500
Macomb County	26099263600
Macomb County	26099263700
Macomb County	26099263800
Macomb County	26099263900
Macomb County	26099264000
Macomb County	26099264200
Macomb County	26099268100
Macomb County	26099268300

County Name	Census tract 2010 ID
Macomb County	26099268400
Macomb County	26099982200
Macomb County	26099982300
Manistee County	26101000100
Manistee County	26101000500
Manistee County	26101000600
Marquette County	26103000500
Marquette County	26103001900
Marquette County	26103002400
Mason County	26105950100
Mason County	26105950400
Mason County	26105950500
Mason County	26105950700
Mecosta County	26107960100
Mecosta County	26107960200
Mecosta County	26107960400
Mecosta County	26107960500
Mecosta County	26107960800
Mecosta County	26107960900
Mecosta County	26107961000
Menominee County	26109960100
Menominee County	26109960200
Menominee County	26109960300
Menominee County	26109960700
Midland County	26111290200
Midland County	26111290600
Midland County	26111291500
Midland County	26111291700
Missaukee County	26113960100
Missaukee County	26113960200
Missaukee County	26113960300
Missaukee County	26113960400
Monroe County	26115831200
Monroe County	26115831400
Monroe County	26115831800
Monroe County	26115831900
Monroe County	26115832100
Monroe County	26115832200

County Name	Census tract 2010 ID
Montcalm County	26117970200
Montcalm County	26117970300
Montcalm County	26117970400
Montcalm County	26117970800
Montcalm County	26117970900
Montcalm County	26117971000
Montmorency County	26119910100
Montmorency County	26119910200
Montmorency County	26119910300
Montmorency County	26119910400
Montmorency County	26119910500
Muskegon County	26121000300
Muskegon County	26121000401
Muskegon County	26121000402
Muskegon County	26121000500
Muskegon County	26121000601
Muskegon County	26121000800
Muskegon County	26121001200
Muskegon County	26121001300
Muskegon County	26121001402
Muskegon County	26121001902
Muskegon County	26121002000
Muskegon County	26121002100
Muskegon County	26121002601
Muskegon County	26121003100
Muskegon County	26121003200
Muskegon County	26121003300
Muskegon County	26121004200
Muskegon County	26121004300
Newaygo County	26123970100
Newaygo County	26123970300
Newaygo County	26123970500
Newaygo County	26123970700
Newaygo County	26123970800
Newaygo County	26123970900
Oakland County	26125135000
Oakland County	26125140900
Oakland County	26125141000

County Name	Census tract 2010 ID
Oakland County	26125141100
Oakland County	26125141200
Oakland County	26125141300
Oakland County	26125141400
Oakland County	26125141500
Oakland County	26125141600
Oakland County	26125141700
Oakland County	26125142000
Oakland County	26125142100
Oakland County	26125142200
Oakland County	26125142300
Oakland County	26125142400
Oakland County	26125142600
Oakland County	26125142700
Oakland County	26125144701
Oakland County	26125160300
Oakland County	26125160400
Oakland County	26125161400
Oakland County	26125162400
Oakland County	26125171300
Oakland County	26125171500
Oakland County	26125171600
Oakland County	26125172400
Oakland County	26125172500
Oakland County	26125175100
Oakland County	26125175200
Oakland County	26125175300
Oakland County	26125181000
Oakland County	26125181300
Oakland County	26125181600
Oakland County	26125198100
Oceana County	26127010300
Oceana County	26127010400
Oceana County	26127010500
Oceana County	26127010600
Ogemaw County	26129950100
Ogemaw County	26129950300
Ogemaw County	26129950400

County Name	Census tract 2010 ID
Ogemaw County	26129950500
Ogemaw County	26129950600
Ogemaw County	26129950900
Ontonagon County	26131970100
Ontonagon County	26131970200
Osceola County	26133970100
Osceola County	26133970200
Osceola County	26133970300
Osceola County	26133970400
Osceola County	26133970500
Oscoda County	26135970201
Oscoda County	26135970300
Oscoda County	26135970400
Oscoda County	26135970500
Presque Isle County	26141950200
Presque Isle County	26141950300
Presque Isle County	26141950400
Roscommon County	26143970100
Roscommon County	26143970200
Roscommon County	26143970300
Roscommon County	26143970500
Roscommon County	26143971000
Roscommon County	26143971100
Roscommon County	26143971200
Saginaw County	26145000100
Saginaw County	26145000200
Saginaw County	26145000400
Saginaw County	26145000600
Saginaw County	26145000700
Saginaw County	26145000800
Saginaw County	26145000900
Saginaw County	26145001000
Saginaw County	26145001100
Saginaw County	26145001200
Saginaw County	26145001300
Saginaw County	26145001400
Saginaw County	26145001500
Saginaw County	26145001600

County Name	Census tract 2010 ID
Saginaw County	26145001700
Saginaw County	26145001800
Saginaw County	26145001900
Saginaw County	26145002000
Saginaw County	26145002100
Saginaw County	26145010401
Saginaw County	26145010700
Saginaw County	26145011000
Saginaw County	26145011100
Saginaw County	26145011500
Saginaw County	26145011600
Saginaw County	26145011800
Saginaw County	26145012500
Saginaw County	26145012600
Sanilac County	26151970200
Sanilac County	26151970300
Sanilac County	26151970400
Sanilac County	26151970500
Sanilac County	26151970700
Sanilac County	26151970900
Sanilac County	26151971000
Sanilac County	26151971100
Sanilac County	26151971200
Schoolcraft County	26153000300
Shiawassee County	26155030500
Shiawassee County	26155030600
Shiawassee County	26155030700
Shiawassee County	26155030800
St. Clair County	26147620000
St. Clair County	26147621000
St. Clair County	26147622000
St. Clair County	26147623000
St. Clair County	26147624000
St. Clair County	26147625000
St. Clair County	26147626000
St. Clair County	26147628000
St. Clair County	26147629000
St. Clair County	26147634100

County Name	Census tract 2010 ID
St. Clair County	26147636000
St. Clair County	26147657100
St. Joseph County	26149040200
St. Joseph County	26149040400
St. Joseph County	26149040500
St. Joseph County	26149040600
St. Joseph County	26149040700
St. Joseph County	26149040800
St. Joseph County	26149041000
St. Joseph County	26149041200
Tuscola County	26157000600
Tuscola County	26157000700
Tuscola County	26157000900
Tuscola County	26157001000
Tuscola County	26157001100
Van Buren County	26159010200
Van Buren County	26159010400
Van Buren County	26159010500
Van Buren County	26159010600
Van Buren County	26159011300
Van Buren County	26159011400
Van Buren County	26159012000
Washtenaw County	26161400200
Washtenaw County	26161404200
Washtenaw County	26161407400
Washtenaw County	26161410100
Washtenaw County	26161410600
Washtenaw County	26161410700
Washtenaw County	26161410800
Washtenaw County	26161411900
Washtenaw County	26161412000
Washtenaw County	26161412100
Washtenaw County	26161412300
Washtenaw County	26161422900
Wayne County	26163500100
Wayne County	26163500200
Wayne County	26163500300
Wayne County	26163500400

County Name	Census tract 2010 ID
Wayne County	26163500500
Wayne County	26163500600
Wayne County	26163500700
Wayne County	26163500800
Wayne County	26163500900
Wayne County	26163501000
Wayne County	26163501100
Wayne County	26163501200
Wayne County	26163501300
Wayne County	26163501400
Wayne County	26163501500
Wayne County	26163501600
Wayne County	26163501700
Wayne County	26163501900
Wayne County	26163502000
Wayne County	26163503100
Wayne County	26163503200
Wayne County	26163503300
Wayne County	26163503400
Wayne County	26163503500
Wayne County	26163503600
Wayne County	26163503900
Wayne County	26163504000
Wayne County	26163504100
Wayne County	26163504200
Wayne County	26163504300
Wayne County	26163504400
Wayne County	26163504700
Wayne County	26163504800
Wayne County	26163504900
Wayne County	26163505000
Wayne County	26163505100
Wayne County	26163505200
Wayne County	26163505400
Wayne County	26163505500
Wayne County	26163506100
Wayne County	26163506200
Wayne County	26163506300

County Name	Census tract 2010 ID
Wayne County	26163506400
Wayne County	26163506500
Wayne County	26163506600
Wayne County	26163506700
Wayne County	26163506800
Wayne County	26163506900
Wayne County	26163507000
Wayne County	26163507100
Wayne County	26163507200
Wayne County	26163507300
Wayne County	26163507400
Wayne County	26163507500
Wayne County	26163507800
Wayne County	26163507900
Wayne County	26163508000
Wayne County	26163508100
Wayne County	26163510400
Wayne County	26163510500
Wayne County	26163510600
Wayne County	26163510700
Wayne County	26163511000
Wayne County	26163511200
Wayne County	26163511300
Wayne County	26163511400
Wayne County	26163511900
Wayne County	26163512100
Wayne County	26163512200
Wayne County	26163512300
Wayne County	26163512400
Wayne County	26163512600
Wayne County	26163512900
Wayne County	26163513200
Wayne County	26163513600
Wayne County	26163513700
Wayne County	26163513900
Wayne County	26163514100
Wayne County	26163514200
Wayne County	26163514300

County Name	Census tract 2010 ID
Wayne County	26163514500
Wayne County	26163515200
Wayne County	26163515300
Wayne County	26163515600
Wayne County	26163515900
Wayne County	26163516000
Wayne County	26163516100
Wayne County	26163516200
Wayne County	26163516300
Wayne County	26163516400
Wayne County	26163516600
Wayne County	26163516700
Wayne County	26163516800
Wayne County	26163516900
Wayne County	26163517300
Wayne County	26163517500
Wayne County	26163518400
Wayne County	26163518500
Wayne County	26163518600
Wayne County	26163518800
Wayne County	26163518900
Wayne County	26163520400
Wayne County	26163521100
Wayne County	26163521300
Wayne County	26163521400
Wayne County	26163521500
Wayne County	26163521800
Wayne County	26163521900
Wayne County	26163522000
Wayne County	26163522100
Wayne County	26163522200
Wayne County	26163522300
Wayne County	26163522400
Wayne County	26163522500
Wayne County	26163523100
Wayne County	26163523200
Wayne County	26163523300
Wayne County	26163523400

County Name	Census tract 2010 ID
Wayne County	26163523800
Wayne County	26163524000
Wayne County	26163524100
Wayne County	26163524200
Wayne County	26163524300
Wayne County	26163524500
Wayne County	26163524700
Wayne County	26163524800
Wayne County	26163524900
Wayne County	26163525000
Wayne County	26163525400
Wayne County	26163525500
Wayne County	26163525600
Wayne County	26163525700
Wayne County	26163525800
Wayne County	26163526000
Wayne County	26163526100
Wayne County	26163526200
Wayne County	26163526300
Wayne County	26163526400
Wayne County	26163526500
Wayne County	26163527200
Wayne County	26163527300
Wayne County	26163530100
Wayne County	26163530200
Wayne County	26163530300
Wayne County	26163530400
Wayne County	26163530500
Wayne County	26163530800
Wayne County	26163530900
Wayne County	26163531100
Wayne County	26163531300
Wayne County	26163531400
Wayne County	26163531500
Wayne County	26163531600
Wayne County	26163531700
Wayne County	26163531800
Wayne County	26163531900

County Name	Census tract 2010 ID
Wayne County	26163532200
Wayne County	26163532400
Wayne County	26163532600
Wayne County	26163532700
Wayne County	26163533000
Wayne County	26163533100
Wayne County	26163533200
Wayne County	26163533300
Wayne County	26163533400
Wayne County	26163533500
Wayne County	26163533600
Wayne County	26163533700
Wayne County	26163533900
Wayne County	26163534100
Wayne County	26163534200
Wayne County	26163534300
Wayne County	26163534400
Wayne County	26163534500
Wayne County	26163534600
Wayne County	26163534700
Wayne County	26163535000
Wayne County	26163535100
Wayne County	26163535200
Wayne County	26163535300
Wayne County	26163535400
Wayne County	26163535500
Wayne County	26163535600
Wayne County	26163535700
Wayne County	26163536100
Wayne County	26163536200
Wayne County	26163536300
Wayne County	26163536400
Wayne County	26163536500
Wayne County	26163536600
Wayne County	26163536700
Wayne County	26163536800
Wayne County	26163536900
Wayne County	26163537000

County Name	Census tract 2010 ID
Wayne County	26163537100
Wayne County	26163537200
Wayne County	26163537300
Wayne County	26163537500
Wayne County	26163537600
Wayne County	26163537700
Wayne County	26163537800
Wayne County	26163538300
Wayne County	26163538500
Wayne County	26163538600
Wayne County	26163538700
Wayne County	26163538900
Wayne County	26163539000
Wayne County	26163539100
Wayne County	26163539200
Wayne County	26163539400
Wayne County	26163539500
Wayne County	26163539600
Wayne County	26163539700
Wayne County	26163540100
Wayne County	26163540200
Wayne County	26163540300
Wayne County	26163540400
Wayne County	26163540500
Wayne County	26163540600
Wayne County	26163540700
Wayne County	26163540800
Wayne County	26163540900
Wayne County	26163541000
Wayne County	26163541100
Wayne County	26163541200
Wayne County	26163541300
Wayne County	26163541400
Wayne County	26163541500
Wayne County	26163541700
Wayne County	26163541800
Wayne County	26163542100
Wayne County	26163542200

County Name	Census tract 2010 ID
Wayne County	26163542300
Wayne County	26163542400
Wayne County	26163542500
Wayne County	26163542600
Wayne County	26163542700
Wayne County	26163542800
Wayne County	26163543200
Wayne County	26163543400
Wayne County	26163543500
Wayne County	26163543600
Wayne County	26163543700
Wayne County	26163543800
Wayne County	26163543900
Wayne County	26163544000
Wayne County	26163544100
Wayne County	26163544200
Wayne County	26163544300
Wayne County	26163545100
Wayne County	26163545200
Wayne County	26163545300
Wayne County	26163545400
Wayne County	26163545500
Wayne County	26163545600
Wayne County	26163545700
Wayne County	26163545800
Wayne County	26163545900
Wayne County	26163546000
Wayne County	26163546100
Wayne County	26163546200
Wayne County	26163546300
Wayne County	26163546400
Wayne County	26163546500
Wayne County	26163546600
Wayne County	26163546700
Wayne County	26163546800
Wayne County	26163546900
Wayne County	26163551400
Wayne County	26163551600

County Name	Census tract 2010 ID
Wayne County	26163552000
Wayne County	26163552100
Wayne County	26163552200
Wayne County	26163552300
Wayne County	26163552400
Wayne County	26163552800
Wayne County	26163553000
Wayne County	26163553100
Wayne County	26163553200
Wayne County	26163553300
Wayne County	26163553400
Wayne County	26163553600
Wayne County	26163553800
Wayne County	26163554100
Wayne County	26163554200
Wayne County	26163554500
Wayne County	26163555100
Wayne County	26163555300
Wayne County	26163555400
Wayne County	26163564900
Wayne County	26163565300
Wayne County	26163566400
Wayne County	26163566500
Wayne County	26163566700
Wayne County	26163566900
Wayne County	26163567000
Wayne County	26163567100
Wayne County	26163568000
Wayne County	26163568300
Wayne County	26163568500
Wayne County	26163568800
Wayne County	26163568900
Wayne County	26163569200
Wayne County	26163570100
Wayne County	26163570200
Wayne County	26163570400
Wayne County	26163570500
Wayne County	26163570600

County Name	Census tract 2010 ID
Wayne County	26163570800
Wayne County	26163570900
Wayne County	26163571000
Wayne County	26163571600
Wayne County	26163571800
Wayne County	26163572000
Wayne County	26163572100
Wayne County	26163572500
Wayne County	26163572600
Wayne County	26163572800
Wayne County	26163573300
Wayne County	26163573400
Wayne County	26163573500
Wayne County	26163573600
Wayne County	26163573701
Wayne County	26163573702
Wayne County	26163573800
Wayne County	26163573900
Wayne County	26163574000
Wayne County	26163574100
Wayne County	26163574300
Wayne County	26163577000
Wayne County	26163577100
Wayne County	26163577200
Wayne County	26163577300
Wayne County	26163577400
Wayne County	26163577500
Wayne County	26163577600
Wayne County	26163577900
Wayne County	26163578000
Wayne County	26163578500
Wayne County	26163578600
Wayne County	26163579100
Wayne County	26163579200
Wayne County	26163579300
Wayne County	26163579500
Wayne County	26163579600
Wayne County	26163579700

County Name	Census tract 2010 ID
Wayne County	26163579800
Wayne County	26163580700
Wayne County	26163582000
Wayne County	26163583100
Wayne County	26163583200
Wayne County	26163583900
Wayne County	26163584300
Wayne County	26163584400
Wayne County	26163584500
Wayne County	26163584600
Wayne County	26163584800

County Name	Census tract 2010 ID
Wayne County	26163585500
Wayne County	26163585900
Wayne County	26163586200
Wayne County	26163588100
Wayne County	26163591501
Wexford County	26165380100
Wexford County	26165380200
Wexford County	26165380300
Wexford County	26165380600
Wexford County	26165380700
Wexford County	26165380800

Census Tracts and Block Groups Identified as disadvantaged by CEJST or EPA's EJScreen

CEJST Census Tracts	
County Name	Census Tract 2010 ID
Alcona County	26001970100
Alcona County	26001970400
Alcona County	26001970500
Alcona County	26001970600
Alger County	26003000100
Allegan County	26005031000
Allegan County	26005031200
Alpena County	26007000100
Alpena County	26007000400
Alpena County	26007000500
Alpena County	26007000700
Alpena County	26007000800
Antrim County	26009960200
Antrim County	26009960700
Arenac County	26011970100
Arenac County	26011970200
Arenac County	26011970300
Arenac County	26011970400
Arenac County	26011970500
Baraga County	26013000100
Baraga County	26013000200
Bay County	26017280300
Bay County	26017280400
Bay County	26017280600
Bay County	26017280700
Bay County	26017280900
Bay County	26017281300
Bay County	26017285202
Bay County	26017285800
Bay County	26017286500
Bay County	26017286600
Berrien County	26021000300
Berrien County	26021000400
Berrien County	26021000500
Berrien County	26021000600
Berrien County	26021002000
Berrien County	26021002100
Berrien County	26021002200
Berrien County	26021002300
Berrien County	26021002500
Berrien County	26021020200
Berrien County	26021020500
Berrien County	26021020600
Berrien County	26021020700
Berrien County	26021020900
Branch County	26023950200
Branch County	26023950800
Branch County	26023951200
Branch County	26023951400

Block Group at or above the 90th percentile for EJScreen Supplemental Indexes compared to nation or state (inclusive of CEJST CT)	
County	Census Block Group 2010 ID
Allegan	260050310011
Allegan	260050310012
Allegan	260050312002
Allegan	260050312004
Allegan	260050319002
Allegan	260050324011
Allegan	260050307031
Allegan	260050312003
Allegan	260050320003
Alpena	260070007002
Alpena	260070004001
Alpena	260070004002
Alpena	260070004003
Alpena	260070004004
Alpena	260070005001
Antrim	260099607021
Antrim	260099607022
Arenac	260119705004
Bay	260172803001
Bay	260172804003
Bay	260172804004
Bay	260172805001
Bay	260172806001
Bay	260172806003
Bay	260172807001
Bay	260172807002
Bay	260172807003
Bay	260172809001
Bay	260172809002
Bay	260172809003
Bay	260172810001
Bay	260172810003
Bay	260172810006
Bay	260172853003
Bay	260172858004
Bay	260172865001
Bay	260172866001
Bay	260172866003
Bay	260172866004
Bay	260172813002
Bay	260172852015
Bay	260172859001
Bay	260172866002
Bay	260172866005
Bay	260172866006
Berrien	260210003001
Berrien	260210003002
Berrien	260210004001
Berrien	260210004002

Geographic area within tribal lands as included in EJScreen	
County	Census Block Group 2010 ID
Alger	260030001002
Alger	260030002002
Allegan	260050305021
Allegan	260050305012
Allegan	260050306002
Allegan	260050306003
Antrim	260099605012
Antrim	260099605022
Arenac	260119705001
Arenac	260119705005
Baraga	260130001001
Baraga	260130001002
Baraga	260130001003
Baraga	260130001004
Baraga	260130002001
Baraga	260130002002
Benzie	260190005004
Berrien	260210113012
Calhoun	260250028001
Calhoun	260250020003
Cass	260270021004
Cass	260270019022
Cass	260270020003
Cass	260270022012
Charlevoix	260290004002
Charlevoix	260290004003
Charlevoix	260290005001
Charlevoix	260290009002
Chippewa	260339702001
Chippewa	260339701001
Chippewa	260339706012
Chippewa	260339706021
Chippewa	260339706022
Chippewa	260339709001
Chippewa	260339709002
Delta	260419701001
Delta	260419707001
Delta	260419711002
Emmet	260479701002
Emmet	260479702011
Emmet	260479703011
Emmet	260479704001
Emmet	260479704002
Emmet	260479705002
Emmet	260479706003
Emmet	260479708003
Emmet	260479708004
Emmet	260479708005
Emmet	260479702012

Branch County	26023951600
Calhoun County	26025000200
Calhoun County	26025000300
Calhoun County	26025000500
Calhoun County	26025000600
Calhoun County	26025000700
Calhoun County	26025000800
Calhoun County	26025001000
Calhoun County	26025001100
Calhoun County	26025001300
Calhoun County	26025001400
Calhoun County	26025002100
Calhoun County	26025002600
Calhoun County	26025002800
Calhoun County	26025003100
Calhoun County	26025003300
Calhoun County	26025003600
Calhoun County	26025004000
Calhoun County	26025004100
Cass County	26027002000
Cass County	26027002100
Charlevoix County	26029000200
Charlevoix County	26029001500
Cheboygan County	26031960200
Cheboygan County	26031960300
Cheboygan County	26031960700
Cheboygan County	26031960800
Chippewa County	26033970200
Chippewa County	26033970400
Chippewa County	26033970500
Chippewa County	26033970700
Chippewa County	26033970900
Chippewa County	26033980200
Chippewa County	26033980300
Clare County	26035000100
Clare County	26035000200
Clare County	26035000300
Clare County	26035000400
Clare County	26035000500
Clare County	26035000600
Clare County	26035000700
Clare County	26035000800
Clare County	26035000900
Clare County	26035001000
Clare County	26035001300
Clinton County	26037010203
Clinton County	26037010702
Clinton County	26037010901
Crawford County	26039960300
Crawford County	26039960400
Crawford County	26039960500
Delta County	26041970100
Delta County	26041970800
Delta County	26041971000
Dickinson County	26043950500
Eaton County	26045020202
Eaton County	26045020901
Emmet County	26047970100
Emmet County	26047970800
Genesee County	26049000100

Berrien	260210005001
Berrien	260210006001
Berrien	260210006002
Berrien	260210007001
Berrien	260210020001
Berrien	260210020002
Berrien	260210021001
Berrien	260210021002
Berrien	260210021003
Berrien	260210022001
Berrien	260210022002
Berrien	260210022003
Berrien	260210023001
Berrien	260210023002
Berrien	260210103002
Berrien	260210103003
Berrien	260210202002
Berrien	260210202004
Berrien	260210202005
Berrien	260210205001
Berrien	260210205002
Berrien	260210205003
Berrien	260210207001
Berrien	260210209001
Berrien	260210209002
Berrien	260210210001
Berrien	260210020003
Berrien	260210025002
Berrien	260210102022
Berrien	260210103001
Berrien	260210103004
Berrien	260210104002
Berrien	260210116002
Berrien	260210207002
Berrien	260210207003
Berrien	260210210002
Branch	260239502001
Branch	260239502003
Branch	260239512002
Branch	260239513012
Branch	260239514002
Branch	260239514003
Branch	260239515001
Branch	260239515002
Branch	260239516002
Branch	260239516003
Calhoun	260250002001
Calhoun	260250002002
Calhoun	260250003001
Calhoun	260250003002
Calhoun	260250005001
Calhoun	260250005002
Calhoun	260250006001
Calhoun	260250006002
Calhoun	260250007001
Calhoun	260250007002
Calhoun	260250008002
Calhoun	260250010001
Calhoun	260250010004
Calhoun	260250011001

Emmet	260479703012
Emmet	260479704004
Emmet	260479708001
Emmet	260479708002
Gogebic	260539508002
Grand Traverse	260555501021
Grand Traverse	260555501023
Grand Traverse	260555507012
Iosco	260690009001
Isabella	260739402002
Isabella	260739402003
Isabella	260739404002
Isabella	260739401001
Isabella	260739401002
Isabella	260739401003
Isabella	260739402001
Isabella	260739402004
Isabella	260739403001
Isabella	260739403002
Isabella	260739403003
Isabella	260739403004
Isabella	260739404001
Isabella	260739404003
Isabella	260739405001
Isabella	260739405002
Isabella	260739406001
Isabella	260739406002
Isabella	260739406003
Isabella	260730007012
Leelanau	260899702011
Luce	260959602002
Mackinac	260979502003
Mackinac	260979504002
Manistee	261010004002
Manistee	261010004003
Manistee	261010004001
Manistee	261010005001
Manistee	261010005002
Manistee	261010005003
Manistee	261010006002
Marquette	261030012003
Marquette	261030028021
Mason	261059506004
Menominee	261099601001
Menominee	261099602003
Menominee	261099602001
Ontonagon	261319701001
Schoolcraft	261530001001
Schoolcraft	261530001002
Van Buren	261590114001
Van Buren	261590120014

Genesee County	26049000200
Genesee County	26049000300
Genesee County	26049000400
Genesee County	26049000500
Genesee County	26049000600
Genesee County	26049000700
Genesee County	26049000800
Genesee County	26049000900
Genesee County	26049001000
Genesee County	26049001100
Genesee County	26049001200
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Genesee County	26049003100
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Genesee County	26049003300
Genesee County	26049003400
Genesee County	26049003500
Genesee County	26049003600
Genesee County	26049003700
Genesee County	26049003800
Genesee County	26049004000
Genesee County	26049010110
Genesee County	26049010113
Genesee County	26049010115
Genesee County	26049010304
Genesee County	26049010305
Genesee County	26049010501
Genesee County	26049010502
Genesee County	26049010504
Genesee County	26049010811
Genesee County	26049010812
Genesee County	26049010910
Genesee County	26049010911
Genesee County	26049010912
Genesee County	26049011301
Genesee County	26049011302
Genesee County	26049011401
Genesee County	26049011508
Genesee County	26049011901
Genesee County	26049012003
Genesee County	26049012006
Genesee County	26049012007
Genesee County	26049012008
Genesee County	26049012100
Genesee County	26049012201
Genesee County	26049012202

Calhoun	260250011002
Calhoun	260250011003
Calhoun	260250013001
Calhoun	260250013004
Calhoun	260250013005
Calhoun	260250014001
Calhoun	260250014003
Calhoun	260250014005
Calhoun	260250018021
Calhoun	260250021001
Calhoun	260250022003
Calhoun	260250026001
Calhoun	260250033001
Calhoun	260250033002
Calhoun	260250033003
Calhoun	260250034001
Calhoun	260250035003
Calhoun	260250036001
Calhoun	260250036002
Calhoun	260250036003
Calhoun	260250040001
Calhoun	260250040002
Calhoun	260250040003
Calhoun	260250041001
Calhoun	260250041002
Calhoun	260250007003
Calhoun	260250008001
Calhoun	260250010002
Calhoun	260250023003
Calhoun	260250032002
Calhoun	260250035001
Calhoun	260250035002
Cass	260270011001
Cass	260270020004
Cass	260270019011
Cass	260270021004
Chippewa	260339702001
Chippewa	260339702002
Chippewa	260339703002
Chippewa	260339704001
Chippewa	260339709002
Chippewa	260339702003
Chippewa	260339703004
Chippewa	260339705002
Chippewa	260339705003
Chippewa	260339709001
Clare	260350006002
Clare	260350006003
Clare	260350006004
Clinton	260370101041
Clinton	260370102031
Clinton	260370102032
Clinton	260370112001
Clinton	260370112002
Clinton	260370112003
Clinton	260370108012
Delta	260419708003
Delta	260419709001
Delta	260419710001
Delta	260419708001

Genesee County	26049012310
Genesee County	26049012311
Genesee County	26049012501
Genesee County	26049012503
Genesee County	26049012601
Genesee County	26049012602
Genesee County	26049013500
Genesee County	26049013600
Gladwin County	26051000100
Gladwin County	26051000200
Gladwin County	26051000300
Gladwin County	26051000400
Gladwin County	26051000500
Gladwin County	26051000600
Gladwin County	26051000700
Gladwin County	26051000800
Gogebic County	26053950100
Gogebic County	26053950200
Gogebic County	26053950500
Gogebic County	26053950600
Gratiot County	26057000300
Gratiot County	26057000400
Gratiot County	26057000700
Gratiot County	26057001000
Hillsdale County	26059050200
Hillsdale County	26059050400
Hillsdale County	26059050600
Hillsdale County	26059050700
Hillsdale County	26059050800
Hillsdale County	26059051100
Hillsdale County	26059051200
Houghton County	26061000100
Houghton County	26061000200
Houghton County	26061000300
Houghton County	26061000400
Houghton County	26061000700
Huron County	26063950300
Huron County	26063950600
Huron County	26063951000
Huron County	26063951200
Ingham County	26065000100
Ingham County	26065000600
Ingham County	26065000700
Ingham County	26065000800
Ingham County	26065001200
Ingham County	26065001703
Ingham County	26065002000
Ingham County	26065002101
Ingham County	26065002600
Ingham County	26065002800
Ingham County	26065003200
Ingham County	26065003301
Ingham County	26065003500
Ingham County	26065003602
Ingham County	26065003700
Ingham County	26065004302
Ingham County	26065005100
Ingham County	26065005201
Ingham County	26065005304
Ingham County	26065005402

Delta	260419708002
Eaton	260450209013
Eaton	260450201033
Eaton	260450202023
Eaton	260450209022
Eaton	260450202011
Genesee	260490002002
Genesee	260490003001
Genesee	260490008001
Genesee	260490008002
Genesee	260490013002
Genesee	260490015001
Genesee	260490024003
Genesee	260490114011
Genesee	260490123102
Genesee	260490123112
Genesee	260490135002
Genesee	260490001001
Genesee	260490001003
Genesee	260490002001
Genesee	260490002003
Genesee	260490003002
Genesee	260490003003
Genesee	260490004001
Genesee	260490004002
Genesee	260490005001
Genesee	260490005002
Genesee	260490005003
Genesee	260490006001
Genesee	260490006002
Genesee	260490007001
Genesee	260490007002
Genesee	260490007003
Genesee	260490007004
Genesee	260490009001
Genesee	260490009002
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Data Source: EPA EJScreen
Data Layer: EPA IRA Disadvantaged Communities
Data Link: https://gaftp.epa.gov/EPA_IRA_Public/
Relevant Guidance: CPRG Implementation Grant Q&A, A4 on page 48

The data in this spreadsheet was separated from the national dataset by selecting the IDs that begain with "26" (Michigan's State ID code), and filtering again by overall disadvantaged status (i.e. "Yes" or "No"). Only census tracts (CTs) and census block groups (CBGs) whose overall disadvantaged status was "Yes" are included here.

EJScreen
Supplemental Index Block Group at or above the 90th percentile for national or state percentile:
Filtered: National_Supp_Index, YES; State_Supp_Index, YES; removed duplicates;
EJScreen Tribal Lands Geographic area within tribal lands as included in EJScreen
Filtered: American_Indian_Reservations, YES; OffReservation_Trust_Lands, YES; removed duplicates;
Data Source: Climate and Economic Justice Screening Tool
Data Layer: CEJST Communities list data
Data Link: https://screeningtool.geoplatform.gov/en/downloads#5.89/45.89/-85.814
Relevant Guidance: To determine CEJST Census Tracts, Filtered for "Identified as Disadvantaged"

CITY OF ANN ARBOR, MICHIGAN

301 E. Huron St., P.O. Box 8647 • Ann Arbor, Michigan 48107-8647

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March 11, 2024

Phil Roos
Director, Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: City of Ann Arbor's Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, The City of Ann Arbor, Michigan, affirm our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Through CPRG grant program period, we anticipate collaborating with the State to deliver increased access to solar projects, financial benefits, grid resilience, and cost-effective energy solutions, including investments in workforce development and entrepreneurship initiatives in low-income and disadvantaged communities as well as on local brownfields throughout our community. We anticipate that the city will submit proposals for the Brownfield Renewable Energy Pilot Program and support our residents with pursuing other opportunities afforded through the State's CPRG programs. To help ensure these goals are met, our commitment extends to offering support in outreach, engagement, and education about CPRG opportunities for our residents and businesses.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

In Ann Arbor, we have even bolder climate commitments – achieving a just transition to community-wide carbon neutrality by the year 2030. And we know that collaboration with our peers at the State is essential to achieving our audacious, aggressive, and scientifically necessary local goals. That is why we are committed to working with the State of Michigan, other local governments, nonprofits, and others in the State to ensure everyone has access to the clean energy revolution.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

CITY OF ANN ARBOR, MICHIGAN

301 E. Huron St., P.O. Box 8647 • Ann Arbor, Michigan 48107-8647

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Sincerely,

Melissa Stults

Missy Stults
Sustainability and Innovations Director, City of Ann Arbor, Michigan
mstults@a2gov.org; 734-794-6430 x 43725

Consumers Energy
Count on Us®

March 18, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Consumers Energy Support for the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Director Roos,

On behalf of Consumers Energy, I am pleased to express our support for the State of Michigan and the Department of Environment, Great Lakes, and Energy's (EGLE) response to EPA-R-OAR-CPRGI-23-07. As one of Michigan's largest energy providers, we are committed to reducing greenhouse gas (GHG) emissions and ambitiously siting renewable energy in Michigan aided by the Climate Pollution Reduction Grant (CPRG) program.

Consumers Energy is proud to be leading our State's clean energy transformation. Our Clean Energy Plan, approved by state regulators in 2022, put us on a path to dramatically reduce GHG emissions achieving net-zero emissions by 2040 and deploy nearly 8,000 MWs of solar energy. In 2023, Michigan policymakers set new, aggressive renewable energy and clean energy targets that position our State to be a national leader in transitioning our energy supply. Achieving these goals will require a significant expansion of renewable development in the coming years and the CPRG program will provide essential resources to help meet these goals.

EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards, and the Brownfield Renewable Energy Pilot Program will provide valuable tools to help unlock significant GHG emissions reductions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

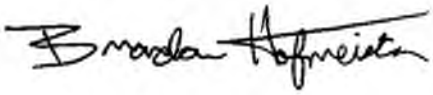
We commit to collaborating with the State, local communities, and other stakeholders, through CPRG grant program period, to ensure resources are deployed in a manner that will help speed the deployment of renewable energy and storage resources. Given the State's commitment to implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application.

Consumers Energy
1 Energy Plaza
Jackson, Michigan 49201

Consumers Energy
Count on Us®

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,



Brandon Hofmeister
Senior Vice President
Sustainability and External Affairs

DTE

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: DTE's support the State of Michigan's Climate Pollution Reduction Grant Program (CPRG) Implementation Grant General Competition Application, (Award# EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, DTE, affirm our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting state-wide.

Through CPRG grant program, DTE anticipates collaborating with the State to leverage our expertise in renewable energy projects. DTE has an extensive renewable energy portfolio that currently includes 20 wind parks and 33 solar farms all located in Michigan. DTE's long-term wind and solar energy plans will generate an additional 15,400 MW of renewable energy by 2042, which will be over 60% of our energy mix, and is equivalent to powering approximately 4 million homes.

DTE Energy (DTE) is a Detroit-based diversified energy company involved in the development and management of energy-related businesses and services nationwide. Its operating units include an electric company serving 2.3 million customers in Southeast Michigan. As an environmental leader, DTE utility operations will reduce carbon dioxide and methane emissions by more than 90% by 20240 to produce cleaner energy while keeping it safe, reliable, and affordable. DTE aspires to achieve net zero carbon and greenhouse gas emissions by 2050.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Signed: Joe Musallam

Date: 3/19/2024

Print Name: Joe Musallam
Company and Title: VP - Renewable Sales & Project Development

Evergreen Collaborative

March 21, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Clean Energy, Environmental and Health Organizations Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

Evergreen Collaborative affirms our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant (CPRG) program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Through the CPRG grant program period, we anticipate collaborating with the State to conduct outreach on the Renewable Ready through our communication channels and campaign efforts. To help ensure these goals are met, our commitment extends to offering support in helping launch navigator programs and events with community organizations in the state to increase awareness about clean energy grant and rebate opportunities for Michigan residents.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

Our organization is part of the statewide coalition Michigan Energy, Michigan Jobs, which is focused on transitioning our state to 100% clean energy, leading to more good-paying jobs that don't require a college degree, cleaner air for the communities most impacted by pollution, and more affordable electricity for Michigan families. Last year, we released a report with partners that analyzed the economic, health and

climate benefits of renewable and clean energy projects in the state. Our research emphasizes how important federal funding from programs like the Climate Pollution Reduction Grants are to making electricity more affordable, reducing pollution, creating good-paying jobs in the state, and reaching Michigan's climate goals.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,
Courtney Bourgoin
Policy Manager, Midwest
Evergreen Collaborative

GVMC

GRAND VALLEY METROPOLITAN COUNCIL

ADA TOWNSHIP • ALGOMA TOWNSHIP • ALLENDALE TOWNSHIP • ALPINE TOWNSHIP • BELDING • BYRON TOWNSHIP • CALEDONIA • CALEDONIA TOWNSHIP • CANNON TOWNSHIP •CASCADE TOWNSHIP
CEDAR SPRINGS • COOPERSVILLE • COURTLAND TOWNSHIP • EAST GRAND RAPIDS • GAINES TOWNSHIP • GEORGETOWN TOWNSHIP • GRAND RAPIDS • GRAND RAPIDS TOWNSHIP • GRANDVILLE
GREENVILLE • HASTINGS • HUDSONVILLE • IONIA • JAMESTOWN TOWNSHIP • KENT COUNTY • KENTWOOD • LOWELL • LOWELL TOWNSHIP • MIDDLEVILLE • NELSON TOWNSHIP
OTTAWA COUNTY • PLAINFIELD TOWNSHIP • ROCKFORD • SAND LAKE • SPARTA • TALLMADGE TOWNSHIP • WALKER • WAYLAND • WYOMING

March 12, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: GVMC Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

Grand Valley Metro Council affirms our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

GVMC has been collaborating with EGLE through the CPRG Planning Grants process, and the partnership has greatly benefited the Grand Rapids-Kentwood MSA. We look forward to collaborating with EGLE throughout the CPRG Implementation Grant process.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

John Weiss
Executive Director

678 FRONT AVENUE NW • SUITE 200 • GRAND RAPIDS, MICHIGAN 49504 • PH. 616 77-METRO (776-3876) • FAX 774-9292 • WWW.GVMC.ORG

Electrical Workers Local 58

1358 ABBOTT ST DETROIT MI 48226-2411
PHONE: 313.963.2130 FAX: 313.963.9348
MAILING ADDRESS: PO BOX 32756, DETROIT MI 48232-0756
www.ibew58.org

March 18, 2024

Phil Roos, Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: International Brotherhood of Electrical Workers (IBEW) Local 58 Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, International Brotherhood of Electrical Workers (IBEW) Local 58, affirm our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant (CPRG) program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Through the CPRG grant program, we anticipate collaborating with EGLE on workforce programming including pre-apprenticeship, work-based learning, career pathway mapping and increased connectivity to established electrical apprenticeships need to implement the proposed Renewables Ready Communities Program. We understand that EGLE and the State of Michigan will continue to partner with labor organizations including unions and workers' rights groups to develop best practices that lift up Michigan Workers, families and businesses.

To help ensure these goals are met, our commitment extends to offering support for community education and outreach, workforce development and outreach, career pathway mapping and industry expertise.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Paul VanOss
IBEW Local 58 Business Manager/Financial Secretary

kl/opeiu42afl-cio

Bay Mills Indian Community
Brimley, Michigan 49715
Grand Traverse Band of Ottawa & Chippewa Indians
Suttons Bay, Michigan 49682
Hannahville Indian Community
Wilson, Michigan 49896
Saginaw Chippewa Indian Tribe
Mt. Pleasant, Michigan 48858
Little Traverse Bay Bands of Odawa Indians
Harbor Springs, Michigan 49740
Nottawaseppi Huron Band of The Potawatomi
Fulton, Michigan 49502

INTER-TRIBAL COUNCIL OF MICHIGAN, INC.

ITC is an equal opportunity provider, and employer.

Keweenaw Bay Indian Community
Baraga, Michigan 49908
Lac Vieux Desert Band of Lake Superior Chippewa
Watersmeet, Michigan 49969
Sault Ste. Marie Tribe of Chippewa Indians
Sault Ste. Marie, Michigan 49783
Pokagon Band of Potawatomi Indians
Dowagiac, Michigan 49047
Match-E-Be-Nash-She-Wish (Gun Lake Tribe)
Dorr, Michigan 49323
Little River Band of Ottawa Indians
Manistee, Michigan 49660

2956 Ashmun Street, Suite A, Sault Ste. Marie, Michigan 49783
Phone: (906) 632-6896 Main Fax: 906-632-1810

March 14, 2024

Clayton Kincheloe
Executive Director
Inter-Tribal Council of Michigan, Inc
2956 Ashmun Street
Sault Ste. Marie, Michigan 49783

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: The Inter-Tribal Council of Michigan, Inc. Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, the Inter-Tribal Council of Michigan (ITCMI) affirm our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

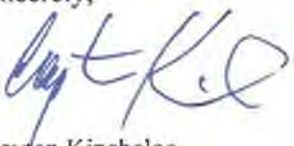
Through the CPRG grant program period, we anticipate collaborating with the State to encourage the twelve federally recognized Tribes ITCMI represents to apply for projects through the proposed Renewables Ready Communities Award program and Brownfield Renewable Energy Pilot Program grant opportunities. We anticipate seeking technical assistance and support from EGLE's Renewable Energy Academy. To help ensure these goals are met, our commitment extends in offering support by continuing our collaboration with EGLE in CPRG activities, and ensuring our member Tribes are aware of project and grant opportunities available to them.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

Our organization's mission is: 1) to act as a forum for member Tribes; 2) to advocate for member Tribes in the development of programs and policies which will improve the economy, education, and quality of life for Michigan's Native Americans; and 3) to provide technical assistance to member Tribes, assisting in the development of Tribal regulations, ordinances, and policies applicable to health and human services. We have been involved in renewable energy projects with Michigan Tribes. Currently ITCMI is working with six of the twelve federally recognized Tribes and assisting them to create their Priority Climate Action Plans and Comprehensive Climate Action Plans. We also are planning to help Tribal members gain access to renewable energy and energy saving technologies for their homes and community buildings across the State of Michigan.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,



Clayton Kinchcloe
Executive Director

A FORTIS COMPANY

March 15, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: ITC Supports the State of Michigan's CPRG Implementation Grant General Competition Application (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We offer this letter in affirmation of our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions reductions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

As ITC maintains its commitment to a greener future, we anticipate collaborating with the State and other stakeholders to interconnect new generation to, and continue to enhance the reliability of, the transmission grid. Further, strong community support is vital to the build out of energy resources; this grant would enable Michigan to provide needed support to communities around the state that partner in the effort to achieve a more sustainable future. ITC has a long track record of providing reliable energy transmission for Michigan's residents. ITC is also among the national leaders in reliable electricity service. Additionally, ITC has interconnected several hundred generators on its systems to date with plans to connect still more through the grant program period and beyond. This grant coupled with the extensive skills of the State of Michigan and ITC offers a powerful combination that will yield benefits to Michigan for years to come.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal grant program.

Sincerely,

DocuSigned by:
Simon Whitelocke
958509F69EED48D...

Simon S. Whitelocke
President, ITC Michigan

MECA
MICHIGAN ELECTRIC COOPERATIVE ASSOCIATION

March 14, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Michigan Electric Cooperative Association - Support for the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos:

The Michigan Electric Cooperative Association (MECA) is pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions reductions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Through the CPRG grant program period, MECA anticipates encouraging its member cooperatives to collaborate with the State to explore potential opportunities as a part of the Renewable Ready Communities Award program, the Brownfield Renewable Energy Pilot Program, and the Renewable Energy Academy

Given the State's proven success in implementing equitable climate policies, MECA is confident in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

MECA is the statewide trade association for Michigan's 10 electric cooperatives. MECA's members provide electricity, natural gas and high-speed fiber telecommunications services to rural residents in more than half of Michigan's 83 counties. Our members are the state's leaders in renewable and carbon free electricity with more than half of the electric energy delivered today to electric cooperative member-customers coming from renewable and/or carbon free resources.

MECA is enthusiastic about collaborating with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Craig A. Borr
President/CEO

201 Townsend St., Suite 900, Lansing, MI 48933 • 517-351-6322 • www.meca.coop

MEGA
Michigan Electric & Gas Association

7201 W. Saginaw Highway, Suite 305, Lansing, MI 48917
517.484.7730
www.megautilities.org

March 15, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Michigan Electric and Gas Association Support for the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, the Michigan Electric and Gas Association, affirm our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program.

Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Dan Dundas
President

Michigan Energy Innovation Business Council
115 W. Allegan, Suite 710
Lansing, MI 48933
517.224.2070
mieibc@mieibc.org

Thursday, March 21st, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Michigan EIBC Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, Michigan Energy Innovation Business Council (Michigan EIBC) affirm our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Through CPRG grant program period, we anticipate collaborating with the State to encourage members to submit proposals for the Renewable Ready Communities Award program, Brownfield Renewable Energy Pilot Program, provide support to the Renewable Energy Academy. To help ensure these goals are met, our commitment extends to offering support by continuing our collaboration with EGLE's State Energy Office and Office of Climate and Energy to support state and federally funded program development.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

Michigan EIBC's mission is to grow Michigan's advanced energy economy by fostering opportunities for innovation and business growth and offering a unified voice in creating a business-friendly environment for the advanced energy industry in Michigan. Michigan EIBC represents a wide range of energy industries, including, but not limited to, the renewable energy and energy storage sectors.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Laura S. Sherman

Dr. Laura S. Sherman
President, Michigan EIBC
laura@mieibc.org

Michael Aaron
President

Alex Zurek
Secretary-Treasurer

Geno Alessandrini, Sr.
Business Manager

Michigan Laborers' District Council

LiUNA!

Feel the Power

Board Members:
Nick DeFauw
Joel Archibald
Dan Minton
Brent Pilarski

1118 Centennial Way, Suite 100, Lansing, MI 48917-9280 • Phone (517) 321-2349 • Fax (517) 321-3266
www.mi-laborers.org

March 21, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Michigan Laborers' District Council Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, the Michigan Laborers District Council, affirm our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant (CPRG) program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Through the CPRG grant program period, we anticipate collaborating with EGLE on workforce development and apprenticeship programs needed to implement the proposed Renewables Ready Communities Program / understand EGLE and the State of Michigan will continue to partner with labor organizations including unions and workers' rights groups to develop best practices that lift up Michigan workers, families, and businesses. To help ensure these goals are met, our commitment extends to offering support in ensuring that Michigan has the necessary skilled tradespeople needed to meet the ever growing infrastructure and energy needs of our state.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

Meeting the goals laid out in the recently passed climate and siting legislation will be an ambitious lift, but with continued collaboration between all levels of government and the unionized construction industry, we are confident these goals can be achieved. If Michigan were to receive these grants, it would supercharge the number of our members working on renewable energy and battery storage projects.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Geno Alessandrini
Business Manager
Michigan Laborers District Council

Michigan Manufacturers Association

March 15, 2024

Phil Roos, Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Michigan Manufacturers Association Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, the Michigan Manufacturers Association, affirm our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Through the CPRG grant program period, we anticipate collaborating with the State to encourage members to submit a proposal for the Brownfield Renewable Energy Pilot Program. To help ensure these goals are met, our commitment extends to offering our members support and education on the opportunities made available by the state and federal government to utilize brownfield property for renewable energy projects.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives. Our organization's mission is to serve as a unifying champion of an industry that is in constant evolution and growth. In the 21st century, our legacy champions of industry and our next generation of innovators are collaborating to drive Michigan into a future that will continue to shape our collective fortunes, our state's economy, the communities we serve, our individual businesses, and our families' livelihoods. As such, we look forward to our continued partnership with EGLE in utilizing remediated brownfield sites for all economic development opportunities, including shaping our energy landscape.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Caroline Liethen
Director of Environmental and Regulatory Policy
Michigan Manufacturers Association

03-17-2024

Phil Roos
Director, Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: The Michigan Regional Council of Carpenters and Millwrights Supports the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, the Michigan Regional Council of Carpenters and Millwrights (MRCC), affirm our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant (CPRG) program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Through the CPRG grant program period, we anticipate collaborating with EGLE on workforce development and apprenticeship programs needed to supply the trained workforce that will be needed to implement the proposed Renewables Ready Communities Program. We also understand EGLE and the State of Michigan will continue to partner with labor organizations including unions and workers' rights groups to develop best practices that lift up Michigan workers, families, and businesses. To help ensure these goals are met, we are committed to recruiting workers from diverse backgrounds and providing the tuition-free training required for them to participate in and benefit from the market opportunities for carpenters, millwrights and solar installers created by the grant program.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

Our organization's mission is to recruit, train and support the men and women who work as carpenters, millwrights, floor layers, pile drivers, and solar installers across Michigan. We have been involved in developing the renewable energy sector by supporting projects, providing a skilled workforce for solar projects already in progress, and developing up-to-date training curriculum to ensure projects are carried out safely and efficiently.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Mike Barnwell
President
Michigan Regional Council of Carpenters and Millwrights

SEMCOG | SOUTHEAST MICHIGAN COUNCIL OF GOVERNMENTS

March 18, 2024

Phil Roos, Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Re: SEMCOG Support for the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

SEMCOG, the Southeast Michigan Council of Governments, confirms our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. SEMCOG's regional Priority Climate Action Plan supports the statewide objectives to reduce greenhouse gas (GHG) emissions and site renewable energy through the Climate Pollution Reduction Grant program. With EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in equity and environmental justice focus areas, and improve capacity and technical expertise in renewable energy siting statewide.

SEMCOG is a regional planning partnership that supports coordinated local planning among over 180 units of local government across seven counties in Southeast Michigan. Through the CPRG grant program period, we anticipate collaborating with the State to encourage Southeast Michigan's local governments to submit proposals for the Renewable Ready Communities Award program and Brownfield Renewable Energy Pilot Program. To help ensure these goals are met, our commitment extends to offering support with outreach and communications, providing interested applicants with relevant resources, aligning opportunities for regional coordination.

Given the State's demonstrated commitment to implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives. We are enthusiastic about partnering with the State of Michigan to connect the nationwide goals of the U.S. Environmental Protection Agency with the regional needs of Southeast Michigan through this pivotal program.

Sincerely,

Amy O'Leary
Executive Director

1001 Woodward Ave., Suite 1400 • Detroit, Michigan 48226 • (313) 961-4266 • Fax (313) 961-4869 • semcog.org

MICHIGAN CHAMBER of Commerce

600 S Walnut St
Lansing, MI 48933

March 15, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Michigan Chamber of Commerce Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, the Michigan Chamber of Commerce affirm our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant emissions benefits in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Through CPRG grant program period, we anticipate collaborating with the State to help address barriers to renewable energy deployment and provide the necessary technical assistance in support of communities hosting this critical energy infrastructure. To help ensure these goals are met, our commitment extends to offering support and collaboration to successfully carry put the goals of this program.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

The Michigan Chamber of Commerce represents over 5,000 company and organization members in every corner of the state, employing well over one million Michiganders. We believe in pursuing policies and initiatives that protect and improve the environment to make Michigan a better place to work, live and play.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Michael P. Alaimo
Director, Environmental and Energy Affairs
Michigan Chamber of Commerce
(517) 281-1336—mobile

Citizens' Climate Lobby
Michigan

March 21, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Clean Energy, Environmental and Health Organizations Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, Citizens' Climate Lobby, MI, affirm our support of the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

To help ensure these goals are met, our support extends to assisting with public education and outreach regarding these programs, as our organization does extensive grassroots outreach and education through tabling, presentations, and meetings with community members and leaders. In addition, our organization is part of the statewide coalition, Michigan Energy, Michigan Jobs, which is focused on transitioning our state to 100% clean energy, leading to more well-paying jobs that don't require a college degree, cleaner air for the communities most impacted by pollution, and more affordable electricity for Michigan families.

We are enthusiastic about working with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this program.

Sincerely,

Linda Racine, Co-Chair
Citizens' Climate Lobby Michigan

Michigan Municipal Electric Association

March 15, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Michigan Municipal Electric Association's (MMEA) Support of the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

The Michigan Municipal Electric Association (MMEA) affirms our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

MMEA represents all 40 of the state's municipally owned electric utilities. This puts us in a unique position to ensure new renewable resources are interconnected to our electric systems. Unlike other cities that may need to work with an outside utility and likely meet their own additional requirements, our Members own the utilities within their communities. This makes it easier and faster to build renewable resources. The State's CPRG is an added incentive for our communities to figure out the necessary zoning and permitting to fast-track project development. Additionally, anything promoting the development of clean energy projects through the local process, at the community level, is preferred and likely more advantageous than an approval process at the State level.

MMEA Member communities eagerly anticipate the opportunity to collaborate with the State during the CPRG grant program period. MMEA is ready to work with the State to facilitate application opportunities to its Members, especially those related to the Renewable Ready Communities Award program and Brownfield Renewable Energy Pilot Program. Given our Members run their electric utilities, we are in an ideal position to help the State meet their goals.

Given Michigan's proven success in implementing equitable climate policies, we have confidence in their ability to achieve the objectives laid out in the application. This initiative will stimulate increased investment in local renewable energy projects critical to achieving the State's climate objectives. We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Katie Abraham

Executive Director

GRAHAM
SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

March 18, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Center for EmPowering Communities Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, the Center for EmPowering Communities at the Graham Sustainability Institute, affirm our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. Under EGLE's proposed Renewables Ready Communities Program, the Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will unlock significant GHG emissions in the near term, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Through the CPRG grant program period, we anticipate collaborating with the State to develop technical assistance and trainings for EGLE's Renewable Energy Academy, especially as it relates to zoning, permitting, and siting renewable energy in majority low-income and disadvantaged communities. The Center for EmPowering Communities is particularly interested in developing a training for local and state government staff to learn more about community benefits agreements negotiation. We anticipate other technical assistance materials related to use of tax revenue funds from the development of projects and financial rewards projection of hosting renewable energy projects. We will also assist in developing materials for renewable energy projects on brownfields. This collaboration is an extension of ongoing work between EGLE and the Center for EmPowering Communities, which includes developing and delivering technical assistance on these topics to communities across the urban-rural spectrum.

Given the State's proven success in implementing equitable climate policies, we have full confidence in their ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

GRAHAM
SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

Our organization's mission is to integrate leading-edge social science research with community engagement and policymaking to foster decarbonization solutions that advance community goals. We have been honored to partner with EGLE for the last five years to conceptualize, develop, and implement the Renewable Energy Academy, which has provided a touchpoint to each of Michigan's 1,350 local zoning jurisdictions responsible for planning and policymaking for renewable energy.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Sarah Mills

Sarah Mills, PhD
Director, Center for EmPowering Communities
Associate Professor of Practice, Urban and Regional Planning Program

Bree L. Bennett

EDUCATION:
Quality of Life Leadership Academy: 2015-2016
Certificate in Watershed Management, MSU: May 2006
M.S. Sustainable Mgmt; University of Wisconsin; 2025
B.S. Environmental Science; Spanish Minor;
Dickinson College, Carlisle, PA; May 2003

RECENT CONTRIBUTIONS:

- Division Advocate on EGLE Climate and Energy Taskforce 2019-Present
  developed an inventory of Climate mitigation opportunities; currently on RRD subcommittee
- Division Advocate on Michigan Interagency Environmental Justice (EJ) Workgroup 2019-2021
  advocate for EJ policies and procedures to lift EJ communities in Michigan
- Group Lead-Interstate Technical and Regulatory Council, 2019-2021
  Sustainable and Resilient Remediation Team-develop an interactive framework to integrate sustainability and resilience into the project lifecycle
- Regional Point of Contact for Technical Assistance and Program Support Team 2012-2022

EXPERIENCE:

Assistant District Supervisor-EGLE-RRD *(October 2021-Present)*

- Supervise, manage, and coordinate staff to implement state-funded cleanup and private party compliance programs.
- Prioritize work, assign tasks, set priorities, identify funding, ensure quality, devise problem resolution strategies.
- Develop department and division policy on technical and administrative issues.
- Represent division mission and values in meetings with the regulated community, citizens, and other public agencies.
- Review staff recommendations on technical and statutory issues, provide feedback, and make programmatic decisions.
- Provide management assistance to the District Supervisor, to maintain operations in the district office.
- Track progress with targets, budgets, and time schedules for achieving project goals at state funded cleanup projects.

Senior Environmental Quality Analyst-EGLE-RRD *(July 2012-October 2021)*

- Drive cross-functional team to achieve risk management goals through compliance and enforcement at clean-up sites.
- Provide direct counseling on enforcement issues and environmental rules and regulations to district staff.
- Act as a resource for staff, present, participate, and provide feedback at statewide compliance meetings.
- Coordinate activities between department staff and/or attorney general staff, potentially liable parties
- Outreach to local Health Departments to educate about the Clean-up programs, including conference presentation.
- Policy and tool development, identify programmatic overlap, improve communication, and update legislation.
- Designed and hosted workshop between State Departments to improve communication and collaboration.

Environmental Quality Analyst (EQA)-EGLE-RRD *(March 2005-July 2012)*

- Project Management of State funded sites manage contracts, budgets and schedules.
- Coordinate consulting and trade contractors, oversee actions at sites of environmental contamination.
- Private Party oversight of response activities, evaluate liable party compliance.
- Respond to Pollution Emergency Alert System calls: Assist municipal officials and emergency responders.
- Coordinate and participate in public meetings regarding sites of environmental contamination.

EQA-EGLE-Environmental Science and Services Division *(Jan 2004-March 2005)*

- Project Manager for the State Revolving Funds Programs under Parts 53, 54 of 1994 PA 451.
- Manage and coordinate activities of clean water and drinking water multi-million dollar loan agreements.
- Research and write environmental assessments; Work with local citizens to address project concerns.
- Work with community officials, consulting firms, and other sectors of government to improve water quality.
- Make decisions regarding program eligibility issues, project plan completeness, and negotiate project schedules

Environmental Database Manager- Pfizer *(Sept-Dec 2003)*

- Created and organized chemical database related to the integration of two companies into Pfizer.

Research Assistant - University of Chicago, Kellogg Biological Station *(May-Sept 2003)*

- Conducted field and lab experiments on the virus Nucleopolyhedrosis and its impacts on the invasive gypsy moth.

bennettb@michigan.gov ♦ (269) 762-2419 ♦ 7067 Hawthorn Valley Kalamazoo, MI 49009

MICHIGAN BROWNFIELD REDEVELOPMENT PROGRAM

WHO'S ON THE TEAM: EGLE BROWNFIELD REDEVELOPMENT SECTION STAFF

Carrie Geyer, Manager, Brownfield Assessment and Redevelopment Section

GeyerC1@Michigan.gov / 517-230-9981

Carrie has been a member of the Department of Environment, Great Lakes, and Energy's (EGLE) Brownfield Redevelopment team for over 15 years, first as a Brownfield Coordinator and now as the Program Manager. She has worked with consultants, developers, and local units of government throughout the state to support local projects with brownfield incentives. Carrie is also active in the national brownfield arena, where she serves as chair of the ASTSWMO Brownfield Focus Group.

Carrie has experience in both the public and private sectors, having worked in local government and consulting prior to joining EGLE. She is a licensed professional engineer and obtained a B.S. in Civil/Environmental Engineering from Michigan Technological University.

Ryan Londrigan, Supervisor, Brownfield Redevelopment Unit

LondriganR@Michigan.gov / 989-891-6072

Ryan is the Supervisor of the EGLE Brownfield Redevelopment Unit, assisting brownfield coordinators and communities find solutions to redevelopment challenges. Prior to joining EGLE in 2016, Ryan spent several years in environmental consulting, serving clients throughout Michigan and managing diverse environmental programs. He utilizes this background to provide perspective for communities and developers with technical, financial, and regulatory redevelopment matters. Ryan holds a B.S. in Natural Resource Ecology from the University of Michigan.

Aaron Assmann, Brownfield Coordinator, Cadillac District

AssmannA@Michigan.gov / 616-430-5275

Aaron joined the Brownfield Redevelopment Unit in 2022 as the Brownfield Coordinator for the Cadillac District which includes Benzie, Grand Traverse, Kalkaska, Lake, Leelanau, Manistee, Mason, Missaukee, Osceola, and Wexford counties. He joined EGLE's Remediation and Redevelopment Division in 2017 as a Field Operations Analyst. Before working with EGLE, Aaron lived in Anchorage, Alaska working in oil and gas with BP Alaska as an environmental compliance advisor. While earning his education, he also worked as a seasonal Biological Technician at Sleeping Bear Dunes National Lakeshore. Aaron holds a B.S. in Biology from Alma College and a M.S. in Conservation Biology from the University of Michigan.

Michelle Bakun, Brownfield Coordinator, Macomb, Oakland, and St. Clair Counties

BakunM@Michigan.gov / 586-233-3408

Michelle has been a Brownfield Coordinator in the EGLE Brownfield Redevelopment Program since 2013. She works in the Warren District office where she covers Macomb, Oakland, and St. Clair counties. She has over twenty-six years of experience with EGLE, including brownfield grants and loans, compliance and enforcement, and project management. Michelle received her B.S. from Michigan State University in Environmental Science and Public Policy.

Jeanine Barks, Administrative Assistant

BarksJ@Michigan.gov / 517-275-1302

Jeanine joined the brownfield staff in 2017 as our secretary/administrative assistant. In addition to keeping the paperwork flowing, Jeanine also helps process FOIA records for the Brownfield Section. She previously worked with automotive warranties at both the dealership and corporate levels. Jeanine received a B.A. in English from Madonna University.

Holden Branch, Brownfield Coordinator, Jackson District

BranchH1@Michigan.gov / 517-331-0993

Holden joined the Brownfield Redevelopment Unit in 2017 as the Brownfield Coordinator for the Jackson District which includes Hillsdale, Jackson, Lenawee, Monroe, and Washtenaw counties. Before coming to work at EGLE, he spent two years working at the Lenawee County Conservation District. While there, he worked closely with Producers to help mitigate environmental risks in order to environmentally verify their farms. Prior to working at the Lenawee County Conservation District, he worked at the Huron Pines Office in Gaylord on invasive species and habitat restoration. Holden earned two B.A. degrees in Biology and Environmental Science, with a minor in Geology from Adrian College.

Heath Bobick, Brownfield Coordinator, Bay City District

BobickH@Michigan.gov / 517-281-6457

Heath joined the Brownfield Redevelopment Unit in 2021 as the Brownfield Coordinator for the Bay City District which includes Arenac, Bay, Clare, Gladwin, Huron, Iosco, Isabella, Midland, Ogemaw, Saginaw, Sanilac, and Tuscola counties. Prior to joining EGLE, he worked in environmental consulting for over 8 years. During that time, he gained experience with Phase I and Phase II environmental assessments, UST removals, soil remediation, air quality monitoring, asbestos and hazardous material inspections, bidding specification activities, HASP development, and environmental and regulatory reporting. He has worked on numerous Brownfield Redevelopment Grant projects. Heath earned his B.S. in Technology and Project Management specializing in Environmental Science from Eastern Michigan University.

Dan Gough, Brownfield Coordinator, Wayne County

GoughD1@Michigan.gov / 517-281-8253

Dan coordinates brownfield projects in Wayne County and is the Act 381 Point of Contact for the Department. He joined the EGLE brownfield staff in 2016, but has been involved in brownfield redevelopment since 2012, serving as the former chair of the Ingham County Brownfield Redevelopment Authority's Board of Directors and as a member of the Ingham County Economic Development Corporation Board of Directors. Dan was a research assistant at Public Policy Associates, Inc., a Lansing-based policy research, development, and consulting firm, where he worked on a number of projects and provided support to the Michigan Sense of Place Council.

Dan holds a B.S. in Interdisciplinary Studies in Social Science – Environmental Policy and a M.S. in Agricultural, Food, and Resource Economics from Michigan State University.

Abbie Hanson, Brownfield Coordinator, Marquette District

HansonA2@Michigan.gov / 906-202-1285

Abbie joined the Brownfield Team in 2021 as the Marquette District Brownfield Coordinator covering the entire Upper Peninsula which includes Alger, Baraga, Chippewa, Delta, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Luce, Mackinac, Marquette, Menominee, Ontonagon, and Schoolcraft counties. Prior to working for EGLE, Abbie was employed as a biologist for an environmental non-profit in Marquette, where she worked closely with local, state, and federal partners to coordinate and implement on-the-ground watershed protection and habitat improvement projects throughout the Upper Peninsula and the Upper Great Lakes region. Abbie holds both a B.S. and M.S. in Biology from Northern Michigan University.

Jeff Hukill, Brownfield Administrator

HukillJ@Michigan.gov / 517-242-9276

Jeff joined the Brownfield team in 2005 and primarily works on administrative and policy related issues associated with Brownfield Grants and Loans. He was a Brownfield Coordinator for 10 years, working with communities in the Upper Peninsula, Lansing, and Jackson Districts. Jeff serves on the EGLE Outgoing Grants Team and the Remediation and Redevelopment Division Incremental Sampling Technical and Program Support Team. Jeff also administers the EGLE Brownfield Grant and Loan web pages and databases. He holds a B.S. in Resource Development from Michigan State University.

Doug Koop, Brownfield Coordinator, Kalamazoo District

KoopD@Michigan.gov / 517-245-5054

Doug joined the Brownfield team in 2022. Prior to joining EGLE, Doug held a variety of positions that served the community and protected, preserved, or enhanced land resources. Doug worked for more than two decades for non-profit land conservancies in Michigan, most of that in a leadership role. He has also served in several government positions including environmental education, local government planning, wetlands, and real estate management. He obtained a B.S, in Biology from Calvin College and a M.A. in Geography from the University of Georgia.

Julie Lowe, Brownfield Coordinator, Gaylord District

LoweJ2@Michigan.gov / 989-619-0617

Julie joined the Brownfield Redevelopment Unit in 2016 and currently serves as the Brownfield Coordinator for the Gaylord District which includes Alcona, Alpena, Antrim, Charlevoix, Cheboygan, Crawford, Emmet, Montmorency, Oscoda, Otsego, Presque Isle, and Roscommon counties. She came to our staff from the EGLE Water Resources Division where she worked assisting permit holders with the MiWaters Database, technical compliance questions and conducted inspections at facilities through the Gaylord District.

Julie is a native Michigander, but spent seven years working in Olympia, Washington at the Washington State Department of Ecology as an environmental planner. Prior to moving to Washington, Julie worked in environmental consulting. She holds a B.S. in Environmental Conservation from Northern Michigan University and a M.S. in Urban and Regional Planning from Eastern Michigan University.

Jolene Melchiori, Michigan State Housing Development Authority (MSHDA) Redevelopment Specialist

MelchioriJ@Michigan.gov / 906-250-2076

Jolene is the statewide MSHDA Redevelopment Specialist for the Division and serves as the EGLE point of contact for MSHDA redevelopment projects. Prior to this position, she worked as a Marquette District Project Manager for the Part 213 and Part 201 programs and spent 9 years as an environmental consultant. She has a diverse background in due diligence, site investigation and characterization, project management, and collaboration with private, public, and regulatory stakeholders. Jolene is a licensed professional geologist and holds a B.S. in Geoscience from Winona State University and an M.S. in Geology from the University of Wisconsin-Milwaukee.

Janet Michaluk, Central Staff Coordinator

MichalukJ@Michigan.gov / 517-643-0314

Janet joined the EGLE Brownfield Team in 2016. Coming to EGLE from consulting, she has over 15 years of experience as a redevelopment and environmental professional including brownfield redevelopment, economic incentives, environmental due diligence, remediation, and quality assurance/quality control. Janet has helped successfully redevelop dozens of brownfield properties throughout Michigan, using innovative approaches to protect human health and the environment and creatively layering incentives to bring public and private funding sources together. Janet received her B.S. in Natural Resources and Economics from Michigan State University, and a M.B.A. from Keller Graduate School.

Jeff Proctor, Redevelopment and Remediation Division (RRD) Communications Representative

ProctorJ2@Michigan.gov / 517-648-0709

Jeff is the Communications Representative for the Remediation and Redevelopment Division. Before joining EGLE in January of 2023 he spent 25 years in Lansing television news, serving as Assignment Manager and Producer at WLAJ, as a Producer at WSYM, and as Executive Producer at WILX where he was part of a team that was twice named the Michigan Association of Broadcasters Station of the Year. He graduated from St. Joseph's College with a B.S. in Mass Communications.

Andrea Ryswick, Brownfield Coordinator, Grand Rapids District

RyswickA@Michigan.gov / 616-401-0827

Andrea is the Brownfield Coordinator for the Grand Rapids District Office which includes Barry, Ionia, Kent, Mecosta, Montcalm, Muskegon, Newaygo, Oceana, and Ottawa counties. Prior to joining EGLE in 2018, she worked in the private sector as an environmental consultant. While working as a consultant, she served a variety of clients across Michigan and occasionally other nearby mid-west states. Clients consisted of individuals, corporations, lending institutions, and government agencies. Andrea also has over 15 years of customer service experience which includes both her consulting work and work at financial institutions. She received a B.S. in Geology from Grand Valley State University.

Ron Smedley, Redevelopment Coordinator, United States Environmental Protection Agency (U.S. EPA) Programs

SmedleyR@Michigan.gov / 517-242-9048

Ron has worked in EGLE's Remediation and Redevelopment programs since 2000. His previous EGLE experience included the former Storage Tank Division and tracking and reporting for the State Funded Cleanup program. Since 2001, Ron has been involved in supporting U.S. EPA funding for brownfield projects throughout the state and has managed numerous brownfield grant and loan projects.

Ron manages the U.S. EPA 128(a) brownfield grant, including the brownfield site assessment program, and provides oversight on petroleum sites for U.S. EPA grantees. He has presented on brownfield redevelopment topics at both statewide and national conferences and is a Certified Economic Developer. Ron has a B.A. in Political Science from Michigan State University and a M.S. in Environmental Policy and Planning from Indiana University-Bloomington.

Sarah Venner, Brownfield Coordinator, Lansing District

VennerS@Michigan.gov / 586-295-2225

Sarah joined the Brownfield Team in October of 2021 as the Brownfield Coordinator for the Lansing District, which includes Clinton, Eaton, Genesee, Gratiot, Ingham, Lapeer, Livingston, and Shiawassee counties. Sarah has worked for EGLE for over 6 years, first in the Water Resource Division and most recently as a Remediation and Redevelopment Division Part 201/213 project manager in the Warren District Office. She has experience conducting environmental cleanups and has worked closely with consultants, local, state, and federal partners on numerous projects. Sarah received her B.S. from the University of Michigan-Dearborn.

J. Cory Connolly

Experienced clean energy and climate leader dedicated to advancing clean energy goals and climate action. Successful policy strategist and advocate, clean energy finance executive, political organizer, public speaker, and Michigan-based climate and energy policy expert with a track-record of building and managing successful projects, campaigns, and organizations. A community builder and convener with a unique combination of relationships with clean energy businesses, organized labor, finance professionals, philanthropy, policymakers, climate activists, environmental justice advocates, and political organizers.

CONTACT

Phone: 231.642.0102

Email:
cory.connolly@gmail.com

Address:
624 W. Alexandrine St.
Apt 303
Detroit, MI 48201

EDUCATION

International Relations
Bachelor of Arts
With honors
Michigan State Univ. James Madison College
2006 - 2010

Clean Energy Project Finance & Deployment
Certificate
Yale University
2019-2020

Public Narrative
Certificate
Harvard University
2022

LANGUAGE

Spanish
(intermediate/advanced)

PROFESSIONAL EXPERIENCE

Chief Climate Officer — January 2022 - Present
Office of Climate and Energy, State of Michigan, Lansing, Michigan

- Lead the Office of Climate and Energy, including development and implementation of Governor Whitmer's MI Healthy Climate Plan to reach carbon neutrality by 2050.
- Manage a team of 10 to deliver policy guidance, interface with stakeholders, and launch new initiatives to drive decarbonization.

Vice President — July 2018 - December 2021
Michigan Energy Innovation Business Council, Lansing, Michigan

- Developed and advocated for public policy solutions on behalf of approximately 140 companies in the clean energy industry in Michigan.
- Managed key partnerships and relationships with other nonprofits, policymakers, trade groups, philanthropy, and labor organizations.

Chief Operating Officer — 2015 - June 2018
Levin Energy Partners/Lean & Green Michigan, Detroit, Michigan

- Led a team that enabled $20 million in innovative financing for clean energy projects.
- Managed a key partnership with the International Brotherhood of Electrical Workers and the National Electrical Contractors Association.

Senior Research Associate — 2011 - 2014
Environmental Law Institute, Washington D.C.

- Co-created and organized the Mexico-U.S. Climate Law Network.
- Supported the Mexican government in the implementation of its 2012 Climate Change Law.

SELECT HONORS & VOLUNTEER ROLES

Notable Sustainability Leader, **Crain's Business Detroit**	2024
Fellow, **Change Collective, Civic Nation**	2023
Member, **Low-Income Energy Policy Board, State of Michigan**	2022-present
Member, **Governor Whitmer's Council on Future Mobility & Electrification**	2021
Liaison, **Governor Whitmer's Council on Climate Solutions**	2021
State Lead, **Clean Energy for Biden**	2020
40 Under 40, **Midwest Energy News**	2018
Founder & Director, **Michigan Clean Energy Leaders Project**	2017-2021
1 Hotels Fellow, **Natural Resources Defense Council**	2017
Detroit Fellow, **New Leaders Council**	2016
Clean Power Player, **Environmental Entrepreneurs**	2016
Climate Leader, **Young Climate Leaders Network**	2014
30 Under 30 for Law & Policy, **Forbes Magazine**	2012
Fellow '11/'12, **Roosevelt Institute**	2011
Carbon Offset Project Intern, **Fundación Biosfera**	2010
Climate Policy Intern, **US Department of State**	2009

Julia M. Field

Lansing, MI 48912
fieldj@michigan.gov

EXPERIENCE

Office of Climate & Energy — *Lansing, MI*
Deputy Climate & Energy Advisor — *November 2023—Present*
Michigan Department of Environment, Great Lakes, and Energy (EGLE)

- Develop programs and policies to execute Michigan's action plan for reducing greenhouse gas emissions and transitioning toward carbon neutrality throughout Michigan's economy

Michigan Climate & Health Adaptation Program (MICHAP) — *Lansing, MI*
Program Manager — *July 2021—November 2023*
Michigan Department of Health & Human Services (MDHHS)

- Directed long-term strategy and day-to-day operations for the program; this includes facilitating meetings for multiple teams, tracking progress and writing annual program reports, applying for federal grants
- Developed emergency response protocols for climate-driven disasters including extreme heat, cold, and floods
- Created climate and health adaptation planning webinars and workshops in (based on Planning Guide)
- Presented to stakeholders on climate health issues, lead health education material development

District of Columbia Department of Energy & Environment — *Washington, DC*
Energy Program Specialist — *April 2020– July 2021*
Building Performance & Enforcement Branch, Energy Administration

- Provided technical assistance to stakeholders regarding the DC benchmarking law and use of the ENERGY STAR Portfolio Manager web tool, drafted updates to benchmarking policies and regulations
- Developed an outreach strategy to educate buildings of upcoming requirement to benchmark energy usage

National Institute of Ecology and Climate Change — *Mexico City, Mexico*
Climate Mitigation and Environmental Justice Intern — *June– August 2019*

- Investigated policies and legislation related to urban electric vehicle adoption for private and public fleets
- Analyzed public gondola system to understand environmental justice and climate mitigation implications

Environmental Protection Agency — *Washington, DC*
Environmental Protection Specialist, GS-11 — *April 2016 – July 2018*
Community Involvement & Program Initiatives Branch
Office of Superfund Remediation & Technology Innovation

- Advised and supported regional staff as the National Program Manager for Superfund Community Advisory Groups
- Coordinated efforts with HUD to improve collaboration at Superfund sites with public housing on/nearby
- Deployed to Puerto Rico to conduct community outreach as a part of EPA's Hurricane Maria relief efforts

United States Peace Corps — *Monte Plata, Dominican Republic*
Community Health Specialist — *October 2013-October 2015*

- Trained 20 health promoters and 40 teen peer health educators in 4 communities on basic health practices

EDUCATION

Massachusetts Institute of Technology — Cambridge, MA
Masters in City Planning, Environmental Planning Certificate — May 2020

University of Michigan — Ann Arbor, MI
B.A. in Anthropology, Minor in Urban Studies, Phi Beta Kappa — May, 2013

SKILLS

Language: Spanish, professional working proficiency

Computing: QGIS, ArcGIS (including ArcGIS Online, StoryMaps), basic R/RStudio & STATA

LinkedIn: https://www.linkedin.com/in/julia-field-3b541545/

Sarah Hutchinson

shutch@umich.edu | C: (734)-709-7989

Education

Columbia University, New York
M.A. Climate & Society — **May 2022**

University of Michigan, Ann Arbor
M.S.E. Applied Climate — **Apr 2021**
B.S.E. Climate Science and Impacts Engineering — **Apr 2020**

Technical Experience

Michigan Office of Climate and Energy, Lansing, MI — **Apr 2022-Present**
Climate Data Science Officer

- Directed to implement the State's goal of carbon neutrality by 2050 as outlined in the MI Healthy Climate Plan, and track and report progress on the goals of the Plan to Gov. Gretchen Whitmer.
- Leading development on a suite of technical programs, including a statewide greenhouse gas inventory, a public-facing climate hub site, annual decarbonization progress reports, specialized work groups, and IRA and BIL-related federal funding opportunities.
- Facilitating internal and cross-department coordination and integration of climate-related initiatives, and programmatic design of the MI Healthy Climate Conference such as speakers, topics, and themes.
- Fostering new and continued academic partnerships with various midwestern Universities.

U.S. Environmental Protection Agency, Ann Arbor, MI — **Jun 2021-Apr 2022**
Student Trainee, GS-07 Level

- Improved energy consumption modeling of light-duty electric vehicles, and integrated the results into the newest version of the Motor Vehicle Emission Simulator (MOVES).
- Explored how to apply this process and methodology to passenger trucks and heavy-duty vehicles.
- Collaborated with the National Renewable Energy Laboratory (NREL) to update start-and-soak emissions from heavy-duty vehicles.

Great Lakes Integrated Sciences and Assessments, Ann Arbor, MI — **Apr 2020-Apr 2021**
Student Climatologist and Physical Scientist

- Pioneered research on freeze-thaw cycles (FTCs) in the Great Lakes Region, including performing data and multivariate statistical analysis to see how they have or may continue to change over time.
- Constructed a GLISA webpage dedicated to FTCs with these results to inform concerned stakeholders.
- Revised other stakeholder-facing documents, including RCP and scenario planning guides, station climatologies, and other webpages on various topics.

Leadership Experience

American Society of Adaptation Professionals, Ann Arbor, MI — **Jan 2020-Apr 2021**
Climate Adaptation Project Lead

- Spearheaded initiative to develop searchable database of climate change adaptation employment opportunities, and perform data analytics on included data.
- Developed multiple qualitative coding schemes with ASAP staff, coded employment data using Dedoose, and composed user guides describing how to code and classify information.
- Analyzed how to incorporate climate projections into demographic models to predict potential migration patterns from climate migration, and interviewed relevant stakeholders.
- Served as the point of contact for the NYSERDA Accelerator project, developed meeting materials and agendas, and coordinated program activities and improvement.

Undergraduate Engineering Student Advisory Board, Ann Arbor, MI — **Sept 2018-Apr 2020**
Board Member

- Worked with the Associate Dean of Undergraduate Education to improve student life, education, and campus well-being.
- Coordinated with various departments to boost course instruction integrity, implement new and enhance existing student recruitment techniques, and work to advance the University's policy of diversity, equity, and inclusion.
- Discuss and tackle complicated issues on campus such as mental health services, dormitory and building infrastructure, sustainability policies, and water and waste management.

Skills

Spoken Languages: Spanish (Basic)
Computing Languages/Software: C++, Matlab, NCL, C#, Python, Dedoose, ArcGIS, R, LaTeX
Organizations: Society of Hispanic Professional Engineers, Society of Women Engineers, American Meteorological Society, American Society of Adaptation Professionals

Zona Martin

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EDUCATION

Master of Science: Environment and Sustainability (2023) University of Michigan (Ann Arbor, MI)

- Concentration: **Environmental Policy & Planning (Planning Track)**

Bachelor of Arts: Government (2020) University of Texas at Austin (Austin, Texas)

PROFESSIONAL EXPERIENCE

Departmental Analyst: EGLE, Energy Services Unit (Lansing, MI - Remote) **(10/2023-Present)**

- Provides program support, grant administration, and project management to the Energy Services Unit. Assists in the development and refinement of community programs and resources to encourage local governments to proactively plan for utility-scale renewable energy. Engages community stakeholders to identify issues, barriers, and opportunities related to renewable energy planning and development. Develop and update educational materials, including best practices and deployment strategies for planning and zoning for renewable energy. Monitors grants, processes payments and amendment requests, and provides oversight and support to grantees to facilitate successful project implementation.
    - Designed and implemented a $30 million dollar state grant called the Renewables Ready Communities Award (RRCA) that awards Michigan municipalities that host and/or permit utility-scale renewable energy projects.
    - Designed and implemented a community engagement and technical assistance program called the Renewable Energy Academy focused on providing Michigan local governments with the tools and resources to plan and zone for utility-scale renewable energy in a new permitting landscape. Incorporates participatory planning concepts with educational materials to reaffirm local government's role in energy planning.
- Research, collect, consolidate, analyze, and maintain these program data necessary to meet program reporting and evaluation requirements and the goals of the State Energy Program (SEP). Prepares related program reports and materials for dissemination on the EGLE website, in publications, and at relevant events.
    - Led presentations about the developed programs and funding opportunities at webinars, conferences, and local government meetings.

Student Consultant: Michigan Department of Environment, Great Lakes, and Energy (EGLE) **(01/2022 – 04/2023)**

- Collaborated with a team of 5 student consultants to design a state-led program to help rural Michigan townships to proactively zone for utility-scale renewable energy.
- Partnered with two Michigan townships for 5–6 months to guide them through the first iteration of the program. This involved designing community engagement materials such as mailers and presentations, organizing town halls, providing resource assessment for utility scale renewable energy, and providing zoning assistance via a draft ordinance tailored specifically to the townships' stated preferences.
- Interviewed township officials throughout the state to gather information around the barriers to proactive renewable energy zoning as well as general township needs and concerns in order to inform the recommendations regarding program incentives.
- Internally, kept the team focused on our stated goals and objectives to accomplish them on our planned timeline and to avoid drifting out of the project's scope.

Sustainability Intern: City of Ann Arbor, Office of Sustainability & Innovations (Ann Arbor, MI) **(10/2022 – 7/2023)**

- Collaborated with the Planning Department to develop an Electrification Communications sheet that provides information to address community questions regarding the city's potential electrification ordinance. This also prepared the OSI team members for stakeholder meetings with accurate information regarding electrification.
- Met with multiple city officials of California cities to learn about their experiences with required building electrification ordinances.
- Developed a comprehensive report of the current technological and economic landscape of geothermal heating districts and main considerations for the deployment of geothermal for a Sustainable Energy Utility. Provided details of case-studies of U.S. cities and/or campuses with geothermal heating districts and current pilots.

Research Associate: Graham Sustainability Institute (Ann Arbor, MI) **(05/2022 - 10/2022), (05/2023-10/2023)**

- Collaborated with the Ann Arbor Planning Department and Office of Sustainability and Innovations Office to design a Carbon Calculator to inform planners of the carbon impact of proposed residential developments and how it compares to surrounding jurisdictions.
- Gathered data greenhouse gas emissions data from various sources and compiled the data together in Microsoft Excel to calculate a most accurate estimate of emissions per proposed development for a respective jurisdiction.
- Performed spatial joins in ArcGIS Pro to combine datasets to then be analyzed in Excel.
- Performed data entry to continue updating the Energy Zoning Database.

Research Assistant: Gerald R. Ford School of Public Policy (Ann Arbor, MI) **(09/2021 - 06/2022)**

- Conducted research on Renewable Portfolio Standard (RPS) policies passed in various U.S. states to find how the various actors involved impacted the evolution of the policy.
- Provided detailed analyses of each version of a bill related to renewable energy standards to note the changes.
- Created a spreadsheet of relevant actors in the renewable energy policy space in multiple states from the years 1998-2020 and provided relevant news articles, affiliated bills, and contact information for each actor.

Summer Intern: Public Citizen (Austin, TX) **(05/2020 - 08/2020)**

- Conducted research on energy and environmental topics relevant to Texas environmental and energy policy advocacy efforts.
- Organized virtual town halls in collaboration with the Healthy Port Communities Coalition (HPCC) to foster conversations around environmental justice and highlight the health impacts that communities around the Port of Houston have faced historically due to these injustices.

Legislative Intern: Texas House of Representatives, Rep. Jessica Farrar (Austin, TX) **(02/2019 - 06/2019)**

- Conducted bill analyses for various bills drafted by the Office of Rep. Farrar.

SKILLS

- Project Management
- Local and State Plan Evaluation
- Zoning Laws and Regulations
- Community/Participatory Planning
- Policy Analysis
- ArcGIS Pro (Proficient)
- R (Beginner)
- Microsoft Excel (Proficient)
- Google Suite
- Stata (Beginner)

RELEVANT COURSEWORK AND CONFERENCES

Planning: Land Use Planning and Development Management; Environmental Planning; Climate Change Planning; Collaborative Planning; Economic Development Planning; Sustainable Development
Policy: Environmental Policy and Politics; Policy Formulation and Implementation
Technical: Principles of GIS; Environmental GIS; Natural Resource Statistics; Sustainable Transportation
Conferences: Michigan EIBC's 10th Annual Michigan Energy Innovators Conference (2022); American Clean Power's Siting and Environmental Compliance Conference (2023, *Poster Presenter)*; CEDAM Rural Partners of Michigan's Small Town and Rural Development Conference (2022)(2023, *Presenter*)(2024, *Presenter*).

PROFESSIONAL REFERENCES

Dr. Sarah Mills

- Senior Project Manager at Graham Sustainability Institute
- Capstone Project Advisor
- sbmills@umich.edu | (734) 763-0726

Julie Staveland, MPA

- Assistant Division Director of the Materials Management Division at EGLE
- 517-420-8544 | StavelandJ@michigan.gov

IAN O'LEARY

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olearyi@michigan.gov

WORK EXPERIENCE

OCT 2023 – PRESENT
ENERGY SERVICES UNIT ANALYST, MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

Renewables Ready Communities Award (RRCA): Grant author and grant manager.

- Assigned with rulemaking for a $30 million State budget allocation to incentivize renewable siting in a context of emergent siting legislation, which prompted existing contention around renewables to gain significant momentum.
- Designing this grant demanded integration of all stakeholder interests into a win-win for Michigan's ambitious climate goals and the satisfaction of its local governments.

Renewable Energy Academy: Program designer and manager.

- Developed a community-focused technical assistance program centered around renewable energy planning and zoning by educating citizens on the how and why of hosting renewables.
- Delivered location-specific presentations on renewable energy, land use, demographics, economic development, and Michigan's complicated new siting legislation, empowering communities with an understanding of their options.
- Initiated the "Clean Energy Information Bureau," an inter-organizational collaboration of renewable expertise throughout the state.
- Authored a successful application to the Department of Energy's R-STEP grant to further fund the Academy and enable more organizations to participate.

Expertise, consultation, and analysis:

- Key contact at EGLE for utility-scale renewable energy, fielding questions from utilities, developers, municipalities and more.
- Expert subject matter communicator, including presentations for conferences, Public Service Commission hearings, instructional webinars, press releases, and more.
- Determined the scale and financial need to attain the MI Healthy Climate Plan goal of 60% clean energy by 2030 through the RRCA, leading to an EPA application for significant funding increase to the grant.
- Developed a "fair share" model which explored a minimum capacity for every municipality based on land type, transmission capacity, resource potential, and more.
- Researched policy impact by determining how many existing renewable energy zoning ordinances were restrictive, permissive, or incompatible with State siting.

APRIL 2022 – OCT 2023

RESEARCHER, GRAHAM SUSTAINABILITY INSTITUTE

Michigan Renewable Energy Development Initiative: Designed and piloted program for EGLE to catalyze renewable siting through community engagement, zoning, and technical assistance, in a state with local permitting and significant renewable opposition.

- Worked closely with a small team of peers to independently design project goals and methodology.
- Used input from interactive engagement (worksheets, surveys, and interviews) to craft wind and solar ordinances aligned with both community preferences and industry standards for two townships.
- Utilized mapping and modeling to highlight areas with siting potential based on setbacks, wind and solar resource potential, and other siting considerations.
- Compiled findings into a final report, including detailed advice on how to improve and iterate our methodology. Additionally, presented these findings at multiple professional conferences.
- Recipient of the Student Award for the 2024 APA Sustainable Communities Division Awards for Excellence in Sustainability.

Carbon Neutrality Acceleration Program (Decarbonization Siting): Created an annotated bibliography, factsheets, and a synthesis report on siting wind, solar, storage, modular reactors, carbon sequestration, transmission, and other decarbonization technologies, emphasizing knowledge gaps that University researchers could fill.

Carbon Neutrality Acceleration Program (Land Use Compendium): Created an annotated bibliography on land use trends and developed a methodology to explore a community's land profile, demographic trends, energy potential, and more to write a land use future plan.

Solar Parcel Ownership Research: Analyzed parcel-level data for photovoltaic projects in five Midwest states to track renewable ownership patterns and trace local financial benefits. Involved quantitative data organization and analysis with Excel and R.

Federal Funding Tracker: Designed and maintained Graham's IIJA and IRA Federal Funding tracker, which translated the White House guidebooks into organized, user-friendly spreadsheets. Involved simplifying and effectively communicating complex information.

JAN 2023 – APRIL 2023

GRADUATE STUDENT INSTRUCTOR, UNIVERSITY OF MICHIGAN

Mentored peers for graduate course "Renewable Electricity and the Grid." This involved creation of course content, assignments, and exams, grading, and sufficient mastery of concepts like wind and solar resource characterization to grid-level system planning to relay these concepts to other graduate-level learners.

2019 – APRIL 2022

SALES MANAGER, BARNES & NOBLE

Leadership position at a high-traffic retail location, which involved project management, operational optimization, scheduling, customer service, sales analysis, and more.

EDUCATION

APRIL 2023

MASTER OF ENVIRONMENT AND SUSTAINABILITY, UNIVERSITY OF MICHIGAN.
Dual concentration in Sustainable Systems; Sustainability & Development.
GPA: 3.97
Selected coursework: Environmental Systems Analysis, Sustainable Energy Systems, Renewables and the Grid, Industrial Ecology, Energy Justice, Science of Social Change, Deep Decarbonization, Program Evaluation, and more.

APRIL 2018

BACHELOR OF BIOLOGY, EASTERN MICHIGAN UNIVERSITY

Focus on biochemistry, molecular biology, and ecology. Dual minors in Chemistry and Criminology; 3.6 GPA.

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EDUCATION

UNIVERSITY OF MICHIGAN, SCHOOL FOR THE ENVIRONMENT AND SUSTAINABILITY - Ann Arbor, MI — **August 2021 – April 2023**
M.S. - Environmental Policy & Planning and Behavior, Education & Communication

KALAMAZOO COLLEGE - Kalamazoo, MI — **September 2008 – June 2012**
B.S. – English

PROFESSIONAL EXPERIENCE

Michigan Department of Environment, Great Lakes, and Energy — **November 2023 - Present**
Office of Climate and Energy — **Lansing, MI**
CLIMATE ACTION OFFICER

- Develop and implement programs to meet the MI Healthy Climate Plan goal of reaching economy-wide carbon neutrality in a just and equitable way by 2050
- Manage $864k AmeriCorps grant for the MI Healthy Climate Corps initiative; 30-members serving to implement climate action, build local capacity, and develop the next cohort of climate leaders

Climate Resiliency Consulting — **August 2023 – October 2023**
CLIMATE GENTRIFICATION CONSULTANT — **Remote**

- Authored content for coastal resiliency project on equitable green infrastructure development
- Conducted quantitative/qualitative research on equitable implementation of climate action projects

Rare: *Global non-profit inspiring social change for people and the planet* — **June 2022 – July 2023**
BEHAVIOR-CENTERED DESIGN, GRADUATE INTERN — **Arlington, VA**

- Independently conducted a needs assessment of Rare's global behavioral-centered design programs
- Developed and implemented stakeholder interviews and surveys, compiled evaluation data, and analyzed data to understand the information needs of stakeholders to develop climate change solutions

The Nature Conservancy, Michigan Business Unit — **January 2020 – June 2022**
OPERATIONS ASSOCIATE — **Lansing, MI**

- Managed 300+ contracts, cooperative agreements, grants, MOUs and more: maintained contracts database, authored agreements and proposals, worked with project managers and contractors to track progress and ensure compliance, generated reports, analyzed data, and approving final deliverables
- Developed a more efficient management and evaluation process for contract management, successfully training staff and leadership on new method
- Supported HR and Finance in workforce development, account management, and budget preparation
- Advanced environmental justice principles as a member of "MI People Team": facilitated virtual talks and trainings, reviewed internal policies, set long and short-term goals and action strategies

City of Woodland, Community Services Department — **July 2018 – January 2020**
MANAGEMENT ANALYST — **Woodland, CA**

- Department Analyst managing 28 budgets totaling over $11 million: monitored and projected revenue/expenditures, progress, and deliverable quality; prioritized short and long-range goals
- Successfully facilitated department-wide strategic planning and program evaluation projects
- Supervised Urban Forestry staff, planned and managed workload, conducted performance evaluations, and supported professional development

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- Managed Urban Forestry projects: coordinated the 2019 Urban Forest Master Plan, successfully managed $356K CALFIRE grant, identified stormwater management opportunities
- Spearheaded project proposals to include extensive public engagement and research, creating detailed project plans and budget justifications, and coordinating with project partners

City of Woodland, Environmental Services Division **September 2015 – July 2018**
WATER CONSERVATION COORDINATOR **Woodland, CA**

- Managed city water conservation program: tracked and analyzed water policy and regulations, developed engagement and outreach programs to meet state and local water reduction goals
- Developed and tracked key performance indicators and regularly reported progress to the public, City Council, regional water boards and commissions, and the State of California
- Managed regional grant resulting in 40% water savings for commercial landscapes
- Engaged key stakeholders on water use reduction and water policy priorities through partnerships, grants, public speaking events, workshop series, and interactive educational events.
- Spearheaded communications strategy including developing daily social media posts, monthly newsletters, regular press releases, and advertisement campaigns, responding to media inquiries, and crafting presentations for the public, city council and at conferences

Tuleyome, *Environmental Advocacy and Conservation Non-profit* **June 2014 – September 2015**
PROGRAM COORDINATOR **Woodland, CA**

- Developed, marketed, and led Home Place Adventure's environmental conservation and education events, targeting under-served youth through diverse partnerships
- Team member in the campaign to establish the new Berryessa Snow Mountain National Monument
- Lead monthly interpretative hikes which saw a 20% increase in participation
- Managed trail restoration project for stormwater management and invasive species control

California Association of Resource Conservation Districts (CARCD) **August 2013 – September 2015**
OUTREACH & DEVELOPMENT COORDINATOR **Sacramento, CA**

- Coordinated 3 state-wide conferences: reviewed presentation proposals, designed the agenda, worked with state agencies and elected officials to organize keynote speakers
- Led conference sponsorship strategy, leading to a doubling of donations from 2013 to 2014
- Managed state-wide list-serve, authored monthly newsletters, represented CARCD at events
- Assisted in compiling a comprehensive progress report of the 97 RCDs in California, translating surveys and interviews, researching policy barriers and opportunities

SKILLS

- Geospatial Visualization and Analysis (ArcGIS)
- Graphic Design (Adobe Illustrator, InDesign, Photoshop; Figma; Canva)
- Project Management Apps (Asana, Monday.com, GanttPro, Box, SharePoint)
- Database Management
- Virtual Meeting Facilitation (Zoom, Microsoft Teams)
- Virtual Collaboration (MURAL, Miro)
- Microsoft Office and Google Workspace Website Design (Blackbaud, Salesforce)
- Data Visualization (Power BI, Tableau)
- Data Analysis (R)
- HR Programs (PeopleSoft)
- CRM Management
- American Society of Adaptation Professionals Member

PROFESSIONAL EXPERIENCE

Assistant Division Director
MI Department of Environment, Great Lakes, & Energy
Materials Management Division, Lansing, MI 03/2023 – present

- Manage budget of approximately $200 million in State and Federal funding annually and oversee and direct 26 staff. Set office priorities, objectives, operating policies, and formulate long-range plans. Serve as primary contact for relevant Department of Energy (DOE) and Environmental Protection Agency (EPA) grant programs. Oversee preparation of federal and state energy and environmental formula and competitive award applications and other grant opportunities that advances EGLE's mission. Direct and review the activities of professional and nonprofessional employees in implementation of EGLE programs. Assess effectiveness of operations, policies and procedures and determine need for improvement. Advise staff in the resolution of sensitive, complex, and precedent-setting situations; determine the appropriate course of action; assign responsibilities and monitor actions and responses. Work with other EGLE entities, the Department of Licensing and Regulatory Affairs (LARA), Michigan Department of Transportation (MDOT), Office of Future Mobility and Electrification (OFME), Department of Health and Human Services (DHHS) and the Michigan Public Service Commission (MPSC) to set and coordinate office priorities and programs. Resolve conflicts of interpretation of regulations, rules, program objectives, policies, and procedures.

Sustainability Section Manager
MI Department of Environment, Great Lakes, & Energy
Sustainability Section, Lansing, MI 03/2021 – 03/2023

- Manage budget of approximately $20 million in State and Federal funding annually and oversee and direct 17 staff. Organize, control, and direct the activities and resources of the Sustainability Section, set priorities and objectives for the Section; formulate long-range plans. Determine hiring needs, conduct interviews, hire, train, and evaluate staff. Assign, review, and approved subordinates' work. Assess effectiveness of operations; develop office policies and procedures to address areas of need. Direct Unit managers to assure their staff are clear on federal and states policies, and program requirements. Coordinate Section's work with the Assistant Division Director of the MMD within EGLE. Work closely with EGLE's Office of Climate and Energy to align programs with Office mission. Serve as contact for relevant DOE and EPA grant programs. Oversee preparation of federal and state energy and environmental formula and competitive award applications and other grant opportunities that advances EGLE's mission. Communicate to DOE and EPA problems and/or issues related to awards and represent the office at DOE and EPA functions. Develop budget recommendations and allocations, work closely with MMD's Administration Section on grants and other financial incentives.

State Administrative Manager, Working Out of Class
MI Department of Environment, Great Lakes, & Energy
Sustainability Section, Lansing, MI 10/2019 – 10/2020

- Serve as the Acting Section Manager, supervising the day-to-day operations, including planning, and directing the goals and objectives of the Section, and work closely with the Assistant Division Director.

State Energy Program (SEP) Specialist
MI Department of Environment, Great Lakes, & Energy
Sustainability Section, Energy Services Unit, Lansing, MI 05/2019 – 03/2021

- Manage approximately $5 million in federal and state funding. Responsible for administering, monitoring, and implementing the most complex and technical grants and contracts for services funded through the DOE SEP. Responsible for ensuring performance of all necessary actions for developing effective grant administration, ensuring compliance with contract terms, and safeguarding the interests of the State of Michigan, Energy Services in its contractual relationships.
  Energy Services Specialist on SEP issues related to the administration of the SEP that provides energy efficiency

and renewable energy serving as the liaison to management, other state agencies and organizations, and the public on issues related to SEP and related federal grants. Develop reports and provide recommendations regarding the status of SEP funding and program operations. Manage Energy Services budget. Process payment requests for all program area grants, incentives, and sponsorship awards. Review payment request documentation to ensure compliance, submit for approval. Enter all payment requests through SIGMA for payment once approved. Track and monitor all current and prospective State and Federal grant obligations and expenditures, provide weekly reports to Manager. Coordinate DOE SEP Quarterly and Annual reports. Collect and maintain program data for reporting purposes. Compile grant information from respective program areas and submit draft reports for both quarterly and annual reports in PAGE. Perform miscellaneous duties to assist auditing staff, program evaluation and DOE reporting. Oversee the Event and Training Sponsorship Program. Review and process sponsorship requests, conduct due diligence, send award notifications to applicants, coordinate event ads, staff attendees and presentations. Maintain and update the Energy website.

Community Programs Coordinator
Michigan Energy Office, Lansing, MI 05/2018 – 05/2019

- Administer and manage approximately $350,000 in DOE SEP Community Energy Management grants and incentives. Develop and solicit grant programs to prospective applicants. Coordinate technical review, due diligence and recommend project proposals for funding. Review and approve revised proposals, work plans and budgets to ensure all projects meet program objectives. Conduct in-person and over the phone kick-off meetings, conduct site visits and hold monthly update meetings with grantees. Regularly communicate with grantees to ensure mutual understanding of roles and responsibilities. Provide oversight and support to grantees to facilitate successful project implementation. Review, approve and process budget revisions, grant amendments and grant extensions as needed. Track, review and update all current and prospective State and Federal grant obligations and expenditures, provide weekly reports. Process payment requests for all program area grants, incentives, and sponsorship awards. Coordinate DOE SEP Quarterly and Annual reports. Collect and maintain program data for reporting purposes. Compile grant information from respective program areas and submit draft reports for both quarterly and annual reports in PAGE. Maintain and update the Michigan Energy Office website.

Human Services Transit Planner
Alaska Department of Transportation & Public Facilities, Juneau, AK 04/2014 – 05/2018

- Managed approximately $2 million in state and federal human service transportation grant programs throughout rural Alaska for the Alaska Community Transit Office (ACT). Prepared transit project information for the Statewide Transportation Improvement Program (STIP). Developed human service transportation grant projects with communities and non-profit organizations around the state. Provided guidelines and technical assistance to communities in the development of coordinated public transit-human services transportation plans. Managed planning, project fiscal and administrative requirements for both public transit and human services grant programs administered through ACT, ensured subrecipient compliance with federal and state requirements. Prepared applications for federal-aid transportation funding in the amount of approximately $13 million in Federal Transit Administration (FTA) 5311 and 5310 funds. Monitored active grant expenditures and processed subrecipient reimbursement billings with AKDOT&PF accounting staff. Completed annual reporting requirements for both public transit and human service grant programs. Performed closeout procedures and file management for expended grants when appropriate. Assisted in functional development of electronic grant management system as appropriate, including online forms for billing and reporting. Assisted in the planning, coordination and execution of trainings and conferences for current subrecipients and other transit professionals. Maintained and updated ACT website.

Outreach & Orientation Coordinator
University of Alaska Southeast, Juneau, AK 06/2006 – 04/2014

- Build and maintain the Enrollment Management Action System (EMAS) database, provide database training, run, and write reports; analyze trends and assist in data driven recruitment effort. Update and modify the

communication plans annually. Perform cost center clerk duties for Admissions and Recruitment staff: process purchase and travel requests, prepare yearly budget of approximately $120,000 for Recruitment activities, maintain department purchasing records and monthly credit card records. Design, coordinate, and implement Admissions Office New Student Events for prospective and incoming students. Work closely with other campus departments to develop New Student programs. Develop objectives and learning outcomes, make logistical arrangements including planning meetings, schedule, budget, activities, evaluation, and written reports after New Student events. Coordinate redesign, ordering and maintain inventory of all print materials, promotional items and mailout items. Create, maintain, and update Admissions and Orientation websites, serve as back-up, and provide training for Registrar and Financial Aid websites. Supervise Telecounseling Center, to include hiring, training, monitoring and evaluating up to four student employees.

Education & Affiliations

Master of Public Administration, 2013 — University of Alaska Southeast, Juneau, AK

- Specific coursework in: Human Resource Administration, Leadership for Public Administration, Organizational Theory and Behavior, and Public Financial Management. Cumulative GPA of 3.70

Bachelor of Business Administration, 2011 — University of Alaska Southeast, Juneau, AK

- Specific coursework in: Principles of Management, Legal Environment of Business, Project Management, Database Concepts & Applications, Principles of Managerial Accounting

Grants Management Certificate: Pass-Through Track, 2016 — Management Concepts

- Specific coursework in: Managing Federal Grants and Cooperative Agreements for Recipients; Cost Principles: 2 CFR Part 220 (A-21), 225 (A-87), 230 (A-122), and FAR 31.2; Advanced Cost Principles; Uniform Administrative Requirements for Federal Grants 2: 2 CFR 200 (Subparts A-D); Detecting and Preventing Fraud on Federal Grant Projects; Financial Administration of Federal Grants for Recipients

Board Member, Midwest Regional Representative – National Association of State Energy Offices

- August 2023 - Present

Board Member - University of Michigan Center for Sustainable Systems (CSS) External Advisory Board

- October 2022 - Present

Board Member - Rural Partners of Michigan

- May 2019 – Present

Training

- Great Lakes Leadership Academy, Leadership Advancement Program, 2024-2025
- U.S. Environmental Protection Agency, State Pollution Prevention Training, 2022
- Department of Energy, State Energy Program Officials Training 2019, 2022
- State of Michigan Fit Leaders Program, 2019
- AK DOT&PF Leadership Development Program, 2015
- Federal Transit Administration (FTA) State Management Review Workshop, 2014 & 2015
- National Transit Institute (NTI) Trainings:
  - Contract Administration, 2014
  - Procurement for Small and Medium Transit Systems, 2015
  - Managing Community Mobility, 2016
  - Orientation to Transit Procurement, 2016
- National Orientation Directors Association (NODA), Orientation Professional Institute, 2009

Yingxin Wang

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EDUCATION

Master of Science: Environment and Sustainability *(09/2021 – 04/2023) University of Michigan (Ann Arbor, MI)*

- Concentrations: **Geospatial Data Sciences**

Bachelor of Science: Geographical Information Science *(09/2017 – 06/2021) Wuhan University (Wuhan, China)*

- Awards: Outstanding Graduates, Honor Student, Scholarship for Academic Excellence
- Summer Program *(06/2019-08/2019) University of British Columbia (Vancouver, Canada)*

PROFESSIONAL EXPERIENCE

Departmental Analyst – Energy Unit: Michigan Department of Environment, Great Lakes, and Energy

(11/2023 - Present)

- **Renewables Ready Communities Award:**
  - Designed award, develop Request for Proposal, monitored grants, processed payment, and provided oversight and support to grantees to facilitate successful project as the grant manager for Renewables Ready Communities Award under the assignment with rulemaking for a $30 million State FY 2023 budget allocation.
- **Renewable Energy Academy:**
  - Designed the technical assistant program to engage community stakeholders to identify issues, barriers, and opportunities related to renewable energy by developing and updating educational materials, including best practices and deployment strategies for energy and zoning.
  - Built GIS models for assessing suitability for renewable energy development potential, then delivered the developed educational materials on planning and zoning for renewable energy to communities in Michigan.
- Researched existing renewable projects in Michigan and created analyses on both the quantitative and qualitative items in their zoning ordinances.
- Provided visual designs and supports in websites and program materials, and became the primary resource for questions about utility-scale renewable energy within energy unit.

Research Assistant: Graham Sustainability Institute ***(08/2022 - Present)***

- Created and updated databases and maps for energy-related projects daily.
- Collaborated with the School for Environment and Sustainability and Eastern Michigan University to conduct multiple studies of renewables in the Midwest.
- Created a GIS database with 9 socio-economic spatial data from 2000 to 2020 for Michigan townships that host wind turbine projects and their geographical neighbors using ArcGIS Pro.
- Generated nearest distances from a subdivision to different voltage classes of transmission lines for over 10,000 subdivisions in 6 states; analyzed the cost of land for building transmission lines based on the nearest distance overlaid with terrain-type raster layer and calculated the area within each land cover type.
- Created a series of wind and solar energy visualizations with 21 thematic maps based on the zoning database for 6 states.

Graduate Research Consultant: University of Michigan Master's Project, Michigan Department of Environment, Great Lakes, and Energy ***(01/2022 – 05/2023)***

- Designed a program to facilitate proactive utility-scale renewable energy zoning across Michigan.
- Interviewed 24 township representatives to facilitate utility-scale renewable zoning development; transcripted and analyzed the interviews using NVivo to make codebooks and over 20 charts for future research.
- Designed flyers, mailers, surveys, and worksheets with around 200 residents' responses to facilitate community engagement in discussing renewable energy.
- Conducted resource assessments to analyze the suitability of wind and solar energy in partner townships using models in Energy Zones Mapping Tool; created setbacks simulation and 14 zoning maps for partner townships in ArcGIS Pro to present at public events.

Personal Project: Wuhan University Bachelor Thesis, Optimal Growth Model of Cherry Blossom Trees Based on Terrestrial Laser Scanning ***(10/2020 - 06/2021)***

- Utilized 3D laser scanner to conduct field measurement to obtain point cloud data of 60 cherry blossom trees.
- Processed data in LiDAR360 to acquire ecological features for each tree, including height, crown size, and trunk diameter; analyzed the correlation of the features to generate the allometric relations and established tree optimal growth model.

Research Project: Spatial-Temporal Visualization for China's Western Region Development Project ***(09/2018 - 12/2019)***

- Collected, analyzed, and visualized the number and origin of the college graduates who participated in the "Western Project" from 1999-2019; presented the intermediate outcomes at the 17th SuperMap GIS contest in 2019.
- Charted migration maps of college graduates and density of the impoverished counties on ArcGIS; analyzed the feasibility of placement plan for the graduates; visualized the geographic distribution, development trends, and outcome.

TECHNICAL SKILLS

- **Software**: ArcGIS Pro, ArcGIS Desktop, Arcpy, AGOL, QGIS, GeoDa, ERDAS Imagine, Survey123, Field Map, CorelDRAW, Adobe Photoshop, Microsoft Suite
- **Coding Languages**: R, Python, C++, C
- **Languages**: Fluent in English and Chinese, conversant in Korean

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

COGNIZANT AGENCY
NEGOTIATION AGREEMENT

State of Michigan
Department of Environment,
Great Lakes, and Energy
Lansing, MI

Date: August 10, 2023

Filing Ref: October 21, 2022

The indirect cost rates contained herein are for use on grants and contracts with the Federal Government to which 2 CFR Part 200 applies, subject to the limitations contained in the Circular and in Section II, A below.

SECTION I: RATES

Type	Effective Period From	To	Rate	Base
Fixed	10/1/2023	9/30/2024	16.65%	(a)

Basis for Application
(a) Direct salaries and wages and fringe benefits.

Treatment of Fringe Benefits: Fringe benefits applicable to direct salaries and wages are treated as direct costs and charged in accordance with rates established by the State.

SECTION II: GENERAL

A. LIMITATIONS: The rates in this Agreement are subject to any statutory and administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the department/agency or allocated to the department/agency by an approved cost allocation plan were included in the indirect cost pool as finally accepted; such costs are legal obligations of the department/agency and are allowable under governing cost principles; (2) The same costs that have been treated as indirect costs have not been claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment; and (4) The information provided by the department/agency which was used to establish the rates is not later found to be materially incomplete or inaccurate by the Federal Government. In such situations the rate(s) would be subject to renegotiation at the discretion of the Federal Government.

B. CHANGES. The final rate contained in this agreement is based on the organizational structure and the accounting system in effect

at the time the proposal was submitted. Changes in the organizational structure or changes in the method of accounting for costs which affect the amount of reimbursement resulting from use of the rate in this agreement, require the prior approval of the authorized representative of the responsible negotiation agency. Failure to obtain such approval may result in subsequent audit disallowances.

C. THE FIXED RATE contained in this agreement is based on an estimate of the cost, which will be incurred during the period for which the rate applies. When the actual costs for such a period have been determined, an adjustment will be made in the negotiation following such determination to compensate for the difference between the cost used to establish the fixed rate and that which would have been used were the actual costs known at the time.

D. NOTIFICATION TO FEDERAL AGENCIES: Copies of this document may be provided to other Federal agencies as a means of notifying them of the agreement contained herein.

E. SPECIAL REMARKS: Please confirm your acceptance of the terms of the indirect cost rate agreement by signing and returning this letter to me. Please retain a copy for your records.

ACCEPTANCE

The undersigned official warrants that he/she has the proper authority to execute this agreement on the behalf of the State Agency:

Paul McDonald Digitally signed by Paul McDonald Date: 2023.08.11 15:34:53 -04'00'

(Signature)

Paul McDonald

(Name)

Chief Financial Officer

(Title)

MI Environment, Great Lakes, and Energy

(Agency)

(Date)

By the Federal Agency:

JACQUELINE SMITH Digitally signed by JACQUELINE SMITH Date: 2023.08.11 11:12:42 -04'00'

(Signature)

National Policy, Training and Compliance Division
U.S. Environmental Protection Agency

Negotiated by: Rose Piard-Hylton
Telephone: (202) 564-4427

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

EPA Project Control Number

CERTIFICATION REGARDING LOBBYING

CERTIFICATION FOR CONTRACTS, GRANTS, **LOANS AND COOPERATIVE AGREEMENTS**

The undersigned certifies, to the best of his or her knowledge and belief, that:

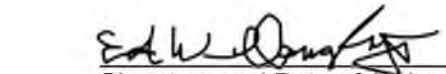
(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including sub-contracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31 U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Ed Willoughby, Federal Aid Coordinator
Typed Name & Title of Authorized Representative



2/1/2023
Signature and Date of Authorized Representative

March 22, 2024

Phil Roos, Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Clean Energy, Environmental and Health Organizations Support the State of Michigan's CPRG Implementation Grant General Competition Application, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

The Michigan Conservative Energy Forum affirms our partnership with the State of Michigan and the Department of Environment, Great Lakes, and Energy (EGLE) in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse Michigan's objective to reduce greenhouse gas (GHG) emissions and ambitiously site renewable energy in Michigan through the Climate Pollution Reduction Grant program. EGLE's Renewables Ready Communities Awards and the Brownfield Renewable Energy Pilot Program will spur signigicant emission-free energy development, provide substantial community benefits in low-income and disadvantaged communities, and improve capacity and technical expertise in renewable energy siting statewide.

Through the CPRG grant program period, we anticipate collaborating with the State through our unparalleled Land & Liberty Coalition® program to facilitate the siting of large-scale wind and solar projects. Land & Liberty has worked on renewable siting in hundreds of local jurisdictions during nearly 6 years of highly-targeted community activisim. In particular, the Renewable Ready awards will offer a tremendous boost to our ongoing field work. Given the years of thwarted renewable energy development in Michigan, this program will represent a critical turning point toward success.

Given the State's history of implementing equitable climate policies, we have full confidence in its ability to achieve the objectives laid out in the application. Furthermore, this initiative will stimulate increased investment in renewable energy projects critical to achieving the State's climate objectives.

Our organization is part of the statewide coalition Michigan Energy, Michigan Jobs, which is focused on transitioning our state to 100% clean energy, leading to more good-paying jobs that don't require a college degree, cleaner air for the communities most impacted by pollution, and more affordable electricity for Michigan families.

MICEF is "all-in" on renewable energy dvelopment and enthusiastic about partnering with the State of Michigan to advance the clean, renewable energy goals of this program.

Sincerely,

Edward Rivet II
Executive Director

State of Michigan CPRG Implementation Grant Workplan

Section 1: Overall Project Summary and Approach

The State of Michigan recognizes the urgency to address greenhouse gas (GHG) pollution contributing to climate change and proposes an ambitious and strategic plan to site renewable energy projects through its Department of Environment, Great Lakes, and Energy (EGLE). If awarded a Climate Pollution Reduction Grant (CPRG) Implementation Grant through the General Competition, EGLE will accelerate the siting, zoning, and permitting of renewable energy through the establishment of the Renewables Ready Communities Program. The goal of the Renewables Ready Communities Program is to overcome barriers to siting renewable energy to enable the adoption of renewable energy at the scale and pace needed to reach 60 percent renewable energy in Michigan by 2030, aligned with the MI Healthy Climate Plan. Few efforts are as essential to climate mitigation as deploying renewable energy, and few barriers to deploying renewables are as challenging as siting. This grant proposal seeks to overcome some of the barriers to siting renewable energy to decarbonize the electricity sector and unlock the deep decarbonization potential across other sectors of Michigan's economy.

The **Renewables Ready Communities Program** will consist of the following:

- Expanding the **Renewables Ready Communities Awards** that provide financial incentives to local unit(s) of government that approve and host utility-scale renewable energy and energy storage through local processes. The Renewables Ready Communities Awards will include an additional incentive to local unit(s) of government that approve and host utility-scale renewable energy and energy storage whose communities are a majority low-income and disadvantaged. CPRG funding will expand an existing Renewables Ready Communities Awards pilot that launched in 2024 with a one-time state budget allocation of $30 million.
- Creating the **Brownfield Renewable Energy Pilot Program** to incentivize siting on brownfields. This pilot program will be run through EGLE's Remediation and Redevelopment Division's Brownfield Program to provide grants for renewable energy projects on brownfields.
- Expanding EGLE's **Renewable Energy Academy** to develop technical assistance materials for low-income and disadvantaged communities and for the Brownfield Renewable Energy Pilot Program. CPRG funds will staff the Renewable Energy Academy to provide technical assistance and community engagement as a part of the efforts of the Renewables Ready Communities Program.
- Developing a **Renewables Ready Communities Strategic Plan** to assess where and how the state should direct efforts for utility-scale renewable energy projects and brownfield renewable energy projects to meet 2030 goals.
- Supporting **State of Michigan workforce development programs** to ensure Michigan has the workforce needed to build enough renewable energy to meet 2030 goals.

At least $10 million of RRC Program incentives will be reserved for renewable energy projects in Tribal communities either through Renewables Ready Communities Awards to Tribal governments that approve and host utility-scale renewable energy projects and/or Brownfield Renewable Energy Pilot Program grants.

1.a. Description of GHG Reduction Measures
Background

Siting renewable energy at-scale is one of the most crucial and urgent climate goals for Michigan. The MI Healthy Climate Plan – Michigan's plan to reduce GHG emissions and transition toward economy-wide carbon neutrality by 2050 – calls for the generation of 60 percent of the state's electricity from renewable resources and sets a 2,500 megawatt (MW) energy storage target by 2030. To achieve this penetration of renewable energy, the MI Healthy Climate Plan calls for a 50 percent renewable energy standard by 2030 and an expansion of customer-driven renewable energy options (like rooftop solar and voluntary green pricing programs) to reach 60 percent renewable energy by 2030. The bulk of this additional capacity is likely to be met via voluntary green pricing programs, which will also require the siting of utility-scale renewable energy projects. In 2023, Michigan Public Act 235 (PA 235) codified the renewable energy and storage targets, among other goals and strategies of the MI Healthy Climate Plan.

One of the biggest challenges to meeting these ambitious targets in the electricity sector is the siting and permitting of renewables. In recent years, siting renewables like wind and solar has become increasingly difficult in Michigan communities. Michigan is home to 1,856 local units of government, including over 1,200 townships. For many rural communities, wind and solar offer an opportunity for income, local tax revenue, quality local jobs, and environmental benefits. In recent years, a small but vocal opposition has organized to fight the siting of wind and solar in communities across Michigan. Projects have been blocked by local opposition and in some cases township officials have been recalled for showing support for renewable energy projects. This opposition can make it impossible for local landowners in rural communities who are interested in pursuing solar or wind to do so. Local restrictions in Michigan have led to the blockage of two dozen utility-scale wind and solar projects as of May 2023.[1] Based on the State's definition of compatible renewable energy zoning, currently only 9.8 percent of solar ordinances and 1.7 percent of wind ordinances in "wind-viable" locations have zoning that fit the basic criteria, according to internal analysis at EGLE. The State of Michigan aims to leverage funding secured via a CPRG Implementation Grant to help overcome these challenges through the creation of the Renewables Ready Communities Program.

Renewables Ready Communities Program Description

The Renewables Ready Communities Program (RRC Program) includes two primary GHG reduction measures:

- **Measure 1: Renewables Ready Communities Awards** will provide financial incentives to local unit(s) of government that approve and host utility-scale renewable energy and energy storage projects through local permitting processes. These incentive awards will provide additional revenue for local governments to spend in their communities for each megawatt of renewable energy installed.
- **Measure 2: Brownfield Renewable Energy Pilot Program** will create a strategy for encouraging renewable energy on brownfields and will provide dedicated funding through EGLE's Remediation and Redevelopment Division's Brownfield Program to provide grants for renewable energy projects on brownfields.

For GHG reduction Measure 1, the Renewables Ready Communities Awards (RRC Awards) will provide financial incentives to communities across Michigan that approve and host renewable energy projects at scale through a local permitting process. These incentive awards will provide additional revenue for local governments to spend in their communities for each MW of renewable energy or energy storage installed. EGLE launched a pilot version of this proposed program in 2024 with a one-time state budget

[1] Sabin Center for Climate Change Law | Columbia Law School | May 2023

allocation of $30 million. With funding from a CPRG Implementation Grant, EGLE will have the ability to expand the pilot and administer the necessary financial incentives to meet the MI Healthy Climate Plan goal of 60 percent renewable energy by 2030, and the state's energy storage goal of 2,500 MW by 2030. EGLE estimates that 20,593 MW of solar and wind and 929 MW of energy storage are needed to reach the 2030 goals, accounting for existing renewable energy resources and the renewable energy MW achieved through the 2024 RRC Award pilot.

Renewables Ready Communities Awards (RRC Awards) will provide initial financial incentives of $5,000 per MW, up to a maximum of $3 million per award, to the local unit(s) of government that hosts and permits eligible utility-scale renewable energy projects. Qualifying projects are expected to be at least 50 MW for solar and energy storage projects and at least 100 MW for wind projects. The CPRG funds will also provide an additional incentive to local unit(s) of government that approve and host utility-scale renewable energy and energy storage whose communities are a majority low-income and disadvantaged. This additional incentive, and the technical assistance offered through the Renewable Energy Academy, will help ensure that all communities can participate in and benefit from the renewable energy transition.

GHG reduction Measure 1 will complement changes in law made with the passage of Michigan Public Act 233 of 2023 (PA 233), which allows renewable energy projects that meet certain capacity thresholds – solar and energy storage facilities with a nameplate capacity of 50 MW or more and wind facilities with a nameplate capacity of 100 MW or more – to go to the Michigan Public Service Commission (MPSC) to permit projects if an attempt to permit through a local unit of government is unsuccessful. While this will help ensure projects are built, the permitting process at the MPSC does not cover all projects and for those projects it does cover, the process may be longer or more expensive as it requires additional considerations that are not required at the local level. When projects are permitted through the MPSC, local units of government where the projects are located will receive host payments of $2,000 per MW, which is not a benefit guaranteed through the local permitting process. To encourage the faster deployment of renewable energy with greater community support, the RRC Awards provide a financial incentive to local units of government who approve and host renewable energy projects through local permitting. EGLE anticipates that the RRC Awards – supported by the Renewable Energy Academy – will result in no less than 16,475 MW of additional renewable energy capacity. This total amount takes into consideration the total MW of additional renewable energy needed to meet the goals of the MI Healthy Climate Plan (23,954 MW) and accounts for projects that will be sited as a result of the current RRC Awards pilot (3,351 MW) and projects that EGLE anticipates will be sited without the need of an RRC Award incentive (4,119 MW).

For GHG reduction Measure 2, EGLE will create a Brownfield Renewable Energy Pilot Program to incentivize siting renewable energy projects on brownfields through a $10 million grant program. Brownfields are generally defined by EGLE as current and formerly contaminated lands, capped landfills, and former mine sites. The grant program will be run through EGLE's Remediation and Redevelopment Division's Brownfield Program, which provides grants and loans to local governments for projects that reuse contaminated properties and provide economic benefit to the community while protecting human health and the environment. The size and number of grants awarded under the $10 million grant program will be modeled from the EGLE Brownfield Program's current grant policies and will be designed to overcome current deployment barriers while maximizing greenhouse gas emissions reductions and community benefits. The CPRG funding will allow EGLE to hire a program manager to run the Brownfield Renewable Energy Pilot Program and provide technical assistance. This initiative is of particular interest to low-income and disadvantaged communities (LIDACs) and urban centers where renewable energy on brownfields can create jobs, stimulate economic growth, and revitalize land.

To support these two measures, EGLE will hire the necessary staff to support the expansion of the RRC Awards, develop and launch the Brownfield Renewable Energy Pilot Program, and provide technical assistance through the Renewable Energy Academy. The RRC Program will be in EGLE's Energy Services Section, and the program manager hired to run the Brownfield Renewable Energy Pilot Program will be in EGLE's Remediation and Redevelopment Division's Brownfield Program. EGLE is currently developing the Renewable Energy Academy to provide modest technical assistance and educational materials to complement the RRC Awards pilot. The CPRG funds will expand programming beyond what is possible with existing funding by providing staff to support the Renewable Energy Academy, create materials and community engagement tools on planning and zoning for renewables with a focus on LIDACs, and create technical assistance materials for the Brownfield Renewable Energy Pilot Program. Staff will develop marketing strategies for both the RRC Awards and the Brownfield Renewable Energy Pilot Program grants and will pay particular attention to promoting and supporting these programs in LIDACs. Finally, at least one staff person will focus on providing technical assistance to Tribes in Michigan.

To support the ambitious efforts of the RRC Program, EGLE will also provide subaward support to workforce development programs in EGLE or through the Michigan Department of Labor and Economic Opportunity (LEO). These may include apprenticeship programs related to the renewable energy sector and partnerships with the MI Energy Workforce Development Consortium, Center for Energy Workforce Development, Michigan Works!, and the Workforce Development Institute through the Michigan branch of the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO). EGLE will also subaward the University of Michigan's Center for EmPowering Communities, in the Graham Sustainability Institute, to develop technical assistance materials. The Center integrates leading-edge social science research with technology design, community engagement, and policymaking to foster decarbonization solutions that advance community goals. The Center is run by Dr. Sarah Mills, a nationally recognized expert in energy policy and land use planning. The Center has experience working with communities across Michigan as they consider energy in their land use planning, zoning, and other policymaking. A letter of commitment from the Center for EmPowering Communities is included in this application.

In the first year of the RRC Program, EGLE will contract support to develop the Renewables Ready Communities Strategic Plan, to assess where and how the state should direct efforts for utility-scale renewable energy projects and brownfield renewable energy projects to meet 2030 goals. This strategic plan will provide technical analysis and aid in RRC Program development.

Tables 1 and 2 detail the major tasks, milestones, and underlying assumptions of this proposal. Table 1 is for GHG reduction Measure 1 (the RRC Awards), and Table 2 is for GHG reduction Measure 2 (the Brownfield Renewable Energy Pilot Program). Table 3 lists potential risks that could occur throughout the grant period and relevant risk mitigation strategies. EGLE does not anticipate that these risks will lead to delays or interruptions in the implementation of these reduction measures or impact their overall effectiveness, given the risk mitigation strategies identified in Table 3.

Table 1: Tasks and Milestones for Measure 1, Renewables Ready Communities Awards

Task #	Task Description	Anticipated Milestones	Assumptions
EPA	*Notification of Funding Selection*	*July 2024*	

1	**RRC Program Pre-Planning Phase:** -Develop position descriptions -Develop criteria for the RRC Awards additional incentive for LIDACs -Evaluate 2024 RRC Awards (ongoing pilot project) for lessons learned, develop second round of the RRC Awards Request for Proposals based on evaluation	October 2024	Relevant EGLE offices work together to plan for the RRC Awards based on the ongoing 2024 RRC Awards pilot.
EPA	*Anticipated Award*	*Oct. 2024*	
2	**Establish the RRC Program** -Hire RRC Program staff -Develop marketing and outreach for RRC Awards -Train staff to run the Renewable Energy Academy -Subaward the University of Michigan's Center for Empowering Communities to develop technical assistance materials -Subaward to State of Michigan workforce development program -Contract support to develop Renewables Ready Communities Strategic Plan in Year 1 -Contract support for regional outreach, engagement, and technical assistance for RRC Awards	November/ December 2024	Funds received from EPA and distributed to EGLE.
3	**RRC Awards – Round 1** -Publish Round 1 RRC Awards Request for Proposals -Award on rolling basis through Fall 2025	November/ December 2024	RFP for ongoing 2024 pilot project closes in Fall 2024.
4	**Renewable Energy Academy technical assistance materials developed, including:** -Planning and zoning materials specific for LIDACs -Community Benefits Mediation Services training local government staff, EGLE staff, etc.	April 2025	EGLE staff and contract support are trained to deliver technical assistance.
5	**Ongoing RRC Program Support** -Contracted regional outreach support assist RRC Program Staff to conduct planning and zoning outreach, education, and engagement and other technical assistance to local governments and Tribes -Marketing and communications -Subaward support to State of Michigan workforce development program and Center for EmPowering Communities (University of Michigan)	**Ongoing,** once program is launched and through end of CPRG grant period	EGLE staff will adjust any technical assistance, trainings, outreach, and engagement as needed to best provide support to local governments, Tribes, and LIDACs.
6	**RRC Awards – Awardee Semiannual Reports** -RRC Awards will be disbursed in two amounts: upon project construction and upon project operation. After the first disbursement, the use of the award will be subject to semiannual reporting to EGLE. RRC Awards will be awarded on a rolling basis with Requests for Proposals updated annually. Awardees should ensure projects are operational by Fall 2029. Projects are projected to take 2-3 years from start to finish.	**Semiannual**, Spring 2025 through end of grant period	EGLE will use these semiannual reports to track progress on permitted projects as well as use of funds by award recipients. It is assumed projects will be operational by Fall 2029.

7	**Semiannual Reports to EPA** -EGLE submits semiannual reports to EPA. Reports will summarize technical progress, accomplishments, milestones achieved, track program metrics, detail outputs and outcomes (community engagement, progress on job quality, etc.), summary of expenditures to date, and description of planned activities for next six months.	**Semiannual,** from Spring 2025 through end of grant period	These semiannual reports should alert EGLE staff to performance measures that are lagging.
8	**RRC Awards Round 2** -Evaluate and adjust the Request for Proposals for RRC Awards Year 2 -Assess technical assistance, community engagement, and marketing needs for Year 2	Fall 2025	Year 1 funds fully allocated to awardees.
9	**RRC Awards Round 3** -Evaluate and adjust the Request for Proposals for RRC Awards -Assess technical assistance, community engagement, and marketing needs for Year 3	Fall 2026	Year 2 funds fully allocated to awardees.
10	**RRC Awards Year 4** -Provide necessary technical assistance, community engagement, and other support as needed to ensure RRC Awards are fully disbursed by Fall 2029	Fall 2027	Permitted projects face few obstacles in construction and are operational by 2029.
11	**RRC Awards Year 5** -Provide necessary technical assistance, community engagement, and other support as needed to ensure RRC Awards are fully disbursed by Fall 2029	Fall 2028	Permitted projects face few obstacles in construction and are operational by 2029.
12	**EGLE submits Final Report to EPA** -Final report will summarize accomplishments, report on program metrics that describe outputs and outcomes (community engagement, job quality, etc.), final expenditures, and more.	Fall 2029, or within 120 days of completion of period of performance	Renewable energy projects hosted by RRC Awardees are complete and operational.

Table 2: Tasks and Milestones for Measure 2, Brownfield Renewable Energy Pilot Program

Task #	Task Description	Anticipated Milestones	Assumptions
EPA	*Notification of Funding Selection*	*July 2024*	
1	**Program Pre-Planning phase for Brownfield Renewable Energy Pilot Program** -Develop position description for program manager -Research and plan the Brownfield Renewable Energy Pilot Program	October 2024	Relevant EGLE offices work together to plan the Brownfield Program Renewable Energy Pilot Program.
EPA	*Anticipated Award*	*Oct. 2024*	

2	**Establish Brownfield Renewable Energy Pilot Program** -Hire program manager -Subaward the University of Michigan's Center for EmPowering Communities to develop brownfield technical assistance -Contract support to develop Renewables Ready Communities Strategic Plan, specifically to create the state strategy for encouraging renewables energy and energy storage on brownfields	November 2024	Funds received from EPA and distributed to EGLE.
3	**Renewable Energy Academy technical assistance materials developed, including:** -Guidebook on developing brownfield renewable energy projects -Materials on community engagement for brownfield renewable energy projects -Materials tailored to Tribal and LIDAC needs	April 2025	EGLE staff are properly trained to deliver technical assistance and community engagement.
4	**Launch Brownfield Renewable Energy Pilot Program Year 1 Grant Application** -Promote the Pilot Program across the state focusing outreach on LIDACs and Tribes -Provide technical assistance to local governments and Tribes -Launch grant application process, accept Pilot Program grant applications on rolling basis	April 2025	Rely on existing EGLE Brownfield Program grant policies in Pilot Program grant design and administration.
5	**Ongoing Brownfield Renewable Energy Pilot Program Support** -Technical assistance to local governments and Tribes -Outreach and engagement to local governments and Tribes -Marketing and communications -Subaward support to Center for EmPowering Communities (University of Michigan)	**Ongoing,** once program is launched and through end of CPRG grant period	EGLE staff will adjust any technical assistance, trainings, outreach and engagement to best provide support to local governments, Tribes, and LIDACs.
6	**Quarterly Reports from grantees to EGLE** -Pilot Program grant recipients complete quarterly reports by following Brownfield Program grant policies. Reports will include progress on project outputs and outcomes and a summary of anticipated work for the following quarter. Grantees will submit invoices for reimbursement to EGLE.	**Quarterly**, Spring 2025 through end of grant period	The established reporting protocols for the Brownfield Program grants are sufficient for the Pilot Program.
7	**Semiannual Reports to EPA** -EGLE submits semiannual report to EPA to summarize technical progress, accomplishments, milestones achieved, track program metrics, detail outputs and outcomes (community engagement, progress on job	**Semiannual,** from Spring 2025 through end of grant period	These semiannual reports should alert EGLE staff to performance measures that are lagging.

	quality, etc.), summary of expenditures to date, and description of planned activities for next six months.		
8	**Brownfield Renewable Energy Pilot Program Year 2 Grant Application** -Make necessary adjustments and identify outreach and technical assistance needs for Year 2 of the Pilot -Accept Pilot Program grant applications on rolling basis	Winter/ Spring 2026	Year 1 grant funds fully allocated. Funded projects face few obstacles in project construction.
9	**Brownfield Renewable Energy Pilot Program Years 3-5** -Provide necessary technical assistance to ensure the Brownfield Renewable Energy Pilot Program allocated grants are fully disbursed by CPRG grant program period end. Funded projects are expected to be complete by Fall 2029.	Winter 2027-Fall 2029	Year 2 grant funds fully allocated. Funded projects face few obstacles in project construction.
10	**EGLE submits Final Report to EPA** -Final report will summarize accomplishments, report on program metrics that describe outputs and outcomes (community engagement, job quality, etc.), final expenditures, and more.	Fall 2029, or within 120 days of completion of period of performance	Pilot Program grants are fully disbursed by Fall 2029, funded projects are complete and operational.

Table 3: Potential Risks for Measures 1 and 2

Risk	Effect on GHG emission reductions	Mitigation Strategy
Community opposition: Siting utility-scale renewable energy can be a contentious issue in communities.	Delays may reduce cumulative GHG emission reductions in the near-term (2025 – 2030).	The RRC Program will work to proactively engage and educate local governments before they are approached by renewable energy developers or as early in the process as possible. This develops trust and provides local governments the necessary technical assistance, tools, and resources to encourage early and meaningful public engagement in their communities in zoning and permitting processes.
Supply chain: Materials for solar panels and wind turbines are subject to price volatility. Rising demand for the materials combined with external factors can potentially reduce availability, increase prices.	Delays may reduce cumulative GHG emission reductions in the near-term (2025 – 2030).	In the short term, the RRC Program will remain flexible enough to account for potential supply chain issues. In the longer term, the State of Michigan, through initiatives like the "Make it in Michigan Advanced Manufacturing and Clean Tech Competitiveness Fund," is bringing manufacturing in the clean energy sector to Michigan to help address this challenge.
Workforce: Demand for workers in the renewable energy construction industry	Delays may reduce cumulative GHG emission reductions in the	EGLE will partner closely with labor organizations throughout the RRC Program and will provide subawards to existing State of Michigan workforce development programs. LEO

is much higher than the available talent.	near-term (2025 – 2030).	is creating an office to help transition workers affected by the energy transition. These combined efforts will help address the potential renewable energy industry worker shortage by providing the resources necessary to train/retrain workers and find them high-quality jobs in clean energy industries.
Brownfields: Siting renewables on brownfields pose unique challenges because of higher costs, fears of liability, and in some cases, ongoing environmental cleanups.	Delays may reduce cumulative GHG emission reductions in the near-term (2025 – 2030).	By developing a state-specific program with $10 million to award in grants and technical assistance support, costs and other challenges to renewable energy brownfield development will be reduced. EGLE will follow best practices promoted by the EPA's "RE-Powering America's Land" initiative.

Michigan's Priority Climate Action Plan

Both measures in this grant proposal, the RRC Awards and the Brownfield Renewable Energy Pilot Program, are supported by "Implementing the MI Healthy Climate Plan: Michigan's Priority Climate Action Plan" (Michigan's PCAP). Reduction Measure #1 of Michigan's PCAP is: "Drive clean energy deployment including improving siting for renewable energy and energy storage across Michigan, including on brownfields and former industrial sites and emphasizing equitable access for Michigan's LIDACs." By deploying clean energy to Michigan's electric grid, this PCAP reduction measure will create significant emission reductions across multiple sectors of the economy. Michigan's electric power sector emitted 58.2 million metric tons of carbon dioxide equivalent from the burning of fossil fuels making it one of Michigan's largest sources of emissions. As other sectors electrify, such as transportation and heating for buildings, the resource mix for generating electricity will play a transformational role in meeting Michigan's decarbonization goals.

Michigan's PCAP analyzed the state's 50 percent renewable energy standard by 2030 and found it would have significant impacts. Given the analysis in Michigan's PCAP, and previous analysis for the MI Healthy Climate Plan, EGLE determined it is possible to reach the more ambitious MI Healthy Climate Plan goal of 60 percent by 2030 with CPRG funding. An important consideration of the 2023 legislation is that utilities can downscale the implementation of renewable energy projects should the 50 percent renewable energy goal prove too difficult to accomplish. However, the efforts of the RRC Program could prevent utilities from downscaling efforts and prevent a shift back to fossil fuels. Beyond ensuring the achievement of the 50 percent renewable energy standard, the RRC Program also applies to projects built pursuant to voluntary green pricing programs (where a customer elects to pay a premium to ensure their electricity comes from renewable energy above and beyond that required by law). The 60 percent goal keeps the State of Michigan on track to meet science-based targets and the state's longer-term goal of carbon neutrality by 2050. As of 2023, approximately 12 percent of Michigan's electric grid is made up of renewable energy, including 966 MW of solar and 3580 MW of wind.[2] As detailed in the Technical Appendix of this application, the State of Michigan estimates that approximately 16,475 additional MW of renewable energy and 743 MW of energy storage need to be incentivized via the RRC Program to reach 60 percent renewable energy by 2030.

[2] Electricity Data Browser | U.S. Energy Information Administration | 2024

The measures in this grant application will advance the U.S. Environmental Protection Agency's (EPA) CPRG goals as follows:

1. Achieve significant cumulative GHG reductions by 2030. The RRC Awards will incentivize the local permitting and hosting of the necessary utility-scale renewable energy projects, approximately 16,475 MW of wind and solar and 743 MW of energy storage, to help achieve 60 percent renewable energy by 2030. The Brownfield Renewable Energy Pilot Program will create a model for siting renewable energy projects (which may include energy storage) on brownfields, transforming the renewable energy potential for contaminated lands across Michigan.
2. Both measures will provide substantial community benefits, particularly for LIDACs. Utility-scale and brownfield renewable energy projects will create jobs and encourage economic growth, which will be especially beneficial in municipalities with high unemployment and lower incomes. The RRC Awards will provide municipalities with funding to invest in public goods and services. The renewable energy projects will lead to a reduction in co-pollutants and improvement in air quality in Michigan. Improvements in air quality, particularly for LIDACs near currently operating power plants or those with legacy fossil-fuel pollution, can lead to positive health outcomes including fewer respiratory issues, improved health and well-being, and fewer hospitalizations and lost workdays.
3. The proposed incentive awards for renewable energy projects complement other federal and state funding sources to maximize both GHG reductions and local community benefits. While the existing programs and tax credits help mitigate market barriers, they do not address siting. The proposed technical assistance helps local governments develop the appropriate zoning and permitting processes to become viable locations for renewable energy projects that can then access those other incentive programs. The RRC Awards incentivize local governments to approve proposed projects.
4. Finally, the efforts of the RRC Program can be replicable and scaled across similar jurisdictions to help drive renewable energy deployment across the country. During the grant period, the early success of municipalities that participate in the RRC Awards or the Brownfield Renewable Energy Pilot Program will encourage other Michigan municipalities to welcome renewable energy development. The RRC Program will demonstrate a way for other states to accelerate the siting, zoning, and permitting of renewable energy.

1.b. Demonstration of Funding Need

CPRG implementation funding is necessary to fully implement the proposed GHG reduction measures. EGLE explored other federal and state funds and tax incentives, but these avenues are not sufficient to fully achieve the 17,218 MW of renewable energy projects needed by 2030 (16,475 MW of wind and solar, 743 MW of energy storage).

Table 4: Funding Sources Examined in Connection to Measure 1, RRC Awards

Funding Source	Funding Status	Need for CPRG funding
State of Michigan one-time budget allocation (FY 2024)	EGLE has a one-time budget allocation of $30 million for the RRC Awards pilot program, which launched in 2024. This funding is solely for the financial incentives, not staff support or workforce development.	One-time budget allocation is insufficient to reach 60 percent renewable energy by 2030 goal.

Renewable Energy Siting through Technical Engagement and Planning (R-STEP)	State of Michigan applied for the R-STEP program to support communities in siting renewables. The R-STEP application proposes to consolidate all resources, services, and experts relevant to energy planning and zoning into a one-stop-shop at EGLE called the Renewable Energy Academy. The R-STEP application requested funds for one staff position within EGLE to run the Renewable Energy Academy.	R-STEP funds would not sufficiently support the development of all needed technical assistance, nor would it sufficiently staff the Renewable Energy Academy. Funds from the CPRG would not be used for activities that would be duplicative with the R-STEP funding and would be used to expand and complement R-STEP funding.
Solar for All through the Greenhouse Gas Reduction Fund	If the State of Michigan is awarded the Solar for All funds, it would focus on distributed renewable energy projects, specifically rooftop solar and community-serving solar for low-income households.	The Solar for All funds would not be duplicative to the CPRG funding request. There would be no overlap in the projects funded through either program.
Federal Tax Credits	For renewable energy projects certain tax credits (§45Y, §48E) are available if the project meets all the necessary criteria, with values ranging from 6 percent of the taxable value of a project to as much as 70 percent of the taxable value of a project.	Tax incentives will make projects more cost-effective but that does not solve the challenge of permitting projects at the local level. The tax incentives are insufficient on their own to solve the challenges this proposal seeks to address.
Solar payment-in-lieu-of tax arrangement (PILT) legislation	Passed in 2023, Public Acts 108 and 109 allow local governments and commercial solar energy developments to opt into solar PILT, which allows those governments to take payments of $7,000 per MW of nameplate capacity, depending on facility type, rather than taxes. For projects sited on brownfields, the payments are $2,000 per MW of nameplate capacity.	Solar PILT is only applicable to solar projects. Solar PILT provides local governments with more predictable and stable revenue, but it is not a notable difference in local revenue from previous tax revenue and in some cases is less than local governments would have received. While complementary to the measures included in this proposal, the solar PILT is insufficient on its own in driving local siting of renewables.
MPSC siting process includes community host payment	PA 233 streamlines the siting process for large-scale wind, solar, and storage projects by allowing the MPSC to review proposed projects if a local government does not establish a compatible ordinance. PA 233 requires developers to pay localities $2,000 per MW in community benefits agreements if the MPSC process is utilized.	The RRC Award is meant to incentivize local permitting by offering a greater financial award than the MPSC process, which also saves the developer money. The financial incentives of the MPSC process are mutually exclusive of the RRC Awards.

The goal of Measure 1, to zone, permit, and site 16,475 MW of renewable energy and 743 MW of energy storage, will not be implementable without CPRG funding. With the 2024 RRC Awards pilot program, the one-time budget allocation is expected to incentivize approximately 5,000 MW of renewable energy (3,351 MW) and energy storage (1,571 MW) projects. With CPRG funding, EGLE estimates the RRC Awards will incentivize more than four times the MWs of renewable energy sited through the 2024 pilot, enabling Michigan to reach the critical goal of 60 percent renewable energy by 2030. The CPRG funds will fully staff the proposed Renewable Energy Academy to deliver much-needed technical assistance across the state. While the tax credits will reduce costs of utility-scale projects, these alone have not significantly made permitting and siting of renewable energy easier. Since community buy-in is a critical part of siting renewables, the RRC Awards' focus on local permitting and direct community payments will encourage new hosts to step forward, accelerating the overall trajectory of renewables in Michigan.

Table 5: Funding Sources Examined in Connection to Measure 2, Brownfield Renewable Energy Pilot Program

Funding Source	Funding Status	Need for CPRG funding
EGLE Brownfield Program Financial Incentives	1. Grants and loans to promote the re-use of contaminated sites. 2. Brownfield Site Assessments at no cost to facilitate brownfield redevelopment (with funds from EPA and State of Michigan's "Renew Michigan Grant"). 3. Michigan Brownfield Redevelopment Financing Act of 1996 authorized tax increment financing as a funding tool to help cover associated costs with redeveloping a brownfield.	These funds do not specifically encourage renewable energy on brownfields and capital costs for renewable energy projects are not an eligible activity for the grants or loans program.
EPA State and Tribal Response Program Grants	Michigan received funding from Brownfield categorical grants.	These funds do not specifically encourage renewable energy on brownfields.
Federal and State Incentives	Like the RRC Awards, the Brownfield Renewable Energy Pilot will be able to take advantage of the two listed federal tax credits (§45Y, §48E). The solar PILT for brownfields in Michigan is $2,000 per MW of capacity for projects greater than 2 MW.	These funds and tax credits alone have not encouraged renewable energy on brownfields.

It is difficult to encourage renewables on brownfields without brownfield grants dedicated to renewable projects, technical assistance tailored to the unique challenges of renewable energy on brownfields, and project staff to plan and administer the program. Funds from the CPRG will enable EGLE to create a focused program that incentivizes brownfield renewable energy projects that would not occur otherwise.

EGLE acknowledges the EPA's intention to not fund the same measure in the same location and commits to ensuring projects pursuant to both measures proposed in this application do not receive funding from more than one CPRG implementation grant award within Michigan. Any project funded with other CPRG implementation funds in Michigan will not be eligible to receive CPRG incentive awards or grants through the RRC Program.

1.c. Transformative Impact

EGLE's RRC Program will create transformative impacts that lead to significant GHG emission reductions. The RRC Program measures will transform and accelerate the rate of clean energy deployment, reduce significant GHG emissions, provide substantial community benefits, and further the impact of all other decarbonization efforts in Michigan. Siting renewable energy is the most urgent effort needed to reduce GHG emissions. By decarbonizing the electric grid through siting renewables, other decarbonization goals for transportation, buildings, and industry become more attainable. The efforts of the proposed RRC Program, through the RRC Awards and the Brownfield Renewable Energy Pilot, will streamline renewable energy siting by incentivizing the local permitting and hosting of projects that will be replicable and scalable across Michigan.

The RRC Awards will accelerate deployment of renewable energy across the state, thereby providing jobs, increasing local tax revenue and granting local governments additional funding, and delivering environmental benefits. The additional LIDAC incentive and targeted technical assistance will help LIDACs overcome obstacles that limit their ability to take part in renewable energy planning and siting processes and maximize the community benefits that can be attained through renewable energy projects. The technical assistance provided by the RRC Program's Renewable Energy Academy will encourage early and meaningful public participation and equitable access in the planning and zoning process. The Renewable Energy Academy aims to develop a pipeline of municipalities fully prepared to permit and host renewable energy projects upon a project's proposal.

The EPA's RE-Powering America's Land initiative emphasizes the need for state-specific programs that encourage renewable energy development on potentially contaminated land. States with a dedicated brownfield renewable energy program have more solar capacity installed on contaminated land than states without programs.[3] The CPRG funds are the mechanism that will allow EGLE's Brownfield Program to dedicate time, funding, and staff capacity to developing a state-specific program. The pilot program will be catalytic, creating examples of brownfield renewable energy developments that can be replicated across underutilized lands statewide. The Pilot Program also increases the types of communities that can participate in renewable energy projects, especially in urban areas where available land is limited. As a result of the CPRG funds, EGLE's Brownfield Program will be able to build long-lasting programmatic capacity to support renewable energy projects on brownfields. Currently, Michigan has four RE-Powering projects, and with CPRG funding, the Brownfield Renewable Energy Pilot Program anticipates developing at least ten brownfields with renewable energy, more than tripling the current number of projects.

Section 2: Impact of GHG Reduction Measures

Table 6 below provides an estimate of the cumulative emission reductions in metric tons of carbon dioxide equivalent ($mtCO_2e$) anticipated from the implementation of the RRC Program for two time periods: 2025 to 2030 and 2025 to 2050. Details on quantification methods are included in the Technical Appendix, which explains the methodology and assumptions used to develop the estimated GHG emission reductions associated with each measure. These calculations consider the direct impact of the two measures on the electric power sector. However, as other sectors electrify, renewable energy projects sited in accordance with this proposal will likely aid in further fossil fuel displacement in buildings, transportation, and industry, yielding a greater amount of emissions reductions than the estimates in Table 6.

[3] RE-Powering America's Land | EPA | 2024

Table 6: Cumulative GHG Emission Reductions Anticipated from Implementation of Measures 1 & 2

GHG Reduction Measures	Cumulative GHG emission reductions, electricity sector (mt CO_2e)	
	2025–2030	2025–2050
Measure 1: Renewables Ready Communities Awards	77,104,073.88	455,549,689.69
Measure 2: Brownfield Renewable Energy Pilot Program	6,096.28	30,481.41
Total	**77,110,170.16**	**455,580,171.10**

These conservative estimates find that the RRC Program will reduce over 77,110,170 mtCO_2e by 2030 and 455,580,171 mtCO_2e by 2050 in the electricity sector alone. The estimate only includes the GHG reductions attributable to the CPRG grant. It is assumed that the renewable energy projects that result from the RRC Awards and Brownfield Renewable Energy Pilot Program grants will qualify for a 30 percent tax credit through Section 48 (and 48E) of the U.S. Tax Code, five times the six percent base rate because projects should meet prevailing wage and apprenticeship requirements. As explained in the Technical Appendix, EGLE attributes 70 percent of the emission reductions from the Brownfield Renewable Energy Pilot Program (Measure 2) to the CPRG funds, assuming all projects will also qualify for the 30 percent federal tax credit. The RRC Awards (Measure 1) emission reductions were calculated with the RMI Energy Policy Simulator (EPS) tool which assumes an increased adoption of renewable energy in the business-as-usual scenario (BAU) due to federal tax incentives such as those provided by the Inflation Reduction Act (IRA). Because the BAU scenario already includes IRA tax incentives, the scenario modeled for the RRC Awards accounts for the difference in renewable energy uptake due directly to the CPRG funds and does not take credit for renewable energy uptake or the resulting emissions reductions expected to result from the IRA tax incentives.

The RRC Program will result in a permanent reduction in GHG emissions. For one, there are no foreseeable issues with the lifespan of renewable energy technologies. The U.S. Department of Energy (DOE) expects the average lifespan of a PV module to be 30-35 years, and expected lifespan of wind turbines is 30 years.[4,5] Secondly, due to the significant time, cost, and resource investment of developing renewable energy systems and supporting development of the corresponding workforce, it is extremely unlikely that utilities and other entities would return to higher emitting technologies and practices after disbursement of CPRG funds. Therefore, both measures will have durable emission reduction impacts.

The implementation of the proposal is highly cost effective. The cost effectiveness of the cumulative reduction measures for the period 2025-2030 is $1.67 per ton of CO_2e, and $0.28 per ton of CO_2e reduced for the period 2025-2050. For more details on the costs of each measure, please refer to the Budget Narrative and Budget Spreadsheet included in this application. The cost effectiveness of the proposal could be affected by changes to the RRC Awards amount, disruptions to supply chains, and unforeseen costs associated with the Brownfield Renewable Energy Pilot Program, as detailed in Table 3, "Potential Risks for Measures 1 and 2." However, EGLE does not anticipate these issues to occur nor have significant impact on the GHG reductions in the near or long-term.

[4] Office of Energy Efficiency & Renewable Energy | DOE
[5] Office of Energy Efficiency & Renewable Energy | DOE | 2023

Section 3: Environmental Results – Outputs, Outcomes, and Performance Measures

This proposal supports the EPA's strategic plan Goal 1, "Tackle the Climate Crisis"; Objective 1.1 "Reduce Emissions that cause Climate Change." Specifically, these measures will aggressively reduce GHG emissions from the electric power sector and enable use of renewable energy by ambitiously siting, zoning, and permitting renewable energy projects in partnership with local host communities.

3.a. Expected Outputs and Outcomes

Expected outputs for both measures over the five-year grant period include:

- Number of RRC Awards distributed to incentivize an estimated 16,475 MW of utility-scale solar and wind projects.
- Number of RRC Awards distributed to incentivize an estimated 743 MW of energy storage.
- Number of RRC Awards for projects in LIDACs.
- Number of grants awarded through the Brownfield Renewable Energy Pilot Program.
- Number of grants awarded through the Brownfield Renewable Energy Pilot Program in LIDACs.
- Additional full-time employees or equivalent hired to run the EGLE RRC Program.
- Number of RRC Awards or Brownfield Renewable Energy Pilot Program grants allocated for renewable energy projects in Tribal communities. At least $10 million of incentives will be reserved for projects in Tribal communities.
- Development of the "Renewables Ready Communities Strategic Plan," a comprehensive strategy for siting utility-scale renewable energy and brownfield renewable energy in Michigan.
- Technical assistance materials developed for siting, zoning, and permitting renewables in majority LIDAC communities.
- Technical assistance materials developed for siting renewables on brownfields.
- Number of communities participating in offered trainings for siting, zoning, and permitting renewables.
- Environmental risk monitoring: if there is an environmental risk at one of the brownfield sites, the EGLE Remediation and Redevelopment Division will update the Remediation Information Data Exchange database to select a risk level of the property and follow existing protocols.
- Semiannual progress reports.
- Detailed final report.

Expected outcomes of both measures:

- Reduction in cumulative metric tons of GHG emissions in the electric sector:
  - 2025-2030: 77,110,170.16 $mtCO_2e$
  - 2025-2050: 455,580,171.1 $mtCO_2e$
- Reduction in annual amount of criteria air pollutant emissions by 2030. These measures are projected to decrease criteria air pollutants including sulfur oxides (SOx), nitrogen oxides (NOx), particulate matter (PM 2.5), and other co-pollutants such as volatile organic compounds (VOCs), carbon monoxide (CO), and ammonia (NH3). These reductions will improve overall air quality and provide health benefits. It is anticipated that these co-pollutant reductions will improve air quality in LIDACs, however the calculations in Table 7 below are estimated statewide reductions. See the Technical Appendix for more details.

Table 7: Criteria Air Pollutants and other Co-Pollutant Cumulative Reductions

Co-pollutant	Cumulative metric tons 2025-2030	Cumulative metric tons 2025-2050
SOx	30,425.12 mt	157,758.86 mt
NOx	30,039.87 mt	181,652.68 mt

PM 2.5	6,709.70 mt	28,038.80 mt
VOCs	2,181.54 mt	9,319.94 mt
CO (RRC Awards Only)*	15,119.62 mt	92,661.24 mt
NH3 (Brownfields Only)*	0.16 mt	0.79 mt

**Note: As explained in the Technical Appendix, the Brownfield Renewable Energy Pilot Program emission reductions were calculated with the EPA AVoided Emissions and geneRation Tool (AVERT), which does not calculate reductions for CO. The RRC Awards emission reductions were calculated with the RMI Energy Policy Simulator (EPS) tool, which does not calculate reductions for NH3.*

- Increased staff capacity for EGLE to implement GHG Reduction measures, including administering the RRC Awards, the Brownfield Renewable Energy Pilot Program, and providing technical assistance to local governments.
- Enhanced level of community engagement for renewable energy projects, as measured by the number of actions to engage local governments, organizations, the public at large and residents of disadvantaged communities, etc.
- Number of high-quality jobs created through the siting of renewable energy projects.
- Number of zoning ordinances enacted to facilitate siting renewables.
- Number of permits granted to renewable energy projects.
- Number of Tribal renewable energy projects developed.
- Number of brownfields developed with renewable energy projects.
- Number of MW of solar, wind, and energy storage installed by 2030.
- Achieving the MI Healthy Climate Plan goal of 60 percent renewable energy by 2030.

3.b. Performance Measures and Plan

The following performance measures will track progress towards expected outputs and outcomes.

- Number of RRC Awards disbursed, including tracking and reporting on awardees and the full and partial award expenditure.
- Number of Brownfield Renewable Energy Pilot Program grants awarded, including tracking and reporting on grantee expenditure.
- Benefits to LIDACs, including co-pollutant changes that are quantifiable, number of quality-jobs created, economic benefits, number of community engagements, etc.
- Annual total MW of solar installed and total number of projects sited.
- Annual total MW of wind installed and total number of projects sited.
- Annual total MW of energy storage installed and total number of projects sited.
- Total number of localities that benefit from incentive awards and grants, noting how many are LIDACs or an IRA energy community.
- Annual GHG emission reductions, as well co-pollutant reductions.

EGLE will track progress for each of the listed performance measures through semiannual reports. The disbursement of the RRC Awards and the Brownfield Renewable Energy Pilot Program grants will be tracked based on existing processes in EGLE. The RRC Award pilot uses semiannual reports to track progress on projects that are awarded incentives. Projects will likely be awarded the first half of the financial award upon commencement of project construction and the remaining funds will be disbursed upon project operation. The Brownfield Renewable Energy Pilot Program will track progress on awarded grants through quarterly reports required by the Brownfield Redevelopment grants program.

3.c. Authorities, Implementation Timeline, and Milestones

The State of Michigan has existing legislative and regulatory authority to implement these measures without additional action. Both proposed measures are voluntary and implementation ready. The RRC Awards builds on an existing pilot and the Brownfield Renewable Energy Pilot Program will follow existing guidelines for the EGLE Brownfield Redevelopment grants program. In addition to the Michigan state constitution (Const. 1963, Art. V, § 2, Eff. Jan. 1, 1964) which led to the establishment of EGLE, and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" – as amended most recently in 2023 – provides authority to implement these measures along with PA 3 of 1939 – as amended most recently in 2023 – which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state.

To implement these measures, additional financial support may be necessary. The State of Michigan has the authority to receive and accept "any grant, devise, bequest, donation, gift or assignment of money, bonds or choses in action, or of any property, real or personal" per MCL §§ 21.161. In addition, MCL §§ 18.1384 authorizes EGLE to follow state budget processes to apply for and receive and appropriate federal funds.

For more information, Section 1.a. details the implementation timeline for each measure, along with milestones and responsible parties.

Section 4: Low-Income and Disadvantaged Communities

Based on the Climate and Economic Justice Screening Tool (CEJST), the State of Michigan has 996 census tracts that are identified as disadvantaged, representing 35 percent of Michigan communities. Based on data in the EPA's EJScreen, excluding the census tracts identified as disadvantaged by CEJST, an additional 661 census block groups are considered disadvantaged because they are in the 90th percentile for any of EJScreen's Supplemental Indexes when compared to the national and state average. Finally, 100 census block groups in Michigan are within tribal lands according to EJScreen. Attached to this proposal is a list of all LIDAC census tracts and block groups affected by this proposal, as identified by CEJST and the EPA EJScreen national and state percentiles and geographic area within tribal lands.

4.a. Community Benefits

The RRC Program and its two GHG measures will deliver substantial economic, environmental, and health benefits to LIDACs. The impacts of this proposal on LIDACs, as defined by EPA, will be both statewide and local to where renewable energy projects are sited. Statewide, any effort to mitigate climate change and drastically reduce GHG emissions will greatly benefit communities particularly vulnerable to climate impacts, especially LIDACs that increasingly face risks related to flooding, extreme heat, and air quality issues. In the near term, this grant proposal will improve air quality in Michigan by reducing reliance in the electric power sector on fossil fuel sources such as coal-fired power plants and natural gas. Section 3 discusses how the RRC Program will likely reduce criteria air pollutants and other co-pollutants across the state. Better air quality can lead to improved health outcomes including fewer respiratory issues, hospitalizations, and lost workdays. LIDACs with higher rates of chronic disease will also see health benefits from air quality improvements.

There are additional community benefits for localities that site renewable energy projects through the RRC Awards or Brownfield Renewable Energy Pilot Program grants. While these benefits will be true across localities that participate in either reduction measure, the benefits will be especially impactful in communities that are a majority LIDAC. Benefits from approving and hosting renewable energy projects include an increase in local tax revenue, creation of good-paying jobs, and an increased sense of community cohesion for projects with equitable community engagement.

For the local government recipients of the RRC Awards, the financial awards can support various public services or projects. RRC Awards are encouraged to be used on projects that benefit the whole community, such as repairing roads, adding broadband access, amenities such as a new park or community center, etc. Most utility-scale renewable energy projects in Michigan will occur in rural areas, some of which experience high rates of unemployment and whose local governments are lower-resourced. CEJST census tracts in rural Michigan are often recognized as IRA Energy Communities, which means the communities either had/have a coal plant closure or meet the Fossil Fuel Employment threshold and have high unemployment rates. Wind, solar, and energy storage projects create short-term construction jobs and longer-term employment in the maintenance and operation of the projects. For example, utility-scale wind projects in Michigan create an estimated seven to 11 full time jobs per 100 MW, so a 200 MW windfarm could provide 14-22 local jobs.[6] Throughout the RRC Program, efforts will be made to encourage local workforce development and local hiring.

Additionally, the RRC Awards and the Renewable Energy Academy offers additional support and incentives to ensure all LIDACs, rural and urban, receive the benefits of the State's clean energy transition. Through a subaward to the University of Michigan's Center for EmPowering Communities, EGLE anticipates creating a training for public officials and local government staff to learn how to negotiate community benefit agreements with renewable energy developers. This will aim to maximize returns a community may realize from hosting renewable energy. Oftentimes, under-resourced local governments are unable to secure the maximum benefits possible because of limited knowledge and understanding of the benefit possibilities. The RRC Awards also provide additional incentives to local unit(s) of government that approve and host utility-scale renewable energy projects whose communities are a majority LIDAC, as discussed in section 1.a. The $15 million budgeted for the RRC Awards additional LIDAC incentives will provide an increased dollars-per-MW incentive and may allow for a lower eligible MW threshold for projects located in LIDACs, to help address challenges LIDACs face in adopting renewable energy.

For the Brownfield Renewable Energy Pilot Program, an added benefit of renewable energy on contaminated lands is an improvement in the aesthetics and quality of the local environment. Around 492 census tracts in Michigan are in the EJScreen 90th national percentile for proximity to underground storage tanks and 125 census tracts for Superfund proximity. While brownfields are found throughout Michigan, many brownfields are in urban areas and LIDACs. Encouraging renewable energy on brownfields increases the number of communities that can benefit in locally siting renewable energy, and the jobs and local tax revenue benefits these projects bring. According to the EPA's RE-Powering America's Land Initiative, around 14 percent of all RE-Powering projects report job creation.[7] Technical assistance and workforce development programs can help projects create pre-apprentice job-training and placement programs, which help residents participate in local projects. This was done in the development of the O'Shea Solar Park in Detroit.[8] Finally, cleaning up a brownfield for renewable energy provides numerous environmental benefits and turns blight into an economic opportunity.

EGLE does not foresee potential disbenefits or negative consequences of the RRC Program to LIDACs. However, to try to mitigate any potential unintended negative consequences the program will provide extensive technical assistance, support stakeholder engagement processes, and use reporting mechanisms to monitor and evaluate the RRC Program's progress. To ensure that majority LIDAC

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[6] Clean Energy in Michigan | University of Michigan | 2020
[7] RE-Powering America's Land Initiative Benefits Matrix | EPA | March 2023
[8] Clean Energy in Michigan | University of Michigan | 2020

communities equally participate in and benefit from the RRC Awards, the Brownfield Renewable Energy Pilot Program grants, and the Renewable Energy Academy, performance measures will track and evaluate program progress, as described in Section 3.b. For example, semiannual reports will track the types of communities that are awarded RRC Awards and Brownfield Renewable Energy Pilot Program grants, including localities that are majority LIDAC. Further tracking will measure progress on the number of high-quality jobs created, the financial benefits realized, the estimated co-pollutant and criteria air pollutant reductions, and other qualitative and quantitative benefits. The program intends to focus marketing, outreach, and technical assistance to LIDACs through both the RRC Awards and Brownfield Renewable Energy Pilot Program grants. If semiannual reports indicate that LIDACs are not receiving at least 40 percent of the financial benefits, the program will be flexible enough to find ways to increase program participation in LIDACs.

4.b. Community Engagement

EGLE conducted extensive community outreach and engagement during the development of the "Implementing the MI Healthy Climate Plan: Michigan's Priority Climate Action Plan." Public feedback was incorporated into the PCAP Reduction Measure #1, related to this proposed program. Community engagement for Michigan's PCAP built on strategies used in the development of the 2022 MI Healthy Climate Plan. These strategies included leveraging and strengthening existing relationships with advisory groups and local partners as well as additional in-person and virtual input sessions.

LIDAC Input in the State of Michigan Climate Pollution Reduction Grant Process

EGLE regularly meets with the Michigan Advisory Council on Environmental Justice, the Council on Climate Solutions, works with municipalities through the EGLE Catalyst Communities program, and has strong relationships with regional planning districts, labor unions and associations, and many grassroots and frontline partners, including groups in all regions of Michigan. EGLE consistently meets with all twelve federally recognized Tribal governments in Michigan and through the CPRG PCAP planning process, met bi-weekly with the Tribes that received CPRG Planning grants. Through a CPRG Planning grant subaward to the Inter-Tribal Council of Michigan, EGLE will continue to engage with Tribes in a meaningful way as the State develops its Comprehensive Climate Action Plan (CCAP). Another CPRG Planning grant subaward is to the University of Michigan to help EGLE develop a benefits analysis for LIDACs for the CCAP.

The Michigan PCAP engagement sessions were developed with consideration of EGLE's core engagement principles including equity, accessibility, transparency, continuous improvement, and a place-based focus. In September 2023, EGLE released a Request for Information (RFI) to get early and wide-ranging feedback on design and process of MI Healthy Climate Plan strategic implementation and meaningful public participation. The feedback received from this RFI was used to develop the methods and objectives of the PCAP regional public input sessions. The five in-person input sessions occurred in November and December of 2023, held in locations across Michigan including Detroit, Grand Rapids, Flint, Marquette, and Petoskey. One additional in-person session was held in Acme to gather specific input from federally recognized Tribes in Michigan during a quarterly Michigan Tribal Environmental Group meeting. EGLE also held two virtual public listening sessions.

The five in-person input session locations were selected with LIDACs at the forefront. Of the six counties with the highest amount of census tracts identified as LIDACs, five of them are within proximity to Detroit and Flint, comprising 55 percent of all census tracts identified by CEJST as LIDACs. The remaining county is Kent County, where the Grand Rapids engagement was held. Petoskey and Marquette also have identified LIDAC census tracts and are identified by the IRA as Energy Communities. EGLE made a deliberate effort to ensure that voices from low-income, disadvantaged, and historically underserved

communities were included in engagement. Environmental justice and accessibility were considered before, during, and after input sessions. EGLE ensured that invitations and registrations for the in-person sessions were shared via an extensive environmental justice contacts listserv along with targeted outreach to trusted messengers and coalitions within LIDAC communities. EGLE also provide a variety of ways and formats for the public to submit comments and feedback.

Sessions were planned to maximize community participation. For example, events were held in the evening from 6-8 p.m. on weekday nights and food and refreshments were provided. Arabic, Spanish, and ASL translation services were advertised in advance of the events, although none were requested. Most locations were chosen with local partners and emphasized access to public transit. Notable partnerships included: the Detroit input session was held at the International Brotherhood of Electrical Workers Local 58 Zero Net Energy Center in partnership with the Southeast Michigan Council of Governments (CPRG Planning Grant MSA recipient); the Grand Rapids input session was held in partnership with the Grand Valley Metropolitan Council (CPRG Planning Grant MSA recipient); and the Flint input session was held at the Michigan State University (MSU) College of Human Medicine in partnership with the MSU Department of Public Health, and Pediatric Public Health Initiative.

At each session, EGLE provided a brief overview of the MI Healthy Climate Plan, and the rest of the time was spent in group activities, developing, and sharing ideas on how to implement the MI Healthy Climate Plan in line with the CPRG program. Virtual listening sessions were designed as an open-forum comment period for Michiganders to discuss any topic as it related to prioritization of measures for inclusion in the PCAP and broader MI Healthy Climate Plan implementation. As a result of the in-person and virtual engagement opportunities, EGLE reached approximately 400 individuals who provided 1,500 comments, project ideas, and feedback. Post-event surveys for the in-person sessions and the virtual listening sessions found that 90 percent of attendees increased their understanding of the MI Healthy Climate Plan. As a final form of public engagement in completing Michigan's PCAP, EGLE released draft PCAP measures for public feedback and received 66 survey responses. Changes were incorporated into the PCAP measures based on this feedback.

For ongoing outreach, EGLE maintains a website on the MI Healthy Climate Plan and associated CPRG activities, which helps make information publicly accessible and increases transparency in planning processes. EGLE updates its website regularly with ways to get involved, key deadlines for input, and CPRG opportunities of interest to community partners. EGLE primarily promotes public engagement opportunities through emails, social media, and through pre-existing relationships with community-based organizations and nonprofits that directly engage community members.

Meaningful Engagement in the Implementation of the RRC Program

In the development and implementation of the proposed GHG reduction measures, EGLE will continue building on engagement successes with Michigan communities with an emphasis on equitable involvement of LIDACs. EGLE's updated Public Participation Policy and Language Access Plan guide engagement efforts to include a diversity of linguistic, cultural, institutional, geographic and other perspectives throughout program development and implementation. EGLE adheres to the Statewide Meaningful Language Access Coordination Act of 2023, which requires state departments to take reasonable steps to help Michiganders with limited English proficiency access state services. In general, EGLE provides translation and interpretation services as needed and uses a four-factor analysis to determine if and when language access issues arise. When seeking public input, EGLE offers a variety of opportunities for community members to provide input – from virtual engagements to different types of public meetings – to increase the diversity and reach of Michiganders and stakeholders engaged in EGLE's work. Through the CPRG grant opportunity, EGLE will continue to closely work with the Michigan

Advisory Council on Environmental Justice, Tribal governments in Michigan, and other environmental justice partners, and anticipates forging new partnerships.

In developing the 2024 RRC Awards pilot, EGLE engaged a variety of stakeholders including local officials from municipalities with utility-scale renewable energy projects, renewable energy developers, electric utilities, and staff of the MPSC. Research on the barriers to siting and zoning renewable energy from the University of Michigan's Center for EmPowering Communities also informed the RRC Awards pilot. Initial outreach for the pilot launched in early 2024 and so far, has included a public webinar on the RRC Awards program and email marketing targeted to Michigan Public Service Commission listservs, members of the Michigan Energy Innovation Business Council, Michigan Township Association, Michigan Association of County, Michigan Association of Planning, and Michigan Municipal League. The webinar had over 250 registrants and further outreach is planned.

The CPRG-funded RRC Program will incorporate lessons learned from the 2024 RRC Awards pilot. The success of RRC Awards relies on offering extensive support and early engagement with local governments, so they understand the expectations and rewards of potentially hosting renewables. These early engagements are critical for a successful buildout of renewable energy and will help ensure communities feel satisfied and proud of their efforts. EGLE intends for the RRC Program's Renewable Energy Academy technical assistance and community engagement to be delivered in part through CPRG-funded EGLE staff and through CPRG-contracted outreach and engagement support to ensure state-wide coverage. The Renewable Energy Academy will provide a community-centered approach to proactive education and engagement on siting and planning for renewable energy. For example, the Renewable Energy Academy will provide guidance to municipalities on available zoning pathways and how to best reflect their community's priorities and zoning preferences through municipal renewable energy plans. These offerings are intended to be provided to municipalities that are not currently working with a renewable energy developer to ensure that community conversations and educational sessions can occur prior to a proposed development, increasing transparency throughout the entire process.

Each community holds varying levels of trust in the state government, so having a suite of resources provided by many different organizations through the program could ease community concerns. If awarded R-STEP funds, EGLE intends to partner closely with the Michigan State University Extension network, University of Michigan's Center for EmPowering Communities, the Michigan Association of Planners, and other trusted partners. While the majority of EGLE's outreach will be directly with local governments, EGLE will also provide guidance on how local governments can meaningfully involve the public in the decision-making process around zoning and permitting renewable energy.

The Brownfield Renewable Energy Pilot Program will also involve extensive community engagement. As the EPA RE-Powering America's Land initiative recommends, any state program addressing site reuse for renewable energy needs to coordinate early and consistently with stakeholders. These stakeholders include renewable energy developers, site owners, municipal agencies, regional and local economic development organizations, electric utilities, environmental justice community organizations, and labor organizations, among others. Early and consistent engagement is especially important in LIDACs, where there may be less trust in the government and greater need to put contaminated land back into reuse. The Brownfield Renewable Energy Pilot Program will develop a community engagement guide and all grants awarded will require community engagement throughout the project process. The Brownfield Renewable Energy Pilot Program will build on the success of EGLE's Brownfield Program, which engages with local governments, community groups, and communities throughout the state through regional meetings, trainings, webinars, and workshops. There are Brownfield Redevelopment Program

Coordinators who live and work in each of EGLE's ten District Offices, ensuring outreach coverage to the entire state.

Finally, as a part of the RRC Program, EGLE will reserve $10 million for either RRC Awards or Brownfield Renewable Energy Pilot Program grants for renewable energy projects in Tribal communities. Close partnerships with Tribal governments and the Inter-Tribal Council of Michigan ensures that EGLE and Tribes will work together to successfully disburse the funds to Tribal communities. If selected for R-STEP funding, the EGLE Renewable Energy Academy plans to develop technical assistance for Tribes. Through CPRG funding, EGLE will have the necessary staff to ensure technical assistance reaches Tribal communities. The Inter-Tribal Council of Michigan provided a letter of commitment for this application.

Section 5: Job Quality

To meet the surge in demand for developing renewable energy projects created by this program, Michigan anticipates the need for a significant increase in skilled workers. Key objectives in the MI Healthy Climate Plan are to spur economic development, create good-paying jobs, and position Michigan as a leader in climate action. Workforce development is a critical component on the path to decarbonization. EGLE and the Michigan Department of Labor and Economic Opportunities (LEO) support education, outreach, and other training activities that provide Michigan businesses, communities, and citizens with information to make informed climate and energy decisions with special attention being given to energy equity issues.

Through CPRG funding, EGLE will subaward existing workforce development programs that leverage worker-centered training models, pre-apprenticeship, and registered apprenticeship programs to ensure workers are receiving the necessary skills to meet the growing demand for renewable energy workers. These programs may offer industry-specific training as well as education on standards and safety procedures. To ensure high-quality jobs and workforce participation from LIDAC participants, Michigan aims to expand equitable access to recruit workers through targeted outreach with trusted, local community partners, train workers in market-leading, worker-focused training and apprenticeship programs, place workers in high-quality, family-sustaining careers that prioritize worker rights, and retain workers by ensuring wrap-around services that enable LIDAC workers to enter and stay in training programs.

Modeling after the eight Good Jobs Principles developed by the U.S. Department of Labor and Department of Commerce, Michigan will prioritize workforce development that meets high labor standards. Additionally, Michigan will support a workforce that empowers workers to freely join and form unions, ensures job security and safe working conditions, cultivates a supportive organizational culture, provides fair and transparent pay, and promotes skills development and career advancement opportunities for all workers. This will apply for all partners involved in implementing the GHG reduction measures, including contractors, sub-contractors, and sub-awardees. For the RRC Awards, eligible projects must meet the labor requirements that comply with the Davis-Bacon Act and that meet or exceed the requirements established in Michigan under clean energy legislation passed in 2023 (including in PA 233 of 2023). These requirements include, but are not limited to, paying at least the prevailing wage rate standard, requiring construction contractors participate in a Department of Labor certified apprenticeship program, and requiring contractors to enter into a project labor agreement where permitted by law. In addition to Davis-Bacon Act requirements, strategies to ensure these measures support high-quality jobs may include:

- Ensure workers' free and fair choice to collectively bargain/to join or form a union.
- Remain neutral in union organizations/operations with the use of the Project Labor Agreement and prioritize local workforce pipelines.

- Hire certain percentage of workers from LIDAC workforce development training programs.
- 'High road' labor practices (e.g., family-sustained benefits, predictable work schedules, retirement contributions).
- Include qualifying as a minority- and/or women-owned business or businesses in historically underutilized business zones (as defined by Small Business Administration's "HUBZone").
- Demonstrate a commitment to paying prevailing wages and paying at least the median area income for all workers (where prevailing wage is not required by law).

Overall, Michigan will continue to partner with labor organizations including unions and workers' rights groups to develop best practices that lift up Michigan workers, families, and businesses. In the first few years of the CPRG grant, Michigan will further identify anticipated workforce shortages that could prevent the state from achieving the goals of these measures and identify potential solutions and partners at the state, regional, and/or local level that are equipped to help address those challenges.

Section 6: Programmatic Capability and Past Performance

Listed below are five relevant federally funded assistance agreements within the last three years. Key to EGLE's success in meeting federal funding requirements are its staff; attached to this proposal are the resumes of EGLE staff members who are key project members in this grant proposal. For the RRC Awards, the team running the current pilot project have graduate degrees in environmental policy and planning, geospatial data sciences, and sustainable systems and experience in participatory planning, proactive zoning, and community engagement in renewable energy projects. The EGLE Brownfield Program is highly regarded. Most of the staff have backgrounds in the environmental sciences and the Brownfield Program staff who contributed to this grant proposal are "Climate Liaisons," meaning they work with the Office of Climate and Energy to further integrate climate considerations into EGLE's work.

Leaking Underground Storage Tank Trust Fund (LUST)

- Program Assistance Agreement Number: (Cooperative Agreement #) LS-97534216
- Funding Agency: U.S. Environmental Protection Agency
- Assistance Listing Number (e.g., CFDA number): 66.805
- Description: The LUST grant is an ongoing, two-year grant from the EPA that provides funds to ensure the appropriate investigation and cleanup of petroleum release sites from leaking underground storage tanks for the protection of human health and the environment.
- Funding Agency Contact: Ethel Crisp, crisp.ethel@epa.gov, 312-353-1442
- Status: Ongoing. The LUST grant is a two-year grant to fund EGLE's implementation of the LUST program. EGLE reports to the EPA biannually on various program metrics.
- Reporting History: EGLE's Remediation and Redevelopment Division (RRD) submitted adequate and timely biannual reports to the EPA about progress toward achieving the expected outputs and outcomes, challenges to meeting expected outputs and outcomes during the reporting period, and strategies to address such challenges.

Section 106 Monitoring Initiative

- Program Assistance Agreement Number: 01E01479-0
- Funding Agency: U.S. Environmental Protection Agency
- Assistance Listing Number: 66.419
- Description: This grant included a project titled, "Climate Change Monitoring Plan," which was intended to outline objectives and a potential sampling plan for the Great Lakes Watersheds Assessment, Restoration, and Management Section to measure impacts to biological stream communities from climate change.
- Funding Agency Contact: Ed Hammer, hammer.edward@epa.gov, 312-886-3019

- Status: Complete. This project deliverable is complete and the Section developed a Quality Assurance Project Plan (QAPP) with a project start date of summer 2024.
- Reporting History: The Michigan Department of Environment, Great Lakes, and Energy's Water Resources Division submitted annual reports to the EPA about progress toward achieving the expected outputs and outcomes, challenges to meeting expected outputs and outcomes during the reporting period, and strategies to address such challenges.

Wetland Program Development Grant – Shorelines and Shallows

- Program Assistance Agreement Number: CD00E02070
- Funding Agency: U.S. Environmental Protection Agency
- Assistance Listing Number: 66.461
- Description: Developing Tools to Protect and Restore Wetland Shorelines and Shallows
- Funding Agency Contact: Kristen Faulhaber, Faulhaber.kristen@epa.gov, 312-353-4378
- Status: Complete. This project has significantly advanced Michigan's ability to address the challenges and improve protection of riparian wetlands on inland lakes statewide.
- Reporting History: EGLE submitted annual reports to the EPA about progress toward achieving the expected outputs and outcomes, challenges to meeting expected outputs and outcomes during the reporting period, and strategies to address such challenges. Annual reports to the EPA included funded activities and explained progress towards the expected environmental outputs and outcomes.

State Clean Diesel Grant Program

- Program Assistance Agreement Number: 00E66606
- Funding Agency: U.S. Environmental Protection Agency
- Assistance Listing Number: 66.04
- Description: Michigan Diesel Emission Reduction Strategy supports a just transition to a low carbon economy with program priorities to implement vehicles, engines, or equipment replacements that reduce diesel engine particulate matter (PM2.5), ozone, and oxides of nitrogen (NOx) emissions.
- Funding Agency Contact: Julia Frusciante, frusciante.julia@epa.gov, 312-886-1478
- Status: Complete. Michigan submitted reporting in a timely matter and received an additional award to continue the program.
- Reporting History: EGLE's Materials Management Division submitted adequate and timely annual reports to the EPA about progress toward achieving the expected outputs and outcomes, challenges to meeting expected outputs and outcomes during the reporting period, and strategies to address such challenges.

Superfund Management Assistance Cooperative Agreement

- Program Assistance Agreement Number: (Cooperative Agreement #) V-07E00776
- Funding Agency: U.S. Environmental Protection Agency
- Assistance Listing Number: 66.802
- Description: Superfund Management Assistance annual grant funding is used to provide technical and community relations support for Federal lead projects in Michigan. Eligible activities under the grant include technical assistance, community relations assistance, legal support, and project coordination and review.
- Funding Agency Contact: Lindaa Ross, ross.lindaa@epa.gov, 312-353-6626
- Status: Ongoing.
- Reporting History: EGLE's Remediation and Redevelopment Division submits adequate and timely bi-annual progress reports to the EPA about state involved site progress and expenditure.

NOTE: USE OF THIS EXAMPLE COVER PAGE IS OPTIONAL. IF THIS INFORMATION IS PROVIDED IN A DIFFERENT FORMAT, EPA WILL NOT REVIEW AN APPLICATION UNFAVORABLY.

CPRG IMPLEMENTATION GRANTS COMPETITION
COVER PAGE FOR APPLICATION

APPLICANT INFORMATION

Organization	Michigan Department of Environment, Great Lakes, and Energy/Office of
Primary Contact Name	Cory Connolly
Phone Number	(517) 881 - 8972
Email Address	ConnollyC3@michigan.gov

TYPE OF APPLICATION ☑ Individual Applicant ☐ Lead Applicant for a Coalition

If lead applicant for a coalition, provide a list of the coalition members below.

FUNDING REQUESTED: *Provide total EPA CPRG Implementation Grant funding requested.*

$ 129,104,391

APPLICATION TITLE: *Provide the title of your proposed project.*

Accelerating Siting, Zoning, and Permitting of 60% Renewable Energy in Michigan

BRIEF DESCRIPTION OF GHG MEASURES: *Describe each GHG reduction measure contained in the application (1-2 sentences each).*

Measure 1: Renewables Ready Communities Awards will provide financial incentives to local unit(s) of government that approve and host utility-scale renewable energy and energy storage projects through local permitting processes. These incentive awards will provide additional revenue for local governments to spend in their communities for each megawatt of renewable energy installed.
Measure 2: Brownfield Renewable Energy Pilot Program will create a strategy for encouraging renewable energy on brownfields and will provide dedicated funding through the Michigan Department of Environment, Great Lakes, and Energy's Remediation and Redevelopment Division's Brownfield Program to provide grants for renewable energy projects on brownfields.

SECTORS: *Identify the sector(s) associated with the GHG reduction measures included in the application.*

- [ ] Industry
- [x] Electricity Generation
- [ ] Transportation
- [ ] Other (please describe)
- [ ] Commercial and Residential Buildings
- [ ] Agriculture/Natural and Working Lands
- [ ] Waste and Materials Management

EXPECTED TOTAL CUMULATIVE GHG EMISSION REDUCTIONS

For all proposed measures combined, provide the estimated cumulative GHG reductions:

Estimated cumulative GHG reductions for 2025-2030 (in metric tons)

77,110,170

Estimated cumulative GHG reductions from 2025-2050 (in metric tons)

455,580,171

LOCATIONS: *List the primary location(s) where the proposed measures will be implemented*

City

State; Territory; Federally recognized Tribe State of Michigan

APPLICABLE PRIORITY CLIMATE ACTION PLAN(S) (PCAP) ON WHICH MEASURES ARE BASED

PCAP Lead Organization(s): Michigan Department of Environment, Great Lakes, and

PCAP Title(s): Implementing the MI Healthy Climate Plan: Michigan's Priority Climate

PCAP Website link(s) (if applicable): https://www.michigan.gov/egle/about/organization/c

List of GHG reduction measures and PCAP page reference for each measure:

Measure 1: Drive clean energy deployment including improving siting for renewable energy and energy storage across Michigan, including on brownfields and former industrial sites and emphasizing equitable access for Michigan's LIDACs (pp 62-66).

Section 7: Budget Narrative for the Renewables Ready Communities Program

7a. Budget Detail

This budget narrative uses the EPA's budget categories to explain costs associated with the Renewables Ready Communities Program through the Renewables Ready Communities Awards (Measure 1) and the Brownfield Renewable Energy Pilot Program (Measure 2). Below is a detailed description of the budget requested including major work components and a description of how each budget item relates to the emission reduction activities. Additional details are included in the attached optional budget spreadsheet.

1. Measure 1: Renewables Ready Communities Awards

See Measure 1 Budget tab in the attached budget spreadsheet within this proposal for itemized costs associated with each budget category. Measure 1 of the Renewables Ready Communities Program, the Renewables Ready Communities Awards (RRC Awards), will provide financial incentives to local governments that approve and/or host utility-scale renewable energy and energy storage projects through local permitting processes.

a. Personnel and Fringe:

All staff are considered "Full Time Equivalent" (FTE). The fringe rate is an estimate. Official retirement and insurance rates are unknown for future years, so the State of Michigan uses a conservative estimate based on current conditions that provides 40 percent of total payroll for fringe expenses for senior staff positions and 60 percent for more junior staff positions, as staff with lower classification levels typically have a smaller salary, but benefits comprise a higher percentage of their total payroll. Benefit estimates include costs for pension, FICA (social security), dental, health, and vision insurance, leave balance payouts when employees separate from state service, and other post-employment retirement costs like retirement health care plans.

Renewables Ready Communities Program Manager (1 FTE, State Administrative Manager 15 or "SAM 15"):

- Annual salary: Salary is estimated to be $140,141 which includes a 5% Cost-of-Living-Adjustment (COLA) for Year 1. COLA of 2.5% is also included for Years 2-5, plus 4% Performance Pay annually (SAM 15 is eligible for Performance Pay and the EGLE Finance Division uses 4% of salary as an estimate).
- Percent of time assigned to project: 100%
- Fringe benefits: Estimated to be 40% of salary plus an additional 1.5% (of salary plus fringe) for terminal leave.
- Total cost for the budget period: $799,505 salary, $336,591 fringe. Total cost for budget period is $1,136,097 for 1 FTE.
- Description of job: Manage five staff and develop the Renewables Ready Communities Program and administer RRC Awards as proposed in this grant application.

Renewables Ready Communities (RRC) Energy Experts (4 FTE, Departmental Analyst 12):

- Annual salary: Salary is $88,661 which includes a 5% Cost-of-Living-Adjustment (COLA) for Year 1. COLA of 2.5% is also included for Years 2-5.
- Percent of time assigned to project: 100%
- Fringe benefits: Estimated to be 60% of salary plus an additional 1.5% (of salary plus fringe) for terminal leave.

- Total cost for the budget period: Per FTE it is $466,029 salary, $290,802 fringe. For all four FTE it is $1,864,117 for salaries and $1,163,209 for fringe benefits. Total cost for budget Period is $3,027,326 for 4 FTE.
- Description of job: Four FTEs will help administer technical assistance for local renewable energy projects across the state. The FTE will require skills in energy planning, zoning, GIS and modeling, and community and stakeholder engagement for local renewable energy projects.

b. Travel

It is estimated that all five FTE may travel ~200 miles a month for the five-year duration of this grant, as projects will require outreach meetings with in-state local officials and communities. Standard rate for mileage is $.44/mile per State of Michigan travel rates. Some travel will require overnight lodging. The budget includes five $85/night hotel stays each year for all five FTE, following State of Michigan's approved travel rates, and $59/day per diem for two days per FTE annually.

Each FTE is also budgeted one out-of-state conference attendance annually. For this, one $850 flight, two nights of $100/night hotel lodging, and three $59/day per diem are budgeted.

The total estimated travel expense over the grant period is $75,045.

c. Equipment

Measure 1 of the RRC Program is not expected to incur investments in equipment that has a cost of $5,000 or more per unit.

d. Supplies

Not applicable.

e. Contractual

Renewables Ready Communities Strategic Plan: Utility-Scale Renewable Energy, Energy Storage

- Contract activities and brief scope of work: EGLE will spend $200,000 in the first year to contract technical analysis on strategically siting renewable energy and energy storage in Michigan. This will include an assessment of where and how the state should direct efforts for utility-scale renewable energy projects and a strategic plan of how to do so by 2030, as well as efforts from 2030-2050.
- Proposed duration: Year 1, Fall 2024-Fall 2025
- Proposed procurement method: EGLE will follow the State of Michigan competitive contract procurement policies.

Language Translation or Interpretation Services

- Contract activities and brief scope of work: To ensure language access at public meetings and/or through written materials EGLE develops, EGLE budgeted $15,000 a year for language translation and interpretation services for a total of $75,000 across the five-year grant period.
- Proposed duration: Available funding for each year of the grant.
- Proposed procurement method: Non-competitive unless the individual contracted request is in excess of $10,000, in which case EGLE will use a competitive process.

Regional Stakeholder Engagement and Technical Assistance Support

- Contract activities and brief scope of work: Measure 1 requires extensive outreach to all townships and municipalities across Michigan. To best support the outreach and community engagement efforts, EGLE will contract services for regional stakeholder engagement and technical assistance support. This contracted service will work with the Renewables Ready Communities Program, and specifically the RRC Awards and the Renewable Energy Academy, to ensure the broadest and deepest reach of the RRC Program, the RRC Awards, and the technical assistance offerings. The Regional Stakeholder Engagement and Technical Assistance Support will ensure that LIDACs are given priority outreach and engagement. EGLE budgeted a total of $5 million for the contract service, with $1.5 million in the first year to ensure extensive engagement in the first year of the program, $1 million the following three years, and $500,000 in the last year, when the RRC Awards require less engagement and assistance.
- Proposed duration: Contract will last Year 1 through Year 5.
- Proposed procurement method: EGLE will follow the State of Michigan competitive contract procurement policies.

f. Other

Subaward to University of Michigan Center for EmPowering Communities

- The Center for EmPowering Communities will develop technical assistance materials for the Renewable Energy Academy, as described in the grant proposal. Specifically, the Center will create technical assistance for LIDACs that provides guidance on planning for renewable energy goals, community benefits agreements negotiation, use of tax revenue funds from the development, and financial rewards projection of hosting renewable energy projects.
- The Center will receive $150,000 a year for all five years of the grant for a total of $750,000.

Renewable Ready Communities Awards (RRC Awards)

- Financial incentives to local governments that approve and/or host utility-scale renewable energy and energy storage projects through local permitting processes. RRC Awards will likely be $5,000 per MW, up to a maximum of $3 million per award. According to calculations in the attached Technical Appendix, Michigan will need an estimated 7,029 MW of solar, 9,446 MW of wind, and 743 MW of storage, for a total of 17,218 MW. At $5,000/MW this results in a total of $86,087,651 of RRC Awards. With an additional 5% buffer for an energy demand increase beyond our 2030 projections, the total is $90,392,034 which rounds to $90.4 million.
- Budgeted to deliver three rounds of the RRC Awards for a total of $90.4 million. Evenly split between Year 1-Year 3, the amount of incentives awarded per year is $30,133,334.

LIDAC Additional Incentive

- The RRC Program will set aside a total of $15 million as an additional incentive to local unit(s) of government that approve and host utility-scale renewable energy and energy storage whose communities are a majority low-income and disadvantaged.

Workforce Development Program Support

- Workforce development programs in EGLE and the Department of Labor and Economic Opportunity (LEO) support apprenticeship programs related to renewable energy sector and partnerships with the MI Energy Workforce Development Consortium, Center for Energy Workforce Development, and Michigan Works!. EGLE will subaward to such existing workforce development programs based on analysis of what is best suited to meet the workforce needs of the Renewables Ready Communities Program and based on input from Michigan stakeholders,

including labor unions. EGLE budgeted $800,000 total, with a higher amount allocated in Year 1 and Year 2 and a smaller amount for Years 3-5.

Conference registration for Renewables Ready Communities Program staff.

- Estimated $1,000 per personnel per year; total $30,000 over five years for six staff.

Employee training funds for Renewables Ready Communities Program staff.

- Estimated $1,000 per personnel per year; total $30,000 over five years for six staff.

Laptops, cell phones, VPNs, and other supplies are calculated at 5% of total wages and fringe for all budgeted personnel. This captures costs for information technology equipment, maintenance, and support for Renewables Ready Communities Program staff. The total for five FTE for all five years is $208,171.

g. Indirect costs

The negotiated FY24 indirect rate for EGLE is 16.65%. This has been applied to salary and fringes for State of Michigan staff that will be hired to manage the program. The total for five FTE for five years is $693,210.

2. Measure 2: Brownfield Renewable Energy Pilot Program

See Measure 2 Budget tab in the attached CPRG Implementation Grants Budget Table within this proposal for itemized costs associated with each budget category. Measure 2 of the Renewables Ready Communities Program, the Brownfield Renewable Energy Pilot Program, will create a strategy for encouraging renewable energy on brownfields and will provide dedicated funding through EGLE's Remediation and Redevelopment Division's Brownfield Program to provide grants for renewable energy projects on brownfields.

a. Personnel and Fringe:

The fringe rate is an estimate. Official retirement and insurance rates are unknown for future years, so the State of Michigan will use a conservative estimate based on current conditions that provides 40% of total payroll for fringe expenses for senior staff positions and 60% for more junior staff positions, as staff with lower classification levels typically have a smaller salary, but benefits comprise a higher percentage of their total payroll. Benefit estimates include costs for pension, FICA (social security), dental, health, and vision insurance, leave balance payouts when employees separate from state service, and other post-employment retirement costs like retirement health care plans.

Brownfield Renewable Energy Pilot Program Manager (FTE, Environmental Quality Specialist 15):

- Annual Salary: Salary is $121,459 which includes a 5% Cost-of-Living-Adjustment (COLA) for Year 1. COLA of 2.5% is also included for Years 2-5.
- Percent of time assigned to project: 100%
- Fringe benefits: Estimated to be 40% of salary plus an additional 1.5% (of salary plus fringe) for terminal leave.
- Total cost for the budget period: $638,428 salary, $268,779 fringe. Total cost for budget period is $907,207 for 1 LTE.
- Position description: Develop and administer the Brownfield Renewable Energy Pilot Program, conduct extensive community and stakeholder engagement, and deliver technical assistance.

b. Travel

It is estimated that the one FTE may travel ~400 miles a month for the five-year duration of this grant, as projects will require outreach meetings with in-state local officials and communities. Standard rate for mileage is $.44/mile per State of Michigan travel rates. Some travel will require overnight lodging. The budget includes monthly $85/night hotel stays each year for one FTE, following State of Michigan's approved travel rates, and $59/day per diem for two days monthly.

One FTE is also budgeted one out-of-state conference attendance annually. For this, one $850 flight, two nights of $100/night hotel lodging, and three $59/day per diem are budgeted.

The total estimated travel expense over the grant period is $28,875.

c. Equipment

Measure 2 of the RRC Program is not expected to incur investments in equipment that has a cost of $5,000 or more per unit.

d. Supplies

Not applicable.

e. Contractual

Renewables Ready Communities Strategic Plan: Brownfield Pilot Program Development

- Contract activities and brief scope of work: EGLE will spend $200,000 in the first year of the grant to contract support for technical analysis to develop the Brownfield Renewable Energy Pilot Program. This will include an assessment of where and how the state should direct efforts for brownfield renewable energy and energy storage and a strategic plan of how to do so by 2030 and then by 2050.
- Proposed duration: Year 1, Fall 2024-Fall 2025
- Proposed procurement method: EGLE will follow the State of Michigan competitive contract procurement policies.

f. Other

Brownfield Renewable Energy Pilot Program Grant Awards

- In Spring 2025, the Brownfield Renewable Energy Pilot Program will launch a grant program to help fund renewable energy projects on brownfields. Total, the grant program will disburse $10 million in grants starting in Year 1 (Spring 2025) and again in Year 2 (Spring 2026). The grant program will likely be run through the EGLE Brownfield Redevelopment grant program and will match the program's policies.

Subaward to University of Michigan Center for EmPowering Communities

- The Center for EmPowering Communities will develop technical assistance materials for the Brownfield Renewable Energy Pilot Program as described in the grant proposal. This could include a guidebook for siting renewable projects on brownfields, community engagement at brownfield renewable energy sites, etc. These materials will be a part of the RRC Program's Renewable Energy Academy.
- The Center will receive $150,000 total for all five years of the grant. Year 1 the Center will receive $50,000 and every year thereafter $25,000.

Conference registration for Renewables Ready Communities Program staff.

- Estimated $1,000 per year; total $5,000 over five years for one staff.

Employee training funds for Renewables Ready Communities Program staff.

- Estimated $1,000 per year; total $5,000 over five years for one staff.

Laptops, cell phones, VPNs, and other supplies are calculated at 5% of total wages and fringe for one staff person. This captures costs for information technology equipment, maintenance, and support for Renewables Ready Communities Program staff. For one FTE for the Brownfield Renewable Energy Pilot Program, the total for five years is $151,050.

g. Indirect costs

The negotiated FY24 indirect rate for EGLE is 16.65%. This has been applied to salary and fringes for State of Michigan staff that will be hired to manage the program.

Consolidated Budget by Year:

BUDGET BY YEAR							
COST-TYPE	CATEGORY	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
Direct Costs	TOTAL PERSONNEL	*$616,244*	*$637,393*	*$659,454*	*$682,469*	*$706,490*	*$3,302,050*
	TOTAL FRINGE BENEFITS	*$331,431*	*$342,135*	*$353,267*	*$364,847*	*$376,899*	*$1,768,579*
	TOTAL TRAVEL	*$16,560*	*$16,560*	*$16,560*	*$16,560*	*$16,560*	*$82,800*
	TOTAL EQUIPMENT	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	TOTAL SUPPLIES	*$38,754*	*$40,131*	*$41,569*	*$43,073*	*$44,644*	*$208,171*
	TOTAL CONTRACTUAL	*$1,915,000*	*$1,015,000*	*$1,015,000*	*$1,015,000*	*$515,000*	*$5,475,000*
	TOTAL OTHER	*$40,634,717*	*$40,611,310*	*$35,479,636*	*$348,032*	*$349,836*	*$117,423,531*
	TOTAL DIRECT	*$43,552,706*	*$42,662,529*	*$37,565,486*	*$2,469,981*	*$2,009,429*	*$128,260,131*
	TOTAL INDIRECT	$157,788	$163,091	$168,618	$174,378	$180,384	$844,260
TOTAL FUNDING		**$43,710,494**	**$42,825,620**	**$37,734,104**	**$2,644,359**	**$2,189,814**	**$129,104,391**

Consolidated Budget by Project:

BUDGET BY PROJECT			
Project Number	Project Name	Total Cost	% of Total
1	Renewables Ready Communities Awards	*$117,611,899*	*91%*
2	Brownfield Renewable Energy Pilot Program	*$11,492,492*	*9%*
Total		*$129,104,391*	*100%*

7b. Expenditure of Awarded Funds

EGLE will ensure that funds will be expended in a timely and efficient manner, in accordance with Michigan laws and procedures for expending the State's own funds. The financial management system for EGLE complies with the requirements of 2 CFR 200.302(b). As noted in the application, EGLE has extensive experience administering EPA grants with great success. EGLE will ensure proper grant management through quarterly reporting, tracking expenditures through itemized budget tables. Furthermore, programs at EGLE meet with the EGLE Finance Division monthly to ensure grant

performance measures are being met. The semi-annual reports and final report to the EPA will include a breakdown of expenditures associated with implementation of this proposal.

The subawards to the University of Michigan and the State of Michigan workforce development programs will be in accordance with the EPA's Subaward Policy and the EPA's General Term and Condition for Subawards.

7c. Reasonableness of cost

The costs outlined in the budget are reasonable and consistent with costs deemed reasonable by the EPA in previous and existing EPA grants to the State of Michigan. The cost effectiveness of the estimated cumulative reduction measures proposed in this grant application further enforces the reasonableness of the proposed costs. For the period 2025 to 2030, EGLE estimates the budget spends $1.67 per metric ton of CO_2e reduced and for the period 2025-2050, $0.28 per metric ton of CO_2e reduced.

Introduction:

This Excel Spreadsheet is provided to aid Climate Pollution Reduction Grant implementation grant applicants in developing the required budget table(s) within the budget narrative. Applicants may submit a budget spreadsheet (no page limit) with their application.

The individual worksheets are formatted for 1 page width of 8.5" x 11" landscape orientation.

Instructions:

The template contains 5 tabs (titled "Measure 1 Budget" through "Measure 5 Budget") where applicants can create budgets for up to 5 discrete GHG measures contained in their application. Applicants should leave excess tabs blank (ie, if an application is for a single GHG measure, only Tab 1 should contain any numerical entries.) The Consolidated Budget tab will automatically sum budget totals across all GHG measure Tabs. If an application includes more than 5 GHG measures, users may add duplicate tabs, but will need to manually update the formulas contained on the Consolidated Budget tab.

Measure Tab Instructions:

Below is a description of the steps an applicant should complete to finish each measure tab of the template.

- **In column C,** provide itemized costs descriptions in each cost category. Insert or delete rows as needed.

- **In columns D through H,** fill in the cost for the line item per year - personnel, fringe benefits, travel, equipment, installation, or labor supplies, contractual costs, and other direct costs (i.e., subawards, participant support costs), and indirect costs for each applicable year. Subtotals will calculate automatically.

- **Column J** will automatically calculate the total cost for the line item for the entire measure, including subtotals for each budget category - personnel, fringe benefits, travel, equipment, installation, or labor supplies, contractual costs, and other direct costs (i.e., subawards, participant support costs), and indirect costs.

Please check all formulas and calculations before finalizing your budget tables.

Consolidated Budget Instructions:

This table will update automatically based on the budget detail entered in the tabs for measures 1-5. If your application includes more than 5 individual measures, you will need to add additional tabs, update the formulas below, and add additional lines to the "Budget by Project" table to include the additional measures.

Consolidated Budget Table

This table will update automatically based on the budget detail entered in the tabs for measures 1-5. If your application includes more than 5 individual measures, you will need to add additional tabs, update the formulas below, and add additional lines to the "Budget by Project" table to include the

BUDGET BY YEAR							
COST-TYPE	**CATEGORY**	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**	**TOTAL**
Direct Costs	TOTAL PERSONNEL	*$616,244*	*$637,393*	*$659,454*	*$682,469*	*$706,490*	*$3,302,050*
	TOTAL FRINGE BENEFITS	*$331,431*	*$342,135*	*$353,267*	*$364,847*	*$376,899*	*$1,768,579*
	TOTAL TRAVEL	*$16,560*	*$16,560*	*$16,560*	*$16,560*	*$16,560*	*$82,800*
	TOTAL EQUIPMENT	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	TOTAL SUPPLIES	*$38,754*	*$40,131*	*$41,569*	*$43,073*	*$44,644*	*$208,171*
	TOTAL CONTRACTUAL	*$1,915,000*	*$1,015,000*	*$1,015,000*	*$1,015,000*	*$515,000*	*$5,475,000*
	TOTAL OTHER	*$40,634,717*	*$40,611,310*	*$35,479,636*	*$348,032*	*$349,836*	*$117,423,531*
	TOTAL DIRECT	*$43,552,706*	*$42,662,529*	*$37,565,486*	*$2,469,981*	*$2,009,429*	*$128,260,131*
	TOTAL INDIRECT	$157,788	$163,091	$168,618	$174,378	$180,384	$844,260
TOTAL FUNDING		**$43,710,494**	**$42,825,620**	**$37,734,104**	**$2,644,359**	**$2,189,814**	**$129,104,391**

BUDGET BY PROJECT			
Project Number	**Project Name**	**Total Cost**	**% of Total**
1	Renewables Ready Communities Awards	*$117,611,899*	*91%*
2	Brownfield Renewable Energy Pilot Program	*$11,492,492*	*9%*
Total		*$129,104,391*	*100%*

Detailed Budget Table

This Excel Workbook is provided to aid applicants in developing the required budget table(s) within the budget narrative.

BUDGET BY YEAR							
COST-TYPE	**CATEGORY**	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**	**TOTAL**
Direct Costs	**Personnel**						
	Renewables Ready Communities Program Manager (SAM 15)	*$140,141*	*$149,390*	*$159,250*	*$169,760*	*$180,964*	*$799,505*
	RRC Energy Expert (Departmental Analyst 12)	*$88,661*	*$90,877*	*$93,149*	*$95,478*	*$97,865*	*$466,029*
	RRC Energy Expert (Departmental Analyst 12)	*$88,661*	*$90,877*	*$93,149*	*$95,478*	*$97,865*	*$466,029*
	RRC Energy Expert (Departmental Analyst 12)	*$88,661*	*$90,877*	*$93,149*	*$95,478*	*$97,865*	*$466,029*
	RRC Energy Expert (Departmental Analyst 12)	*$88,661*	*$90,877*	*$93,149*	*$95,478*	*$97,865*	*$466,029*
	TOTAL PERSONNEL	*$494,785*	*$512,898*	*$531,846*	*$551,671*	*$572,422*	*$2,663,622*
	Fringe Benefits						
	Program Manager - Renewables Ready Communities Program (SAM 15)	*$58,999*	*$62,893*	*$67,044*	*$71,469*	*$76,186*	*$336,591*
	RRC Energy Expert (Departmental Analyst 12)	*$55,324*	*$56,707*	*$58,125*	*$59,578*	*$61,068*	*$290,802*
	RRC Energy Expert (Departmental Analyst 12)	*$55,324*	*$56,707*	*$58,125*	*$59,578*	*$61,068*	*$290,802*
	RRC Energy Expert (Departmental Analyst 12)	*$55,324*	*$56,707*	*$58,125*	*$59,578*	*$61,068*	*$290,802*
	RRC Energy Expert (Departmental Analyst 12)	*$55,324*	*$56,707*	*$58,125*	*$59,578*	*$61,068*	*$290,802*
	TOTAL FRINGE BENEFITS	*$280,297*	*$289,722*	*$299,544*	*$309,781*	*$320,456*	*$1,499,800*
	Travel						
	Outreach travel for meetings - 200 miles/month, $.44 per mile, x4 staff	*$4,224*	*$4,224*	*$4,224*	*$4,224*	*$4,224*	*$21,120*
	Outreach travel lodging - 5 night hotel stay per year for 5 staff	*$1,700*	*$1,700*	*$1,700*	*$1,700*	*$1,700*	*$8,500*
	Conference attendance - 5 flights	*$4,250*	*$4,250*	*$4,250*	*$4,250*	*$4,250*	*$21,250*
	Conference attendance lodging - 1 hotel stay of 2 nights, 5 staff annually	*$1,000*	*$1,000*	*$1,000*	*$1,000*	*$1,000*	*$5,000*
	Per Diem - full per diem, 13 days/year, 5 staff annually for conference and outreach travel	*$3,835*	*$3,835*	*$3,835*	*$3,835*	*$3,835*	*$19,175*
							$0
							$0
							$0
	TOTAL TRAVEL	*$10,785*	*$10,785*	*$10,785*	*$10,785*	*$10,785*	*$75,045*
	Equipment						
							$0
							$0
	TOTAL EQUIPMENT	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Supplies						*$0*
							$0
	TOTAL SUPPLIES	*$38,754*	*$40,131*	*$41,569*	*$43,073*	*$44,644*	*$208,171*
	Contractual						
	Renewables Ready Communities Strategic Plan: Utility-Scale Renewable Energy, Energy Storage	*$200,000*					*$200,000*
	Language translation or interpretation services	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$15,000*	*$75,000*
	Regional Stakeholder Engagement and Technical Assistance Support	*$1,500,000*	*$1,000,000*	*$1,000,000*	*$1,000,000*	*$500,000*	*$5,000,000*
							$0

	TOTAL CONTRACTUAL	*$1,715,000*	*$1,015,000*	*$1,015,000*	*$1,015,000*	*$515,000*	*$5,275,000*	
	OTHER							
	Subward to University of Michigan for technical assistance material development, trainings for EGLE's Renewable Energy Academy	*$150,000*	*$150,000*	*$150,000*	*$150,000*	*$150,000*	*$750,000*	
	Renewables Ready Communities Awards - financial incentive, $5k/MW	*$30,133,333*	*$30,133,333*	*$30,133,333*			*$90,400,000*	
	LIDAC Additional Incentive	*$5,000,000*	*$5,000,000*	*$5,000,000*			*$15,000,000*	
	Workforce Development Program Support	$240,000	$240,000	$106,667	$106,667	$106,667	*$800,000*	
	Conference attendance for 6 employees once per year ($1,000/employee)	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$30,000*	
	Employee training at $1,000 per year per employee	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$30,000*	
	Laptops, cell phones, VPNs, and other supplies (calculated at 5% of total wages and fringe for Renewables Ready Communities Program Manager)	*$9,957*	*$10,614*	*$11,315*	*$12,061*	*$12,858*	*$56,805*	0.05 DTMB cost rate
	Laptops, cell phones, VPNs, and other supplies (calculated at 5% of total wages and fringe for RRC Energy Expert)	*$7,199*	*$7,379*	*$7,564*	*$7,753*	*$7,947*	*$37,842*	
	Laptops, cell phones, VPNs, and other supplies (calculated at 5% of total wages and fringe for RRC Energy Expert)	*$7,199*	*$7,379*	*$7,564*	*$7,753*	*$7,947*	*$37,842*	
	Laptops, cell phones, VPNs, and other supplies (calculated at 5% of total wages and fringe for RRC Energy Expert)	*$7,199*	*$7,379*	*$7,564*	*$7,753*	*$7,947*	*$37,842*	
	Laptops, cell phones, VPNs, and other supplies (calculated at 5% of total wages and fringe for RRC Energy Expert)	*$7,199*	*$7,379*	*$7,564*	*$7,753*	*$7,947*	*$37,842*	
	TOTAL OTHER	*$35,574,087*	*$35,575,464*	*$35,443,569*	*$311,739*	*$313,311*	*$107,218,171*	
	TOTAL DIRECT	*$38,113,708*	*$37,444,000*	*$37,342,314*	*$2,242,049*	*$1,776,618*	*$116,918,689*	
Indirect Costs	**Indirect Costs**							0.1665 Indirect**
	Renewables Ready Communities Program Manager (SAM 15)	*$33,156.81*	*$35,345.12*	*$37,677.98*	*$40,164.64*	*$42,815.48*	*$189,160*	
	RRC Energy Expert (Departmental Analyst 12)	*$23,973.58*	*$24,572.78*	*$25,187.10*	*$25,816.77*	*$26,462.19*	*$126,012*	
	RRC Energy Expert (Departmental Analyst 12)	*$23,973.58*	*$24,572.78*	*$25,187.10*	*$25,816.77*	*$26,462.19*	*$126,012*	
	RRC Energy Expert (Departmental Analyst 12)	*$23,973.58*	*$24,572.78*	*$25,187.10*	*$25,816.77*	*$26,462.19*	*$126,012*	
	RRC Energy Expert (Departmental Analyst 12)	*$23,973.58*	*$24,572.78*	*$25,187.10*	*$25,816.77*	*$26,462.19*	*$126,012*	
							$0	
	TOTAL INDIRECT	*$129,051*	*$133,636*	*$138,426*	*$143,432*	*$148,664*	*$693,210*	
TOTAL FUNDING		***$38,242,760***	***$37,577,637***	***$37,480,740***	***$2,385,480***	***$1,925,282***	***$117,611,899***	

Detailed Budget Table

This Excel Workbook is provided to aid applicants in developing the required budget table(s) within the budget narrative.

BUDGET BY YEAR							
COST-TYPE	CATEGORY	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
Direct Costs	**Personnel**						
	Brownfield Renewable Energy Pilot Program Manager (Environmental Quality Specialist 15)	*$121,459*	*$124,495*	*$127,608*	*$130,798*	*$134,068*	*$638,428*
							$0
	TOTAL PERSONNEL	*$121,459*	*$124,495*	*$127,608*	*$130,798*	*$134,068*	*$638,428*
	Fringe Benefits						
	Brownfield Renewable Energy Pilot Program Manager (Environmental Quality Specialist 15)	*$51,134*	*$52,413*	*$53,723*	*$55,066*	*$56,443*	*$268,779*
							$0
	TOTAL FRINGE BENEFITS	*$51,134*	*$52,413*	*$53,723*	*$55,066*	*$56,443*	*$268,779*
	Travel						
	Program Manager Outreach Travel -- 400 miles per month, $.44 per mile	*$2,112*	*$2,112*	*$2,112*	*$2,112*	*$2,112*	*$10,560*
	Program Manager Outreach travel lodging - 1 hotel stay per month	*$1,020*	*$1,020*	*$1,020*	*$1,020*	*$1,020*	*$5,100*
	Conference attendance -- 1 flight annually	*$850*	*$850*	*$850*	*$850*	*$850*	*$4,250*
	Conference attendance lodging -- 1 hotel stay of 2 nights, annually	*$200*	*$200*	*$200*	*$200*	*$200*	*$1,000*
	Per Diem -- full per diem, 3 days annually for conference; 2 full per diem/month for outreach	*$1,593*	*$1,593*	*$1,593*	*$1,593*	*$1,593*	*$7,965*
							$0
							$0
							$0
							$0
	TOTAL TRAVEL	*$5,775*	*$5,775*	*$5,775*	*$5,775*	*$5,775*	*$28,875*
	Equipment						
							$0
							$0
	TOTAL EQUIPMENT	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Supplies						
							$0
	TOTAL SUPPLIES	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Contractual						
	Renewables Ready Communities Strategic Plan: Brownfield Pilot Program Development	*$200,000*					*$200,000*
							$0
							$0
							$0
							$0
	TOTAL CONTRACTUAL	*$200,000*	*$0*	*$0*	*$0*	*$0*	*$200,000*
	OTHER						
	Brownfield Renewable Energy Pilot Program Grant Awards	*$5,000,000*	*$5,000,000*				*$10,000,000*

	Subward to University of Michigan for technical assistance material development, trainings for EGLE's Renewable Energy Academy	*$50,000*	*$25,000*	*$25,000*	*$25,000*	*$25,000*	*$150,000*
	Conference attendance for employee $1,000 per year	*$1,000*	*$1,000*	*$1,000*	*$1,000*	*$1,000*	*$5,000*
	Employee training at $1,000 per year	*$1,000*	*$1,000*	*$1,000*	*$1,000*	*$1,000*	*$5,000*
	Laptops, cell phones, VPNs, and other supplies calculated at 5% of total wages and fringe for Brownfield Renewable Energy Pilot Program Manager	*$8,630*	*$8,845*	*$9,067*	*$9,293*	*$9,526*	*$45,360*
							$0
	TOTAL OTHER	*$5,060,630*	*$5,035,845*	*$36,067*	*$36,293*	*$36,526*	*$10,205,360*
	TOTAL DIRECT	*$5,438,998*	*$5,218,528*	*$223,173*	*$227,932*	*$232,812*	*$11,341,442*
Indirect Cos	**Indirect Costs**						
	Brownfield Renewable Energy Pilot Program Manager (Environmental Quality Specialist 15)	*$28,736.73*	*$29,455.18*	*$30,191.61*	*$30,946.36*	*$31,720.08*	*$151,050*
							$0
	TOTAL INDIRECT	*$28,737*	*$29,455*	*$30,192*	*$30,946*	*$31,720*	*$151,050*
TOTAL FUNDING		***$5,467,734***	***$5,247,984***	***$253,364***	***$258,879***	***$264,532***	***$11,492,492***

0.05 DTMB cost rate

0.1665 Indirect**

Renewables Ready Communities Program Technical Appendix

This technical appendix explains the methodology and assumptions used for developing the estimated greenhouse gas (GHG) emissions reduced for each measure of the RRC Program that will result in direct GHG emission reductions. The "GHG Emission Reduction Calculation Spreadsheet" included with this application provides the specific GHG emission reduction calculations for each measure, as well as the settings used to represent the Inflation Reduction Act (IRA) within RMI's Energy Policy Simulator (EPS).

Measure 1: Renewables Ready Communities Awards (RRC Awards)

GHG Reduction Estimate Method

The web version of RMI's Energy Policy Simulator (EPS, version 3.4.3 specific to Michigan) was used to create a business-as-usual (BAU) scenario as a basis for comparison for Measure 1 emissions reductions from 2025 to 2030 and 2025 to 2050. The EPS tool was also used to calculate emission reductions for reduction measures in the State of Michigan's PCAP. The PCAP uses a goal of 50 percent renewable energy by 2030 and 60 percent renewable energy by 2035, consistent with Public Act 235. Measure 1 of the RRC Program aims to achieve the more ambitious goal of 60 percent renewable energy by 2030, consistent with the science-based targets presented in the MI Healthy Climate Plan, as explained in Section 1.a. of the Workplan under the sub-header "Michigan's Priority Climate Action Plan". Due to this measure intending to incentivize a significant deployment of renewable energy to the electric grid, requiring large capital investments and offsetting a significant amount of fossil fuel generation, the emissions reductions realized through this measure are anticipated to be permanent.

The BAU and proposed emission reduction scenarios produced by the EPS both take into account forecasted changes in electricity demand and consumption related to increased electrification of transportation and the built environment, independent of changing individual policy levers. However, no additional assumptions were made related to the implementation of increased electrification outside of the electricity sector. As a result, the effects in this analysis of increased electrification outside of the electricity sector may be minimal. Additionally, the impact of non-CPRG related federal incentives provided through programs or legislation, such as the Inflation Reduction Act (IRA), Bipartisan Infrastructure Law (BIL), and Creating Helpful Incentives to Produce Semiconductors (CHIPS) Act were represented in this analysis, in both the BAU and proposed emissions reduction scenario (see the "EPS IRA BAU Settings" tab on the attached GHG Emission Reduction Calculation Spreadsheet). Similarly, non-federal incentives provided prior to the passage of the IRA are included. Additionally, no changes to default values such as emission factors or emission rates were changed or substituted, and global warming potentials from the Synthesis Report of the Intergovernmental Panel on Climate Change Fifth Assessment Report (AR5) were used. For more details on how the EPS is structured, models emissions across different sectors, and other assumptions used in the base tool, please visit the posted online documentation. For further documentation of methodologies and data sources used for each U.S. state, please visit the U.S. State Energy Policy Simulators (EPS) webpage.

To reach the MI Healthy Climate Plan goals by 2030, the Michigan Department of Environment, Great Lakes, and Energy (EGLE) conservatively estimates that around 20 percent of the total MW needed will not require a financial incentive via the RRC Awards program and will be sited either through the state siting process at the Michigan Public Service Commission (MPSC) or through other means. This

assumption was made due to the framework of the RRC Awards incentivizing and encouraging local permitting processes and because the RRC Awards include a higher incentive amount per MW than the MPSC permitting process ($5,000/MW and $2,000/MW, respectively).

Since projects permitted through the MPSC are not eligible for RRC Awards, any renewable energy projects permitted in that manner or that fall below the capacity threshold for the RRC Awards are not included in the emission reductions calculations for Measure 1.

To create the BAU scenario through the EPS, changes were made to default settings as shown in the "EPS IRA BAU Settings" tab on the attached GHG Emission Reduction Calculation Spreadsheet, and via the link to the EPS Scenario. To create the 60 percent renewable energy scenario, no changes were made to any of the following categories, outside of those made to incorporate the effects of the IRA: Transportation, Buildings and Appliances, and Industry. Within the Electricity Supply category, no changes were made to any of the following default sub-categories: Ban New Power Plants, Carbon Capture and Sequestration, Change Electricity Imports, Change Electricity Exports, Demand Response, Early Retirement of Power Plants, Grid-Scale Electricity Storage, Increase Transmission, Reduce Plant Downtime, Reduce Soft Costs, Reduce Transmission & Distribution Losses, Subsidy for Capacity Construction, and Subsidy for Electricity Production.

The Clean Electricity Standard sub-category within the Electricity Supply category was the only policy lever that was edited, other than edits made to incorporate the effects of the IRA, using the following data points as parameters and milestones:

- 2020: 0 percent Clean Energy
- 2021: 0 percent Clean Energy
- 2022: 0 percent Clean Energy
- 2023: 0 percent Clean Energy
- 2024: 0 percent Clean Energy
- 2030: 73 percent Clean Energy (60 percent Renewable Energy)
- 2040: 100 percent Clean Energy
- 2050: 100 percent Clean Energy

Within EPS, policy changes only take effect after 2023, hence the "0 percent Clean Energy" setting for years 2020-2023. It is assumed most projects incentivized through the RRC Awards will not be fully operational until late 2024, so a value of 0 percent Clean Energy was used as a conservative estimate. Additionally, EPS assumes an annual linear uptake of the policy between policy milestones. Once both scenarios were created, the projected annual emissions for each year between 2020 and 2050 for the electricity sector alone was downloaded. To determine the amount of emissions reduced and measure the anticipated impact of this Measure 1, the annual emissions calculated in the 60 percent renewable energy scenario was subtracted from the annual emissions calculated in the BAU scenario. The annual values between 2025-2030 and the annual values between 2025-2050 were then summed to create estimates of anticipated realized, cumulative emissions reductions resulting from CPRG funding for the RRC Awards, the one-time State budget allocation of $30 million to the 2024 RRC Awards Pilot (referred to as "state budget allocation"), and the 20% of renewable energy achieved outside the RRC Awards program, as shown in Table 1 below.

Further analysis was performed to determine the approximate emissions reductions anticipated to result from each category from the broader calculations above. To begin, it was necessary to determine the total amount of megawatts (MW) of capacity needed to be generated by renewable energy sources in 2030 – namely, solar and wind. This value was generated by the EPS in the 60 percent renewable energy scenario. To determine how many MWs still need to be sited, accounting for existing renewable energy projects, the current distribution of renewable energy capacity was sourced from Form EIA-860M, and subtracted from the approximation of total need that was originally calculated by EPS.

It was previously estimated that the state budget allocation would spur development of approximately 5,000 MW of some combination wind, solar, and energy storage projects. In this analysis, energy storage was assumed to not result in any direct emissions reductions because it does not directly offset electricity produced from fossil fuels. Data from the Midcontinent Independent System Operator (MISO) includes the percentage of projects in its database that are wind, solar, storage, or a hybrid of the three. For hybrid projects, it was assumed that these projects generally adhered to the MISO distribution percentage of exclusively wind, solar, and storage projects, and were split among those three categories accordingly. It is important to note that the projects represented in MISO are representative of proposals between the years 2023-2027, prior to the passage of the 2023 clean energy legislation in Michigan, including PA 233 and PA 235 discussed in the Workplan. Both laws are anticipated to support greater development and implementation of renewable energy projects, therefore the distributions currently represented in MISO are expected to change as projects are proposed and developers begin to explore the feasibility of an increased number of sites. The MISO percentages were applied to the total capacity value expected from the state budget allotment of 5,000 MW.

Given the assumption explained earlier, the RRC Awards would conservatively incentivize 80 percent of the renewable energy needed to reach the 2030 goal. Therefore, to calculate the portion of MWs installed outside of the RRC Awards program, the remaining portion of needed renewable energy capacity (i.e., the total amount of needed capacity calculated by EPS minus existing renewable energy capacity and the capacity expected to result from the state budget allocation) was multiplied by 0.2. As mentioned previously, these MWs will likely be sited either through the MPSC siting process or by other means (referred to as "MPSC or Other" in the tables below).

The corresponding portfolio distribution (shown in Table 2) was then applied to the total amount of emissions reductions calculated by EPS in Table 1, resulting in the emissions reductions shown below in Tables 3-6. Due to the BAU scenario already taking incentives from the IRA into account, including federal tax credits, it can be assumed that the entirety of the emissions reductions shown in Table 4 can be fully attributed to the renewable energy incentivized by Measure 1, the RRC Awards. Estimated annual emissions reductions are shown in Table 7, and annual corresponding co-pollutant reductions also generated by the EPS are shown in Table 8.

Models/Tools Used

- The web version of RMI's Energy Policy Simulator (EPS, version 3.4.3 specific to Michigan)

Measure Implementation Assumptions

- To reach the 60 percent renewable energy by 2030 goal, it is a conservative assumption that 80 percent of the needed capacity will be achieved through Measure 1, RRC Awards. The remaining

capacity is assumed to be met through a siting process that falls outside of the RRC Awards (such as through the MPSC or through projects that may not need the RRC Awards).

- Assumes any renewable energy projects that fall below the capacity threshold for the RRC Awards are considered to be additional to those realized through this measure.
- Assumes an annual linear uptake of the measure between policy milestones.
- Assumes that the CPRG funding will serve to fill the remaining gap in incentivizing MW necessary to reach the 60 percent renewable energy by 2030 goal, after incorporating current renewable energy capacity, the estimated capacity that the State of Michigan budget allocation will incentivize, and the estimated capacity resulting from a siting process that falls outside of the RRC Awards.
- Assumes that the distribution of projects in MISO are representative of the projects that will eventually be sited and operational due to the funding provided by the State of Michigan's budget allocation.
- Assumes that the "hybrid" project category in MISO follows the same distribution as exclusively wind, solar, and storage projects.
- Assumes that all emissions reductions realized through this measure can be attributed to the CPRG since the effects of the IRA are already integrated into both the BAU and the emissions reduction scenario.

GHG Reduction Estimate Assumptions

- Assumes all projects are operational by 2030.
- Assumes no emissions reductions from a CPRG award are realized in 2024.
- Forecasted changes in electricity demand and consumption related to increased electrification of transportation and the built environment are taken into account.
- No changes to default values such as emission factors or emission rates were changed or substituted, and global warming potentials from AR5 were used.
- To create a BAU scenario that incorporates the IRA, uses the settings as shown in the "EPS IRA BAU Settings" tab on the attached spreadsheet, or via the link to the EPS Scenario.
- For more details on how the Energy Policy Simulator (EPS) is structured, models emissions across different sectors, and other assumptions used, please visit the posted online Introduction to EPS.
- For further documentation of methodologies, data sources, and assumptions used for each U.S. State within the EPS, please visit the U.S. State EPS Methodology.
- Assumes any renewable energy projects permitted via the MPSC or that fall below the capacity threshold for the RRC Awards are not considered to be part of the emissions reductions estimated to result from a CPRG award.
- Assumes that storage does not result in any direct emissions reductions.
- Assumes that all emissions reductions realized through this measure can be attributed to the CPRG since the effects of the IRA are already integrated into both the BAU and the emissions reduction scenario.

Reference Case Scenario (GHG Emissions or Activity Level)

- To create a BAU scenario that incorporates the IRA and corresponding incentives such as tax credits, the reference case uses the settings as shown in the "EPS IRA BAU Settings" tab on the attached spreadsheet, or via the link to the EPS Scenario.

- For more details on how the Energy Policy Simulator (EPS) is structured, models emissions across different sectors, and other assumptions used, please visit the posted online EPS Introduction.
- For further documentation of methodologies, data sources, and assumptions used for each U.S. State within the EPS, please visit the U.S. State EPS Methodology.
- Forecasted changes in electricity demand and consumption related to increased electrification of transportation and the built environment are taken into account.

Measure-Specific Activity Data

In order to track the implementation and success of this measure, metrics such as annual renewable energy capacity (MW) installed and electrical output (MWh) will be regularly reported on as available, in addition to regular updates on related permitting, construction, and other related activities. See Section 3 of the Workplan for more information.

GHG Emissions Reduced

Cumulative Emissions Reductions from Combined Funding (CPRG + State Budget + Existing Renewables + MPSC & Other)	
	Electricity Sector Only (MTCO2e)
2025-2030	133338240.00
2025-2050	787794870.00
Annual Reductions	See "EPS Elec Sector Emission Output" Tab

Table 1: Total cumulative emissions reductions expected to result from existing renewable energy projects, projects anticipated to be sited due to an allocation from the State Budget, projects anticipated to be sited outside the RRC Awards (such as the MPSC or other process), and projects anticipated to be sited due to an allocation from the EPA's CPRG, as compared to BAU.

	EPS Est. Total MW Needed by 2030	**Projects Currently Operational**		**State Budget Allocation**		**CPRG Allocation**		**MPSC & Other Allocation**	
		MW	**% of Total 2030 Need**	**MW**	**% of Total 2030 Need**	**MW**	**% of Total 2030 Need**	**MW**	**% of Total 2030 Need**
Solar + Wind	28490	4545.4	15.95	3351.34	11.76	16474.61	57.83	4,118.7	14.46
Storage	2500	0	0.00	1571.35	62.85	742.92	29.72	186	0.07

Table 2: The contribution of current renewable energy projects, projects anticipated to be sited from the State Budget, and projects anticipated to be sited from CPRG funding to the total capacity approximately needed to reach the MI Healthy Climate Plan goal of 60% renewable energy by 2030. Note: the 2,500 MW of energy storage needed by 2030 is sourced from the MI Healthy Climate Plan and PA 235.

Cumulative Emissions Reductions from State Budget Only	
	Electricity Sector Only (MTCO2e)

2025-2030	15684871.55
2025-2050	92670049.85

Table 3: Emissions reductions expected to result from an allocation from the State of Michigan budget of $30,000,000, as compared to BAU.

Cumulative Emissions Reductions from Combined CPRG Only	
	Electricity Sector Only (Total MTCO2e)
2025-2030	77104073.88
2025-2050	455549689.69

Table 4: Emissions reductions expected to result from Measure 1, RRC Awards, an allocation from the EPA's CPRG program of $90,400,000, as compared to BAU.

Cumulative Emissions Reductions from Existing Renewable Energy	
	Electricity Sector Only (MTCO2e)
2025-2030	21273276.10
2025-2050	125687708.04

Table 5: Emissions reductions expected to result from renewable energy projects that are already in operation, as compared to BAU.

Cumulative Emissions Reductions from MPSC & Other Siting Only	
	Electricity Sector Only (MTCO2e)
2025-2030	19276018.47
2025-2050	113887422.42

Table 6: Emissions reductions expected to result outside the RRC Awards program, such as through the MPSC siting or other processes, as compared to BAU.

Year	Electricity Sector CO2e Emissions, 60% RE by 2030 [metric tons/year]	Cumulative Emissions [metric tons]	Electricity Sector CO2e Emissions, BAU [metric tons / year]	Cumulative Emissions [metric tons]	Annual Difference Attributable to CPRG [metric tons / year]	Annual Cumulative Difference Attributable to CPRG [metric tons]
2020	43511200	N/A	43511200	N/A	N/A	N/A
2021	48594600	N/A	48594600	N/A	N/A	N/A
2022	40930500	N/A	40930500	N/A	N/A	N/A
2023	38955200	N/A	38955200	N/A	N/A	N/A
2024	39020000	N/A	39020000	N/A	N/A	N/A
2025	30897500	30897500	37525200	37525200	3832529	3832529
2026	26244900	57142400	39538400	77063600	7687090	11519619
2027	20754200	77896600	40633000	117696600	11495100	23014719
2028	15355400	93252000	35472600	153169200	11632957	34647677

2029	10885400	104137400	35141700	188310900	14026430	48674107
2030	5313460	109450860	35175200	223486100	17267828	65941935
2031	4282350	113733210	34510900	257997000	17479939	83421874
2032	3364030	117097240	34817600	292814600	18188319	101610193
2033	3940690	121037930	35295200	328109800	18131036	119741229
2034	3268300	124306230	34793600	362903400	18229797	137971026
2035	3260040	127566270	34738200	397641600	18202538	156173564
2036	3254990	130821260	34569800	432211400	18108079	174281644
2037	3250460	134071720	34775000	466986400	18229358	192511001
2038	3246200	137317920	34749800	501736200	18217249	210728250
2039	3241080	140559000	34965500	536701700	18344940	229073190
2040	3202960	143761960	35261100	571962800	18537917	247611107
2041	3209370	146971330	35685300	607648100	18779508	266390615
2042	3208190	150179520	36041900	643690000	18986397	285377012
2043	3194030	153373550	36538200	680228200	19281576	304658587
2044	3183870	156557420	36811900	717040100	19445720	324104308
2045	3187500	159744920	37240300	754280400	19691347	343795655
2046	3152770	162897690	37507100	791787500	19865710	363661365
2047	3150760	166048450	37856300	829643800	20068800	383730165
2048	3146850	169195300	37618000	867261800	19933262	403663428
2049	3145600	172340900	37299500	904561300	19749809	423413237
2050	3143550	175484450	37167800	941729100	19674838	443088075

Table 7: Annual emissions reductions in the electricity sector expected to result from an allocation from the EPA's CPRG program only (Measure 1, RRC Awards), as compared to BAU.

Cumulative Reduction of Pollutants from CPRG Only, Compared to BAU					
	SOx (metric tons)	**NOx (metric tons)**	**PM 2.5 (metric tons)**	**VOCs (metric tons)**	**CO (metric tons)**
	Electricity Sector Only	**Electricity Sector Only**	**Electricity Sector Only**	**Electricity Sector Only**	**Electricity Sector Only**
2025-2030	30422.60	30036.78	6709.02	2181.29	15119.62
2025-2050	157746.24	181637.20	28035.39	9318.67	92661.24

Table 8: Cumulative co-pollutant reductions expected to result from an allocation from the EPA's CPRG program (Measure 1, RRC Awards), as compared to BAU.

Measure 2: Brownfield Renewable Energy Pilot Program

GHG Reduction Estimate Method

The web version of the EPA's AVoided Emissions and geneRation Tool (AVERT, last updated on April 25, 2023) was used to calculate the emissions reductions expected to result from a $10 million investment in grants to encourage brownfields in Michigan to host renewable energy projects. Due to limited knowledge of specific features of existing brownfields in Michigan, it was assumed that the data in the EPA's RE-Powering America's Land Mapper for Michigan was representative of brownfield renewable

energy potential in the state. As such, various features of brownfields used in this analysis were derived from this dataset, including projected renewable energy capacity per site.

An average of the Michigan RE-Powering America locations' estimated PV capacity (column Q on tab "Raw RE-Powering Data" in the attached reduction calculation spreadsheet) was used to determine an approximate value to represent the anticipated renewable energy capacity per brownfield site. Due to brownfields often being smaller in size, it was assumed that each of the developments to receive CPRG funds through Measure 2 would host a solar project rather than a wind project. Based on the RE-Powering data, the average capacity is approximately 1.18 MW per site.

The framework for this proposal budgets approximately $1,000,000 per brownfield site redeveloped. As such, it's reasonable to assume that approximately 10 brownfield sites will be redeveloped into host sites for renewable energy developments, leading to a total solar capacity of 11.8 MW across all 10 sites using the average capacity previously derived. The Brownfield Renewable Energy Pilot Program is not included in Measure 1 estimates to achieve the 60 percent renewable energy by 2030 goal because it is a relatively small MW capacity compared to MWs incentivized through the RRC Awards.

The brownfield renewable energy projects are assumed to meet prevailing wage and apprenticeship requirements pursuant to Section 48 and 48E in the U.S. Tax Code, and therefore will likely qualify for the corresponding 30 percent federal tax credit for renewable energy projects. The emission reductions attributable to the CPRG funds through Measure 2 will therefore be 70 percent of the total since an estimated 30 percent of the project can be attributed to federal tax credits.

The emission reduction calculations for Measure 2 are based on the conservative assumption that 10 brownfield sites are redeveloped with renewable energy. However, it is highly likely that the Pilot Program will catalyze other brownfields to redevelop with renewable energy projects, and the emission reductions attributable to the CPRG funds for Measure 2 will be larger than the conservative calculations.

When providing inputs into AVERT, each of these projects were assumed to be utility projects rather than rooftop or distributed solar to account for distribution and transmission losses. Additionally, due to data and tool limitations, and in order to isolate the direct effects of this particular program and its impact on emissions reductions, none of the other available input options (i.e. energy efficiency, electric vehicles) were used in AVERT. Similarly, this means this analysis only estimates direct emissions reductions in the electricity sector, rather than a more comprehensive cross-sector analysis. None of the default information included in AVERT (i.e., emission factors and emission rates) was changed or substituted for other values.

Additionally, it is assumed that GHG emissions reductions from this proposal measure are realized linearly between 2025 and 2030, with remediated sites immediately ready for construction being prioritized, identified, and construction beginning post-award in late 2024 and early 2025. While this assumption was made for ease of calculations, it's likely that various issues and delays will arise in practice that result in a non-linear emissions realization. Regardless, all brownfield renewable developments from this pilot are anticipated to be operational by 2030. Similarly, these emissions reductions will be permanent due to the significant financial and time investment required when planning, permitting, and constructing a source of electricity generation.

In recent years, only one brownfield has been redeveloped to host a renewable energy project via the State of Michigan's Brownfield Redevelopment program, even with the existence of non-CPRG related federal incentives provided through programs or legislation such as the IRA, BIL, and CHIPS. Therefore, it is reasonable to assume the baseline of comparison to be a business-as-usual scenario of zero brownfield renewable energy developments in a given year.

Due to the direct emission reduction assumptions made through this analysis, as well as the narrative ones related to measure implementation, the below tables of AVERT-estimated GHG emission and co-pollutant reductions are a conservative estimate that will be realized through this measure of the proposal and are not anticipated to occur otherwise without CPRG funding.

Models/Tools Used

- The web version of the EPA's AVoided Emissions and geneRation Tool (AVERT, last updated on April 25, 2023).
- The EPA's RE-Powering America's Land Mapper, sites located within Michigan.

Measure Implementation Assumptions

- Assumes linear rate of project development, siting, and operation between 2025 and 2030, and 2025 and 2050.
- Assumes all projects are operational by 2030.
- Assumes that each award is $1,000,000.
- Assumes that 10 brownfield sites become hosts for renewable energy projects.
- Assumes an average project capacity of 1.18 MW.
- Assumes each project meets prevailing wage and apprenticeship requirements pursuant to Section 48 and 48E.
- Assumes each project takes advantage of the 30 percent tax credits pursuant to Section 48 and 48E.

GHG Reduction Estimate Assumptions

- Assumes that the data included in the EPA's RE-Powering America's Land Mapper located within Michigan is representative of brownfields in Michigan.
- Assumes linear rate of GHG emission reductions as projects become operational.
- Assumes all projects are operational by 2030.
- Assumes all projects are solar developments rather than wind developments.
- Assumes all solar projects are utility rather than distributed to account for distribution and transmission losses.
- No emission factors, emission rates, or global warming potentials were changed from default AVERT values.
- No assumptions made related to EV uptake or energy efficiency gains.

Reference Case Scenario (GHG Emissions or Activity Level)

Within recent years, only one brownfield has been redeveloped to host a renewable energy project via the State of Michigan's Brownfield Redevelopment program, even with the existence of non-CPRG related federal incentives provided through programs or legislation such as the IRA, BIL, and CHIPS.

Therefore, it is reasonable to assume the baseline of comparison to be a business-as-usual scenario of zero brownfield renewable energy developments in a given year.

Measure-Specific Activity Data

In order to track the implementation and success of this measure, metrics such as project capacity (MW) installed and electrical output (MWh) will be regularly reported on as available, in addition to regular updates on related permitting, construction, and cleanup/redevelopment activities. For more information, refer to Section 3 of the Workplan.

GHG Emissions Reduced

Emissions Reductions			
	Electricity Sector Only (Total MTCO2e)	**Electricity Sector Only (CPRG MTCO2e)**	**Electricity Sector Only (Tax Credit MTCO2e)**
2025-2030	8708.97	6096.28	2612.69
2025-2050	43544.87	30481.41	13063.46
Approx. Annual Reductions	1741.79	1219.26	522.54

Table 9: Emissions reductions expected to result from an allocation from the EPA's CPRG program, by taking advantage of federal tax credits, and a corresponding total, as compared to BAU.

Cumulative Reduction of Pollutants from CPRG Only, Compared to BAU					
	SO2 (metric tons)	**NOx (metric tons)**	**PM2.5 (metric tons)**	**VOCs (metric tons)**	**NH3 (metric tons)**
2025-2030	2.524	3.096	0.683	0.254	0.159
2025-2050	12.621	15.479	3.413	1.270	0.794
Approx. Annual Reductions	0.505	0.619	0.137	0.051	0.032

Table 10: Cumulative co-pollutant reductions expected to result from an allocation from the EPA's CPRG program when combined with tax credits and other incentives, as compared to BAU.

GHG Emission Reduction Calculation Spreadsheet

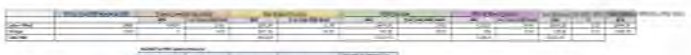
Cumulative Emissions Reductions from CPRG	
	Electricity Sector Only (Total MTCO2e)
2025-2030	77110370.16
2025-2050	455580171.10

Cumulative Emissions Reductions - All Incentives (State Budget +	
	Electricity Sector Only (Total MTCO2e)
2025-2030	133346948.97
2025-2050	787838414.87

	MWs Needed	MW without Storage
RRC Awards	17,218	16,475
Brownfields	11.78	11.78
Total MW Achieved	17,229	16,486.39

Cumulative Reduction of Pollutants from CPRG Only, Compared to BAU						
	SOx (metric tons)	NOx (metric tons)	PM 2.5 (metric tons)	VOCs (metric tons)	CO (metric tons, RRC Only)	NH3 (metric tons, Brownfields Only)
	Electricity Sector Only	Electricity Sector Only	Electricity Sector Only	Electricity Sector Only	Electricity Sector Only	Electricity Sector Only
2025-2030	30425.12	30039.87	6709.70	2181.54	15119.62	0.3587565
2025-2050	157758.86	181652.68	28038.80	9319.94	92661.34	0.7937825

	Cost Effectiveness of All Grant Measures ($/metric ton)	Total Budget Requested CPRG
2025-2030	$1.67	$129,104,391
2025-2050	$0.28	



Emissions Reductions			
	Electricity Sector Only (Total MTCO2e)	Electricity Sector Only (CPRG MTCO2e)	Electricity Sector Only (Tax Credit MTCO2e)
2025-2030	8708.57	6096.28	2612.69
2025-2050	43544.87	30481.41	13063.46
Approx. Annual Reductions	1741.79	1219.26	522.54

Additional Emissions Reductions Compared to BAU			
	Electricity Sector Only (MTCO2e)	Electricity Sector Only (CPRG MTCO2e)	Electricity Sector Only (Tax Credit MTCO2e)
2025-2030	8708.57	6096.28	2612.69
2025-2050	43544.87	30481.41	13063.46
Approx. Annual Reductions	1741.79	1219.26	522.54

Cumulative Reduction of Pollutants from CPRG Only, Compared to BAU - Electric Sector Only					
	SO2 (metric tons)	NOx (metric tons)	PM2.5 (metric tons)	VOCs (metric tons)	NH3 (metric tons)
2025-2030	2.524	3.096	0.683	0.259	0.158
2025-2050	12.621	15.479	3.413	1.270	0.794
Approx. Annual Reductions	0.505	0.619	0.137	0.051	0.032

Constants/Calculated Values	
CPRG Funding Requested	10,000,000
Anticipated Number of Projects	10
Anticipated Funding per Project	1000000
MW per Project	1.18
Total MW of Solar	11.78
BAU (projects per year)	0
BAU (emissions reductions per project)	0
1 MWH	1,102,311.31
AVERT Output - Annual Reductions of All Projects (tons of CO2)	1,920.00
AVERT Output - Annual Reductions of All Projects (million metric tons of CO2)	0.00174
1 lb	0.00045359

Year	Electricity Sector CO2e Emissions, 60% RE by 2030 [metric tons/year]	Cumulative Emissions	Electricity Sector CO2e Emissions, BAU [metric tons / year]	Cumulative Emissions	Annual Difference [metric tons / year]	Annual Cumulative Difference	Annual Difference Attributable to CPRG	Annual Cumulative Difference Attributable to CPRG
2020	43511200	N/A	43511200	N/A	0.00	N/A	N/A	N/A
2021	48594600	N/A	48594600	N/A	0.00	N/A	N/A	N/A
2022	40930500	N/A	40930500	N/A	0.00	N/A	N/A	N/A
2023	38955200	N/A	38955200	N/A	0.00	N/A	N/A	N/A
2024	39020000	N/A	39020000	N/A	0	N/A	N/A	N/A
2025	30897500	30897500	37525200	37525200	6627700	6627700	3832529	3832529
2026	26244900	57142400	39538400	77063600	13293500	19921200	7687090	11519619
2027	20754200	77896600	40633000	117696600	19878800	39800000	11495100	23014719
2028	15355400	93252000	35472600	153169200	20117200	59917200	11632957	34647677
2029	10885400	104137400	35141700	188310900	24256300	84173500	14026430	48674107
2030	5313460	109450860	35175200	223486100	29861740	114035240	17267828	65941935
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2032	3364030	117097240	34817600	292814600	31453570	175717360	18188319	101610193
2033	3940690	121037930	35295200	328109800	31354510	207071870	18131036	119741229
2034	3268300	124306230	34793600	362903400	31525300	238597170	18229797	137971026
2035	3260040	127566270	34738200	397641600	31478160	270075330	18202538	156173564
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2037	3250460	134071720	34775000	466986400	31524540	332914680	18229358	192511001
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2041	3209370	146971330	35685300	607648100	32475930	460676770	18779508	266390615
2042	3208190	150179520	36041900	643690000	32833710	493510480	18986397	285377012
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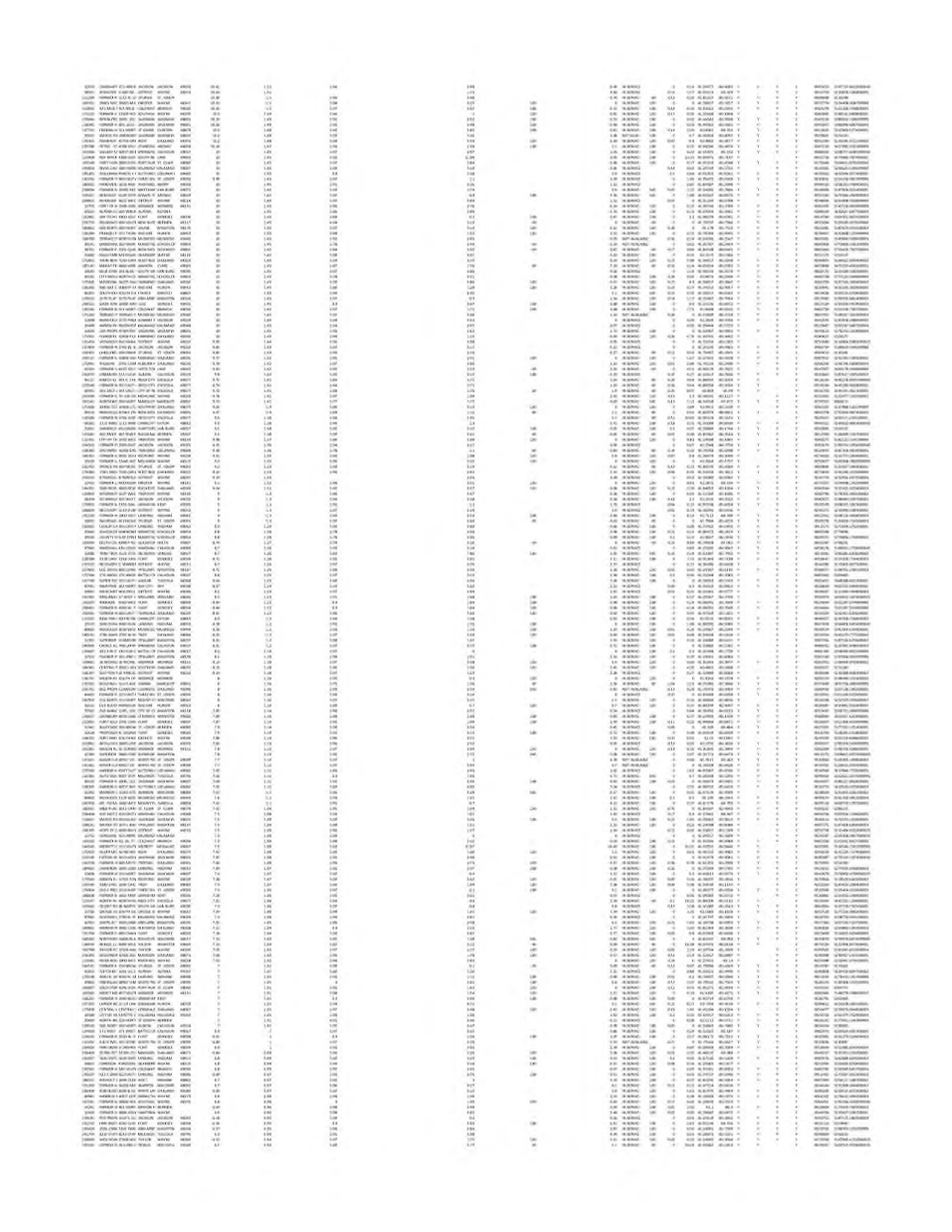
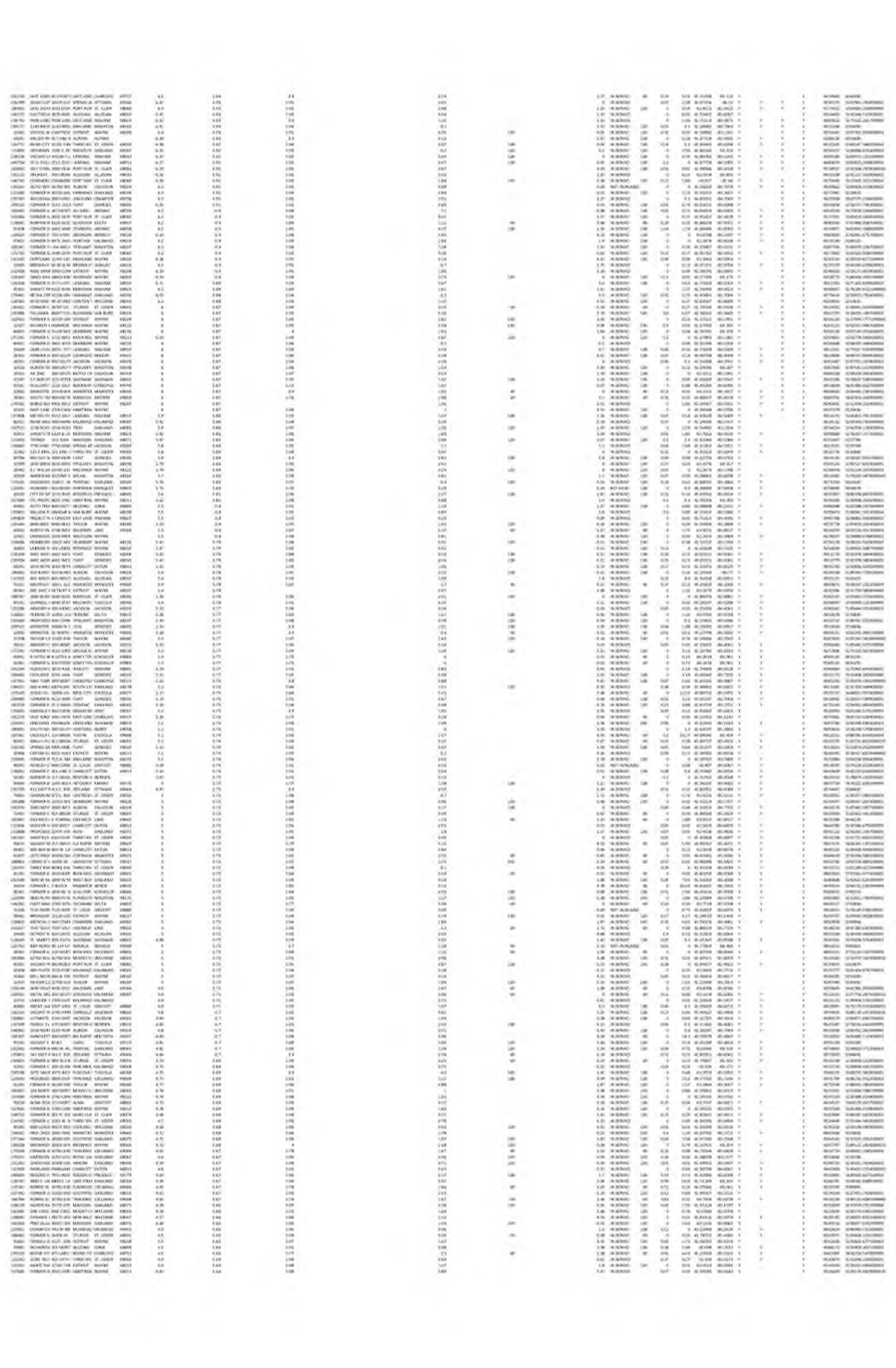
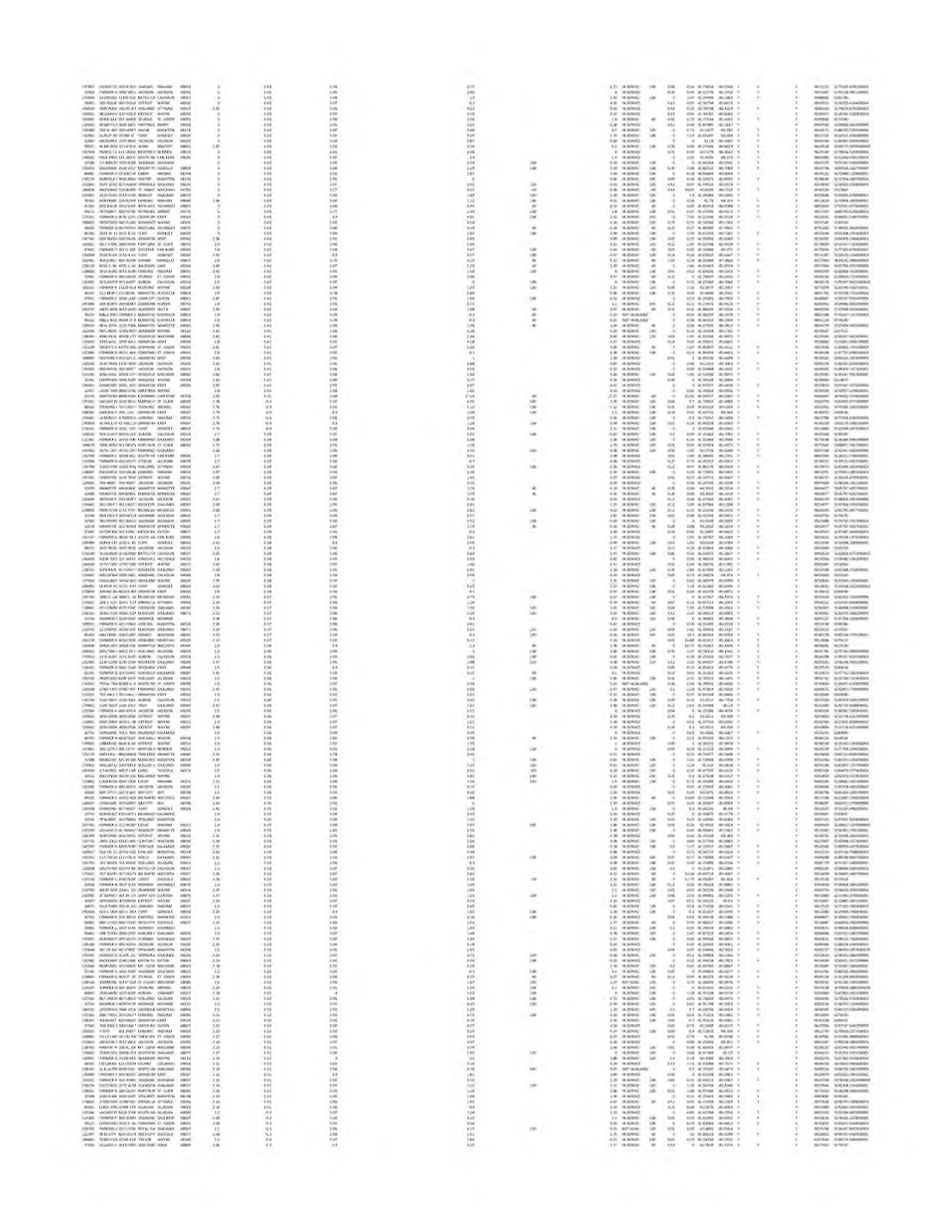
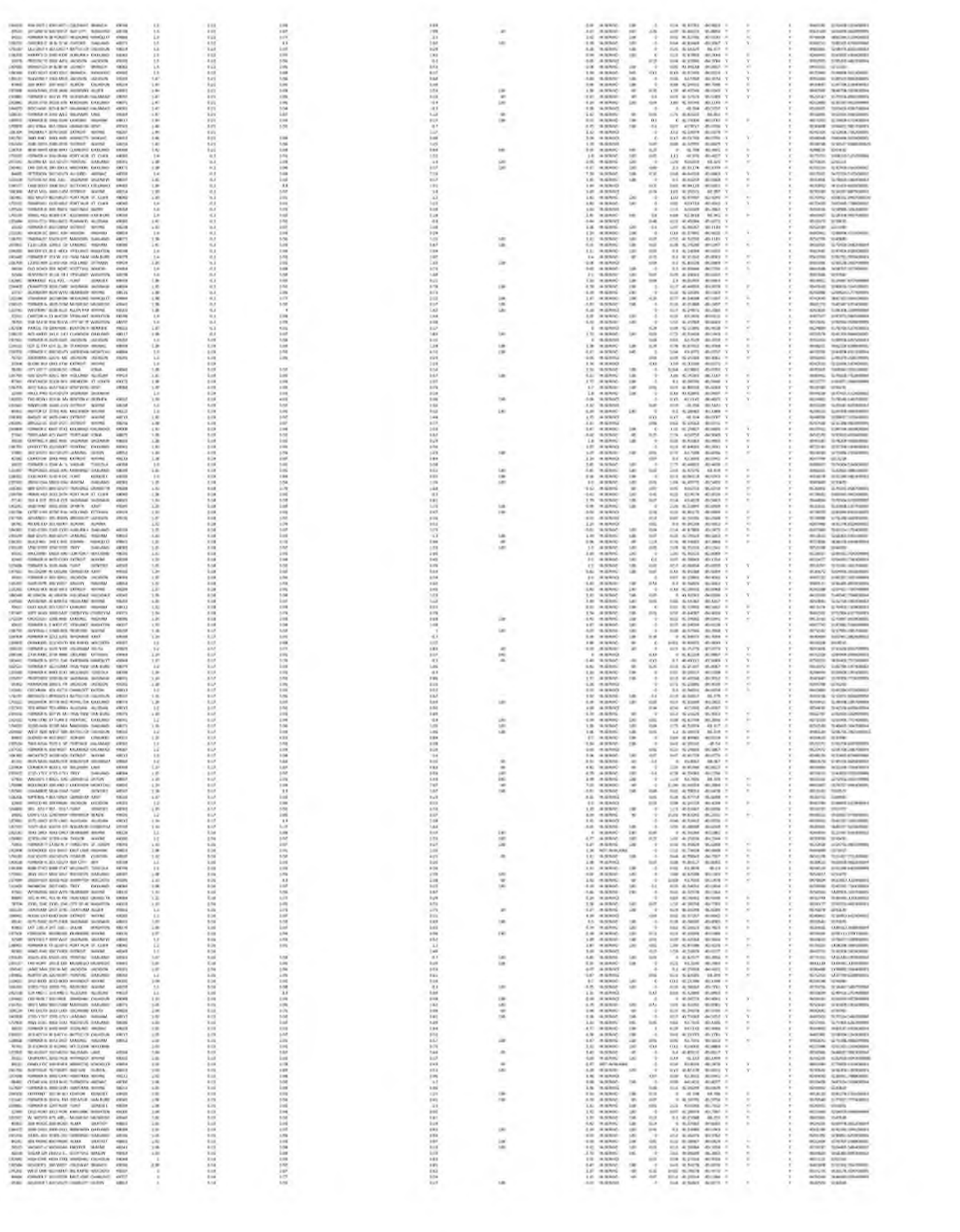
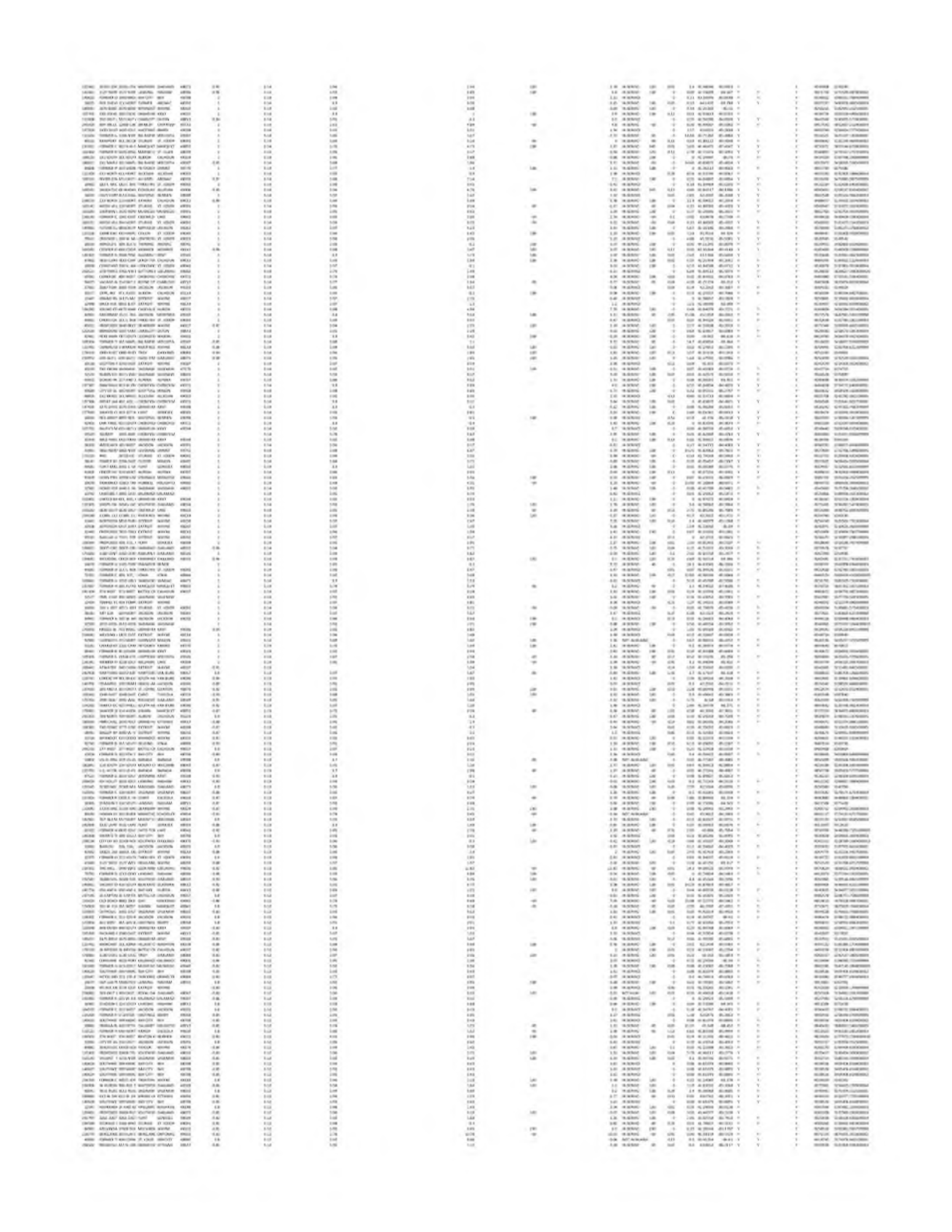
2044	3183870	156557420	36811900	717040100	33628030	560482680	19445720	324104308
2045	3187500	159744920	37240300	754280400	34052800	594535480	19691347	343795655
2046	3152770	162897690	37507100	791787500	34354330	628889810	19865710	363661365
2047	3150760	166048450	37856300	829643800	34705540	663595350	20068800	383730165
2048	3146850	169195300	37618000	867261800	34471150	698066500	19933262	403663428
2049	3145600	172340900	37299500	904561300	34153900	732220400	19749809	423413237
2050	3143550	175484450	37167800	941729100	34024250	766244650	19674838	443088075

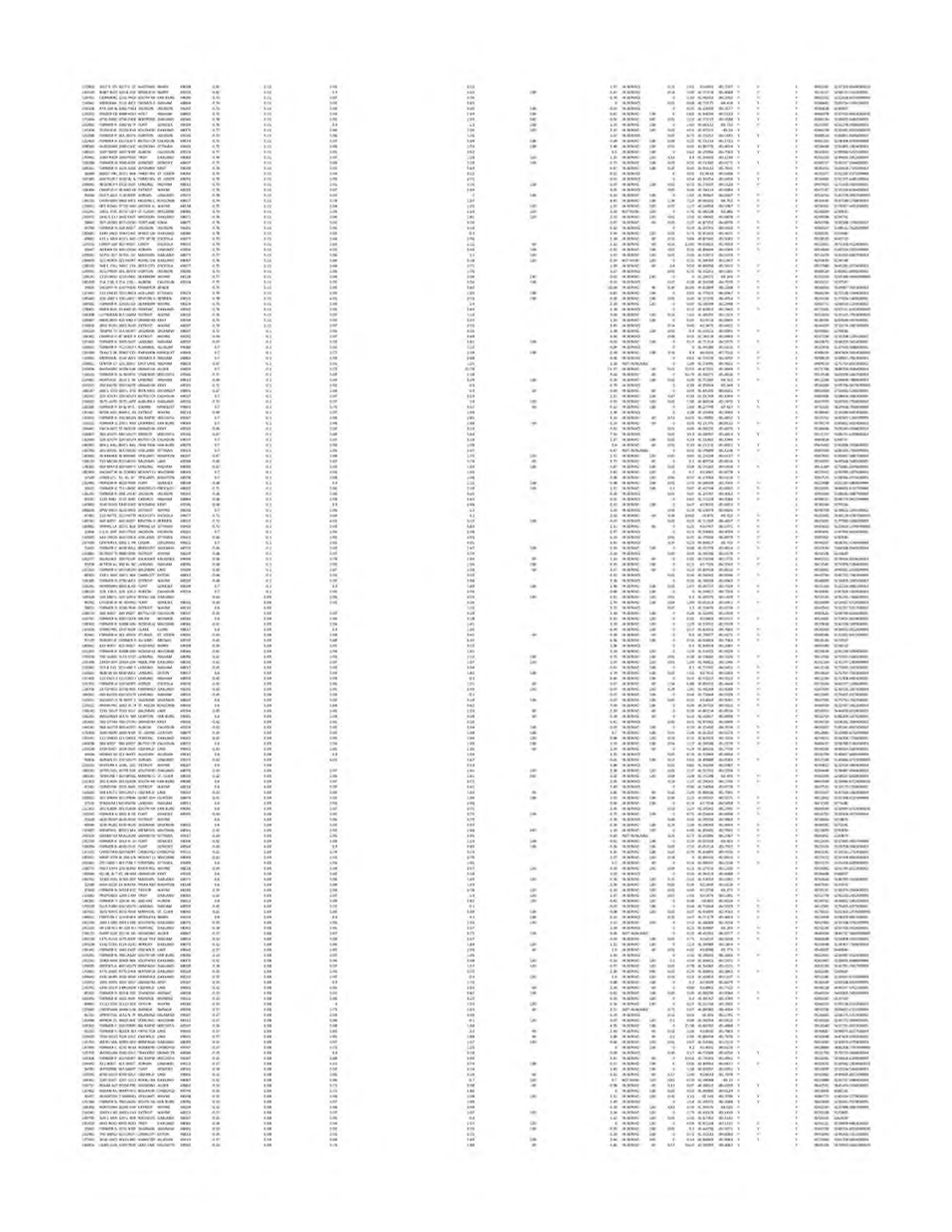


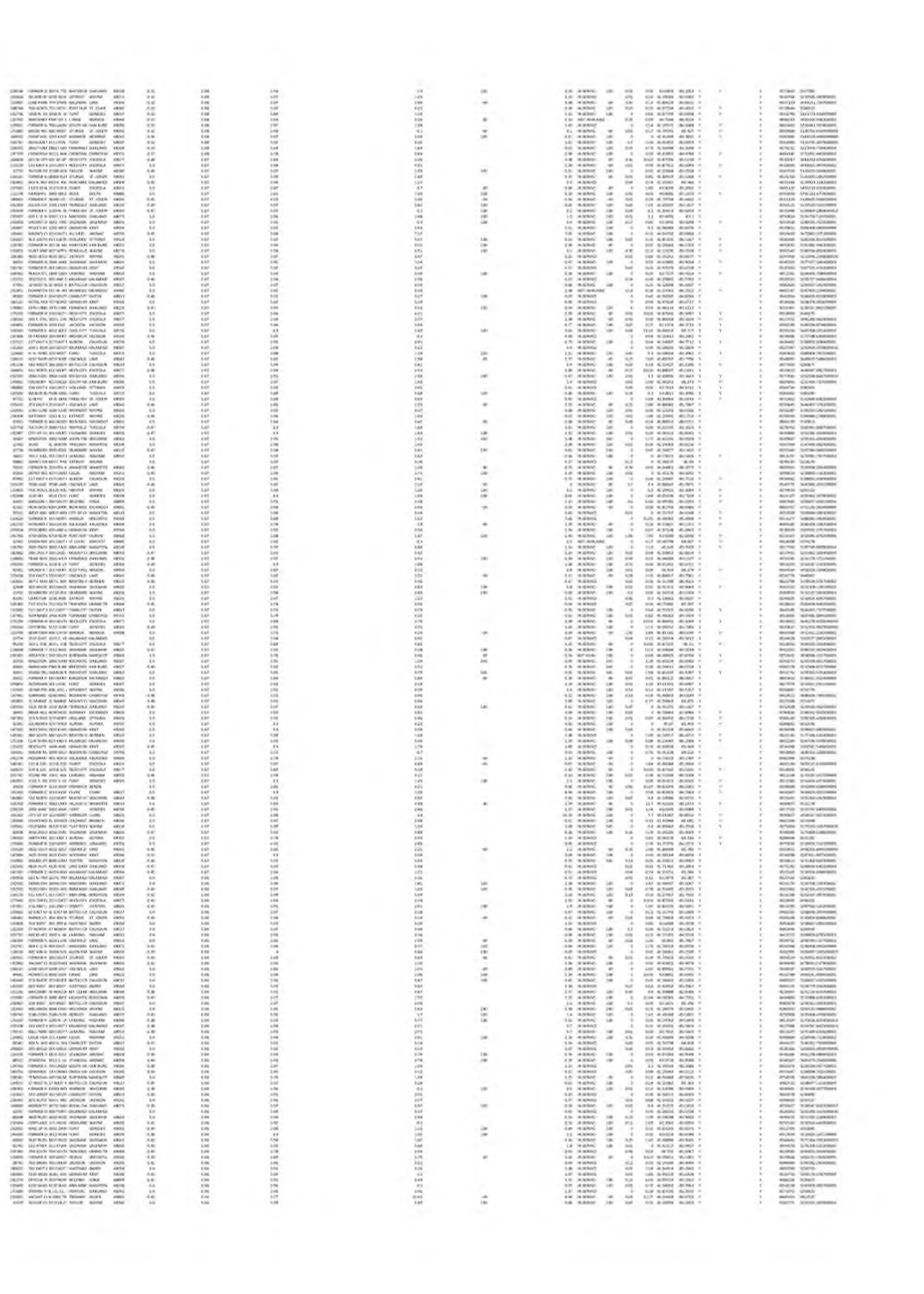


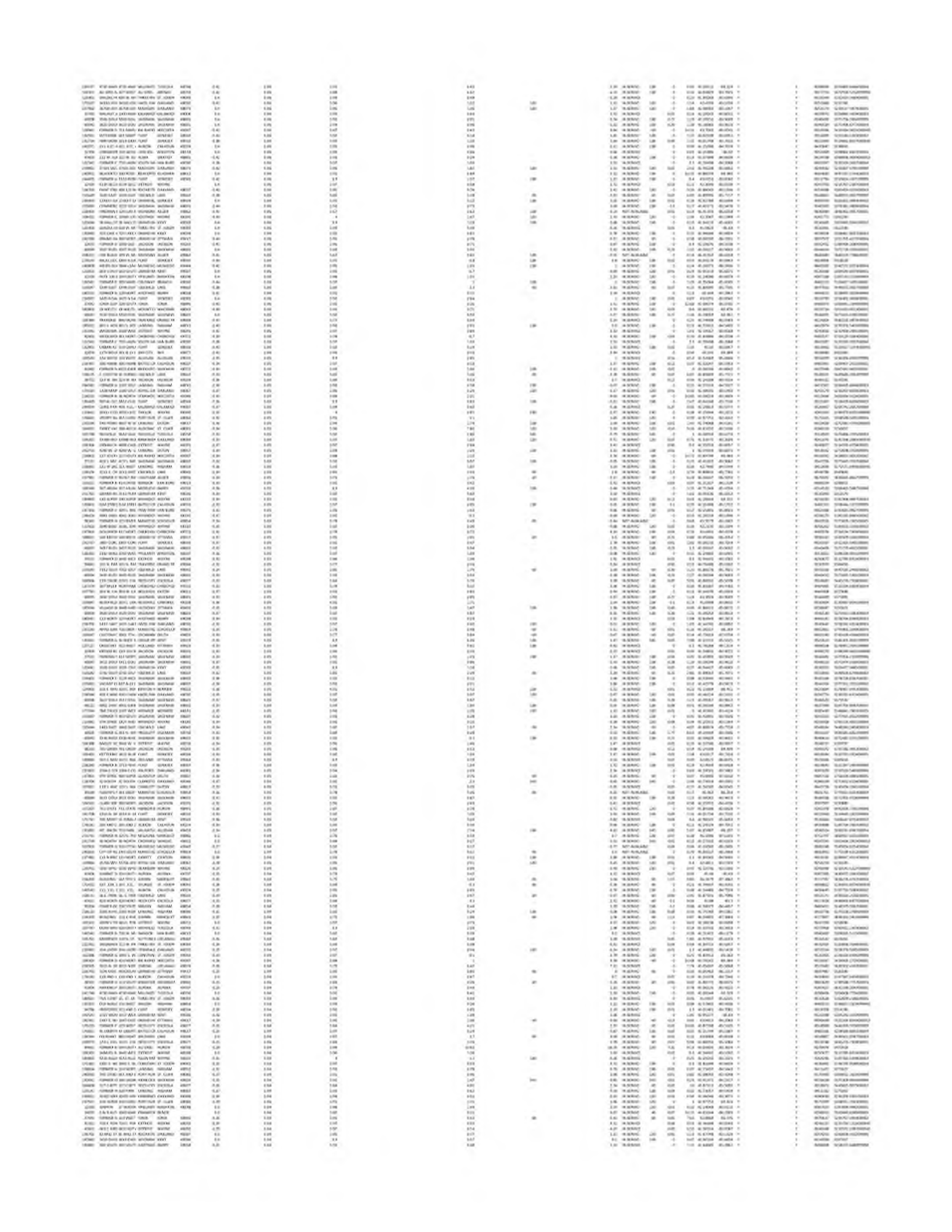


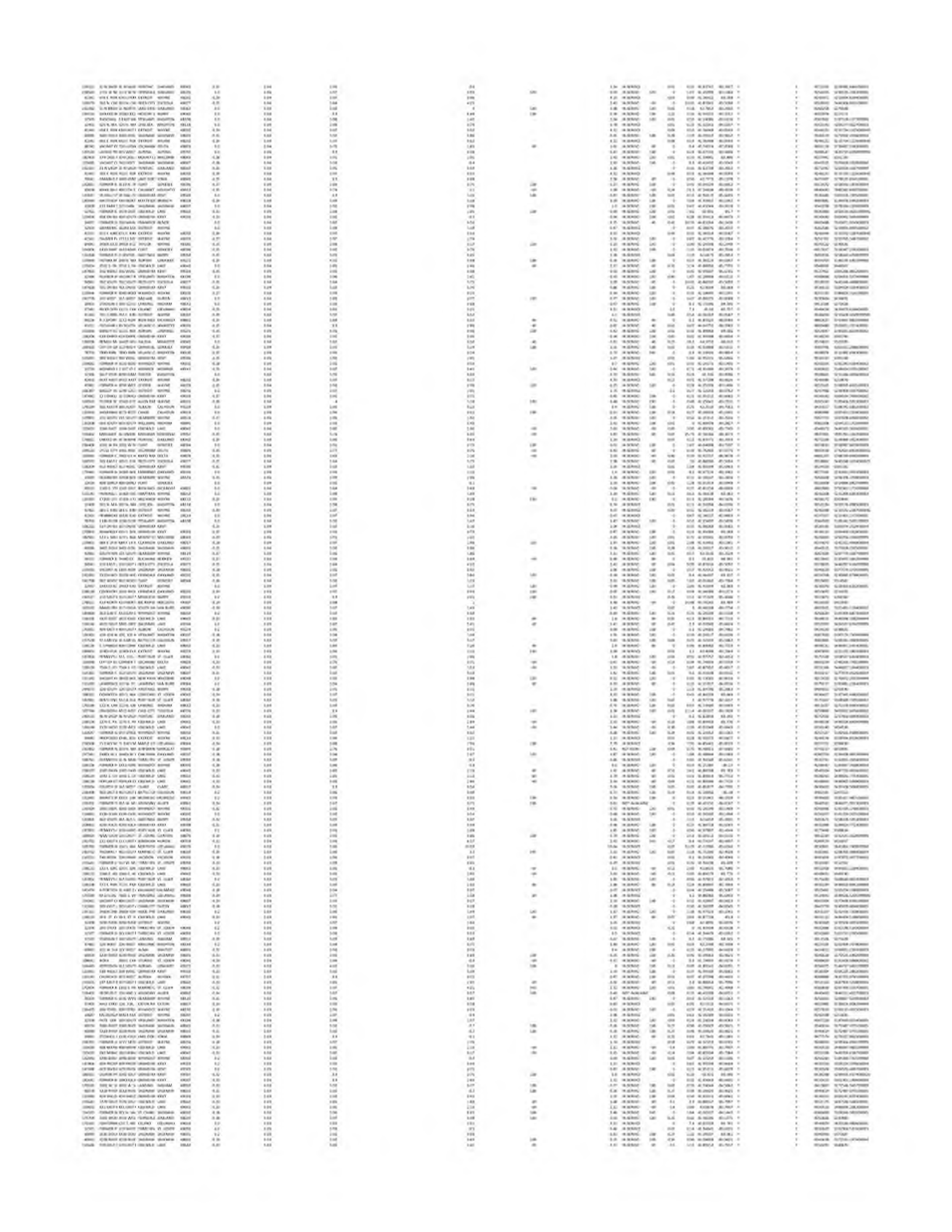


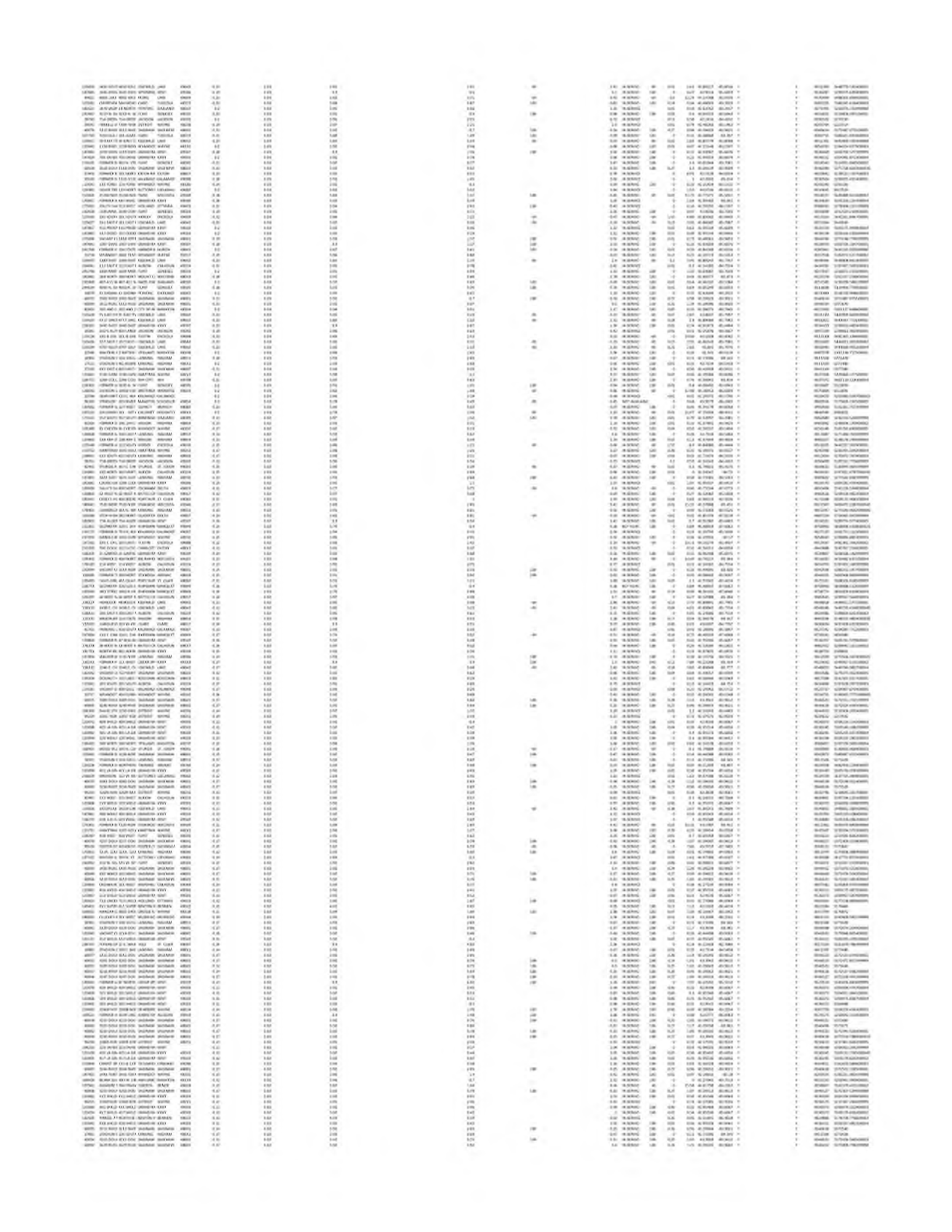


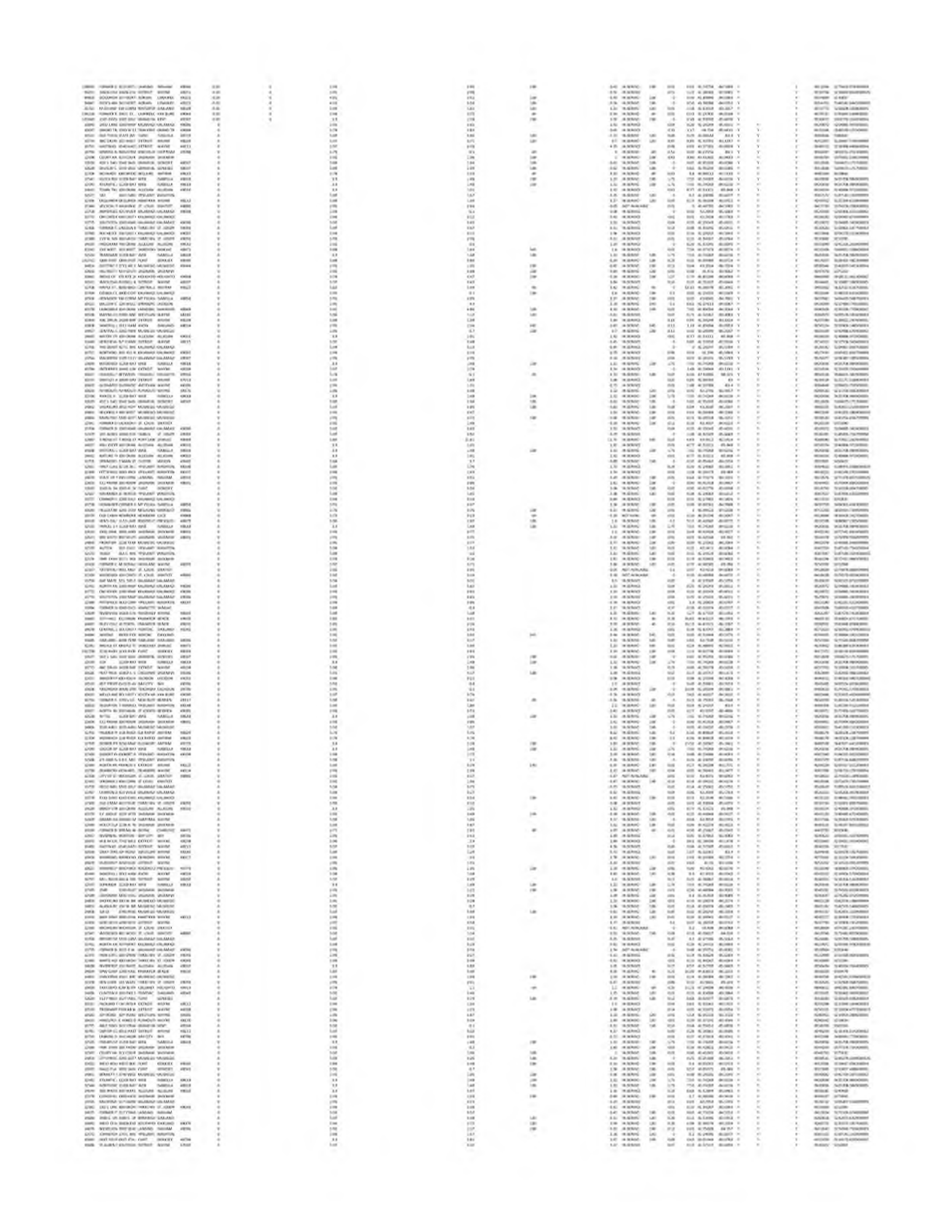












Year	Total CO2e Emissions by Sector [Electricity Only] [million metric tons/year]	Year-Over-Year Reductions	Cumulative Emissions
2020	43.51	5.10	N/A
2021	48.59	-8.50	N/A
2022	40.93	-2.14	N/A
2023	38.96	-5.66	N/A
2024	39.02	-5.79	N/A
2025	30.90	-4.07	26.51
2026	26.24	-5.29	48.96
2027	20.75	-5.14	66.11
2028	15.36	-4.05	78.12
2029	10.89	-3.89	86.08
2030	5.31	-0.79	90.15
2031	4.28	-0.01	93.43
2032	3.36	-0.01	96.70
2033	3.94	0.00	99.96
2034	3.27	0.00	103.22
2035	3.26	0.00	106.48
2036	3.25	0.00	109.73
2037	3.25	0.00	112.98
2038	3.25	-0.01	116.23
2039	3.24	-0.07	119.46
2040	3.20	0.00	122.62
2041	3.21	0.00	125.79
2042	3.21	0.00	128.95
2043	3.19	0.00	132.11
2044	3.18	-0.01	135.26
2045	3.19	-0.04	138.41
2046	3.15	0.00	141.52
2047	3.15	0.00	144.63
2048	3.15	0.00	147.73
2049	3.15	0.00	150.83
2050	3.14	-3.10	153.93

Year	Total CO2e Emissions by Sector[electricity sector] [million metric tons / year]	Cumulative Emissions (MMTCO2e)
2020	43.5112	N/A
2021	48.5946	N/A
2022	40.9305	N/A
2023	38.9552	N/A
2024	39.02	N/A
2025	37.5252	37.5252
2026	39.5384	77.0636
2027	40.633	117.6966
2028	35.4726	153.1692
2029	35.1417	188.3109
2030	35.1752	223.4861
2031	34.5109	257.997
2032	34.8176	292.8146
2033	35.2952	328.1098
2034	34.7936	362.9034
2035	34.7382	397.6416
2036	34.5698	432.2114
2037	34.775	466.9864
2038	34.7498	501.7362
2039	34.9655	536.7017
2040	35.2611	571.9628
2041	35.6853	607.6481
2042	36.0419	643.69
2043	36.5382	680.2282
2044	36.8119	717.0401
2045	37.2403	754.2804
2046	37.5071	791.7875
2047	37.8563	829.6438
2048	37.618	867.2618
2049	37.2995	904.5613
2050	37.1678	941.7291

Year	Geotherm	Biomass [g	Solar Ther	Distributed	Utility Sola	Onshore W	Offshore W	Hydro [gig	Nuclear [g	Distributed	Municipal	Petroleum	Natural Ga	Natural Ga	Lignite [gig	Hard Coal	CHP [gigawatts (GW) / year]
2020	0.19	0.3463	0	0.094076	4.361	7.5807	0.01	0.2625	4.0896	0.098627	0	0.4411	4.1455	6.23404	0	8.38393	0.4856
2021	0.2	0.0023	0	0.117714	4.607	8.4907	0	0.2625	4.0896	0.096933	0	0.4401	4.1455	5.83378	0	7.33096	0.4856
2022	0.2	0.0043	0	0.134167	5.231	9.2407	0	0.2625	3.06798	0.098309	0	0.4401	4.19571	8.13525	0	5.62615	0.4856
2023	0.21	0.0113	0	0.150954	5.961	9.9307	0	0.2625	3.06798	0.099521	0	0.4241	4.19571	8.13525	0	5.12473	0.4856
2024	0.22	0.0063	0	0.167451	6.825	10.5857	0	0.2615	3.06798	0.100618	0	0.4241	4.19571	8.03518	0	5.07459	0.4856
2025	0.24	0.0143	0	0.178869	7.707	11.2457	0	0.2615	3.06798	0.102072	0	0.4241	4.19571	8.98579	0	3.47006	0.4856
2026	0.26	0.0083	0	0.191732	8.477	12.0007	0	0.2615	3.06798	0.103457	0	0.4241	4.19571	8.93575	0	3.41992	0.4856
2027	0.28	0.0073	0	0.202631	9.333	12.7757	0	0.2615	3.06798	0.104797	0	0.4241	4.19571	8.83569	0	3.36978	0.4856
2028	0.3	0.0073	0	0.210645	10.299	13.5807	0	0.2615	3.06798	0.105887	0	0.4241	4.19571	8.78566	0	2.01595	0.4856
2029	0.32	0.0063	0	0.221086	11.425	14.4457	0	0.2615	3.06798	0.106951	0	0.4241	4.19571	8.63556	0	1.91567	0.4856
2030	0.27	0.0073	0	0.227343	12.957	15.5257	0	0.2615	3.06798	0.108043	0	0.4241	4.19571	8.43544	0	1.81539	0.4856
2031	0.21	0.0043	0	0.23718	14.019	16.2507	0	0.2615	3.06798	0.10925	0	0.4241	3.24169	8.23531	0	1.71511	0.4856
2032	0.2	0.0043	0	0.243799	15.053	16.9407	0	0.2615	3.06798	0.110358	0	0.4241	3.24169	8.18528	0	1.71511	0.4856
2033	0.18	0.0043	0	0.25378	16.171	17.6707	0	0.2615	3.06798	0.111781	0	0.4241	3.24169	8.13525	0	1.66496	0.4856
2034	0.16	0.0043	0	0.262524	17.355	18.4257	0	0.2615	3.06798	0.113066	0	0.4241	3.24169	8.03518	0	1.61482	0.4856
2035	0.15	0.0043	0	0.26608	18.593	19.2007	0	0.2615	3.06798	0.114098	0	0.4241	3.24169	7.98515	0	1.61482	0.4856
2036	0.14	0.0043	0	0.27586	19.873	19.9907	0	0.2615	3.06798	0.115117	0	0.4241	3.24169	7.93512	0	1.61482	0.4856
2037	0.13	0.0053	0	0.285596	21.225	20.8157	0	0.2615	3.06798	0.116132	0	0.4241	3.24169	7.88509	0	1.61482	0.4856
2038	0.12	0.0053	0	0.294352	22.649	21.6807	0	0.2615	3.06798	0.117125	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2039	0.12	0.0053	0	0.308065	24.127	22.5657	0	0.2615	3.06798	0.118478	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2040	0.13	0.0053	0	0.320616	25.581	23.4207	0	0.2615	3.06798	0.119639	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2041	0.13	0.0073	0	0.330787	26.277	23.8257	0	0.2615	3.06798	0.120651	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2042	0.14	0.0093	0	0.343067	27.127	24.3157	0	0.2615	3.06798	0.122009	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2043	0.15	0.0113	0	0.356726	27.965	24.7857	0	0.2615	3.06798	0.123425	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2044	0.15	0.0133	0	0.364852	28.607	25.1557	0	0.2615	3.06798	0.12441	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2045	0.15	0.0143	0	0.379002	29.089	25.4407	0	0.2615	3.06798	0.125683	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2046	0.15	0.0153	0	0.397258	29.601	25.7707	0	0.2615	3.06798	0.12678	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2047	0.15	0.0153	0	0.407527	29.755	25.8807	0	0.2615	3.06798	0.127806	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2048	0.15	0.0143	0	0.42323	29.869	25.9707	0	0.2615	3.06798	0.129188	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2049	0.15	0.0143	0	0.436076	29.997	26.0757	0	0.2615	3.06798	0.130262	0	0.4241	3.24169	7.83505	0	1.61482	0.4856
2050	0.15	0.0143	0	0.445062	30.165	26.2307	0	0.2615	3.06798	0.131303	0	0.4241	3.24169	7.83505	0	1.61482	0.4856

Year	Sum of Sectors	District He	Water & W	Agricultur	Buildings (	Transporta	Electricity	Industry (r	Geoengine	Land Use
2020	4.54E-02	1.00E-08	0	0.00032	0.001613	0.002903	0.028581	0.012223	0	0
2021	5.27E-02	1.00E-08	0	0.000278	0.001653	0.003201	0.035498	0.012064	0	0
2022	4.15E-02	1.00E-08	0	0.000256	0.00168	0.003476	0.023572	0.012546	0	0
2023	3.79E-02	0	0	0.000274	0.001673	0.003361	0.029035	0.012592	0	0
2024	3.80E-02	0	0	0.000277	0.001664	0.003429	0.019625	0.013031	0	0
2025	[illegible]	0	0	0.00028	0.001651	0.003477	0.012802	0.01359	0	0
2026	[illegible]	0	0	0.000284	0.001645	0.003502	0.010969	0.013876	0	0
2027	2.69E-02	0	0	0.000288	0.001628	0.003517	0.007381	0.014106	0	0
2028	2.38E-02	0	0	0.000292	0.001599	0.003521	0.00464	0.014453	0	0
2029	2.35E-02	0	0	0.000296	0.001576	0.003525	0.003058	0.01463	0	0
2030	2.24E-02	0	0	0.0003	0.001551	0.003520	0.001121	0.014924	0	0
2031	2.28E-02	0	0	0.000304	0.001524	0.003517	0.002023	0.015219	0	0
2032	2.29E-02	0	0	0.00031	0.001501	0.003513	0.002008	0.015553	0	0
2033	2.30E-02	0	0	0.000313	0.00148	0.003488	0.002002	0.015769	0	0
2034	2.33E-02	0	0	0.000315	0.001458	0.00340	0.001902	0.015953	0	0
2035	2.33E-02	0	0	0.000315	0.001439	0.003367	0.0019	0.016211	0	0
2036	2.34E-02	0	0	0.000316	0.00142	0.003342	0.001887	0.016462	0	0
2037	2.37E-02	0	0	0.000318	0.001405	0.003298	0.001897	0.016775	0	0
2038	2.41E-02	0.00E+00	0	0.000321	0.001391	0.003248	0.001887	0.017199	0	0
2039	2.44E-02	0.00E+00	0	0.000324	0.001376	0.003189	0.001898	0.017606	0	0
2040	2.45E-02	0.00E+00	0	0.000326	0.001363	0.00311	0.001871	0.017949	0	0
2041	2.47E-02	0.00E+00	0	0.000328	0.00134	0.003038	0.001876	0.018133	0	0
2042	2.50E-02	0.00E+00	0	0.00033	0.001322	0.002969	0.001875	0.018486	0	0
2043	2.53E-02	0.00E+00	0	0.000332	0.001306	0.002894	0.001867	0.018906	0	0
2044	2.55E-02	0.00E+00	0	0.000334	0.001292	0.00281	0.001863	0.019212	0	0
2045	2.57E-02	0.00E+00	0	0.000336	0.00128	0.002723	0.001862	0.019483	0	0
2046	2.67E-02	0.00E+00	0	0.000338	0.00127	0.002632	0.001843	0.019682	0	0
2047	2.57E-02	0.00E+00	0	0.00034	0.001262	0.00254	0.001841	0.019798	0	0
2048	[illegible]	0.00E+00	0	0.000341	0.001255	0.002447	0.001809	0.01995	0	0
2049	2.62E-02	0.00E+00	0	0.000342	0.00125	0.002353	0.001808	[illegible]	0	0
2050	[illegible]	0.00E+00	0	0.00034	0.001246	0.002256	0.001807	[illegible]	0	0

million metric tons / year)

Year	Sum of Se	District He	Water & W	Agricultur	Buildings (	Transporta	Electricity	Industry (r	Geoengine	Land Use
2020	4.54E-02	1.00E-08	0	0.00032	0.001613	0.002903	0.028180	0.012223	0	0
2021	5.27E-02	1.00E-08	0	0.000278	0.001653	0.003201	0.035498	0.012064	0	0
2022	4.15E-02	1.00E-08	0	0.000256	0.00168	0.003476	0.023572	0.012546	0	0
2023	3.79E-02	0	0	0.000274	0.001673	0.003361	0.029035	0.012592	0	0
2024	3.80E-02	0	0	0.000277	0.001664	0.003429	0.019625	0.013031	0	0
2025	3.37E-02	0	0	0.00028	0.001651	0.003477	[illegible]	0.01359	0	0
2026	3.79E-02	0	0	0.000284	0.001635	0.003501	[illegible]	0.013875	0	0
2027	3.83E-02	0	0	0.000287	0.001617	0.003511	0.018673	0.014087	0	0
2028	3.27E-02	0	0	0.00029	0.001587	0.00351	0.013013	0.014303	0	0
2029	3.29E-02	0	0	0.000293	0.001575	0.00351	0.012918	0.014572	0	0
2030	3.33E-02	0	0	0.000297	0.00155	0.003506	0.013347	0.014883	0	0
2031	3.38E-02	0	0	0.0003	0.001523	0.0035	0.013993	0.015195	0	0
2032	3.46E-02	0	0	0.000306	0.0015	0.003497	0.013767	0.015537	0	0
2033	3.53E-02	0	0	0.000309	0.001478	0.003471	0.014452	0.015771	0	0
2034	3.50E-02	0	0	0.000311	0.001457	0.003419	0.013771	0.015984	0	0
2035	3.51E-02	0	0	0.000312	0.001436	0.003379	0.013296	0.016279	0	0
2036	3.50E-02	0	0	0.000316	0.001419	0.003338	0.013422	0.016521	0	0
2037	3.31E-02	0	0	0.000316	0.001404	0.003292	0.013462	0.016851	0	0
2038	3.53E-02	0.00E+00	0	0.000319	0.001389	0.003242	[illegible]	0.017271	0	0
2039	[illegible]	0.00E+00	0	0.000322	0.001375	0.003184	[illegible]	0.017688	0	0
2040	3.54E-02	0.00E+00	0	0.000324	0.001361	0.003108	0.0127	0.017908	0	0
2041	3.56E-02	0.00E+00	0	0.000326	0.001339	0.003036	[illegible]	0.018211	0	0
2042	3.58E-02	0.00E+00	0	0.000329	0.00132	0.002968	0.012629	0.018597	0	0
2043	3.68E-02	0.00E+00	0	0.00033	0.001304	0.002895	0.012711	0.019048	0	0
2044	3.64E-02	0.00E+00	0	0.00033	0.00129	0.002813	0.013618	0.019395	0	0
2045	3.58E-02	0.00E+00	0	0.000335	0.001279	0.002726	0.01279	0.01968	0	0
2046	3.67E-02	0.00E+00	0	0.000338	0.001269	0.002637	0.012645	0.019797	0	0
2047	3.67E-02	0.00E+00	0	0.00034	0.00126	0.002544	0.012662	0.019937	0	0
2048	3.69E-02	0.00E+00	0	0.000342	0.001254	0.002449	0.012586	0.02024	0	0
2049	3.66E-02	0.00E+00	0	0.000344	0.001249	0.00235	[illegible]	0.020643	0	0
2050	3.69E-02	0.00E+00	0	0.000348	0.001248	0.002234	0.011885	0.021123	0	0

million metric tons / year)

KEY
SOS (Gross-ablated by 2050)
BAU

Year	Sum of Se	District He	Water & W	Agricultur	Buildings (	Transporta	Electricity	Industry (n	Geoengine	Land Use
2020	1.87E-01	4.50E-07	5.07E-17	0.003569	0.025734	0.093884	0.025403	0.039116	0	0
2021	1.99E-01	4.30E-07	5.07E-17	0.003504	0.026766	0.099485	0.030313	0.038572	0	0
2022	1.96E-01	3.90E-07	5.07E-17	0.003586	0.026454	0.100025	0.022473	0.039794	0	0
2023	1.94E-01	3.20E-07	5.07E-17	0.003702	0.026332	0.10355	0.020162	0.0405	0	0
2024	1.96E-01	2.60E-07	5.07E-17	0.003795	0.026141	0.10357	0.020173	0.041864	0	0
2025	1.90E-01	2.10E-07	5.07E-17	0.003886	0.025888	0.103076	0.015411	0.043372	0	0
2026	1.88E-01	1.60E-07	5.11E-17	0.00396	0.025491	0.10177	0.012976	0.043877	0	0
2027	1.84E-01	1.20E-07	5.13E-17	0.004023	0.025346	0.099861	0.010111	0.044334	0	0
2028	1.79E-01	9.00E-08	5.16E-17	0.004093	0.024856	0.097876	0.007173	0.044397	0	0
2029	1.75E-01	6.00E-08	5.19E-17	0.004158	0.02442	0.099424	0.005898	0.045056	0	0
2030	1.70E-01	3.00E-08	5.21E-17	0.004244	0.023998	0.0927	0.003871	0.045491	0	0
2031	1.67E-01	3.00E-08	5.22E-17	0.004302	0.023412	0.089655	0.003579	0.045805	0	0
2032	1.63E-01	2.00E-08	5.23E-17	0.004262	0.022938	0.086245	0.003248	0.046486	0	0
2033	1.60E-01	2.00E-08	5.26E-17	0.004464	0.022485	0.08278	0.003436	0.046768	0	0
2034	1.55E-01	1.00E-08	5.25E-17	0.004511	0.022025	0.078409	0.003214	0.047084	0	0
2035	1.52E-01	1.00E-08	5.27E-17	0.004565	0.021584	0.074492	0.003205	0.047524	0	0
2036	1.48E-01	1.00E-08	5.29E-17	0.004621	0.021165	0.070687	0.003205	0.047969	0	0
2037	1.44E-01	1.00E-08	5.30E-17	0.004681	0.020782	0.067012	0.003212	0.048443	0	0
2038	1.41E-01	1.00E-08	5.32E-17	0.004751	0.020425	0.063207	0.003225	0.049158	0	0
2039	1.38E-01	2.00E-08	5.34E-17	0.004817	0.020065	0.059467	0.003244	0.050016	0	0
2040	1.34E-01	2.00E-08	5.36E-17	0.004902	0.019714	0.055432	0.003154	0.050359	0	0
2041	1.30E-01	2.00E-08	5.39E-17	0.004991	0.019356	0.051517	0.003161	0.050925	0	0
2042	1.27E-01	3.00E-08	5.41E-17	0.005075	0.018935	0.047905	0.00316	0.051455	0	0
2043	1.24E-01	3E-08	5.43E-17	0.005161	0.018632	0.044037	0.003146	0.052306	0	0
2044	1.20E-01	3E-08	5.44E-17	0.005245	0.018383	0.040779	0.003136	0.05308	0	0
2045	1.18E-01	4E-08	5.45E-17	0.005334	0.018185	0.037551	0.003139	0.053628	0	0
2046	1.15E-01	4E-08	5.45E-17	0.005428	0.018027	0.034605	0.003105	0.053948	0	0
2047	1.12E-01	4E-08	5.46E-17	0.005517	0.017903	0.031808	0.003103	0.054036	0	0
2048	1.10E-01	4E-08	5.46E-17	0.005607	0.017812	0.029188	0.003099	0.054463	0	0
2049	1.09E-01	4E-08	5.46E-17	0.005702	0.017757	0.026774	0.003098	0.055484	0	0
2050	1.08E-01	4E-08	5.44E-17	0.005798	0.017736	0.024589	0.003096	0.056089	0	0

million metric tons / year)

Year	Sum of Se	District He	Water & W	Agricultur	Buildings (	Transporta	Electricity	Industry (n	Geoengine	Land Use
2020	1.87E-01	4.50E-07	5.07E-17	0.003569	0.025734	0.093884	0.025403	0.039116	0	0
2021	1.99E-01	4.30E-07	5.07E-17	0.003504	0.026766	0.099485	0.030313	0.038572	0	0
2022	1.95E-01	3.90E-07	5.07E-17	0.003586	0.026454	0.100025	0.022473	0.039794	0	0
2023	1.94E-01	3.20E-07	5.07E-17	0.003702	0.026332	0.10355	0.020162	0.0405	0	0
2024	1.96E-01	2.60E-07	5.07E-17	0.003795	0.026141	0.10357	0.020173	0.041864	0	0
2025	1.95E-01	2.10E-07	5.07E-17	0.003886	0.025888	0.103076	0.019891	0.043542	0	0
2026	1.95E-01	1.60E-07	5.08E-17	0.00396	0.025582	0.101732	0.019819	0.044012	0	0
2027	1.94E-01	1.20E-07	5.08E-17	0.004016	0.025231	0.099779	0.020137	0.044447	0	0
2028	1.88E-01	9.00E-08	5.10E-17	0.004071	0.024833	0.097579	0.016349	0.044889	0	0
2029	1.85E-01	6.00E-08	5.14E-17	0.004129	0.024296	0.095053	0.016217	0.045449	0	0
2030	1.83E-01	3.00E-08	5.13E-17	0.004095	0.023908	0.092344	0.01637	0.0461	0	0
2031	1.80E-01	3.00E-08	5.16E-17	0.004246	0.02338	0.089272	0.016208	0.046739	0	0
2032	1.77E-01	2.00E-08	5.19E-17	0.004392	0.022914	0.085898	0.016478	0.047435	0	0
2033	1.74E-01	2.00E-08	5.21E-17	0.004405	0.022464	0.082501	0.016779	0.04781	0	0
2034	1.69E-01	1.00E-08	5.21E-17	0.004458	0.022005	0.078217	0.01547	0.048235	0	0
2035	1.66E-01	1.30E-08	5.24E-17	0.004523	0.021566	0.074373	0.016423	0.048771	0	0
2036	1.62E-01	1.00E-08	5.25E-17	0.004587	0.021148	0.070601	0.016266	0.049149	0	0
2037	1.58E-01	1.00E-08	5.27E-17	0.004622	0.020766	0.066947	0.016328	0.049738	0	0
2038	1.55E-01	1.00E-08	5.28E-17	0.004724	0.020408	0.063168	0.016309	0.050542	0	0
2039	1.52E-01	2.00E-08	5.29E-17	0.004768	0.020047	0.059468	0.016151	0.051018	0	0
2040	1.48E-01	2.00E-08	5.31E-17	0.004871	0.019694	0.055491	0.016032	0.051689	0	0
2041	1.44E-01	2.00E-08	5.33E-17	0.00496	0.019274	0.051608	0.016211	0.052313	0	0
2042	1.41E-01	3.00E-08	5.35E-17	0.005045	0.018932	0.047909	0.016296	0.05314	0	0
2043	1.38E-01	3E-08	5.36E-17	0.005134	0.018609	0.044355	0.016444	0.054095	0	0
2044	1.36E-01	4E-08	5.37E-17	0.005225	0.018361	0.040908	0.016473	0.05479	0	0
2045	1.33E-01	4E-08	5.38E-17	0.005321	0.018165	0.037688	0.016658	0.055437	0	0
2046	1.31E-01	4E-08	5.39E-17	0.005422	0.018008	0.034733	0.016888	0.055731	0	0
2047	1.28E-01	4E-08	5.40E-17	0.005519	0.017886	0.031924	0.016767	0.056868	0	0
2048	1.26E-01	4E-08	5.41E-17	0.005614	0.017798	0.029254	0.016675	0.056632	0	0
2049	1.24E-01	4E-08	5.41E-17	0.005713	0.017746	0.02686	0.016492	0.057533	0	0
2050	1.23E-01	4E-08	5.42E-17	0.005812	0.017737	0.024604	0.016215	0.058616	0	0

million metric tons / year)

KEY
[illegible] by 2030
BAU

Year	Sum of Se	District He	Water & W	Agriculture	Buildings (	Transport	Electricity	Industry (I	Geoengine	Land Use
2020	46.67908	0.00001	0	0.335706	26.1699	3.03245	1.45575	15.5079	0	0
2021	47.70419	0.00001	0	0.323762	27.7901	3.27525	1.78817	15.5269	0	0
2022	48.42356	0.00001	0	0.535447	28.5454	3.40813	1.21547	13.7381	0	0
2023	48.37539	0.00001	0	0.543902	28.488	3.42911	1.07497	13.8374	0	0
2024	48.77754	0	0	0.356009	28.394	3.44008	1.07755	14.3099	0	0
2025	48.76897	0	0	0.368013	28.2740	3.40964	1.69652	14.8407	0	0
2026	48.59006	0	0	0.578785	28.1813	3.40019	1.45686	15.0929	0	0
2027	48.30652	0	0	0.588594	27.9882	3.34906	1.13257	15.1327	0	0
2028	48.19700	0	0	0.599281	27.8364	3.28937	0.86656	15.4484	0	0
2029	47.85195	0	0	0.610791	27.6254	3.23645	0.65745	15.7319	0	0
2030	47.59088	0	0	0.621843	27.4296	3.13588	0.40516	15.9704	0	0
2031	47.53104	0	0	0.633632	27.2571	3.04034	0.35937	16.3364	0	0
2032	47.53896	0	0	0.644109	27.1192	2.93525	0.3144	16.506	0	0
2033	47.55072	0	0	0.654618	27.0418	[illegible]	[illegible]	16.6253	0	0
2034	47.36485	0	0	0.660888	26.9334	2.68467	0.30975	16.7756	0	0
2035	47.3447	0	0	0.667052	26.8684	2.55675	0.30926	16.9512	0	0
2036	47.40883	0	0	0.673852	26.8066	2.43216	0.30888	17.0835	0	0
2037	47.49081	0	0	0.681572	26.7903	2.31187	0.30997	17.2071	0	0
2038	47.61062	0	0	0.69036	26.7934	2.18862	0.31294	17.6164	0	0
2039	47.82873	0	0	0.69907	26.8304	2.06732	0.30904	17.936	0	0
2040	47.85086	0	0	0.709551	26.8352	1.9337	0.30541	18.069	0	0
2041	47.79833	0	0	0.720377	26.6174	1.80264	0.30401	18.2598	0	0
2042	47.71587	0	0	0.730715	26.4086	1.67853	0.3039	18.599	0	0
2043	47.78636	0	0	0.741188	26.2132	1.55793	0.30256	18.9313	0	0
2044	47.70023	0	0	0.751846	26.029	1.44088	0.3016	19.1779	0	0
2045	47.64162	0	0	0.762013	25.8554	1.33095	0.30034	19.3913	0	0
2046	47.47291	0	0	0.773196	25.6878	1.22986	0.29865	19.4794	0	0
2047	47.32181	0	0	0.785881	25.5518	1.11937	0.29846	19.5944	0	0
2048	47.34	0	0	0.79863	25.4138	1.04178	0.29809	19.7917	0	0
2049	47.47917	0	0	0.80591	25.2919	0.95889	0.29797	20.1168	0	0
2050	47.54616	0	0	0.817594	25.1826	0.87565	0.29778	20.3690	0	0

thousand metric tons / year)

Year	Sum of Se	District He	Water & W	Agriculture	Buildings (	Transport	Electricity	Industry (I	Geoengine	Land Use
2020	46.67908	0.00001	0	0.335706	26.1699	3.03245	1.45575	15.5073	0	0
2021	47.70419	0.00001	0	0.323762	27.7901	3.27525	2.78817	15.5269	0	0
2022	48.42566	0.00001	0	0.535447	28.5454	3.40813	2.21547	13.7381	0	0
2023	48.37539	0.00001	0	0.543902	28.488	3.42911	2.07497	13.8374	0	0
2024	48.77754	0	0	0.356009	28.394	3.44008	2.07755	14.3099	0	0
2025	49.38112	0	0	0.568013	28.2741	3.41364	1.57567	14.8467	0	0
2026	49.26406	0	0	0.578868	28.1234	3.39883	2.08638	15.0676	0	0
2027	49.28791	0	0	0.587607	27.9611	3.34305	1.13833	15.2406	0	0
2028	48.96363	0	0	0.596167	27.8059	3.27921	1.84545	15.4345	0	0
2029	48.95774	0	0	0.605043	27.6284	3.20386	1.82734	15.6931	0	0
2030	48.87726	0	0	0.614783	27.4269	3.12376	1.83271	15.9811	0	0
2031	48.95024	0	0	0.62346	27.2205	3.0272	1.80218	16.2709	0	0
2032	49.0006	0	0	0.635308	27.1162	2.92332	1.82967	16.5041	0	0
2033	49.04642	0	0	0.645308	27.0108	2.81727	1.84701	16.7154	0	0
2034	48.94631	0	0	0.659142	26.9091	2.67807	1.8034	16.8846	0	0
2035	48.95866	0	0	0.66098	26.8389	2.5526	1.81388	17.0816	0	0
2036	48.92406	0	0	0.668706	26.7894	2.42018	1.80517	17.2362	0	0
2037	49.02768	0	0	0.677598	26.7686	2.30965	1.81489	17.4572	0	0
2038	49.17504	0	0	0.686408	26.7769	2.18529	1.81925	17.7709	0	0
2039	49.44799	0	0	0.695851	26.7857	2.06730	1.80826	18.081	0	0
2040	49.49579	0	0	0.705061	26.8077	1.93692	1.82951	18.2137	0	0
2041	49.48774	0	0	0.715853	26.5864	1.80571	1.84698	18.4528	0	0
2042	49.42354	0	0	0.726458	26.376	1.68072	1.86236	18.7772	0	0
2043	49.53142	0	0	0.737585	26.1809	1.56293	1.8826	19.1686	0	0
2044	49.5163	0	0	0.748589	25.9889	1.44944	1.89407	19.4305	0	0
2045	49.5288	0	0	0.76022	25.8263	1.33572	1.91488	19.6739	0	0
2046	49.38016	0	0	0.772287	25.6706	1.23457	1.9248	19.778	0	0
2047	49.26628	0	0	0.784092	25.527	1.13704	1.94091	19.8779	0	0
2048	49.39383	0	0	0.795624	25.3984	1.04402	1.92999	20.1308	0	0
2049	49.42062	0	0	0.807575	25.2761	0.9581	1.90885	20.4732	0	0
2050	49.48796	0	0	0.819481	25.1711	0.87989	1.89682	20.5207	0	0

thousand metric tons / year)

KEY
[illegible] by 2030
BAU

Year	Sum of Se	District He	Water & W	Agriculture	Buildings (	Transport	Electricity	Industry (	Geoengine	Land Use
2020	104.0034	0.00004	0	6.50652	20.4385	44.0931	0.75461	31.2496	0	0
2021	107.1657	0.00004	0	6.6567	21.7839	46.0401	0.79133	31.8936	0	0
2022	110.1629	0.00004	0	6.91353	22.6091	47.1774	0.66257	32.8063	0	0
2023	112.089	0.00003	0	7.03193	22.5776	47.6834	0.644	34.172	0	0
2024	113.2919	0.00002	0	7.19567	22.5243	47.3707	0.6451	35.5361	0	0
2025	113.745	0.00002	0	7.36385	22.458	46.4923	0.58036	36.8987	0	0
2026	112.883	0.00001	0	7.50971	22.3879	45.6503	0.47025	36.4928	0	0
2027	111.4288	0.00001	0	7.64747	22.3177	44.332	0.39173	36.7399	0	0
2028	109.5291	0	0	7.80537	22.2383	41.9999	0.31503	36.1326	0	0
2029	107.4771	0	0	7.97062	22.1493	41.4272	0.24299	35.6876	0	0
2030	105.2871	0	0	8.13193	22.0347	38.8096	0.15248	35.238	0	0
2031	103.5899	0	0	8.24821	21.9617	38.6799	0.13945	34.1612	0	0
2032	100.5044	0	0	8.43671	21.9415	36.3424	0.1342	34.2856	0	0
2033	99.19535	0	0	8.60948	21.9371	34.2502	0.12813	34.2704	0	0
2034	97.53674	0	0	8.73893	21.925	32.0626	0.13651	34.7337	0	0
2035	95.93776	0	0	8.87665	21.9493	30.1273	0.13631	34.8742	0	0
2036	94.44927	0	0	9.02045	21.9755	28.7483	0.13637	35.094	0	0
2037	93.15574	0	0	9.17209	22.0377	26.4279	0.11685	35.4012	0	0
2038	91.85555	0	0	9.33909	22.114	24.4725	0.11806	35.8119	0	0
2039	90.58915	0	0	9.5141	22.2048	22.5768	0.11085	36.369	0	0
2040	89.33131	0	0	9.7014	22.2983	20.6868	0.11361	36.4299	0	0
2041	87.97433	0	0	9.90689	22.1707	18.8969	0.11414	36.8915	0	0
2042	86.9144	0	0	10.1064	22.0835	17.2943	0.1141	37.4932	0	0
2043	85.95339	0	0	10.3026	21.9098	15.61	0.11329	38.0074	0	0
2044	85.15751	0	0	10.5014	21.7799	14.1171	0.11323	38.6059	0	0
2045	84.29246	0	0	10.7086	21.6496	12.7331	0.11306	39.0877	0	0
2046	83.45553	0	0	10.9211	21.527	11.4819	0.11213	39.5994	0	0
2047	82.67716	0	0	11.1293	21.4098	10.3184	0.11206	39.7098	0	0
2048	82.18736	0	0	11.334	21.2914	9.54654	0.11154	40.2095	0	0
2049	82.08708	0	0	11.5608	21.1827	8.29913	0.11187	[illegible]	0	0
2050	81.96958	0	0	11.7521	21.0796	7.43754	0.1118	40.3458	0	0

(thousand metric tons / year)

Year	Sum of Se	District He	Water & W	Agriculture	Buildings (	Transport	Electricity	Industry (	Geoengine	Land Use
2020	105.0034	0.00004	0	6.50652	20.4385	44.0931	0.75461	31.2496	0	0
2021	107.1657	0.00004	0	6.6567	21.7839	46.0401	0.79133	31.8936	0	0
2022	110.1629	0.00004	0	6.91353	22.6091	47.1774	0.66257	32.9063	0	0
2023	112.089	0.00003	0	7.03193	22.5776	47.6834	0.644	34.172	0	0
2024	113.2919	0.00002	0	7.19567	22.5243	47.3707	0.6451	35.5361	0	0
2025	113.8581	0.00002	0	7.36386	22.458	46.6922	0.63691	36.8807	0	0
2026	113.7772	0.00001	0	7.5108	22.3801	45.3086	0.65897	37.6477	0	0
2027	113.088	0.00001	0	7.63483	22.3041	44.2598	0.67695	38.2195	0	0
2028	111.9171	0	0	7.76271	22.2175	42.8338	0.61585	38.5032	0	0
2029	110.4909	0	0	7.89554	22.1277	41.372	0.61034	38.5873	0	0
2030	109.2758	0	0	8.03871	22.0286	39.6679	0.60931	38.9934	0	0
2031	107.7462	0	0	8.14599	21.9971	37.5265	0.59624	39.1449	0	0
2032	106.2171	0	0	8.32143	21.9381	36.0054	0.59008	39.3726	0	0
2033	104.7063	0	0	8.49531	21.9135	34.1424	0.58614	39.549	0	0
2034	103.1372	0	0	8.6565	21.9052	31.998	0.59881	40.3057	0	0
2035	101.7488	0	0	8.79466	21.9257	30.0829	0.52813	40.3447	0	0
2036	100.3295	0	0	8.95491	21.9583	28.2162	0.58549	40.6056	0	0
2037	99.09541	0	0	9.11521	22.0139	26.4050	0.6	40.9573	0	0
2038	97.84299	0	0	9.2862	22.0949	24.4575	0.60573	41.4037	0	0
2039	96.65079	0	0	9.45708	22.1833	22.5892	0.60671	41.8253	0	0
2040	95.413	0	0	9.64063	22.2765	20.7023	0.61358	42.1736	0	0
2041	94.34469	0	0	9.84464	22.1449	18.927	0.62505	42.8064	0	0
2042	93.47981	0	0	10.0473	22.0137	17.2426	0.62711	43.5306	0	0
2043	92.69075	0	0	10.2497	21.8808	15.6607	0.63405	44.2665	0	0
2044	92.07256	0	0	10.4614	21.7545	14.1566	0.63966	45.0582	0	0
2045	91.44731	0	0	10.6891	21.6253	12.7746	0.64581	45.7185	0	0
2046	90.745	0	0	10.9087	21.5042	11.523	0.6511	46.1606	0	0
2047	90.14018	0	0	11.1314	21.3878	10.3465	0.65798	46.6096	0	0
2048	89.77689	0	0	11.3482	21.2743	9.26017	0.65667	47.44	0	0
2049	[illegible]	0	0	11.5867	21.1605	8.29205	0.66858	47.9799	0	0
2050	[illegible]	0	0	11.7824	21.0701	7.43058	0.66754	48.6043	0	0

(thousand metric tons / year)

KEY
[illegible] by 2030
BAU

Year	Sum of Se	District He	Water & W	Agricultur	Buildings (	Transport	Electricity	Industry (I	Geoengine	Land Use
2020	0.810658	2.5E-07	0	0.027932	0.14545	0.514497	0.012684	0.110294	0	0
2021	0.838796	2.4E-07	0	0.027708	0.155079	0.535166	0.01489	0.105959	0	0
2022	0.85783	2.2E-07	0	0.029062	0.161114	0.546463	0.010308	0.110888	0	0
2023	0.862976	1.8E-07	0	0.029631	0.160899	0.551288	0.009223	0.111935	0	0
2024	0.864368	1.5E-07	0	0.030471	0.160533	0.546858	0.00953	0.117296	0	0
2025	0.857613	1.2E-07	0	0.031287	0.16008	0.538804	0.006761	0.123482	0	0
2026	0.846907	9E-08	0	0.031917	0.159604	0.524406	0.005678	0.125105	0	0
2027	0.831488	7E-08	0	0.032417	0.159133	0.508822	0.004139	0.126857	0	0
2028	0.815014	5E-08	0	0.03302	0.158289	0.489823	0.002821	0.128756	0	0
2029	0.798319	3E-08	0	0.033496	0.158092	0.473401	0.002062	0.131318	0	0
2030	0.780133	3E-08	0	0.034293	0.157368	0.451083	0.001051	0.133339	0	0
2031	0.761246	1E-08	0	0.034767	0.15675	0.433063	0.000881	0.135795	0	0
2032	0.742307	1E-08	0	0.035573	0.156056	0.409806	0.000733	0.138479	0	0
2033	0.720635	1E-08	0	0.036168	0.156673	0.387268	0.000841	0.13975	0	0
2034	0.696544	1E-08	0	0.036608	0.156636	0.363826	0.000717	0.140967	0	0
2035	0.676652	0	0	0.037146	0.156818	0.338968	0.000715	0.142964	0	0
2036	0.655737	0	0	0.037575	0.157098	0.317051	0.000714	0.144196	0	0
2037	0.638848	0	0	0.038231	0.157292	0.295798	0.00073	0.146497	0	0
2038	0.620552	1E-08	0	0.038873	0.158185	0.273925	0.000758	0.149811	0	0
2039	0.601005	1E-08	0	0.039566	0.158875	0.250768	0.000706	0.152084	0	0
2040	0.582537	1E-08	0	0.040255	0.159807	0.228904	0.000691	0.15389	0	0
2041	0.56446	1E-08	0	0.041052	0.158719	0.20826	0.000862	0.155697	0	0
2042	0.54742	1E-08	0	0.041873	0.157885	0.189864	0.000682	0.158186	0	0
2043	0.530279	1E-08	0	0.042673	0.156897	0.170667	0.000689	0.161152	0	0
2044	0.516195	2E-08	0	0.043473	0.155985	0.154442	0.000687	0.16295	0	0
2045	0.502642	2E-08	0	0.044307	0.155056	0.137858	0.000682	0.164593	0	0
2046	0.488831	2E-08	0	0.045202	0.154183	0.123429	0.00068	0.165307	0	0
2047	0.475217	2E-08	0	0.046048	0.153307	0.107516	0.00068	0.164836	0	0
2048	0.465443	2E-08	0	0.046895	0.152496	0.098504	0.000675	0.167699	0	0
2049	0.458052	2E-08	0	0.047788	0.151753	0.08768	0.000678	0.170003	0	0
2050	0.451237	2E-08	0	0.048751	0.150968	0.078489	0.000678	0.174387	0	0

million metric tons / year)

Year	Sum of Se	District He	Water & W	Agricultur	Buildings (	Transport	Electricity	Industry (I	Geoengine	Land Use
2020	0.810658	2.5E-07	0	0.027932	0.14545	0.514497	0.012684	0.110294	0	0
2021	0.838796	2.4E-07	0	0.027708	0.155079	0.535166	0.01489	0.105959	0	0
2022	0.85788	2.2E-07	0	0.029062	0.161114	0.546463	0.010308	0.110888	0	0
2023	0.862976	1.8E-07	0	0.029631	0.160899	0.551288	0.009223	0.111935	0	0
2024	0.864368	1.5E-07	0	0.030471	0.160533	0.546858	0.00953	0.117296	0	0
2025	0.861277	1.2E-07	0	0.031287	0.16008	0.538804	0.008624	0.123482	0	0
2026	0.850176	9E-08	0	0.031702	0.159548	0.524268	0.009078	0.12534	0	0
2027	0.835485	7E-08	0	0.032583	0.159036	0.507997	0.009037	0.126792	0	0
2028	0.817617	5E-08	0	0.032846	0.158451	0.488441	0.007405	0.128472	0	0
2029	0.801124	3E-08	0	0.033342	0.157847	0.471665	0.007334	0.130935	0	0
2030	0.784023	2E-08	0	0.033888	0.157182	0.45328	0.007406	0.133465	0	0
2031	0.765584	1E-08	0	0.034917	0.156575	0.431329	0.007535	0.136009	0	0
2032	0.746149	1E-08	0	0.035548	0.156488	0.408267	0.007466	0.138881	0	0
2033	0.726653	1E-08	0	0.035888	0.156525	0.385898	0.007523	0.140036	0	0
2034	0.702726	1E-08	0	0.036179	0.156495	0.36078	0.007463	0.141839	0	0
2035	0.683521	0	0	0.036808	0.156659	0.338492	0.00744	0.144063	0	0
2036	0.664865	0	0	0.037401	0.156975	0.316676	0.007582	0.14542	0	0
2037	0.646087	0	0	0.037993	0.157464	0.295527	0.007404	0.147699	0	0
2038	0.627777	1E-08	0	0.038644	0.158048	0.271765	0.007339	0.150981	0	0
2039	0.610089	1E-08	0	0.039322	0.158779	0.25085	0.007348	0.154184	0	0
2040	0.591141	1E-08	0	0.040001	0.159443	0.229213	0.007354	0.155138	0	0
2041	0.572551	1E-08	0	0.040834	0.158533	0.208679	0.00874	0.157106	0	0
2042	0.555868	1E-08	0	0.041628	0.15761	0.189295	0.007447	0.158868	0	0
2043	0.54114	2E-08	0	0.043454	0.156703	0.171118	0.00751	0.163325	0	0
2044	0.525859	2E-08	0	0.043309	0.155797	0.153895	0.007535	0.165281	0	0
2045	0.512583	2E-08	0	0.0442	0.154882	0.138106	0.007629	0.167495	0	0
2046	0.49868	2E-08	0	0.045133	0.15402	0.123826	0.007648	0.167772	0	0
2047	0.485226	2E-08	0	0.046057	0.153188	0.110614	0.00771	0.167707	0	0
2048	0.475493	2E-08	0	0.046954	0.152573	0.098468	0.007667	0.170951	0	0
2049	0.467978	2E-08	0	0.047887	0.151618	0.087701	0.007513	0.173261	0	0
2050	0.460012	2E-08	0	0.048804	0.150898	0.078492	0.007506	0.178318	0	0

million metric tons / year)

KEY
[illegible] by 2030
BAU

EPA KEY CONTACTS FORM

OMB Number: 2030-0020
Expiration Date: 06/30/2024

Authorized Representative: *Original awards and amendments will be sent to this individual for review and acceptance, unless otherwise indicated.*

Name: Prefix: | First Name: Ed | Middle Name:
Last Name: Willoughby | Suffix:
Title: Federal Aid Coordinator
Complete Address:
Street1: P.O. Box 30473
Street2:
City: Lansing | State: MI: Michigan
Zip / Postal Code: 48909-7973 | Country: USA: UNITED STATES
Phone Number: 517-242-1285 | **Fax Number:**
E-mail Address: willoughbye@michigan.gov

Payee: *Individual authorized to accept payments.*

Name: Prefix: | First Name: Ed | Middle Name:
Last Name: Willoughby | Suffix:
Title: Federal Aid Coordinator
Complete Address:
Street1: P.O. Box 30473
Street2:
City: Lansing | State: MI: Michigan
Zip / Postal Code: 48909-7973 | Country: USA: UNITED STATES
Phone Number: 517-242-1285 | **Fax Number:**
E-mail Address: willoughbye@michigan.gov

Administrative Contact: *Individual from Sponsored Programs Office to contact concerning administrative matters (i.e., indirect cost rate computation, rebudgeting requests etc).*

Name: Prefix: | First Name: Lisa | Middle Name:
Last Name: Root | Suffix:
Title: Financial Manager
Complete Address:
Street1: P.O. Box 30473
Street2:
City: Lansing | State: MI: Michigan
Zip / Postal Code: 48909-7973 | Country: USA: UNITED STATES
Phone Number: 989-445-0127 | **Fax Number:**
E-mail Address: rootl@michigan.gov

EPA KEY CONTACTS FORM

Project Manager: *Individual responsible for the technical completion of the proposed work.*

Name: Prefix: | First Name: Cory | Middle Name:

Last Name: Connolly | Suffix:

Title: Climate and Energy Advisor

Complete Address:

Street1: P.O. Box 30473

Street2:

City: Lansing | State: MI: Michigan

Zip / Postal Code: 48909-7973 | Country: USA: UNITED STATES

Phone Number: 517-881-8972 | **Fax Number:**

E-mail Address: connollyc3@michigan.gov

OMB Number: 2030-0020
Expiration Date: 06/30/2024

Preaward Compliance Review Report for All Applicants and Recipients Requesting EPA Financial Assistance

Note: Read Instructions before completing form.

I. A. Applicant/Recipient (Name, Address, City, State, Zip Code)

Name: Michigan Department of Environment, Great Lakes, and Energy

Address: P.O. Box 30473

City: Lansing

State: MI: Michigan Zip Code: 48909-7973

B. Unique Entity Identifier (UEI): D1CZA6WQ2L85

C. Applicant/Recipient Point of Contact

Name: Ed Willoughby

Phone: 517-242-1285

Email: willoughbye@michigan.gov

Title: Federal Aid Coordinator

II. Is the applicant currently receiving EPA Assistance? ☒ Yes ☐ No

III. List all pending civil rights lawsuits and administrative complaints filed under federal law against the applicant/recipient that allege discrimination based on race, color, national origin, sex, age, or disability. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

EPA complaint #s 03DRr-22-R5; 01RNO-22-R5; 02RNO-22-R5; and 04R-21-R5. EGLE complaint #20-001-D

IV. List all civil rights lawsuits and administrative complaints decided against the applicant/recipient within the last year that alleged discrimination based on race, color, national origin, sex, age, or disability and enclose a copy of all decisions. Please describe all corrective actions taken. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

None

V. List all civil rights compliance reviews of the applicant/recipient conducted under federal nondiscrimination laws by any federal agency within the last two years and enclose a copy of the review and any decisions, orders, or agreements based on the review. Please describe any corrective action taken. (40 C.F.R. § 7.80(c)(3))

None

VI. Is the applicant requesting EPA assistance for new construction? If no, proceed to VII; if yes, answer (a) and/or (b) below.

☐ Yes ☒ No

a. If the grant is for new construction, will all new facilities or alterations to existing facilities be designed and constructed to be readily accessible to and usable by persons with disabilities? If yes, proceed to VII; if no, proceed to VI(b).

☐ Yes ☒ No

b. If the grant is for new construction and the new facilities or alterations to existing facilities will not be readily accessible to and usable by persons with disabilities, explain how a regulatory exception (40 C.F.R. 7.70) applies.

VII. **Does the applicant/recipient provide initial and continuing notice that it does not discriminate on the basis of race, color, national origin, sex, age, or disability in its program or activities? (40 C.F.R 5.140 and 7.95)** ☒ Yes ☐ No

a. **Do the methods of notice accommodate those with impaired vision or hearing?** ☒ Yes ☐ No

b. **Is the notice posted in a prominent place in the applicant's/recipient's website, in the offices or facilities or, for education programs and activities, in appropriate periodicals and other written communications?** ☒ Yes ☐ No

c. **Does the notice identify a designated civil rights coordinator?** ☒ Yes ☐ No

VIII. **Does the applicant/recipient maintain demographic data on the race, color, national origin, sex, age, or disability status of the population it serves? (40 C.F.R. 7.85(a))** ☒ Yes ☐ No

IX. **Does the applicant/recipient have a policy/procedure for providing meaningful access to services for persons with limited English proficiency? (Title VI, 40 C.F.R. Part 7, *Lau v Nichols* 414 U.S. (1974))** ☒ Yes ☐ No

X. **If the applicant is an education program or activity, or has 15 or more employees, has it designated an employee to coordinate its compliance with 40 C.F.R. Parts 5 and 7? Provide the name, title, position, mailing address, e-mail address, fax number, and telephone number of the designated coordinator.**

Katherine Lambeth, Nondiscrimination Compliance Coordinator
525 West Allegan St, PO Box 30473
Lansing, MI 48909
EGLE - NondiscriminationCC@michigan.gov
Phone: 517-249-0906

XI. **If the applicant is an education program or activity, or has 15 or more employees, has it adopted grievance procedures that assure the prompt and fair resolution of complaints that allege a violation of 40 C.F.R. Parts 5 and 7? Provide a legal citation or applicant's/recipient's website address for, or a copy of, the procedures.**

https://www.michigan.gov/-/media/project/Websites/egle/Documents/Policies-Procedures/Department/09-024-Nondiscrimination-EGLE-Programs.pdf

For the Applicant/Recipient

I certify that the statements I have made on this form and all attachments thereto are true, accurate and complete. I acknowledge that any knowingly false or misleading statement may be punishable by fine or imprisonment or both under applicable law. I assure that I will fully comply with all applicable civil rights statutes and EPA regulations.

A. Signature of Authorized Official	B. Title of Authorized Official	C. Date
James Garry	Federal Aid Coordinator	03/28/2024

For the U.S. Environmental Protection Agency

I have reviewed the information provided by the applicant/recipient and hereby certify that the applicant/recipient has submitted all preaward compliance information required by 40 C.F.R. Parts 5 and 7; that based on the information submitted, this application satisfies the preaward provisions of 40 C.F.R. Parts 5 and 7; and that the applicant has given assurance that it will fully comply with all applicable civil rights statures and EPA regulations.

A. *Signature of Authorized EPA Official	B. Title of Authorized Official	C. Date

Instructions for EPA FORM 4700-4 (Rev. 04/2021)

General. Recipients of Federal financial assistance from the U.S. Environmental Protection Agency must comply with the following statutes and regulations.
Title VI of the Civil Rights Acts of 1964 provides that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. The Act goes on to explain that the statute shall not be construed to authorize action with respect to any employment practice of any employer, employment agency, or labor organization (except where the primary objective of the Federal financial assistance is to provide employment). Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act provides that no person in the United States shall on the ground of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under the Federal Water Pollution Control Act, as amended. Employment discrimination on the basis of sex is prohibited in all such programs or activities. Section 504 of the Rehabilitation Act of 1973 provides that no otherwise qualified individual with a disability in the United States shall solely by reason of disability be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. Employment discrimination on the basis of disability is prohibited in all such programs or activities. The Age Discrimination Act of 1975 provides that no person on the basis of age shall be excluded from participation under any program or activity receiving Federal financial assistance. Employment discrimination is not covered. Age discrimination in employment is prohibited by the Age Discrimination in Employment Act administered by the Equal Employment Opportunity Commission. Title IX of the Education Amendments of 1972 provides that no person in the United States on the basis of sex shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance. Employment discrimination on the basis of sex is prohibited in all such education programs or activities. Note: an education program or activity is not limited to only those conducted by a formal institution. 40 C.F.R. Part 5 implements Title IX of the Education Amendments of 1972. 40 C.F.R. Part 7 implements Title VI of the Civil Rights Act of 1964, Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act, and Section 504 of The Rehabilitation Act of 1973.

Items "Applicant" means any entity that files an application or unsolicited proposal or otherwise requests EPA assistance. 40 C.F.R. §§ 5.105, 7.25. "Recipient" means any State or its political subdivision, any instrumentality of a State or its political subdivision, any public or private agency, institution, organizations, or other entity, or any person to which Federal financial assistance is extended directly or through another recipient, including any successor, assignee, or transferee of a recipient, but excluding the ultimate beneficiary of the assistance. 40 C.F.R. §§ 5.105, 7.25. "Civil rights lawsuits and administrative complaints" means any lawsuit or administrative complaint alleging discrimination on the basis of race, color, national origin, sex, age, or disability pending or decided against the applicant and/or entity which actually benefits from the grant, but excluding employment complaints not covered by 40 C.F.R. Parts 5 and 7. For example, if a city is the named applicant but the grant will actually benefit the Department of Sewage, civil rights lawsuits involving both the city and the Department of Sewage should be listed. "Civil rights compliance review" means: any federal agency-initiated investigation of a particular aspect of the applicant's and/or recipient's programs or activities to determine compliance with the federal non-discrimination laws. Submit this form with the original and required copies of applications, requests for extensions, requests for increase of funds, etc. Updates of information are all that are required after the initial application submission. If any item is not relevant to the project for which assistance is requested, write "NA" for "Not Applicable." In the event applicant is uncertain about how to answer any questions, EPA program officials should be contacted for clarification.

CERTIFICATION REGARDING LOBBYING

Certification for Contracts, Grants, Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Statement for Loan Guarantees and Loan Insurance

The undersigned states, to the best of his or her knowledge and belief, that:

If any funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this commitment providing for the United States to insure or guarantee a loan, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions. Submission of this statement is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required statement shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

* APPLICANT'S ORGANIZATION

Michigan Department of Environment, Great Lakes, and Energy

* PRINTED NAME AND TITLE OF AUTHORIZED REPRESENTATIVE

Prefix: | * First Name: Ed | Middle Name:

* Last Name: Willoughby | Suffix:

* Title: Federal Aid Coordinator

* SIGNATURE: James Garry | * DATE: 03/28/2024

Other Attachment File(s)

*** Mandatory Other Attachment Filename:** 1234-ImplementingtheMIHealthyClimatePlanPCAP_Michi

Add Mandatory Other Attachment | Delete Mandatory Other Attachment | View Mandatory Other Attachment

To add more "Other Attachment" attachments, please use the attachment buttons below.

Add Optional Other Attachment | Delete Optional Other Attachment | View Optional Other Attachment

Project Narrative File(s)

*** Mandatory Project Narrative File Filename:** 1253-Workplan_Michigan_MidwestIndustrialDecarbCoalitio

Add Mandatory Project Narrative File | Delete Mandatory Project Narrative File | View Mandatory Project Narrative File

To add more Project Narrative File attachments, please use the attachment buttons below.

Add Optional Project Narrative File | Delete Optional Project Narrative File | View Optional Project Narrative File

OMB Number: 4040-0004
Expiration Date: 11/30/2025

Application for Federal Assistance SF-424

* 1. Type of Submission:
- [ ] Preapplication
- [x] Application
- [ ] Changed/Corrected Application

* 2. Type of Application:
- [x] New
- [ ] Continuation
- [ ] Revision

* If Revision, select appropriate letter(s):

* Other (Specify):

* 3. Date Received: 03/28/2024

4. Applicant Identifier:

5a. Federal Entity Identifier:

5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:

7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name: Michigan Department of Environment, Great Lakes, and Energy

* b. Employer/Taxpayer Identification Number (EIN/TIN): 38-6000134

* c. UEI: D1CZA6WQ2L85

d. Address:

* Street1: P.O. Box 30473
Street2:
* City: Lansing
County/Parish:
* State: MI: Michigan
Province:
* Country: USA: UNITED STATES
* Zip / Postal Code: 48909-7973

e. Organizational Unit:

Department Name:

Division Name:

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:
* First Name: Ed
Middle Name:
* Last Name: Willoughby
Suffix:

Title: Federal Aid Coordinator

Organizational Affiliation:

* Telephone Number: 517-242-1285
Fax Number:

* Email: willoughbye@michigan.gov

Application for Federal Assistance SF-424

*** 9. Type of Applicant 1: Select Applicant Type:**

A: State Government

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

Environmental Protection Agency

11. Catalog of Federal Domestic Assistance Number:

66.046

CFDA Title:

Climate Pollution Reduction Grants

*** 12. Funding Opportunity Number:**

EPA-R-OAR-CPRGI-23-07

* Title:

Climate Pollution Reduction Grants Program: Implementation Grants (General Competition)

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

Add Attachment | Delete Attachment | View Attachment

*** 15. Descriptive Title of Applicant's Project:**

Midwest Industrial Decarbonization Challenge. A CPRG Coalition of States Illinois, Michigan, Minnesota, Ohio, and Wisconsin

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: MI-008 * b. Program/Project: MI-all

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 10/01/2024 * b. End Date: 09/30/2029

18. Estimated Funding ($):

* a. Federal	500,000,000.00
* b. Applicant	0.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	500,000,000.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

☐ a. This application was made available to the State under the Executive Order 12372 Process for review on .

☒ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

☐ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes," provide explanation in attachment.)**

☐ Yes ☒ No

If "Yes", provide explanation and attach

Add Attachment | Delete Attachment | View Attachment

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 18, Section 1001)**

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: * First Name: Ed

Middle Name:

* Last Name: Willoughby

Suffix:

* Title: Federal Aid Coordinator

* Telephone Number: 517-242-1285 Fax Number:

* Email: willoughbye@michigan.gov

* Signature of Authorized Representative: James Garry * Date Signed: 03/28/2024

BUDGET INFORMATION - Non-Construction Programs

OMB Number: 4040-0006
Expiration Date: 02/28/2025

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. Midwest Industrial Decarbonization Challenge Coalition		$	$	$ 5,000,000,000.00	$	$ 5,000,000,000.00
2.						
3.						
4.						
5. Totals		$	$	$ 5,000,000,000.00	$	$ 5,000,000,000.00

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SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1)	(2)	(3)	(4)	Total (5)
	Midwest Industrial Decarbonization Challenge Coalition				
a. Personnel	$ 2,675,653.00	$	$	$	$ 2,675,653.00
b. Fringe Benefits	1,103,061.00				1,103,061.00
c. Travel	110,550.00				110,550.00
d. Equipment	0.00				0.00
e. Supplies	0.00				0.00
f. Contractual	5,150,000.00				5,150,000.00
g. Construction	0.00				0.00
h. Other	490,331,580.00				490,331,580.00
i. Total Direct Charges (sum of 6a-6h)	499,370,844.00				$ 499,370,844.00
j. Indirect Charges	629,156.00				$ 629,156.00
k. TOTALS (sum of 6i and 6j)	$ 500,000,000.00	$	$	$	$ 500,000,000.00
7. Program Income	$	$	$	$	$

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SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8. Midwest Industrial Decarbonization Challenge Coalition	$	$	$	$
9.				
10.				
11.				
12. TOTAL (sum of lines 8-11)	$	$	$	$

SECTION D - FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 27,027,906.00	$ 6,756,977.00	$ 6,756,977.00	$ 6,756,976.00	$ 6,756,976.00
14. Non-Federal	$				
15. TOTAL (sum of lines 13 and 14)	$ 27,027,906.00	$ 6,756,977.00	$ 6,756,977.00	$ 6,756,976.00	$ 6,756,976.00

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (YEARS) (b)First	(c) Second	(d) Third	(e) Fourth
16. Midwest Industrial Decarbonization Challenge Coalition	$ 27,134,923.00	$ 148,349,088.00	$ 148,606,722.00	$ 148,881,361.00
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$ 27,134,923.00	$ 148,349,088.00	$ 148,606,722.00	$ 148,881,361.00

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges:

22. Indirect Charges:

23. Remarks:

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 · (217) 782-3397
JB PRITZKER, GOVERNOR **JOHN J. KIM**, DIRECTOR

March 21, 2024

Hon. Michael Regan
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, DC 20004

Subject: Letter of Intent to Sign Coalition MOA for
Midwest Industrial Decarbonization Challenge (NOFO EPA-R-OAR-CPRGI-23-07)

Dear Administrator Regan,

The Illinois Environmental Protection Agency submits this letter of support for the State of Michigan's coalition application entitled "Midwest Industrial Decarbonization Challenge" in response to EPA's Notice of Funding Opportunity (NOFO) No. EPA-R-OAR-CPRGI-23-07.

As required by the NOFO, as a member of the coalition we intend to enter into a Memorandum of Agreement with the Michigan Department of Environment, Great Lakes & Energy (EGLE) and the other members of the coalition that sets forth the specific roles and responsibilities of each partner agency as well as the other information called for by the NOFO. EGLE expects to submit this MOA no later than July 1 2024.

We are pleased to join EGLE in this coalition application and thank you for your consideration.

Sincerely,
JC Kibbey
Climate Advisor
Illinois Environmental Protection Agency

Wisconsin

Emissions Reduction Roadmap

WISCONSIN OFFICE OF
Sustainability
& Clean Energy

Prepared by:
Wisconsin Department of Administration
Office of Sustainability and Clean Energy
101 E Wilson St., 5th Fl.
Madison, WI 53703
osce@wisconsin.gov

Acknowledgements and Disclaimer

The Wisconsin Department of Administration (DOA), Office of Sustainability and Clean Energy (OSCE) is delivering this roadmap as a tool to support investments in policies, practices, and technologies that reduce pollutant emissions, create high-quality jobs, spur economic growth, protect and preserve natural resources, improve air quality, and enhance the health and well-being for all residents in Wisconsin.

The OSCE recognizes and thanks the following for their contribution to this roadmap:

- Organizations from the States Deployment Initiative - Conveners Network for their considerable contributions in facilitation, analysis, resources, and insight throughout the development of Wisconsin's planning process.
- The University of Wisconsin – Madison, Nelson Institute for Environmental Studies, Energy Analysis and Policy Program, and the University of Wisconsin – Milwaukee Office of Sustainability for their contributions to the benefits analysis and review of local climate action plans, respectively.
- The many contributors who participated in the process via stakeholder engagement activities, providing essential perspectives and subject matter expertise to advise on key pathways and strategies. Stakeholders were engaged via meetings, participating in statewide events, and online written comments.
- State agency leadership and staff who provided guidance and review of this roadmap.

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement 00E03465 to the Wisconsin Department of Administration. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency (US EPA), nor does the US EPA endorse trade names or recommend the use of commercial products mentioned in this document.

Table of Contents

Introduction

The Wisconsin Department of Administration, Office of Sustainability and Clean Energy (OSCE) leads the state of Wisconsin in addressing the effects of climate change through programs and policies that support the use of clean energy resources and technology. Governor Tony Evers' Executive Order #38 created the office and charges the OSCE to partner with other state agencies and state utilities to achieve the goal of ensuring all electricity consumed within Wisconsin is 100 percent carbon-free by 2050.[i] By consistently facilitating interagency coordination, the OSCE elevates and aligns clean energy and sustainability work across agencies. Additionally, the OSCE serves as an information and resource hub for Wisconsin local governments, businesses, and residents. This is done by providing energy information and meeting with stakeholders (businesses, Native Nations, local governments, utilities, etc.) to discuss and support the advancement of policy and projects and gather input on state-led efforts.

The U.S. Environmental Protection Agency's (US EPA) Climate Pollution Reduction Grants (CPRG) program is a $5 billion investment over four years that provides states, local governments, Native Nations, and territories with funding to develop and implement plans for reducing greenhouse gas (GHG) emissions and other harmful air pollution. The OSCE serves as the designated state lead for the CPRG Program and developed the Wisconsin Emissions Reduction Roadmap (roadmap) with support from the phase one planning award to the state of Wisconsin. Along with the OSCE, one Metropolitan Statistical Area (MSA) in Wisconsin (Milwaukee-Waukesha, WI Metro Area) received a planning grant along with two MSAs outside of the state in Minnesota (Minneapolis-St. Paul-Bloomington, MN-WI Metro Area) and Illinois (Chicago-Naperville-Elgin, IL-IN-WI Metro Area) that cover a small portion of Wisconsin. In addition, multiple Native Nations located in Wisconsin opted into the CPRG program, including the Midwest Tribal Energy Resources Association (representing five Nations in Wisconsin), St. Croix Chippewa Indians of Wisconsin, Sokaogon Chippewa Community - Mole Lake Band of Lake Superior Chippewa, Forest County Potawatomi, and Red Cliff Band of Lake Superior Chippewa.

The elements in the scope of Wisconsin's roadmap support the US EPA's Fiscal Year 2022-2026 Strategic Plan Goal 1 (Tackle the Climate Crisis); Objective 1.1 (Reduce Emissions that Cause Climate Change) through:

- Emissions reductions associated with the priority measures identified during strategic planning.
- Justice40 metrics identified and tracked (health, social, and economic).[ii]
- Individuals and communities who have been most impacted by pollution and climate change are involved in the planning and decision-making process.
- Transparency on applicable laws, rules, and regulations.
- Actions aligned with state, local, private, Inflation Reduction Act (IRA), Bipartisan Infrastructure Law (BIL), Creating Helpful Incentives to Produce Semiconductor and Science Act (CHIPS), America Rescue Plan Act (ARPA), and other funding and programs.

- Number of community members participating in roadmap development; Meetings, events, stakeholder sessions, etc.; and/or, dissemination of project/technology information via listservs, websites, and outreach events.

This roadmap is based on extensive strategic planning and analysis with key stakeholders to set priorities, via the identified sectors. As part of the process to develop this roadmap the OSCE also reviewed existing local climate action planning processes and overlayed them with the statewide strategies. This provided a more holistic statewide view of the priorities in the state, outlined in the approach section below. The OSCE conducted stakeholder outreach, which is outlined in the engagement section below. This roadmap is flexible and tailored to Wisconsin's specific resources and capacity and includes a mix of key sectors responsible for emitting and absorbing GHG.

Overview

The OSCE produced this roadmap to support investment in policies, practices, and technologies that reduce pollutant emissions, create high-quality jobs, spur economic growth, and enhance the quality of life for all residents in Wisconsin. The measures contained herein should be construed as broadly available to any entity in the state eligible for receiving funding under the US EPA's CPRG program and other funding streams, as applicable.

Table 1: Overview of Wisconsin's Roadmap

Element	Definition
GHG Inventory	A list of emission sources and sinks, and the associated emissions quantified using standard methods. Emissions include air pollutants carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), fluorinated gases (F-gases) including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).
Benefits Analysis	Improvements in air quality/reduction in harmful air pollutants. This includes co-benefits, positive effects beyond the stated goal of a GHG reduction measure (e.g., improved public health outcomes, economic benefits, increased climate resilience).
GHG Reduction Measures	Policies, programs, actions, or projects that reduce GHG emissions or enhance carbon removal.
Low Income/Disadvantaged Communities (LIDAC) Benefits Analysis	Communities with residents that have low incomes, limited access to resources, and disproportionate exposure to environmental or climate burdens.
Review of Authority to Implement	Identification of the ability and authority to implement a measure or whether authority should be obtained.
Intersection with Other Funding Availability	Consideration of the public investment available because of the passage of the BIL and IRA.

The scope of this roadmap encompasses a statewide, multi-sector approach which includes the following focus areas:

- Industrial Efficiency, Electrification, and Decarbonization,
- Building Electrification and Retrofitting,
- Clean Transportation, Fuels, and Infrastructure,

- Transit Planning and Expansion,
- Distributed Renewable Energy, and
- Agriculture and Soil Solutions.

Approach

In 2019, Governor Tony Evers created the OSCE to serve as a central point of coordination for climate and clean energy programs and polices across the state enterprise. This coordination helps to create collective actions around strategies to address climate change and the state's clean energy transition. In addition to the work of the OSCE, in October 2019, Governor Evers established the Governor's Task Force on Climate Change (Task Force) via Executive Order #52, which then commenced work and subsequently published a final report in December 2020.[iii,iv] The Task Force advanced a set of 55 recommendations covering nine sectors and three policy pathways. Sectors include climate justice and equity, energy, transportation, agriculture, resilient systems, clean economy, education, food systems, and forestry.

As directed by Governor Evers, in April 2022 the OSCE published the state's first-ever Clean Energy Plan.[v] The plan outlines over 70 strategies to address climate change via the transition to a clean energy economy. Key strategies include prioritizing health equity, environmental justice, and equitable economic development; fast-tracking workforce development and a just transition; economic development; accelerating government-led efforts (Lead-by-Example); accelerating clean energy technology deployment; maximizing energy efficiency; modernizing buildings and industry; and innovating transportation.

Led by the OSCE, the state of Wisconsin's work on reducing emissions and combatting climate change has required extensive interagency participation and robust stakeholder engagement. The OSCE engaged with 21 state agencies, the Universities of Wisconsin, local governments, and Native Nations on both the Task Force and Clean Energy Plan development efforts. This work was expanded as part of the CPRG application preparation process. The OSCE has reached out to the Native Nations located within Wisconsin's borders, the state's nine Regional Planning Organizations, and many political jurisdictions (either directly or through a relevant association) to ensure they are participating as a coordinating entity. The OSCE also conducted extensive community engagement to receive input and hear lived experiences from those who have not necessarily been engaged or had the resources to do so in the past. The above entities were engaged throughout the entirety of the planning process and have access to the final list to move forward with applications for federal CPRG implementation dollars if they desire to do so. For any of the above eligible entities to apply for CPRG implementation funding, their application must address a priority action in this roadmap.

The OSCE also collaborated closely with the Southeastern Wisconsin Regional Planning Commission (SEWRPC), the lead organization of the MSA planning grant in Milwaukee, and participated in meetings with the MSA leads in Minnesota (Metropolitan Planning Group) and Illinois (Metropolitan Mayors Caucus). The OSCE also meets regularly with several Native

Nations and will continue to support their planning through their timeline. The primary focus of coordination is to align priorities and engage stakeholders.

As part of the planning process, the OSCE worked with UW-Milwaukee and the Wisconsin Local Governments Climate Coalition (WLGCC) to review existing local climate action planning processes and overlay them with the statewide Task Force on Climate Change recommendations and Clean Energy Plan strategies. Appendix B highlights the recommendations and strategies in both reports. This provided a holistic statewide view of the priorities. In addition to extensive engagement and the overview and analysis of existing related plans; the approach included energy and emissions benchmarking and scenario summaries; and tracking of outputs and impacts (Justice40 metrics, LIDAC benefits, emissions reductions, etc.).

Lastly, the modeling outlined in this roadmap considers Wisconsin's carbon budget and utilizes the best available data, analysis, and input to examine what strategies will make considerable strides toward emissions reductions in select sectors. Modeling is not used to predict the future and do not constitute the setting of goals, but rather is based on a set of assumptions (specifically, select priority emissions reduction actions) and provides a trend of what could happen in the future, if fully implemented. The assumptions and expected impacts do not consider new technology, new policies, or unforeseeable events in the future. Where possible, estimated impacts from the strategies in the roadmap are modeled using the Rocky Mountain Institute and Energy Innovation Policy and Technology, LLC's Energy Policy Simulator (EPS).[vi,vii]

Low-Income Disadvantaged Communities Identification and Analysis[viii]

The implementation of the measures included in this roadmap are anticipated to provide significant benefits to low-income and disadvantaged communities (LIDACs). Within each measure detailed below is a list of impacts identified for LIDACs and expected co-benefits. This section identifies each LIDAC within the jurisdiction of this roadmap as well as risks, benefits, and impacts assessment. In the Coordination and Outreach section, the OSCE identifies how Wisconsin meaningfully engaged with LIDACs in the development of this roadmap, and how Wisconsin will continue to engage in the future. The OSCE partnered with the University of Wisconsin - Madison, Nelson Institute for Environmental Studies, Energy Analysis and Policy Program (EAP team) to conduct this analysis.

Identifying LIDACs

US EPA guidance defines LIDACs as "communities with residents that have low incomes, limited access to resources, and disproportionate exposure to environmental or climate burdens". In identifying Wisconsin's LIDACs, the OSCE followed US EPA's recommended definition from the LIDAC Technical Guidance: (1) any Census tract that is included as disadvantaged in the Climate and Economic Justice Screening Tool (CEJST); (2) and/or any census block group that is at or

above the 90th percentile in any Supplemental Index of the Environmental Justice Screening and Mapping Tool (EJScreen) when compared to the nation or state; and/or (3) any geographic area within Tribal lands and indigenous areas as included in EJScreen.[ix,x] The EAP team constructed a list of Wisconsin LIDACs by downloading the *US EPA IRA Disadvantaged Communities* layer as a table from EJScreen (under the *Places* icon), which includes all LIDACs in the U.S. The team then deleted the non-Wisconsin identifiers (IDs) and removed the block group (IDs) that were not categorized as LIDAC. The LIDACs identified in Wisconsin have been listed as block group IDs in Appendix D. To provide more detailed information on each LIDAC block group, the EAP team matched the block group IDs from the *US EPA IRA Disadvantaged Communities* layer, with the block group IDs from EJScreen. The EJScreen data was downloaded from US EPA's website using their *Download EJScreen Data* page.[xi] The preliminary evaluation of the data sources described above has found that:

- 34% of Wisconsin's block groups (1,475 out of 4,292) are considered disadvantaged.
- 27.5% of Wisconsin's population (1,617,485 individuals living in the 1,475 LIDAC block groups, based on the census population of each) are considered disadvantaged.
- Of the 1,475 disadvantaged block groups, 132 are Tribal block groups.

Figures 1 and 2 illustrate the geographic distribution of LIDACs in Wisconsin and Southeast Wisconsin, respectively.

Figure 1. Wisconsin's LIDACs are the green colored block groups. The red lines are Wisconsin's nonattainment areas, which are only for 2015 ozone nonattainment. Non-attainment area designation is based on data provided by the Wisconsin Department of Natural Resources.

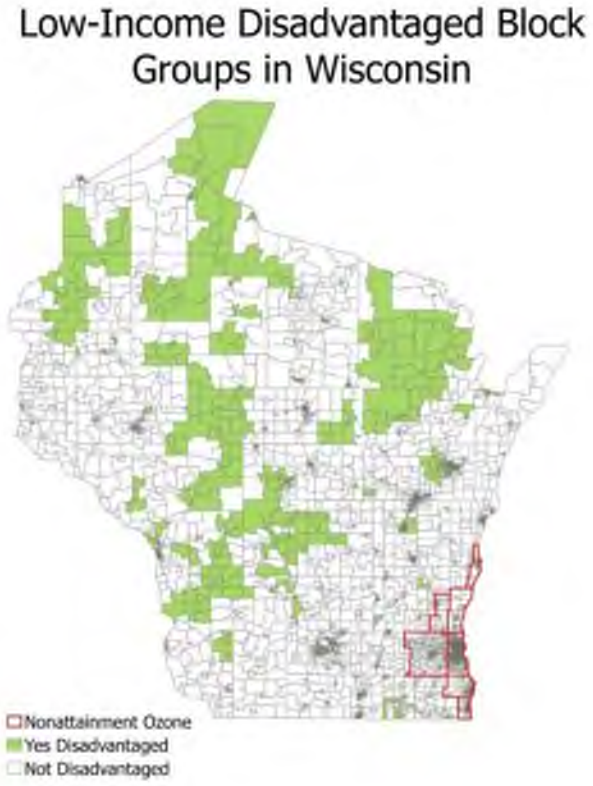
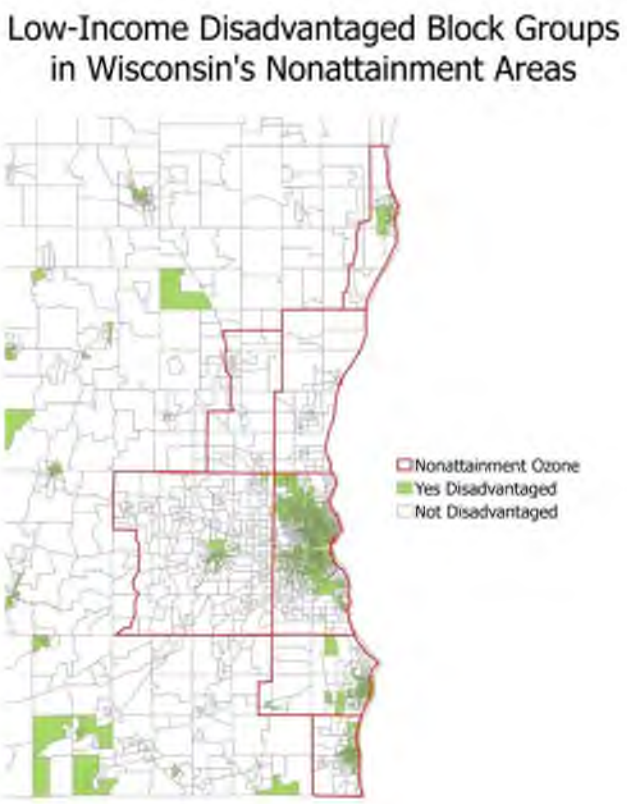


Figure 2. LIDAC block groups located in the nonattainment areas of southeastern Wisconsin: Milwaukee area (five counties), Kenosha County, and Sheboygan County.



Climate Risks, Impacts, and Vulnerabilities among LIDACs

This section briefly summarizes the climate risks, impacts, and vulnerabilities within Wisconsin, with a particular emphasis on LIDACs. The effects of climate change disproportionately affect marginalized groups, exacerbating existing social and economic disparities.[xii] The LIDACs in Wisconsin face disproportionate impacts from climate change due to a combination of social, economic, and environmental factors. Vulnerabilities arise from inadequate infrastructure, limited access to resources, and the inability to adapt to changing conditions. Wisconsin is also susceptible to various climate risks, including extreme weather events, rising temperatures, changes in precipitation patterns, and worsening air quality.[xiii,xiv] Heat waves, intense storms, and flooding events have become more frequent and severe, posing threats to infrastructure, agriculture, and public health. The disproportionate impacts on LIDACs include, but are not limited to:

- **Health Risks:** Rising temperatures contribute to the spread of vector-borne diseases, while poor air quality from increased wildfires and heatwaves exacerbates respiratory conditions.[xv,xvi] Limited access to healthcare and resources further compounds the health risks faced by disadvantaged communities, creating a cycle of vulnerability.
- **Economic Disparities:** The economic repercussions of climate change also hit LIDACs harder. Agricultural disruptions affect livelihoods, and extreme weather events can lead to job losses, especially in sectors sensitive to climate variability. Additionally, property damage from flooding or storms often results in increased financial burdens for those without adequate insurance or resources to recover. A transition to in-state energy resources would help Wisconsin regain dollars and jobs.[xvii]

- **Vulnerabilities:** Understanding the vulnerabilities of LIDACs is crucial for developing effective emissions reduction strategies. Collaborative efforts involving community engagement, policy changes, and targeted investments in infrastructure are essential. Green infrastructure projects, renewable energy, electrification, and more can enhance resilience in disadvantaged neighborhoods.
- **Housing Inequality:** As areas transition to cleaner technologies, there is a risk of increased property values and potential gentrification. Strategies should be in place to avoid the displacement of existing residents, ensuring that the benefits of environmental improvements are shared equitably.

Qualitative LIDAC Benefit Assessment

The implementation of the measures included in Wisconsin's roadmap are anticipated to have a broad range of benefits. Anticipated benefits, and any potential disbenefits associated with measure implementation, are summarized in the following sections. The OSCE and EAP team reviewed the categories of burden from the CEJST tool and will consider adoption of additional metrics for future reporting. [xviii] For the initial qualitative assessment, burdens were categorized as follows:

- **Economic Development:** the economic development category encompasses issues such as insufficient access to resources, education, and employment opportunities; often perpetuating a cycle of poverty and inequality.
- **Environmental Justice**: the environmental justice category signifies LIDACs' disproportionate exposure to environmental hazards and pollution, amplifying health risks and exacerbating socio-economic disparities within these communities.
- **Air Quality & Health**: the air quality and health category encapsulates the heightened vulnerability of LIDAC residents to adverse health effects resulting from poor air quality, often stemming from proximity to industrial activities and traffic emissions and volume.
- **Energy Burden**: the burden of energy refers to the challenges associated with inadequate access to affordable and reliable energy sources.
- **Transportation Access:** the transportation access category encompasses the challenges associated with limited availability of affordable and reliable transportation options, hindering residents' mobility, access to essential services, and economic opportunities, thereby contributing to social and economic disparities within these communities.
- **Safe & Affordable Housing**: the burden of safe and affordable housing for LIDACs involves the challenges associated with insufficient access to secure and reasonably priced housing, leading to substandard living conditions, homelessness, and perpetuation of socio-economic disparities within these communities.

US EPA's April 2023 Technical Guidance defined direct and indirect benefits based on the measures' geographic proximity to LIDACs:

- **Direct Benefits**: projected benefits of GHG reduction measures that could be implemented on GHG emission sources located within LIDACs.
- **Indirect Benefits:** expected advantages of actions that might be taken on sources outside such communities but could nonetheless have benefits for identified LIDACs.[xix]

The attribution to benefit categories is preliminary and anticipated to evolve with ongoing stakeholder communications. A summary of direct and indirect benefits is provided with each measure in the sections below. For a full qualitative LIDAC analysis for each measure, see *Assessing Potential Benefits of Greenhouse Gas Mitigation Measures for Low-Income and Disadvantaged Communities in Wisconsin*.[xx] Additionally, this roadmap outlines specific outreach and engagement activities and next steps on how the OSCE will continue to engage LIDACs throughout the implementation.

Coordination and Outreach Activities

The central goals of the OSCE's coordination and outreach efforts are to ensure strong input from interagency and intergovernmental entities and to foster empowered engagement from key stakeholders and the public, with emphasis on providing early and frequent engagement with low-income and disproportionately impacted communities. As the OSCE developed the roadmap, they leveraged existing partnerships with state agencies, local governments, Native Nations, and community organizations to expand their network and ensure they achieved inclusive representation from low-income and disproportionately impacted communities. The OSCE's commitment to equity, justice, and collective action is evidenced in methods used in the statewide planning efforts outlined below, which include robust stakeholder engagement activities.

Governor's Task Force on Climate Change Report: Through the Governor's Task Force on Climate Change, the OSCE worked closely with a diverse group of 32 Task Force members to develop 55 policy recommendations to combat the climate crisis. The Task Force included representatives from agriculture, the business community, Native Nations, state agencies, utility companies, labor, youth, public health professionals, local government, and other industries and communities from across the state. The Governor's Task Force on Climate Change hosted over 1,000 participants at five public listening sessions; 69 of 72 counties participated in the planning effort; and the Task Force received 513 public comments. The Task Force delivered the Governor's Task Force on Climate Change Report in December 2020.

Wisconsin Clean Energy Plan: Building from the recommendations and public participation in the Governor's Task Force on Climate Change Report, in 2021 the OSCE commenced bringing together extensive advisory teams to create Wisconsin's first-ever Clean Energy Plan (CEP). The OSCE hosted four sector-specific listening sessions and an environmental justice focus group on the development of the CEP. Following the release of the CEP, the OSCE staff markedly increased their clean energy and sustainability outreach efforts throughout the state. They presented and sought input on the CEP and its related work at 43 conferences, meetings, and events whose audiences included state agency staff, environmental advocacy groups, environmental justice groups, labor, utility representatives, nonprofits, businesses, Native Nations, and local governments. In 2022, the OSCE's estimated reach at these CEP events was approximately 2,875 individual stakeholders. After extensive engagement, Wisconsin published

the CEP in April 2022, and subsequently released the Clean Energy Plan Progress Report in May 2023 to highlight progress towards recommendations in the plan and ensure transparency and accountability to residents.

The relationships forged in the creation of the above plans served as a springboard to further expand outreach and engagement efforts to develop Wisconsin's roadmap. The following section outlines stakeholder engagement activities relevant to this roadmap planning process.

Climate Pollution Reduction Grant: The OSCE, using US EPA's continuum of authentic community engagement as a foundation, provided information regarding CPRG planning through a transparent manner that allowed reasonable opportunities for input on preliminary and final planning products. [xxi] At the outset of CPRG planning, the OSCE outlined a comprehensive process to gather the voices of Wisconsinites and ensure that this roadmap reflects the values of Wisconsin. The first step was to conduct a gap analysis of existing stakeholder lists to ensure equitable engagement from all stakeholder groups, particularly those who will be impacted by the implementation of this roadmap.

The OSCE also built upon strong relationships with state agencies, sub-state entities, and Native Nations developed in collaboration on the Task Force and CEP. This work continues as part of the CPRG planning process. The OSCE reached out directly to the 11 federally recognized Native Nations located within Wisconsin's borders, the state's nine Regional Planning organizations, and many political jurisdictions (either directly or through a relevant association) to ensure engagement and access to CPRG planning resources. The OSCE also worked closely with nine state agencies through a CPRG agency advisory team workgroup, individual agency meetings, and other recurring cross-agency coordination calls. The OSCE also consulted with subject matter experts throughout the state representing labor, environmental justice, natural working lands, renewable energy, energy efficiency, and more for input on measures from existing action plans and provided expertise on programs, policy, and data to assist in moving measures forward.

Historically, Native American communities have been left out of the conversation on transforming our energy system. Furthermore, Native communities often face a disproportionate burden of the effects from a changing climate. In seeking to mitigate climate damage, Native Nations must be empowered in decision-making processes, including enabling and supporting the incorporation of traditional Indigenous knowledge. Therefore, as part of the CPRG planning process, OSCE began outreach to Native Nations in September 2023 at the Tribal Energy Symposium hosted at the Forest County Potawatomi Community Center in Crandon, WI. In November, OSCE participated in a state Tribal Consultation to hear from Native leaders regarding energy priorities, projects, and barriers to implementation. The OSCE then reached out to Native Nations in Wisconsin to build partnership to advance shared climate action and clean energy priorities. Following this outreach, OSCE met individually with staff from four Native Nations to learn about cultural values, seek input on the planning process, share resources, and offer technical support. The OSCE also coordinated with the Midwest Tribal Energy Resources Association (MTERA) as they developed a plan for Native Nations in US EPA

Region 5. Once priority measures were finalized in February 2024, OSCE shared the list and resources with all leaders and relevant staff of Native Nations in Wisconsin to help ensure transparency and funding accessibility. Moving forward, the OSCE will continue engagement with Native Nations to ensure equitable access to resources and funding and further explore opportunities for partnership. The timeline in Appendix E highlights relevant meetings, presentations, and opportunities for input related to OSCE engagement with Native Nations.

The OSCE also worked through several channels to ensure municipalities were informed of opportunities for engagement and had the resources to access available funding. OSCE worked with the WLGCC, the Green Tier Legacy Communities, regional planning commissions, the Wisconsin Towns Association, the Wisconsin Counties Association, the League of Wisconsin Municipalities, Workforce Development Boards, individual local governments, and other stakeholders who represent municipalities. The OSCE and Wisconsin Department of Natural Resources (DNR) also coordinated closely with the SEWRPC to ensure alignment between state and local CPRG planning with the Milwaukee MSA. Additionally, the OSCE initiated work through a sub-award with UW-Milwaukee to identify local priorities through analyzing local climate and comprehensive plans. The OSCE will continue to work closely with local governments to facilitate collective action, empower local knowledge, and ensure equity through the implementation of actions in this roadmap. The timeline in Appendix E highlights relevant meetings, presentations, and opportunities for input related to OSCE engagement with local governments.

Throughout the CPRG planning process, the OSCE attended or presented at over 44 conferences, meetings, and events, with an estimated reach of 765 individual stakeholders statewide. The OSCE also hosted a public stakeholder webinar and distributed a public input survey. [xxii] The webinar recording, public input survey, up-to-date information on the planning process, staff contact information, and other resources were made available to the public at www.osce.wi.gov. Additionally, the OSCE conducted one-on-one meetings with as many stakeholders as possible to inform entities of opportunities for engagement, hear input on the planning processes, and provide resources for project-specific requests.

Wisconsin's Greenhouse Gas Inventory

In Executive Order #38, Governor Tony Evers committed Wisconsin to a goal of ensuring all electricity consumed in the state is 100 percent carbon-free by 2050 and that Wisconsin is contributing to U.S. climate emissions reduction targets, as part of the U.S. nationally determined contribution (NDC) of the Paris Agreement, which is now 50-52 percent economywide net GHG emissions reductions below 2005 levels by 2030. While GHG emissions in the state have decreased since 2005, the state will need to do more to meet these emission reduction targets. The data below is the foundation of that effort and tracks Wisconsin's progress towards meeting state and national goals for GHG emissions reductions.

The DNR, in cooperation with the OSCE, identified, evaluated, and utilized existing data resources to develop a statewide inventory of the major sources of GHG emissions within Wisconsin and used that inventory data to develop this roadmap. [xxiii] The GHG inventory utilized the US EPA's State Inventory Tool (SIT), [xxiv] state-level GHG inventories prepared by the US EPA, [xxv] and data reported to US EPA's Greenhouse Gas Reporting Program (GHGRP) [xxvi] together with any independent, sector-specific estimates prepared by the state. The Wisconsin inventory includes the following sectors and gases:

Sectors

1. Electricity
2. Residential, Commercial, & Industrial
3. Transportation
4. Industrial Processes
5. Natural Gas and Oil
6. Waste
7. Agriculture
8. Land-Use, Land-Use Change & Forestry (LULUCF)

GHGs (across all sectors)

carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), fluorinated gases (F-gases) including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3)

For this roadmap, the OSCE and DNR received approval from US EPA to utilize the state's most current GHG inventory. The *2021 Wisconsin Greenhouse Gas Emissions Inventory Report* published by the DNR provides a breakdown of Wisconsin emissions by economic sector. The data by sector for 1990, 2005, and 2018, shows that the gross GHG emissions decreased by 9.5 percent from 2005 to 2018. The electricity sector showed the largest decrease in emissions from 2005 to 2018 (20.1 percent). During that period, industrial emissions decreased by 10.8 percent while transportation, natural gas and oil, and waste sectors showed modest decreases. Between 2005 and 2018, agricultural emissions increased by 21.3 percent (mostly methane and nitrous oxide), the highest increase in emissions among all sectors.

Land use, land-use change, and forestry (LULUCF) are also defined as GHG inventory sectors because these natural and working lands can add or remove carbon dioxide from the atmosphere and play a key role in the response to climate change. The *2021 Wisconsin Greenhouse Gas Emissions Inventory Report* includes carbon storage estimates from natural and

working lands. The LULUCF sector sequestered or stored 19.1 million metric tons (MMT) of carbon dioxide equivalents (CO_2e) in 2018. Storing that amount of carbon is equivalent to removing the emissions from just over 4.1 million passenger vehicles driven on Wisconsin's roads over one year. Table 2 details GHG emissions in $MMTCO_2e$ for all economic sectors.

Table 2. Wisconsin GHG emissions in MMT CO_2e by Sector[xxvii]

Sector	1990	2005	2018	Change (2005 to 2018)	
				Amount	Percent
Electricity	41.0	58.7	46.9	-11.8	-20.1
Generation	*33.4*	*48.3*	*39.2*	*-9.1*	*-18.8*
Import	*7.6*	*10.4*	*7.7*	*-2.7*	*-26.0*
Residential	9.6	10.2	10.2	0.0*	+0.0*
Commercial	4.9	6.2	6.7	0.5	+8.1
Industrial	14.5	15.8	14.1	-1.7	-10.8
Transportation	29.0	40.2	39.9	-0.3	-0.7
Industrial Processes	0.8	3.5	4.2	0.7	+20.0
Natural Gas and Oil	0.2	0.6	0.5	-0.1	-16.7
Waste	3.0	3.2	3.1	-0.1	-3.1
Solid Waste	*2.3*	*2.3*	*2.2*	*-0.1*	*-4.3*
Wastewater	*0.7*	*0.9*	*0.9*	*0.0**	*+0.0**
Agriculture	17.2	16.4	19.9	3.5	+21.3
Gross Total Emissions	**120.3**	**154.9**	**145.4**	**-9.5**	**-6.1**
LULUCF	-19.3	-15.9	-19.1	-3.2	-20.1
Net Total Emissions	**101.1**	**139.0**	**126.3**	**-12.7**	**-9.1**

** Totals may not sum due to independent rounding. Does not exceed 0.05 MMT CO_2e or 0.05 percent.*

This inventory accounts for seven different GHGs. Table 3 shows gross state emissions by type of GHG for 2005 and 2018.

Table 3. Wisconsin GHG emissions in MMT CO2e by Gas

GHG	2005	2018	Percent of 2018 Emissions	Change	
				Amount	Percent
Carbon Dioxide (CO_2)	131.3	118.4	81.4	-12.9	-9.8
Methane (CH_4)	12.6	14.7	10.1	+2.1	16.7
Nitrous Oxide (N_2O)	8.8	9.3	6.7	+0.5	5.7
F-Gases (HFC, PFC, NF_3 and SF_6)	2.2	3.1	2.1	+0.9	40.9
Total - All Gases	154.9	145.4	100	-9.5	-6.1

Note: Totals may not sum due to independent rounding.

Wisconsin's Greenhouse Gas Reduction Measures

Wisconsin has identified six priority emissions reduction implementation measures. The measures in this section have been identified as priority measures for the purposes of pursuing funding to implement emissions reductions through CPRG implementation grants. Table 4 summarizes Wisconsin's priority measures and the potential emissions reductions associated with each measure. This list is not exhaustive of Wisconsin's priorities. Rather, the priority implementation measures included in this roadmap meet the following criteria:

- The measure is implementation ready in the near-term, meaning that the design work for the policy, program, or project is complete enough that a full scope of work and budget can be included in a CPRG implementation grant application.
- The measure can also be completed in the near term, meaning that all funds will be expended, and the project completed, within the five-year performance period for the CPRG implementation grants.
- The measure advances the following state priorities: significant and sustained emission reductions; public health; equity; justice; rural development; maximizing reach; reserving nature; retaining or creating quality jobs; retaining and attracting businesses to the state; and collective action to address climate change.

Table 4. Wisconsin Priority Climate Action Measures Summary

Priority Measure	Cumulative estimated GHG emission reductions (MMT CO_2e) **		Implementing Agency or Agencies***	Geographic Scope
	2025–2030	2025-2050		
Industrial Efficiency, Electrification, and Decarbonization	8.0	15.6	DOA	Wisconsin
Building Electrification and Retrofitting	2.425	13.625	DOA	Wisconsin
Clean Transportation, Fuels, and Infrastructure	10.5	13.4	DOA, WisDOT, DNR	Wisconsin
Transit Planning and Expansion*	11.1	10.1	Local Governments	Wisconsin
Distributed Renewable Energy	0.708	1.242	DOA	Wisconsin
Agriculture and Soil Solutions	0.6	1.5	DOA, UW	Wisconsin

GHG emissions for this section incorporate a holistic view of transportation electrification broader than what is defined and are not reflective of the specific scope of the measure.

****Methodology can be found in Appendix A.***

***** DOA = Department of Administration, WisDOT = Wisconsin Department of Transportation, DNR = Wisconsin Department of Natural Resources, UW= University of Wisconsin – Madison***

The implementation of the measures included in this roadmap are anticipated to have a broad range of benefits across the state of Wisconsin and Native Nation lands. Quantifications of GHGs are done at a statewide level and are not meant to be predictions, but rather indications of the potential for emissions reductions under ambitious decarbonization scenarios associated with the related actions. The assumptions used in development of the quantifications are

similarly representative of potential and should not be interpreted as specific state goals or commitments, as outcomes will vary based on actual program implementation details and timelines that will be developed fully as implementation funding opportunities are realized. Within each measure, the OSCE detailed specific priority actions that could be taken to achieve the measure; the anticipated co-pollutant reductions associated with the implementation of the priority measures identified in this roadmap; and the effects of the measures on economic development, environmental justice, energy burden, air quality and health, transportation access, and safe and affordable housing within LIDACs. A schematic representation of the direct and indirect benefits for industrial efficiency, electrification, and decarbonization are provided for each measure.

Implementation Schedule and Milestones

If the measures in this roadmap are pursued as part of a multi-partner coalition, the implementation schedules would be determined based on coalition-wide planning activities. If pursued as a state-level action, assuming implementation award funding is received by the end of 2024, program design and launch is anticipated to take 1-3 years. Where possible, the OSCE has identified potential implementing agencies for each measure presented in this roadmap. However, this does not constitute a guarantee of leadership for a measure.

Co-Pollutants Emission Changes from Priority Measures

This section provides an estimate of the statewide potential for GHG and co-pollutant emission reductions resulting from sector-level deployment of selected emissions reduction measures. The OSCE utilized the EPS to analyze the emission impacts of the proposed mitigation measures. The EPS tool refers to individual measures as "policies" and collections of measures as "energy policy scenarios". The resulting EPS scenario is intended to represent the total potential of all proposed measures calculated on EPS, implemented statewide. The team extracted the sector-level emissions reported by the EPS tool for this scenario. The GHG-equivalent emissions are reported (excluding land use), directly from the EPS tool, as well as co-pollutant emissions for fine particulate matter (PM2.5), nitrogen oxides (NO_X), sulfur dioxide (SO_2), volatile organic compounds (VOCs), and carbon monoxide (CO), which are regulated under the Clean Air Act to protect human health and public welfare. For these co-pollutants, the percent emission change (relative to 2020) reported by the EPS tool were multiplied by the statewide pollutant total reported in US EPA's National Emission Inventory for 2020 (excluding biogenic and fire sources).[xxviii] Table 5 reports projected emissions reductions (relative to 2023) for 2030, 2040, and 2050.

Table 5. Emissions of EPS-reported Emission Trajectory Changes in tons.

	GHG	PM2.5	NO_X	SO_2	VOCs	CO
By 2030	-32,211,000 -27%	-3,996 5%	-6,837 -6%	-910 -43%	-3,547 -2%	-71,577 -9%
By 2040	-47,382,600 -40%	-5,190 -7%	-15,326 -14%	-749 -36%	-8,295 -4%	-144,909 -19%
By 2050	-55285,000 -46%	-5,270 -7%	-17741 -16%	-664 -32%	-1,896 -1%	-173,548 -23%

Measure 1: Industrial Efficiency, Electrification, and Decarbonization

Relevant GHG Inventory Sector:
Industry, Buildings

Cumulative GHG emission reductions 2025-2030:
8.0 MMT CO_2e

Cumulative GHG emission reductions 2025-2050:
15.6 MMT CO_2e

According to the *2021 Wisconsin Greenhouse Gas Emissions Inventory Report*, non-electricity energy usage such as space, water, and industrial process heating for the industrial sector accounted for 9.7 percent of gross emissions statewide. While this sector has seen an overall decrease from the base year 2005, it is still the fourth-highest emitting sector in Wisconsin. Industrial facilities are also among the last in the state to continue using coal combustion, accounting for 13.1 percent of industrial sector emissions, with petroleum following at 22.5 percent, and natural gas claiming the remaining 64.4 percent. The combustion of coal and petroleum is highly inefficient compared to other available fuels and results in high co-pollutants and detrimental impacts on the communities working in and living around these facilities. Improvements in industrial facilities are often cost-prohibitive and require intense energy and efficiency assessments. A cost-effective overall reduction in emissions in this sector would require both fuel-switching to electricity and clean hydrogen, carbon capture efforts, as well as efficiency improvements in industrial facilities that reduce overall energy demand and fuel usage. Wisconsin is home to an Industrial Assessment Center and the award-winning Focus on Energy® program, both of which have a strong working relationship with industrial facilities located in Wisconsin, and which can support the efforts of facilities looking to take advantage of existing federal tax credits and any incentives that might come from this effort.

Priority Actions

1.1 FACILITATE AN INDUSTRIAL DECARBONIZATION CHALLENGE THROUGH A COALITION OF MIDWEST STATES

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 *(MMT CO_2e)*	2050 *(MMT CO_2e)*
Estimated GHG Emissions Reductions	8.0	15.6
Model: Energy Policy Simulator		

IMPLEMENTING AGENCY

Wisconsin Department of Administration, Wisconsin has been involved in introductory conversations with other states and organizations on the possibility of forming a coalition effort to address this priority action.

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of qualified facilities/organizations applying for the funding.

- Number of qualified facilities/organizations successfully implementing projects within the given timeline.
- Amount of CO_2 and other co-pollutants emissions reduced at each participating site, both on an annual basis and over the duration of the program.
- Amount of CO_2 and other co-pollutants emissions reduced in each participating state and across the coalition region, both on an annual basis and over the duration of the program.

Federal Funding Intersection

This measure intends to fill gaps in funding left after implementation of the federal 48C Clean Manufacturing Tax Credit. That program is currently funded at $4 billion, applications were due in December 2023, and recipients of 48C credits are not yet announced. The demand for the 48C Clean Manufacturing Tax Credit program is expected to exceed available funding, resulting in the potential for unfunded yet high-quality projects to spur innovation and reduce emissions. Efforts to advance this priority action will build on the 48C grants and focus on projects that do not receive 48C funding.

LIDAC Analysis

Improving energy efficiency for industrial processes and buildings leads to lower manufacturing costs, more competitive local businesses, and reduces harmful emissions, particularly where combustion sources are electrified. Better energy management by industrial businesses will reduce overall energy usage, potentially at peak times, thus reducing grid-operation costs for all customers. Implementing a GHG measure focused on industrial efficiency and electrification can have direct and indirect benefits for LIDACs represented below.

Figure 3. Schematic representation of the direct and indirect benefits for the industrial efficiency, electrification, and decarbonization measure.

Measure 2: Building Electrification and Retrofitting

Relevant GHG Inventory Sector:
Buildings

Cumulative GHG emission reductions 2025-2030:
2.425 MMT CO_2e

Cumulative GHG emission reductions 2025-2050:
13.625 MMT CO_2e

Residential and commercial buildings account for a combined 11.6 percent of gross emissions in the state of Wisconsin. In addition, emissions in these areas have been increasing since the base year 2005, with commercial building emissions rising 8.1 percent in that time. While coal combustion represents almost none of the fuel used in these areas, petroleum still accounts for 19.0 percent of residential and 15.3 percent of commercial fuel types, with natural gas taking up the remaining amount. As the Midcontinent Power Sector Coalition highlighted in their *A Roadmap to Decarbonization in the Midcontinent - Buildings*, "Decarbonization of buildings will require making buildings more energy efficient and replacing fossil fuels currently used for space and water heating with very-low and zero-carbon electricity, as well as pursuing very-low and zero-carbon alternative fuels such as renewable natural gas and hydrogen."[xxix]

Many residents struggle to afford the necessary improvements and equipment replacements to decarbonize their homes. While programs do exist within the state to support them, the demand is often much higher than the funding available. In addition, residents often need costly improvements to their homes prior to even being able to qualify for the weatherization, energy efficiency upgrades, and fuel-switching equipment offered. A recent analysis of the State's weatherization program showed that almost half of all applicants had to be deferred from the program due to a variety of conditions such as hazardous living and working conditions, repairs needed on the home, and the presence of asbestos-containing materials. Furthermore, owners of multi-family and multi-unit complexes often face considerable costs when considering energy efficiency and electrification upgrades - costs that would be burdensome to pass onto their residents at a time when affordable housing is difficult to find. Various sources of funding for residential and commercial upgrades are available but include a complex map of eligibility requirements that are often difficult for individuals to navigate on their own.

Public entities are also in need of support for building electrification and retrofitting. They face many of the same issues as residents and commercial building owners but encounter unique challenges in obtaining funding for upgrades and improvements. The Public Service Commissio of Wisconsin, Office of Energy Innovation has administered multiple rounds of a successful grant program designed to help public entities secure funding for these upgrades called the Energy Innovation Grant Program (EIGP). After reviewing the data from 2018-2022 grant years for the program, it is evident that the need is considerably higher than the funding available. Table 6 below shows a summary of the EIGP requests and awards for 2018-2022.

Table 6: EIGP 2018-2022 Awards Summary

Grant Year	Total Grants	Percent of Total	Total Grant Dollars	Percent of Total
Application Total Requested	440		137,669,641.35	
Total Grant Request Awarded	141	32%	31,989,362.51	23%
Total Unawarded Request	299	68%	105,680,278.84	77%

Priority Actions

2.1 IMPROVE THE EFFICIENCY OF HOMES AND BUILDINGS THROUGH BUILDING COMPONENT ELECTRIFICATION

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 ***(MMT CO_2e)***	**2050** ***(MMT CO_2e)***
Estimated GHG Emissions Reductions	1.8	11.5
Model: Energy Policy Simulator		

IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Administration

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of electric building components sold and installed.
- Number of buildings served.
- Amount of CO_2 and other co-pollutants emissions reduced at each participating site, both on an annual basis and over the duration of the program.

2.2 RETROFIT EXISTING BUILDINGS

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 ***(MMT CO_2e)***	**2050** ***(MMT CO_2e)***
Estimated GHG Emissions Reductions	0.6	2.0
Model: Energy Policy Simulator		

IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Administration

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of buildings retrofitted.
- Measured annual amount of energy used in retrofitted buildings.
- Amount of CO_2 and other co-pollutants emissions reduced at each participating site, both on an annual basis and over the duration of the program.

2.3 CREATE A PRE-WEATHERIZATION PROGRAM AND INTEGRATE BUILDING INCENTIVES

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 *(MMT CO_2e)*	2050 *(MMT CO_2e)*
Estimated GHG Emissions Reductions	0.025	0.125
Model: Formula		

IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Administration

Wisconsin has been involved in introductory conversations with other states and organizations on the possibility of forming a coalition effort to address this priority action.

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of homes deferred from Weatherization Program to Pre-weatherization Program.
- Number of homes pre-weatherized.
- Number of contacts to program administrator for assistance.
- Amount of CO_2 and other co-pollutants emissions reduced at each participating site, both on an annual basis and over the duration of the program.

Federal Funding Intersection

The pre-weatherization and integrated building incentives program is fundamentally about improving the outcome of a suite of revenue streams by offering an integrated approach to **leveraging and coordinating other related but distinct opportunities for federal funding.** For example:

- The Clean Energy and Energy Efficiency Tax Credits will provide $37 billion for residential clean energy improvements.
- The National Clean Investment Fund and Clean Communities Investment Accelerator will provide $20 billion in financing for clean energy projects.
- Solar for All will provide $7 billion for solar in LIDACs.
- The Homes Energy Rebates Programs will provide $8.8 billion for electrification and efficiency updates.
- The Weatherization Assistance Program will provide $3.5 billion for weatherization of low-income households.

Note: A small portion of several other federal funding sources can be used for pre-weatherization, none of which can cover the full amount necessary for the level of remediation required: Weatherization Assistance Program (typically 15% of state formula funds, restrictions on eligible measures and costs) and pilot of DOE Weatherization Readiness Funds; Low-Income Household Energy Assistance Program (mostly energy bill assistance, up to 25% of funds could be used to supplement WAP/home health activities); and under Solar for All, only a small

portion of funding can go to supporting roof repair to facilitate PV deployment, among other enabling upgrades (up to 20% of funding).

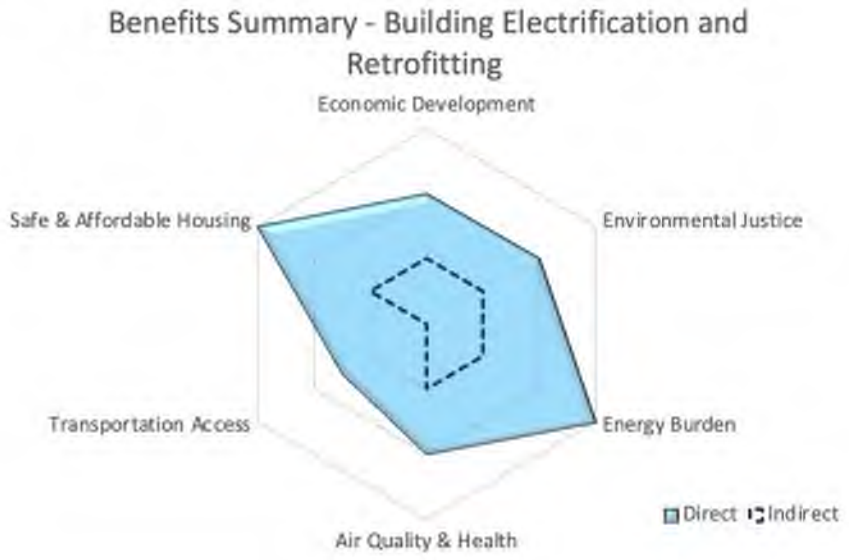
Despite over $75 billion invested in infrastructure, there is not one cohesive, programmatic approach to make sure that the money is spent equitably. Using flexible CPRG funds will ensure this once in a generation federal funding is spent well, gets continually reinvested, and transforms the clean energy economy.

Municipal and other sub-state entities can take advantage of many federal tax credit programs through the elective pay provisions added under IRA. However, this is a new process for many entities. Providing technical assistance to maximize available incentives would be a critical part of any outreach effort tied to these programs.

LIDAC Analysis

The electrification of buildings, energy storage, and energy efficiency projects and practices have the potential to substantially reduce utility bills and increase energy reliability. Therefore, these strategies hold tremendous promise for increasing equity and decreasing the high energy burdens experienced by low-income households, communities disproportionately impacted by climate change, and Native Nations. The building electrification and retrofitting measures could help address environmental injustices by mitigating the impact of indoor air pollution and improving building comfort, performance, and affordability. Implementing a GHG measure focused on building electrification and retrofitting, particularly in LIDACs, can bring about several direct and indirect benefits identified below.

Figure 4. Schematic representation of the direct and indirect benefits for the building electrification and retrofitting measure.



Measure 3: Clean Transportation, Fuels, and Infrastructure

Relevant GHG Inventory Sector:
Transportation

Cumulative GHG emission reductions 2025-2030:
10.4 MMT CO_2e

Cumulative GHG emission reductions 2025-2050:
13.4 MMT CO_2e

Transportation sector emissions account for the second-largest share of GHG emissions in Wisconsin at 27 percent in 2018. According to the MPSC *A Roadmap to Decarbonization in the Midcontinent - Transportation Electrification*, "carbon emissions in the transportation sector depend on the interplay of three primary factors: the carbon content of the fuel used to power vehicles, the efficiency of the vehicles, and how far the vehicles are driven, usually measured in vehicle miles traveled." Policies to decarbonize the transportation sector should focus on decreasing the carbon content of the fuel that powers vehicles and improving the efficiency of vehicles to emphasize zero-emission vehicle (ZEV) operation in the state.[xxx]

Cars, buses, trucks, off-road vehicles, commercial aircraft, boats, and rail all contribute to transportation end-use emissions. Strategies that reduce or eliminate our fossil fuel dependence are critical to creating a clean, resilient transportation system and directly address climate change in Wisconsin. Passenger and light duty trucks account for 58 percent of transportation emissions in 2018 with diesel heavy-duty vehicles taking up the next spot at 24.6 percent.

Advancements in transportation technology since 2018 have been extensive. Wisconsin is poised to capitalize on these efforts due to development of the state's Wisconsin Electric Vehicle Infrastructure (WEVI) Program. A robust network of public chargers is a prerequisite to support the transition to cleaner transportation. The WEVI Program, in deploying approximately 64 charging locations throughout the state as detailed on page 73 of the approved 2023 WEVI Plan, will be a means to accelerate electric vehicle (EV) adoption and therefore reduce GHG emissions.[xxxi] This infrastructure will help Wisconsin prepare for an influx of electric passenger and light-duty vehicles. However, more needs to be done to ensure the transition to ZEVs is supported across all vehicle classes. A similar plan should be considered for medium- and heavy-duty vehicle charging and alternative-fueling infrastructure. Furthermore, purchasing electric vehicles and the charging infrastructure needed to support them is still too cost-prohibitive for many individuals and organizations. Reducing barriers to purchasing electric vehicles and the charging infrastructure buildout is important.

Wisconsin has identified an opportunity to initiate a region-wide transition to electric medium- and heavy-duty vehicles by addressing the charging infrastructure gaps along key commercial corridors. Expanding charging infrastructure accessible to the public along the key commercial corridors that pass through Wisconsin and neighboring states is essential to transition to ZEV fleets and is integral to the state's commitment to environmental sustainability and GHG emissions reduction. Wisconsin aims to develop an optimized plan for the location of

infrastructure for medium- and heavy-duty electric vehicles, integrating technical and safety benchmarks for charging stations while considering transportation statistics, grid information, and projected usage patterns. Subsequently, charging facilities will be established at high-priority sites as determined by the study.

On a smaller scale, small engine equipment powered by two and four-stroke motors also contributes to transportation GHG emissions in Wisconsin. These smaller engines often lack the advanced emissions controls found in cars and trucks. The replacement of small gasoline-powered equipment provides an opportunity for Wisconsin to address not only GHG emissions, but important air pollutants like particulate matter (PM), nitrogen oxides (NOx), and air toxins. This specific subsector of emissions also notably lacks funding from other sources.

Another area of potential emissions reductions is in the utilization of low-carbon cement in transportation infrastructure. The potential to participate in a coalition to catalyze innovation and deployment of low-carbon cement and concrete would be transformative. The coalition would target and mitigate barriers to currently deployable emissions reduction measures such as the substitution of cement with supplementary cementing materials (SCMs) and low carbon cement mixes, as well as methods to use less clinker in cement, use less cement in concrete, improve plant energy efficiency, use alternative and/or renewable fuel sources for heat, capture emissions at cement plants, and utilize different source materials and chemical reactions to produce innovative, ultra-low carbon cement.

Priority Actions

3.1 REDUCE BARRIERS FOR ACCESS TO ELECTRIC VEHICLES AND ASSOCIATED INFRASTRUCTURE

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 ***(MMT CO_2e)***	**2050** ***(MMT CO_2e)***
Estimated GHG Emissions Reductions	0.4	1.2
Model: Energy Policy Simulator		

IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Administration

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of electric vehicles purchased.
- Number of charging units installed.
- Kilowatt hours (kWh) used from charging.
- Amount of petroleum displaced.
- Amount of CO_2 and other co-pollutants emissions reduced at each participating site, both on an annual basis and over the duration of the program.

3.2 SUPPORT RECYCLING AND REPLACEMENT OF SMALL ENGINES

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 *(MMT CO_2e)*	2050 *(MMT CO_2e)*
Estimated GHG Emissions Reductions	0.04	0.08
Model: MOVES		

IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Natural Resources

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of gasoline-powered small engine equipment recycled.
- Number of electric or alternative fuel powered small engine equipment purchased.
- Amount of petroleum displaced.
- Amount of CO_2 and other co-pollutants emissions reduced at each participating site, both on an annual basis and over the duration of the program.

3.3 EXPAND MEDIUM-HEAVY DUTY ELECTRIFICATION AND HYDROGEN INFRASTRUCTURE

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 *(MMT CO_2e)*	2050 *(MMT CO_2e)*
Estimated GHG Emissions Reductions	9.7	8.8
Model: Energy Policy Simulator		

IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Transportation, Wisconsin has been involved in introductory conversations with other states and organizations on the possibility of forming a coalition effort to address this priority action.

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of medium- and heavy-duty electric vehicles on the road.
- Number of charging and alternate fuel stations installed that can serve medium- and heavy-duty electric and alternative fuel vehicles.
- Amount of CO_2 and other co-pollutants emissions reduced at each participating site, both on an annual basis and over the duration of the program.

3.4 UTILIZE LOW-CARBON CEMENT IN TRANSPORTATION INFRASTRUCTURE

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 *(MMT CO_2e)*	2050 *(MMT CO_2e)*
Estimated GHG Emissions Reductions	0.393	3.313
Model: Formula		

*Indirect Scope 3 emissions reductions for Wisconsin as a purchaser of low-carbon cement and concrete.

IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Transportation
Wisconsin Department of Administration
Wisconsin has been involved in introductory conversations with other states and organizations on the possibility of forming a coalition effort to address this priority action.

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of procurement commitments from member states.
- Establishment of production and procurement targets.
- Collaborative events with producers, states agencies, and technical experts.
- Plant upgrades.
- Decrease in plants' energy use.
- Increase in production and purchase of low carbon blended cements and advanced mix designs.
- Demonstration projects.
- Updated specifications (preference for performance-based specifications); and federal funding for low carbon cement/ concrete projects acquired.
- Total annual emissions from cement producers.
- Scope 3 emissions from procured cement/concrete for state projects.

Federal Funding Intersection

Funding sources related to priority actions 3.1 - 3.3 could include the following:

- Volkswagen settlement grants.
- Federal EV and commercial lawn mower purchase rebates.
- US EPA Clean School Bus program.
- US Department of Transportation's (US DOT), Federal Transit Administration Low- or No- Emission and Grants for Buses and Bus Facilities Competitive Programs.
- Diesel Emissions Reduction Act.
- US Department of Homeland Security, Federal Emergency Management Agency Congestion Mitigation and Air Quality Improvement Program.
- IRA Clean Ports
- US DOT Federal Highway Administration (FHWA), Charging and Fueling Infrastructure Discretionary Grant
- IRA Alternative Fuel Vehicle Refueling Property Credit Direct Pay

- US DOT FHWA, National Electric Vehicle Infrastructure program
- 48C and 45Q tax credits
- US DOT, Low Carbon Materials grant program
- US EPA Reducing Embodied GHG Emissions for Construction Materials and Products grant program.
- US General Services Administration, Low Embodied Carbon Program
- US Department of Energy, pilot projects and research/development
- Federal Buy Clean Initiative

LIDAC Analysis

Low-income communities and communities of color are disproportionately affected by air pollution from transportation. Emissions from gasoline and diesel vehicles, such as NO_X, PM2.5, and hydrocarbons are a major source of pollution causing significant health problems such as asthma, cancer, and lung and heart diseases. Compared to conventional fuels, electric vehicles eliminate tailpipe emissions that can greatly impact the health of communities. Pursuing clean transportation solutions is expected to result in economic, health, and social benefits including improved air quality, safer streets, local economic development, and improved mobility for low- and moderate-income communities. There are direct and indirect benefits from transportation electrification and clean fuels deployment that are further delineated below.

Figure 5. Schematic representation of the direct and indirect benefits for clean transportation, fuels, and infrastructure measures.

Measure 4: Transit Planning and Expansion

Relevant GHG Inventory Sector:
Transportation

Cumulative GHG emission reductions 2025-2030:
11.1 MMT CO_2e

Cumulative GHG emission reductions 2025-2050:
10.1 MMT CO_2e

In addition to transportation electrification and other clean fuel switching, the build out of public transportation, transportation planning, and support of other modes of transportation through the expansion of bicycle and e-bike usage and the development of pedestrian pathways present an opportunity for Wisconsin to address disparities in alternative transportation access. Communities across the state are considering mode-shifting and alternative transportation options in their local plans and the state is well-positioned to support them in those efforts. According to EPS's measure documentation, "example measures include improved public transit systems, more walking and bike paths, zoning for higher density along transit corridors, zoning for mixed-use developments, roadway and congestion pricing, and increased parking fees. Commercial passenger and freight flight trips may be shifted to inter-city rail or eliminated using technology such as videoconferencing."

Priority Actions

4.1 ENABLE MODE SHIFTING TO ALTERNATIVE FORMS OF TRANSPORTATION AND EXPAND PUBLIC TRANSIT

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 ***(MMT CO_2e)***	**2050** ***(MMT CO_2e)***
Estimated GHG Emissions Reductions	1.4	1.3
Model: Energy Policy Simulator		

IMPLEMENTING AGENCY OR AGENCIES
Local Units of Governments

AUTHORITY TO IMPLEMENT
The authority to implement such measures would be determined by the governmental body seeking funding.

IMPLEMENTATION SCHEDULE AND MILESTONES
Implementation schedule and milestones would depend upon a variety of factors relative to the implementing authority's focus and capabilities.

POTENTIAL METRICS FOR TRACKING PROGRESS

- Public transit ridership.
- Vehicle counts done on roadway arteries.

- Completed public transit plans.
- Amount of CO_2 and other co-pollutants emissions reduced at each participating site, both on an annual basis and over the duration of the program.

4.2 ELECTRIFY PUBLIC TRANSIT

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 *(MMT CO_2e)*	2050 *(MMT CO_2e)*
Estimated GHG Emissions Reductions	9.6	8.8
Model: Energy Policy Simulator		

Note: The above calculation represents the impact of the full measure including fuel switching in other vehicle classes not represented by this measure. A more precise calculation could be used to quantify the measure for individual vehicle replacements.

IMPLEMENTING AGENCY OR AGENCIES

Local Units of Governments

AUTHORITY TO IMPLEMENT

The authority to implement such measures would be determined by the governmental body seeking funding.

IMPLEMENTATION SCHEDULE AND MILESTONES

Implementation schedule and milestones would depend upon a variety of factors relative to the implementing authority's focus and capabilities.

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of internal combustion engine (ICE) buses replaced with ZEV buses.
- Number of new ZEV buses purchased.
- Amount of CO_2 and other co-pollutants emissions reduced at each participating site, both on an annual basis and over the duration of the program

Federal Funding Intersection

There are numerous federal programs to support such efforts detailed above including Federal IRA Tax Credits, Low- or No- Emissions Bus Program, Transit Oriented Development Pilot Program, Charging and Fueling Infrastructure Discretionary Grant Program, Environmental and Climate Justice Block Grants – Change Grants, and Active Transportation Infrastructure Investment Program.

LIDAC Analysis

Low-income communities and communities of color are disproportionately affected by air pollution from transportation. Emissions from gasoline and diesel vehicles, such as NO_X, PM2.5, and hydrocarbons, are a major source of pollution causing significant health problems such as asthma, cancer, and lung and heart diseases. Compared to conventional fuels, electric vehicles

eliminate tailpipe emissions that can greatly impact the health of communities. Pursuing clean transportation solutions is expected to result in economic, health, and social benefits including improved air quality, safer streets, local economic development, and improved mobility for low- and moderate-income communities. Implementing a GHG measure on transit planning and electrification with a focus on LIDACs may yield several direct and indirect benefits identified below.

Figure 6. Schematic representation of the direct and indirect benefits for the transit planning and electrification measure.

Measure 5: Distributed Renewable Energy

Relevant GHG Inventory Sector:
Electricity Generation, Buildings

Cumulative GHG emission reductions 2025-2030:
0.708 MMT CO_2e

Cumulative GHG emission reductions 2025-2050:
1.242 MMT CO_2e

Electricity generation is Wisconsin's highest emissions sector, though the sector has been trending downward in emissions since 2005. Emissions in this sector are primarily driven by the burning of coal. While utilities are taking drastic steps to reduce emissions, the build out of many measures detailed in this report will depend on an increase in electricity consumption. One way to aid in relieving demand on the grid is to build out renewable energy production at residences and buildings across the state. The deployment of renewable energy and storage systems for local government buildings to reduce energy costs and provide resilience in case of an electric grid outage is a priority for Wisconsin. Support could include additional incentives to complement newly available "direct pay" options for local governments to receive energy tax credits and technical assistance for such projects.

Priority Actions

5.1 SUPPORT DISTRIBUTED WIND, GEOTHERMAL, BIOGAS, SOLAR, STORAGE INSTALLATIONS

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 ***(MMT CO_2e)***	**2050** ***(MMT CO_2e)***
Estimated GHG Emissions Reductions	0.7	1.2
Model: Energy Policy Simulator		

IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Administration

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of facilities installing renewable energy and storage.
- Number of kilowatts of installed renewable energy.
- The expected lifespan of projects .
- Number of performance years to quantify lifetime pollution reductions.
- Amount of CO_2 and other co-pollutants emissions reduced at each participating site, both on an annual basis and over the duration of the program.

5.2 IMPROVE RESILIENCY OF LOCAL GOVERNMENTS THROUGH INSTALLATION OF SOLAR AND STORAGE

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 *(MMT CO_2e)*	2050 *(MMT CO_2e)*
Estimated GHG Emissions Reductions*	0.009	0.042
Model: PVWatts, ReOpt		

**Should a revolving loan fund model be utilized, emissions reductions would increase.*

IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Administration

Wisconsin has been involved in introductory conversations with other states and organizations on the possibility of forming a coalition effort to address this priority action.

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of facilities installing renewable energy and storage.
- Number of kilowatts of installed renewable energy.
- Number of kilowatts of battery power installed.
- Number of kilowatt hours battery capacity installed.
- Expected lifespan of projects.
- Number of performance years to quantify lifetime pollution reductions.
- Amount of CO_2 and other co-pollutants emissions reduced at each participating site, both on an annual basis and over the duration of the program.

Federal Funding Intersection

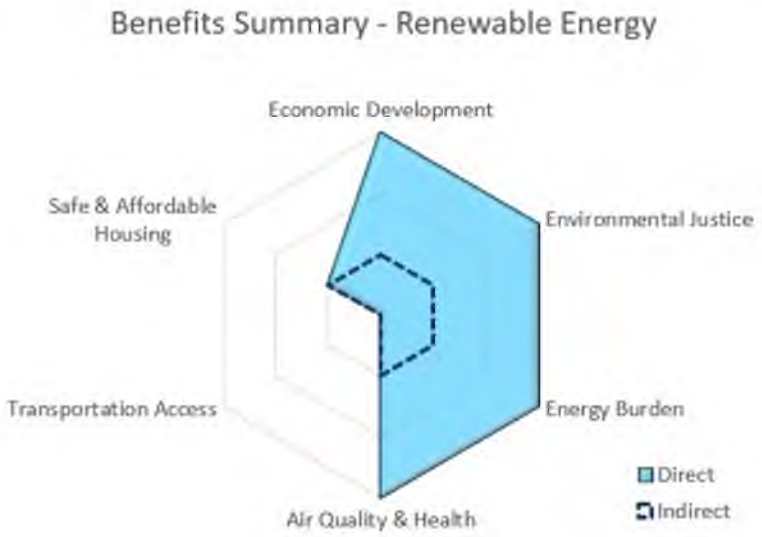
These strategies intend to leverage the complementary funding available through elective pay (sometimes called direct pay) of certain clean energy tax credits (§45Y, §48E). These tax credits only cover up to 30% of the projects contemplated under this measure, which may be insufficient for some buildings to achieve a return on investment through cost-savings from energy bills. In addition to directly supporting projects through technical assistance and deployment of renewable energy and storage systems, this measure will also serve to educate potential recipients on the available tax credits and provide technical assistance to recipients in designing such systems. As a result, this measure will catalyze widespread adoption of renewable energy and storage systems.

The following additional funding sources were identified as available for the purpose of installing solar plus storage projects but are not believed to be duplicative due to different program foci: US Department of Energy's Energy Efficiency and Conservation Block Grant, US EPA's Greenhouse Gas Reduction Fund, and Federal Emergency Management Agency's Building Resilient Infrastructure and Communities.

LIDAC Analysis

This measure is intended to lower costs and barriers for new distributed renewable energy systems. Relevant activities may include incentives for industry, municipalities, and universities to install renewable energy systems including battery storage to support grid resiliency and lower emissions. Implementing a GHG measure for renewable energy can have several direct and indirect benefits for LIDACs as identified below.

Figure 7. Schematic representation of the direct and indirect benefits for distributed renewable energy.



Measure 6: Agriculture and Soil Solutions

Soil carbon storage is a highly impactful way of improving the removal of CO_2. There are a variety of methodologies that Wisconsin is interested in researching and implementing including improved tillage practices, retiring organic and marginal soils, and establishing windbreaks/shelterbelts.

Relevant GHG Inventory Sector:
Agriculture/Natural and Working Lands

Cumulative GHG emission reductions 2025-2030:
0.6 MMT CO_2e

Cumulative GHG emission reductions 2025-2050:
1.5 MMT CO_2e

Priority Actions

6.1 PROMOTE SOIL CARBON INTENSITY BEST PRACTICES.

ESTIMATE OF THE QUANTIFIABLE GHG EMISSIONS REDUCTIONS

	2030 *(MMT CO_2e)*	2050 *(MMT CO_2e)*
Estimated GHG Emissions Reductions	0.6	1.5
Model: Energy Policy Simulator		

IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Administration, Wisconsin has been involved in introductory conversations with other states and organizations on the possibility of forming a coalition effort to address this priority action.

POTENTIAL METRICS FOR TRACKING PROGRESS

- Number of farms enrolled in program.
- Metric tons of soil carbon improvements.

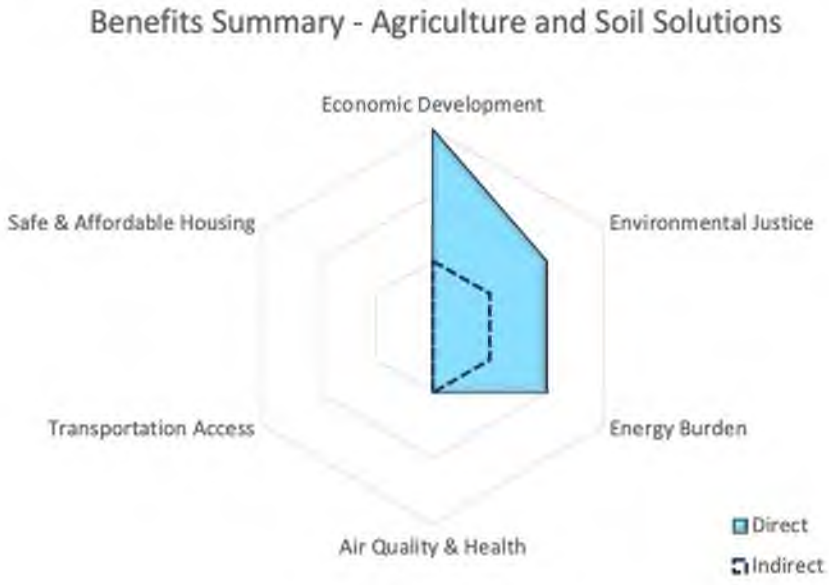
Federal Funding Intersection

Federal funding exists to support some of the actions represented by this measure in the Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP) and Conservation Innovation Grants (CIG). A more thorough analysis of federal programs will be completed before funding is applied for in the CPRG program.

LIDAC Analysis

Climate-smart agriculture encompasses agricultural practices and systems that mitigate GHG emissions, enhance carbon sequestration, and adapt to climate change while promoting sustainable food production and increasing resilience to climate-related challenges. Adopting these practices can lower production costs for farmers, increase market access for sustainably produced goods, and contribute to rural economic development. Potential benefits are identified below.

Figure 8. Schematic representation of the direct and indirect benefits for the agriculture and soil solutions measure.



Non-Emissions Focused Initiatives

Climate and Clean Energy Workforce Development Program

Efforts to provide support for workforce development related to the deployment of energy efficiency, renewed electrification opportunities, and renewable energy implementation throughout the state are a necessary part of any climate-changing emissions reduction measures and actions. Specifically, to ensure success of these measures and actions, OSCE, in conjunction with the Wisconsin Department of Workforce Development, will support employers to create relevant jobs with family-supporting wages and high-quality benefits, assist job seekers and employees to connect with those jobs, expand apprenticeship and other clean-energy related training program opportunities, and collaborate with labor unions, development boards, technical colleges and other educational institutions, and other workforce partners. While many actions have already been taken in Wisconsin to support workforce transitions as outlined in the Wisconsin Clean Energy Plan 2023 Progress Report, support is still needed to ensure an equitable and inclusive workforce. Wisconsin will be completing a full workforce inventory of clean energy jobs for inclusion in the next steps of the CPRG Planning grant process.

KEY IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Workforce Development (DWD)
Wisconsin Department of Administration

POTENTIAL RECIPIENTS OF SECURED IMPLEMENTATION FUNDING

DWD, Workforce Development Boards, Wisconsin Technical Colleges, Universities of Wisconsin

Outreach and Engagement Through the Wisconsin Climate Action Navigators

The Wisconsin Climate Action Navigators (WI CAN) will support outreach and engagement related to climate pollution reduction efforts occurring around the state at all levels. OSCE leveraged a portion of CPRG planning funding to launch the WI CAN initiative in November 2023 as an extensive community engagement effort. The goal of this effort is to catalyze transformative climate action through:

1. Extend OSCE's reach into local communities by leveraging a trusted network to help develop, coordinate, and promote robust clean energy education and outreach efforts across the state.
2. Elevate local priorities and increase opportunities for community self-determination and cross-sector collaboration.
3. Setting up continuous communication and feedback loops to engage Wisconsinites in shared clean energy progress by collecting public input and sharing progress transparently.

The connections made as part of this initiative will inform the creation and deployment of the state's Comprehensive Climate Action Plan, help rapidly diffuse funding opportunities, and subsequently establish an ongoing network of communities and partners that will carry this work through the coming decades. Read more about WI CAN's future efforts in Next Steps.

KEY IMPLEMENTING AGENCY OR AGENCIES

Wisconsin Department of Administration

Authority to Implement

Executive Order #38, issued by the Governor Tony Evers, via the authority of the Constitution of and the Laws of the State, designates the Department of Administration – Office of Sustainability and Clean Energy to ensure the State of Wisconsin is fulfilling the carbon reduction goals of the 2015 Paris Climate Accord and working with stakeholders to ensure all electricity consumed in the state is 100% carbon free by 2050. Under s. 16.54, Wis. Stats., the Governor on behalf of the state is authorized to accept federal funds made available to the State. All applications for and receipt of federal funds by a state agency, as well as the creation of federally funded positions, are subject to the Governor's approval.

Next Steps

After submission of this roadmap to the US EPA, the immediate next step is to apply for CPRG phase 2 implementation funding. Simultaneously, OSCE will begin to develop Wisconsin's CCAP. Wisconsin's CPRG Phase 2 Implementation Grant application(s) and Comprehensive Climate Action Plan(CCAP) development will have support from the Wisconsin Climate Action Navigators. The following section details US EPA's requirements and OSCE's approach to creating and delivering a holistic CCAP, which centers lived experiences and spurs transformative climate action.

Developing Wisconsin's CCAP: While this roadmap outlines high-impact and implementation ready measures with direct benefits to LIDACs, it is not intended to be a holistic representation of all measures Wisconsin could implement to realize transformative emissions reduction. Measures and actions in this roadmap are designed to be competitive in CPRG Phase 2 Implementation Grants and serve to complement the implementation of existing initiatives and priorities not outlined in this roadmap. Where this roadmap is narrow, the CCAP will provide an all-encompassing, multi-sector pathway to define strategies for energy and non-energy related GHG emissions reduction, carbon sequestration, and mitigation.[xxxii] As required by US EPA, Wisconsin's CCAP will include the following:

- GHG inventory, emissions projections, and reduction targets,
- Quantified GHG reduction measures,
- Benefits analysis,
- LIDAC benefits analysis,
- Review of authority to implement,
- Leverage and intersection with other funding,
- Workforce planning analysis, and
- Stakeholder engagement activities.

Ongoing stakeholder engagement: catalyzing transformative climate action - WI CAN represents a new framework for authentic community engagement in the development and implementation of this roadmap, the CCAP and beyond. OSCE began gathering stakeholder feedback and buy-in for WI CAN in September 2023 and hosted the first in-person meeting in January 2024. The design of WI CAN draws from a collective impact approach[xxxiii] where OSCE serves as the backbone organization. Over 70 organizations from across WI attended the January 2024 in-person meeting, including community-based organizations, Native Nations, other Wisconsin state agencies, local government coalitions, LIDAC representatives, workforce development organizations, agriculture experts, universities, environmental justice advocates, industry representatives, business advocates, and labor groups. Moving forward, WI CAN provides a framework to empower Wisconsinites to engage in the clean energy transition and climate action in three key ways:

1. Extend OSCE's reach into local communities by leveraging a trusted network to help develop, coordinate, and promote robust clean energy education and outreach efforts across the state.

2. Elevate local priorities and increase opportunities for community self-determination and cross-sector collaboration.
3. Set up continuous communication and feedback loops to engage Wisconsinites in shared clean energy progress by collecting public input and sharing progress transparently.

As OSCE moves on to implementing priority actions identified in this roadmap and developing the CCAP, WI CAN serves as new model for authentic community engagement that can help build trust in government, equitably diffuse funding, provide resources and technical assistance to underserved communities, and drive systemic change. Not only will OSCE's planning, implementation, and engagement efforts serve to continue to transform Wisconsin's energy system to a clean energy economy and directly address climate change impacts, but they will also create family-supporting jobs, improve public health, address historic injustice, and protect our planet for generations to come.

Appendix A: Quantified Emissions Background

The Office of Sustainability and Clean Energy used a variety of quantification methods for determining the potential emissions reductions for each measure and strategy. In many cases, Rocky Mountain Institute's Energy Policy Simulator (EPS) v3.4.3 tool was used to identify measures and potential emissions reductions related to those measures. EPS shows a "business as usual" (BAU) case to aid in comparison for selected measures. The BAU case assumes a reduction in overall GHG emissions due to other enacted policies. In other cases, individual formulas or calculations were used to determine potential GHG emissions related to a measure based on a variety of datasets and inputs.

These calculations are not meant to be predictions, but rather indications of the potential for emissions reductions under ambitious decarbonization scenarios associated with the related actions. The assumptions used in the development of quantifications are similarly representative of potential and should not be interpreted as specific state goals or commitments, as outcomes will vary based on actual program implementation details and timelines that will be developed fully as implementation funding opportunities are realized. The methods for quantification utilized for each strategy are outlined below.

Industrial Efficiency, Electrification, and Decarbonization

FACILITATE AN INDUSTRIAL DECARBONIZATION CHALLENGE THROUGH A COALITION OF MIDWEST STATES.

Model: Energy Policy Simulator	2025 *(million metric tons CO_2e)*	2030 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
Business as Usual	113.5	111.0	106.1
GHG Emissions with Measure	-	103.0	90.5
Reduction from Base Year 2025	-	10.5	23.0
Reduction from Business as Usual	-	8	15.6

Building Electrification and Retrofitting

IMPROVE THE EFFICIENCY OF HOMES AND BUILDINGS THROUGH BUILDING COMPONENT ELECTRIFICATION.

Model: Energy Policy Simulator	2025 *(million metric tons CO_2e)*	2030 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
Business as Usual	113.5	111.0	106.1
GHG Emissions with Measure	-	109.2	94.6
Reduction from Base Year 2025	-	4.3	18.9
Reduction from Business as Usual	-	1.8	11.5

RETROFIT EXISTING BUILDINGS.

Model: Energy Policy Simulator	2025 *(million metric tons CO_2e)*	2030 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
Business as Usual	113.5	111.0	106.1
GHG Emissions with Measure	-	110.4	104.1
Reduction from Base Year 2025	-	3.1	9.4
Reduction from Business as Usual	-	0.6	2.0

CREATE A PRE-WEATHERIZATION PROGRAM AND INTEGRATE BUILDING INCENTIVES.

The OSCE created a formula based on metrics from the Weatherization Assistance Program and EPA guidance for determining GHG emissions reductions potential for this measure.

Model: Formula	2030 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
GHG Emissions Reductions	0.025	0.125

Clean Transportation, Fuels, and Infrastructure

REDUCE BARRIERS FOR ACCESS TO ELECTRIC VEHICLE AND ASSOCIATED INFRASTRUCTURE

Model: Energy Policy Simulator	2025 *(million metric tons CO_2e)*	2030 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
Business as Usual	113.5	111.0	106.1
GHG Emissions with Measure	-	110.6	104.9
Reduction from Base Year 2025	-	2.9	8.6
Reduction from Business as Usual	-	0.4	1.2

SUPPORT RECYCLING AND REPLACEMENT OF SMALL ENGINES.

Model: MOVES	2025 *(metric tons)*	2030 *(metric tons)*	2050 *(metric tons)*
Business as Usual	415,242.7	415,242.7	415,242.7
GHG Emissions with Measure	-	373,718.4	332,194.1
Reduction from Base Year 2025	-	41,524.3	83,048.5
Reduction from Business as Usual	-	41,524.3	83,048.5

EXPAND MEDIUM-HEAVY DUTY ELECTRIFICATION AND HYDROGEN INFRASTRUCTURE.

Model: Energy Policy Simulator	2025 *(million metric tons CO_2e)*	2030 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
Business as Usual	113.5	111.0	106.1
GHG Emissions with Measure	-	101.3	97.3
Reduction from Base Year 2025	-	12.2	16.2
Reduction from Business as Usual	-	9.7	8.8

UTILIZE LOW-CARBON CEMENT IN TRANSPORTATION INFRASTRUCTURE.

Georgetown Climate Center developed calculations and a formula for determining Wisconsin's Scope 3 indirect emissions related to a coalition-based measure that would transform the low-carbon cement industry.

Model: Formula	2030 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
GHG Emissions Reductions	0.393	3.313

Transit Planning and Expansion

ENABLE MODE SHIFTING TO ALTERNATIVE FORMS OF TRANSPORTATION AND EXPAND PUBLIC TRANSIT.

Model: Energy Policy Simulator	2025 *(million metric tons CO_2e)*	2030 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
Business as Usual	113.5	111.0	106.1
GHG Emissions with Measure	-	109.6	104.8
Reduction from Base Year 2025	-	3.9	8.7
Reduction from Business as Usual	-	1.4	1.3

ELECTRIFY PUBLIC TRANSIT.

Model: Energy Policy Simulator	2025 *(million metric tons CO_2e)*	2030 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
Business as Usual	113.5	111.0	106.1
GHG Emissions with Measure	-	101.3	97.3
Reduction from Base Year 2025	-	12.2	16.2
Reduction from Business as Usual	-	9.7	8.8

Distributed Renewable Energy

SUPPORT DISTRIBUTED SOLAR, GEOTHERMAL, WIND, AND BIOGAS INSTALLATIONS.

Model: Energy Policy Simulator	2025 *(million metric tons CO_2e)*	2030 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
Business as Usual	113.5	111.0	106.1
GHG Emissions with Measure	-	110.3	104.9
Reduction from Base Year 2025	-	3.2	8.6
Reduction from Business as Usual	-	0.7	1.2

IMPROVE RESILIENCY OF LOCAL GOVERNMENTS THROUGH INSTALLATION OF SOLAR AND STORAGE.

Great Plains Institute estimated GHG and criteria pollutant emission reductions based on a case evaluation. Actual emissions reductions will vary depending on selected program parameters.

Model: PVWatts, ReOpt	2035 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
GHG Emissions Reductions	.008628	.042142

Agriculture and Soil Solutions

PROMOTE SOIL CARBON INTENSITY BEST PRACTICES.

Model: Energy Policy Simulator	2025 *(million metric tons CO_2e)*	2030 *(million metric tons CO_2e)*	2050 *(million metric tons CO_2e)*
Business as Usual	113.5	111.0	106.1
GHG Emissions with Measure	-	110.4	104.6
Reduction from Base Year 2025	-	3.1	8.9
Reduction from Business as Usual	-	0.6	1.5

Appendix B: Alignment with Previous Planning

Below is a list of Governor's Task Force on Climate Change recommendations and Clean Energy Plan strategies that align with the Wisconsin Emissions Reductions Roadmap.

Priority Measure	Clean Energy Plan and Governor's Task Force on Climate Change References
Industrial Efficiency, Electrification, and Decarbonization	• Support commercial and industrial energy efficiency. (CEP, Page 120) • Reduce agriculture energy use. (CEP, Page 121) • Support high-value conservation. (CEP, Page 132) • Create a plan to adopt net carbon zero thermal solutions to scale up renewable heating and cooling in the industrial and building sectors. (CEP, Page 133; GTFCC #46)
Building Electrification and Retrofitting	• Support clean energy and energy efficiency projects via State Agency Performance Contracting and other financing options. (CEP, Page 90) Incentivize tax credit developers that incorporate energy efficiency and sustainability into the construction and rehabilitation of affordable housing developments. (CEP, Page 106) • Pursue a healthy whole-home approach. (CEP, Page 122-123) • Leverage federal funding for energy efficiency grant program. (CEP, Page 124) • Empower schools to fund or implement energy efficiency programs. (CEP, Page 124; 2021-2023 Executive Budget; GTFCC Rec #36) • Support energy efficiency improvements through the WHEDA Foundation Annual Housing Grant Program. (CEP, Page 124) • Deploy rapid building electrification. (CEP, Page 130) • Increase outreach and support deployment of air-source heat pumps. (CEP, Page 132-133)
Clean Transportation, Fuels, and Infrastructure	• Work to transition the State's vehicle fleet to clean fuels and zero-emission vehicles (ZEV). (CEP, Page 88) • Decarbonize the transportation sector via EV and infrastructure deployment. (CEP, Page 142) • Implement sustainable land use planning and transportation demand management (TDM). (CEP, Page 142; GTFCC #18; GTFCC #20) • Support the transition to Electric Vehicles (EV) statewide. (CEP, Page 144-145) • Ensure that electric charging infrastructure and federal funding to support infrastructure buildout is widely available for all types of vehicles and that it reaches rural, low-income, and communities of color. (CEP, Page 145-146)
Transit Planning and Expansion	• Support Transit for Job Access and Reverse Commute Program funding. (CEP, Page 81) • Implement sustainable land use planning and transportation demand management (TDM). (CEP, Page 142; GTFCC #18; GTFCC #20) • Decarbonize the transportation sector via EV and infrastructure deployment. (CEP, Page 142)

	• Support the transition to Electric Vehicles (EV) statewide. (CEP, Page 144-145) • Ensure that electric charging infrastructure and federal funding to support infrastructure buildout is widely available for all types of vehicles and that it reaches rural, low-income, and communities of color. (CEP, Page 145-146)
Distributed Renewable Energy	• Reduce energy consumption and GHG emissions. (CEP, Page 89) • Support clean energy and energy efficiency projects via State Agency Performance Contracting and other financing options. (CEP, Page 90)
Agriculture and Soil Solutions	Pay farmers to increase soil carbon storage in agricultural and working lands. (GTFCC #22, Page 52)
Climate and Clean Energy Workforce Development	• Launch a clean energy job inventory and outreach program. (CEP, Page 78) • Support the Clean Energy Workforce Advisory Council. (CEP, Page 78) • Support communities and workers who will experience power generation plant closures. (CEP, Page 78) • Increase engagement and collaboration with labor unions. (CEP, Page 80) • Ensure the clean energy transition supports family-supporting wages. (CEP, Page 80) • Launch a Clean Energy Reentry Pilot Program. (CEP, Page 80) • Support the creation of a certified training program for digester operators. (CEP, Page 80) • Support Clean Jobs Training Grants. (CEP, Page 81) • Support clean energy and energy efficiency job creation. (CEP, Page 82) • Expand agriculture clean energy workforce development. (CEP, Page 82) • Create and deploy workforce transition plans. (GTFCC #31, Page 68) • Support public post-secondary educational entities. (GTFCC #32, Page 70) • Create new jobs through conservation and prepare individuals for work within the green energy sector. (GTFCC #33, Page 71)
Engagement	• Develop, coordinate, and promote robust clean energy education and outreach efforts across the state. (CEP, Page 74) • Increase engagement and collaboration with labor unions. (CEP, Page 80) • Improve the state consultation process with Native Nations. (GTFCC #02, Page 24)

Appendix C: Other State Programs

The OSCE has identified many existing state programs that support the measures listed in this roadmap. This list is not comprehensive but tells a compelling story for Wisconsin's efforts and what progress has already been made. The measures in this roadmap will complement, not duplicate, these important programs.

Industrial Efficiency, Electrification, and Decarbonization

- Focus on Energy has limited custom and prescriptive incentives for manufacturing customers.
- Wisconsin Office of Energy Innovation
- Wisconsin Economic Development Corporation – Green Innovation Fund
- UW-Milwaukee - Industrial Assessment Center
- Wisconsin Manufacturing and Extension Partnership

Building Electrification and Retrofitting

- Focus on Energy
- Wisconsin Office of Energy Innovation - Energy Innovation Grant Program (EIGP)
- Wisconsin Housing and Economic Development Authority – Qualified Allocation Plan
- Wisconsin Economic Development Corporation – Green Innovation Fund
- Wisconsin Department of Administration:
    - Wisconsin Home Energy Assistance Program (WHEAP)
    - Weatherization Assistance Program (WAP)
    - Home Energy Plus (HE+) Program Services
    - HOME Homebuyer and Rehabilitation Program (HHR)
    - Energy Savings Conservation Programs
    - Help for Homeowners (WHH)
- Wisconsin Department of Health Services: Asthma Safe Homes/ Healthy Homes
- Inflation Reduction Act HOMES and HEERA rebate programs

Clean Transportation, Fuels, and Infrastructure

- Wisconsin Department of Transportation
    - Wisconsin Electric Vehicle Infrastructure (WEVI) program
    - Transportation Alternatives Program
    - Congestion Mitigation and Air Quality Improvement Program
- Wisconsin Department of Natural Resources - Diesel Emissions Reduction Act Clean Diesel Grant Program
- Wisconsin Office of Energy Innovation - Energy Innovation Grant Program
- Wisconsin Economic Development Corporation – Green Innovation Fund

Transit Planning and Expansion

- Wisconsin Department of Transportation
    - Carbon Reduction Program
    - Transportation Alternatives Program
    - Congestion Mitigation and Air Quality Improvement Program

Distributed Renewable Energy

- Focus on Energy
- Wisconsin Office of Energy Innovation - Energy Innovation Grant Program
    - Wisconsin Economic Development Corporation
    - Green Innovation Fund
    - Business Development Credit
- Solar for All
- Wisconsin Department of Administration
    - Energy Savings Conservation Programs

Agriculture and Soil Solutions

- Department of Agriculture, Trade, and Consumer Protection:
    - Producer-Led Watershed Protection grants
    - Commercial Nitrogen Optimization Pilot Program
    - Crop insurance premium rebates for planting cover crops
    - Nutrient Management farmer education

Climate and Clean Energy Workforce Development Program

- Inflation Reduction Act State-Based Home Energy Efficiency Contractor Training Grants

Appendix D: LIDAC Census Block Group IDs

LIDAC Census Block Group IDs were collected using EJScreen. Methods are outlined in section "Identifying Low Income and Disadvantaged Communities."

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Appendix E: Outreach and Engagement Timelines

Native Nation Government Engagement Timeline

September 2023: Presentation at Tribal Energy Symposium
November 2023: Attended Department of Administration Tribal Consultation
November 2023: Meeting with Wisconsin Tribal Conservation Advisory Council
December 2023: Letter sent to all Native Nation Leaders
January 2024: Individual meetings with Native Nation government staff
January 2024: Presentation at MTERA Board Meeting
January 2024: Presentation at Wisconsin Tribal Conservation Advisory Council Board Meeting
February 2024: Shared WI's draft priority measures and resource list to Native Nation Leaders, staff, and Tribal Consortia

Local Government Engagement Timeline

July 2023: WLGCC submitted feedback on priority strategies to reduce GHG emissions
September 2023: Meeting with SEWRPC
October 2023: Initiated sub-award process with UW-Milwaukee to complete a local plan analysis
October 2023: Presentation at Green Tier Legacy Communities Meeting
November 2023: Meeting with WI Towns Association
November 2023: Meeting with WI Counties Association
December 2023: "WI Climate Pollution Reduction Grant Update" public stakeholder webinar (https://www.youtube.com/watch?v=hrkFjX_g7sQ)
December 2023: Request for priority project information via a public input survey
January 2024: Meeting with Association of Regional Planning Commissions
January 2024: Presentation at Green Tier Legacy Communities meeting
February 2024: Shared WI Draft Priority Measures with local government stakeholders

Other outreach activities related to CPRG planning

The below timeline below highlights other meetings, conferences, and events the OSCE attended or presented at to engage Wisconsinites, specifically LIDACs, in CPRG planning. This list is not all encompassing and the OSCE will continue to expand outreach efforts through implementation and planning.

September 2023: Attended Agriculture and Rural Resilience Summit
October 2023: Presentation at UW Sustainability Annual Meeting
October 2023: Tabling at University of Wisconsin – Stevens Point Sustainability Fair
October 2023: Climate and Healthy Communities Collaborative Workgroup Meeting
November 2023: Meeting with Wisconsin Building Trades Council
November 2023: Meeting with Wisconsin EcoLatinos

November 2023: Attended Dane County High School Climate Conference
November 2023: Meeting with Tribal Communities Technical Assistance Center
November 2023: Meeting with Focus on Energy
November 2023: Speaker on SustainUW podcast: "Wisconsin's Renewable Future: Spotlighting the Wisconsin Office of Sustainability and Clean Energy"[xxxiv]
November 2023: Meeting with Savanna Institute
November 2023: Meeting with the National Association for the Advancement of Colored People (NAACP)
December 2023: Meeting with Wisconsin Sustainable Business Council and Wisconsin Manufacturing Extension Partnership
December 2023: Meeting with Wisconsin's Green Fire
January 2024: Presentation at Wisconsin Climate Table meeting
January 2024: Meeting with Our Future Milwaukee Coalition
January 2024: Meeting with Dane County Youth Environmental Coalition
February 2024: Meeting with WI Workforce Development Board
February 2024: Presentation to Wisconsin Clean Energy Communities Initiative

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FEBRUARY 2024

Priority Climate Action Plan

Climate pollution reduction grants

MINNESOTA

Charge

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Key definitions

Climate Pollution Reduction Grants (CPRG) program: a federal program providing $5 billion in grants[1] to states, local governments, Tribes, and territories to develop and implement ambitious plans for reducing greenhouse gas emissions and other harmful air pollution.

Comprehensive Climate Action Plan (CCAP): a narrative report that provides an overview of the grantees' significant greenhouse gas sources/sinks and sectors, establishes near-term and long-term greenhouse gas emission reduction goals and provides strategies and identifies measures that address the highest priority sectors to help the grantees meet those goals.

eligible entities: Section 137(d)(1) of the Clean Air Act defines "eligible entities" under the CPRG program as states, air pollution control agencies, municipalities, Tribes, and groups of one or more of these entities.

Greater Minnesota: refers to the areas of the state of Minnesota outside of the Minneapolis-St. Paul metropolitan (Twin Cities) area.

greenhouse gas inventory: a list of emission sources and sinks and the associated emissions quantified using standard methods. Greenhouse gases included are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)

low-income and disadvantaged communities (LIDACs): communities with residents that have low incomes, limited access to resources, and disproportionate exposure to environmental or climate burdens. Although the Inflation Reduction Act does not formally define LIDACs, EPA strongly recommends that grantees use the Climate and Economic Justice Screening Tool[2] and the Environmental Justice Screening and Mapping Tool[3] to identify LIDACs in their communities. These tools identify LIDACs by assessing indicators for categories of burden: air quality, climate change, energy, environmental hazards, health, housing, legacy pollution, transportation, water and wastewater, and workforce development.

Priority Climate Action Plan (PCAP): a narrative report that includes a focused list of near-term, high-priority, and implementation-ready measures to reduce greenhouse gas pollution and an analysis of greenhouse gas emissions reductions.

metropolitan statistical area (MSA): metropolitan statistical areas as defined by the U.S. Census 2020 MSA population. A list of eligible MSAs can be found in Appendix 15.2 in EPA's CPRG: Formula Grants for Planning, Program Guidance for States, Municipalities, and Air Control Agencies.[4]

municipality: EPA defines municipality for the Climate Pollution Reduction Grants as "a city, town, borough, county, parish, district, or other public body created by or pursuant to State law. Consistent with section 137(d)(1) of the Clean Air Act, a group of municipalities, such as a council of governments, may also be considered an eligible entity under this program in some cases." This definition can be

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[1] EPA CPRG. https://www.epa.gov/inflation-reduction-act/climate-pollution-reduction-grants
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found in Section 4 in EPA's CPRG: Formula Grants for Planning, Program Guidance for States, Municipalities, and Air Control Agencies.[5]

Tribes and territories: Consistent with section 137(d)(1) of the Clean Air Act, groups of Tribes, including Tribal consortia and Tribal partnerships, may be considered an eligible entity under this program. Tribes, Tribal partnerships, and Tribal consortia can also participate as collaborating partners in planning efforts managed by lead organizations for states or metropolitan areas. More information can be found in EPA's CPRG Guidance for Tribes and Territories.[6]

Acronyms and abbreviations

AR4	Fourth Assessment Report of the United Nations Intergovernmental Panel on Climate Change
AR5	Fifth Assessment Report of the United Nations Intergovernmental Panel on Climate Change
BWSR	Board of Water and Soil Resources
CCAP	Comprehensive Climate Action Plan
CPRG	Climate Pollution Reduction Grants
CO_2e	carbon dioxide equivalent
DEED	Department of Employment and Economic Development
DNR	Department of Natural Resources
EPA	Environmental Protection Agency
IPCC	Intergovernmental Panel on Climate Change
LIDAC	low-income and disadvantaged communities
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MMT	million metric tons
MnCIFA	Minnesota Climate Innovation Finance Authority
MnDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MSA	metropolitan statistical area
PCAP	Priority Climate Action Plan
$PM_{2.5}$	fine particulate matter
USDA	United States Department of Agriculture

[5] CPRG: Formula Grants for Planning, Program Guidance for States, Municipalities, and Air Control Agencies, https://www.epa.gov/system/files/documents/2023-02/EPA CPRG Planning Grants Program Guidance for States-Municipalities-Air Agencies 03-01-2023.pdf

[6] CPRG Guidance for Tribes and Territories. https://www.epa.gov/system/files/documents/2023-02/EPA CPRG Planning Grants Program Guidance for Tribes-Tribal Consortia-Territories 03-01-2023.pdf

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Introduction

The Minnesota Pollution Control Agency (MPCA) led the development of the state's Priority Climate Action Plan (PCAP) in collaboration with the Minnesota Department of Health (MDH), University of Minnesota Duluth, and the Climate Change Subcabinet. This plan is a deliverable of the Climate Pollution Reduction Grant (CPRG) program and builds on the state's climate change planning work, including and the state's greenhouse gas emissions inventory.[7]

This PCAP applies to the area within the boundaries of the state of Minnesota and focuses on climate change mitigation actions in four Climate Action Framework goal areas: Clean Transportation, Climate-Smart Natural and Working Lands, Clean Energy and Efficient Buildings, and Clean Economy.

Climate Pollution Reduction Grants program overview

The EPA Climate Pollution Reduction Grant program[8] provides $5 billion in grants to states, local governments, Tribes, and territories to develop and implement ambitious plans for reducing greenhouse gas emissions and other harmful air pollution. Authorized under Section 60114 of the Inflation Reduction Act, this two-phase program provides $250 million for noncompetitive planning grants and $4.6 billion for competitive implementation grants.

The CPRG program is part of the Biden Administration's Justice40 initiative, which sets a goal that 40 percent of the benefits of certain federal investments flow to disadvantaged communities that are marginalized, underserved, and overburdened by pollution.

Planning grants

MPCA accepted a planning grant on behalf of the state of Minnesota in June 2023. In addition to the state, the EPA awarded planning grants to the following entities within the geography of Minnesota:

- Shakopee Mdewakanton Sioux Community
- Mille Lacs Band of Ojibwe
- Midwest Tribal Energy Resources Association (MTERA) (covering a consortium of Tribal Nations in the region)
- Metropolitan Council (for the Minneapolis-St. Paul-Bloomington metropolitan statistical area)

EPA maintains a list of the lead organizations for planning grants.[9]

The planning grant includes three deliverables: the Priority Climate Action Plan (PCAP), a Comprehensive Climate Action Plan (CCAP), and a Status Report. For the state's planning grant, the deliverable deadlines are:

- PCAP: March 1, 2024
- CCAP: June 28, 2025
- Status Report: June 28, 2027

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[7] Minnesota Climate Trends and Data. https://www.pca.state.mn.us/air-water-land-climate/climate-change-trends-and-data
[8] EPA Climate Pollution Reduction program. https://www.epa.gov/inflation-reduction-act/climate-pollution-reduction-grants
[9] CPRG Planning Grant Information. https://www.epa.gov/inflation-reduction-act/cprg-planning-grant-information

The PCAP provides a focused list of near-term, high-priority, implementation-ready measures to reduce climate pollution from greenhouse gas emissions. The PCAP requires the following elements:

- Greenhouse gas inventory
- Priority quantified greenhouse gas reduction measures
- Low-income and disadvantaged communities benefits analysis
- Review of authority to implement

The Comprehensive Climate Action Plan will consist of several key components, including a comprehensive greenhouse gas inventory, projections for greenhouse gas emissions, clearly defined greenhouse gas reduction targets, specified measures for greenhouse gas reduction, and a thorough benefits analysis covering the entire geographic scope and population addressed by the plan.

For more information about the planning phase, visit the EPA's CPRG Planning Grant Information page.[10]

Implementation grants

The EPA launched two competitions in the implementation phase: a $4.3 billion general competition open to states, Tribes, territories, and municipalities, or coalitions of these entities, and a $300 million competition open to Tribes, territories, and coalitions of these entities. Eligible entities can apply for general competition funding through the CPRG program to implement projects included in an applicable PCAP submitted to EPA by March 1, 2024. Eligible entities applying or the Tribes and territories competition must submit applications to the EPA by May 1, 2024.

Projects must be described in an applicable PCAP to be eligible for CPRG implementation grants. An applicable PCAP geographically covers an entity and contains greenhouse gas reduction measures that the entity can implement. In some cases, multiple PCAPs may cover an entity. For example, an applicable state PCAP and an applicable metropolitan PCAP may each include measures that a particular municipality could implement. The municipality could reference measures from either or both PCAPs in its application.

Eligible entities, whether or not they received planning grants, can apply to implement measures outlined in applicable PCAPs. For the general competition, individual grants will range from $2 million to $500 million. For the Tribes and territories competition, awards will range from $1 million to $25 million.

Additional information on the implementation grants can be found on the EPA's CPRG implementation grants page.[11]

State context

Climate change executive order

Governor Walz and Lt. Gov. Flanagan built on years of climate change planning and action when they established the Climate Change Subcabinet by executive order[12] in 2019. The Subcabinet's role is to identify policies and strategies for climate mitigation and resiliency and meaningfully engage the public

[10] CPRG Planning Grant Information. https://www.epa.gov/inflation-reduction-act/about-cprg-planning-grant-information
[11] CPRG Implementation Grants Information. https://www.epa.gov/inflation-reduction-act/about-cprg-implementation-grants
[12] Minnesota Executive Order 19-37. https://mn.gov/governor/assets/2019_12_2_EO_19-37_Climate_tcm1055-412094.pdf

to ensure that those impacted by climate change have a voice in the process. The members of the Subcabinet are the executive leaders of the Minnesota Pollution Control Agency, Board of Water and Soil Resources (BWSR), Metropolitan Council, Environmental Quality Board, Minnesota Housing Finance Agency (Minnesota Housing), and departments of Commerce, Labor and Industry, Management and Budget, Employment and Economic Development (DEED), Agriculture (MDA), Public Safety, Natural Resources (DNR), Health (MDH), Transportation (MnDOT), and Administration. The executive order names the commissioner of the MPCA as the chair of the Subcabinet. The Subcabinet is supported by interagency staff teams that collaborate on climate engagement, policy development, analysis, implementation, and reporting.

The climate change executive order also created the Governor's Advisory Council on Climate Change. The advisory council works with the Climate Change Subcabinet to identify opportunities for, and barriers to, policies and strategies to reduce greenhouse gas emissions and increase climate resiliency. The council is comprised of up to 15 members appointed by the governor, and includes civic and community leaders, individuals with experience in business, agriculture, conservation, environmental protection, and other relevant stakeholders.

Minnesota's Climate Action Framework

In September 2022, the Subcabinet published the Minnesota Climate Action Framework,[13] a plan that sets a vision for how the state will address and prepare for climate change. The framework broadly guides the direction of climate action toward a carbon-neutral, resilient, and equitable future for Minnesota and contains immediate, near-term actions, as well as key progress indicators with measurable targets.

The framework is organized into six goal areas:

- Clean Transportation – Connect all people through a safe, equitable, and sustainable transportation system
- Climate-Smart Natural and Working Lands – Manage our lands to reduce greenhouse gas emissions, enhance terrestrial carbon sinks, and sustain resilient landscapes
- Resilient Communities – Prepare communities with resources to build a more resilient future for themselves
- Clean Energy and Efficient Buildings – Expand the use of carbon-free energy and create healthy, comfortable buildings that are cheaper to operate and pollute less
- Healthy Lives and Communities – Protect the health and wellbeing of all Minnesotans in the face of climate change, especially those who live in the communities that are most affected
- Clean Economy – Build an economy that addresses climate change and creates equitable opportunities

Greenhouse gas targets in Minnesota

In 2007, as part of the Next Generation Energy Act, the Minnesota Legislature adopted greenhouse gas emissions targets to reduce emissions 15% below 2005 levels by 2015, 30% by 2025, and 80% by 2050. In 2022, as part of the Climate Action Framework, Governor Walz and Lieutenant Governor Flanagan

[13] Minnesota Climate Action Framework, 2022. https://climate.state.mn.us/minnesotas-climate-action-framework

endorsed the state's economy-wide greenhouse gas goal to reduce emissions by 50% by 2030 and become net-zero by 2050. The Legislature adopted these statewide goals in 2023.[14] The Framework also contains goals within each chapter, including:

- Reduce greenhouse gas emissions from the transportation sector 80% by 2040
- By 2035, increase by 25% the amount of carbon sequestered and stored annually in natural and working lands, compared to 2014-2018 average levels
- By 2035, reduce greenhouse gas emissions from existing buildings by 50% compared to 2005 levels

The Next Generation Energy Act of 2007 also set a statutory goal for 25% renewable electricity by 2025. Minnesota achieved the goal eight years early. In the 2023 Minnesota Legislative Session, the Legislature acted on a priority measure included in the Climate Action Framework: Governor Walz signed a bill requiring 100% carbon-free electricity by 2040, with at least 55% coming from renewable sources.[15] The law sets interim targets: 80% carbon-free by 2030 and 90% by 2035, except for rural electric co-ops, which must only reach 60% by 2030. These requirements will create momentum for major changes in the energy sector.

Low-income and disadvantaged communities in Minnesota

Equity and environmental justice are foundational to Minnesota's climate work. In fact, equity is one of the three pillars of the state's climate vision, as expressed in the Minnesota Climate Action Framework:

> Minnesotans acknowledge and address inequitable and inaccessible systems that contribute to some communities experiencing disproportionate climate change impacts; ensure fair distribution of the costs and benefits of action now and to future generations; and ensure meaningful participation in planning.[16]

Minnesota's Climate Action Framework also includes a goal to align state climate action with the principles of the Justice40 Initiative:

> By 2025, ensure at least 40% of the benefits of certain state and federal climate investments are in disadvantaged communities.[17]

For CPRG planning and implementation work, the state prioritizes benefits for low-income and disadvantaged communities (LIDACs) to fulfill its commitment to climate equity. LIDACs are areas, typically census tracts and census block groups, that the Climate Economic Justice Tool (CEJST)[18] and the EPA's Environmental Justice Screening and Mapping Tool (EJScreen)[19] have identified to be both low-income and disadvantaged based on meeting any of eight categories of burden. These categories relate to climate change vulnerability, health vulnerability, proximity to sources of hazardous pollution and waste, exposure to water pollution, heavy energy cost burden, historical housing underinvestment, proximity to high traffic pollution, linguistic isolation, poverty, unemployment, and others. To respect

[14] 2023 Minn. Statutes Chapter 216H, Section 02, Subdivision 1. https://www.revisor.mn.gov/statutes/cite/216H.02
[15] 2023 Minn. Statutes Chapter 216B, Section 1691. https://www.revisor.mn.gov/statutes/cite/216b.1691
[16] Minnesota Climate Action Framework. https://climate.state.mn.us/minnesotas-climate-action-framework
[17] Minnesota Climate Action Framework. https://climate.state.mn.us/sites/climate-action/files/Climate%20Action%20Framework.pdf. Pg. 57
[18] Climate Economic Justice Tool. https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5
[19] EPA EJScreen. https://www.epa.gov/ejscreen

Tribal sovereignty and self-government and to fulfill federal trust and treaty responsibilities to Tribal Nations, lands of Federally Recognized Tribes are also designated as LIDACs.

Two hundred census tracts out of Minnesota's 1,338 census tracts are classified as LIDACs. Because census tract boundaries do not generally align with Tribal lands, portions of an additional 16 Minnesota census tracts are classified as LIDACS as these areas are within federally recognized Tribal lands. Roughly half of these census tracts are located within urban areas of the Twin Cities metropolitan area while the remainder are in Greater Minnesota. In total approximately 724,000 Minnesotans live in LIDACs, comprising 13% of the state's population. Appendix D contains a list of all Minnesota LIDACs.

Greenhouse gas inventory

MPCA has developed a statewide inventory of major and minor sources of greenhouse gas emissions within Minnesota, including emissions associated with electricity generation occurring outside the state but necessary to meet in-state demand greater than in-state electricity generation. The most recent version of the inventory report is in Appendix A.

The MPCA greenhouse gas inventory has been in development for many years and serves many purposes. Beyond our ability to provide timely reports on progress toward statutory goals, the inventory contains information to support analysis and answer policy questions with confidence, credibility, and transparency.

MPCA used best practices and accounting principles to design the greenhouse gas inventory system. Tradeoffs between principles are sometimes required and create tension. In this context, MPCA strives to maximize the following criteria:

- Relevance: information is timely and appropriate for decision-making
- Completeness: all sources are included, and gaps are disclosed
- Consistency: methods, data sources, and boundaries are consistent to ensure estimates are comparable within the time series, with disclosed recalculations as necessary
- Transparency: methods, sources, and assumptions are documented and reported
- Accuracy: best practices are followed, and measures are taken to improve the inventory

Inventory boundaries

To report on progress toward meeting the goals, the MPCA estimates the statewide baseline greenhouse gas emissions in 2005 and estimates emissions through the most recent year for which data is available. The inventory covers emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). MPCA divides the inventory by economic sectors rather than the type of activity (e.g., energy, processes). The economic sectors used are transportation, electricity generation, industrial, commercial, residential, waste, and a category encompassing agriculture, forestry, and natural and working lands.

The most recent legislative report based on the statewide greenhouse gas inventory is in Appendix A. MPCA prepared this inventory using many supporting data resources and methods based primarily on

the EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks,[20] the Intergovernmental Panel on Climate Change (IPCC) 2006 Guidelines for National Greenhouse Gas Inventories[21] and 2019 Refinements,[22] and The Climate Registry's Local Government Operations[23] and General Reporting Protocol.[24]

Not all emissions are included in statewide emission totals. Ideally, all sources of greenhouse gas emissions from Minnesota would be inventoried and tracked. In practice, the inventory includes only those sources for which a well-developed scientific understanding of the physical and biological processes involved in the production and emission of greenhouse gases exists, and data must be available to support the estimation effort. Important emissions sources not currently included in the greenhouse gas inventory include many land-use sources of emissions and carbon sequestration. Within the limits of available data, methods, and models, MPCA aims to develop a progressively more comprehensive and accurate inventory over time.

Data management and quality assurance

MPCA archives all the data used to generate the estimates. Where possible, MPCA maintains databases with information from multiple sources for quality control of input data and keeps a record of all methods, equations, conversions, and emissions factors used.

Generally, MPCA uses methods based on simplified equations that are easily applied and ensure replicable results. MPCA selects methods based on best international practice, conformity with EPA practice, data availability, and resource requirements.

MPCA updates and applies methods to the entire inventory where appropriate when new data, research, and guidance are available.

MPCA acquires data at the most local level possible. Facility-level data is preferable to sector-based survey data. Permitted facilities are only a portion of facilities operating in Minnesota, so MPCA must employ other methods to have a complete inventory. Aggregate fuel sales and use data fill in the remainder of information about stationary source energy consumption and emissions. State-level data is the most detail available for agricultural activities, residential energy and housing information, and other sources.

Where disaggregated data is necessary for decision-makers and the reported data is unavailable at this level of detail, MPCA models the data to the end-user level. Vehicle emissions are an example of modeled disaggregation; MPCA models these emissions using the Motor Vehicle Emission Simulator (MOVES[25]) based on vehicle registration data, vehicle miles traveled estimates, vehicle counts, and other related data.

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[20] EPA. Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2020. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

[21] IPCC. Guidelines for National Greenhouse Gas Inventories. https://www.ipcc.ch/report/2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

[22] IPCC. 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

[23] California Air Resources Board, California Climate Action Registry, ICLEI, and The Climate Registry. 2010. Local Government Operations Protocol. Version 1.1. https://ww2.arb.ca.gov/sites/default/files/classic/cc/protocols/lgo_protocol_v1_1_2010-05-03.pdf

[24] The Climate Registry. General Reporting Protocol. https://theclimateregistry.org/registries-resources/protocols/

[25] EPA. Motor Vehicle Emission Simulator. Version MOVES3. https://www.epa.gov/moves

Program staff review the activity data for completeness, consistency, accuracy, and applicability before incorporating it into the inventory. The reviews vary, but include steps such as:

- Comparing fuel use trends to authoritative sources (e.g., Energy Information Administration)
- Reviewing facility-level activities for mistakes (e.g., misplaced units, exceeding design capacity)
- Researching survey data recommendations (e.g., agricultural census)
- Correcting revised data

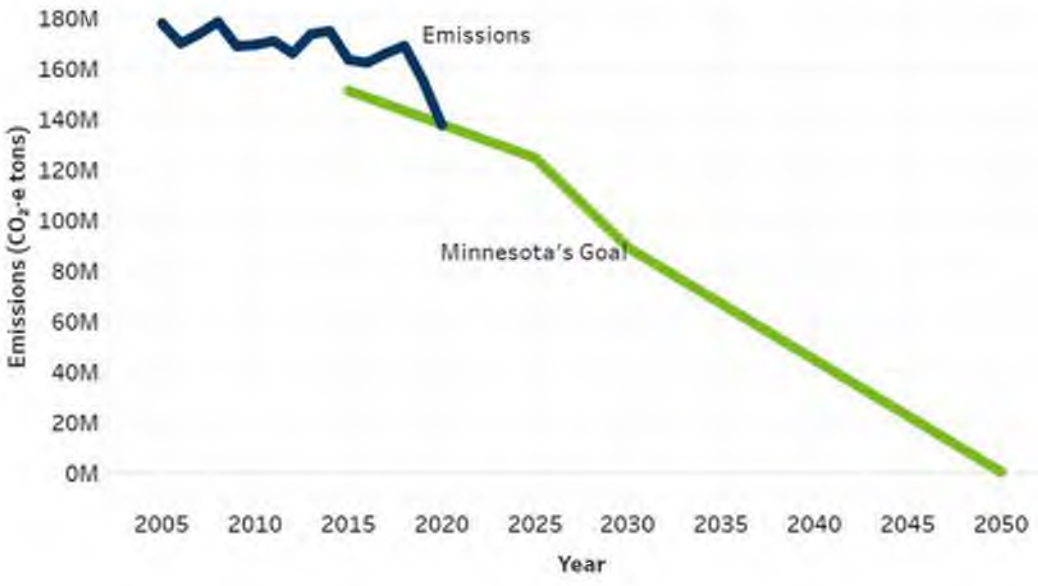
Significant differences identified as correct are noted (e.g., temporary shutdowns and closures). The process for compiling the inventory is continuously improved for efficiency, scope expansion, and incorporation of new methods.

Minnesota greenhouse gas emissions

Recent emission reductions show that collaborative action can forge a path to achieving greenhouse gas reduction goals and reach net-zero emissions by 2050 (Figure 1). Minnesota's greenhouse gas emissions declined by 23% between 2005 and 2020. However, 2020 was atypical as individuals, organizations, and governments took action to reduce the impacts of the COVID-19 pandemic, causing disruptions across all parts of the economy and impacting Minnesota's greenhouse gas emissions.

While the pandemic certainly impacted those results, emissions across many sectors were already declining between 2018 and 2019. Based on other inventories published with more recent data,[26] emissions increased post-pandemic with the economic recovery but were lower than pre-pandemic levels. However, much work is still ahead to achieve our ambitious but necessary goals.

Figure 1: Minnesota's greenhouse gas emissions from 2005-2020 and greenhouse gas reduction goals (short tons)



[26] EPA. 2024. Draft US Inventory of Greenhouse Gas Emissions and Sinks: 1990-2022. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks

Most greenhouse emissions occur as CO_2 from fossil fuel combustion, but other gases and sources are also important to track. Table 1 shows Minnesota's 2020 greenhouse gas emissions in million metric tons (MMT) of carbon dioxide equivalents (CO_2e) and the proportion of each gas to the total greenhouse gas emissions.

Table 1: Greenhouse gas emissions in Minnesota by gas in 2020

Greenhouse gas	Emissions in 2020 (MMT CO_2e)	Percent of total emissions in 2020
CO_2	86.8	70%
CH_4	17.7	14%
N_2O	17.5	14%
HFCs	2.37	1.9%
PFCs	0.043	0.03%
SF_6	0.041	0.03%
Total	**124.5**	

Table 2 details greenhouse gas emissions for all economic sectors. Minnesota Statute 216H.01[27] requires the inventory to include emissions from electricity needed to meet Minnesota demand that exceeds the electricity generated in-state. While electricity is traded freely across state boundaries, this framework is useful for developing state policy. Electric utility sector emissions in Table 2 include emissions from out-of-state electricity generation to serve Minnesota demand.

Transportation is the sector with the highest emissions (26%), followed by agriculture, forestry, and land use (21%).

Table 2: Greenhouse gas emissions (MMT CO_2e) by sector in Minnesota

Sector	Emissions in 2005	Emissions in 2020	Net change, 2005-2020	Percent change, 2005-2020	Percent of total emissions in 2020
Electric utility	52.0	23.7	-28.2	-54%	19%
Transportation	39.7	32.7	-7.0	-18%	26%
Agriculture, forestry, and land use	26.1	25.9	-0.2	-1%	21%
Industrial	16.1	18.4	2.3	14%	15%
Residential	8.0	9.1	1.1	14%	7%
Commercial	17.2	13.3	-3.9	-22%	11%
Waste	2.2	1.4	-0.8	-38%	1%
Total	**161.3**	**124.5**	**-36.7**	**-23%**	

Table 3 shows the emissions from the electricity sector without out-of-state electricity generation emissions.

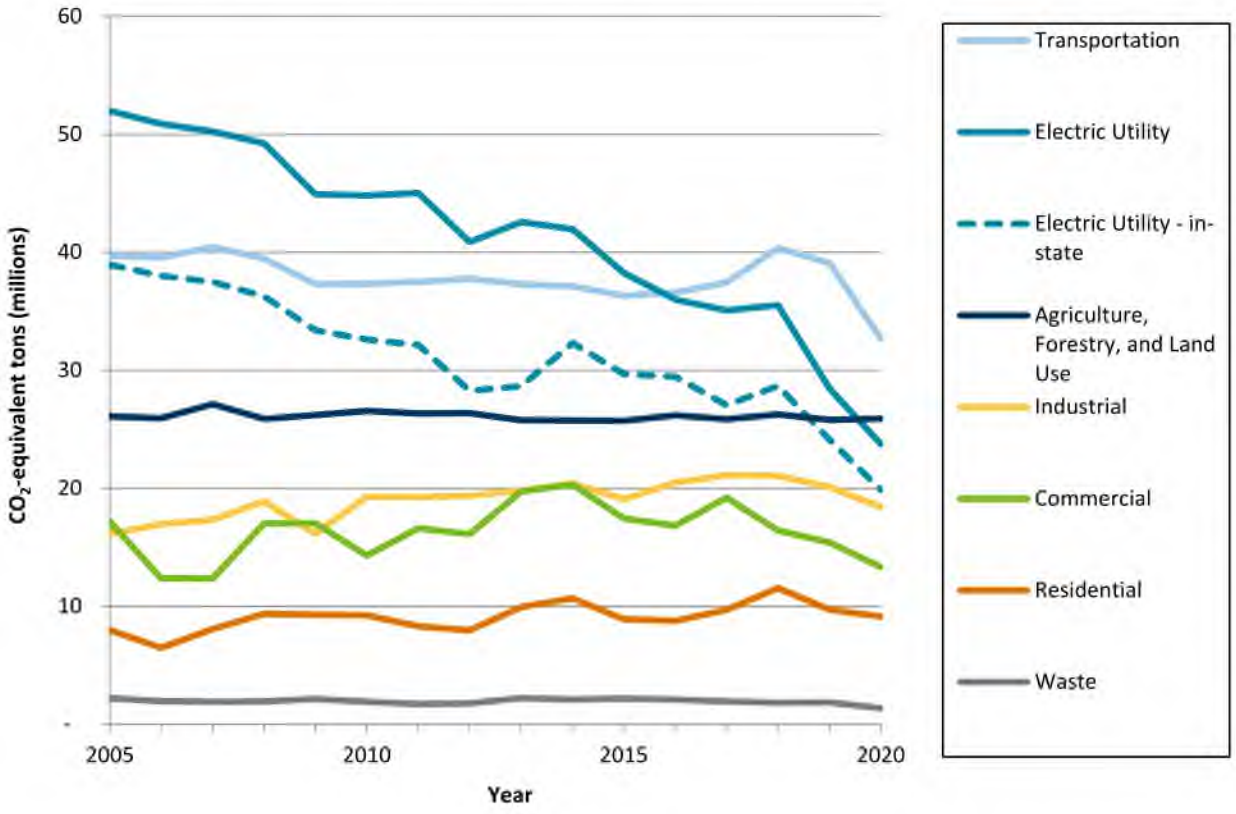
[27] Minn. Statutes 216H.01, https://www.revisor.mn.gov/statutes/cite/216H.01

Table 3: Greenhouse gas emissions (MMT CO_2e) from the electric utility sector, excluding out-of-state emissions

Sector	Emissions in 2005	Emissions in 2020	Net change, 2005-2020	Percent change, 2005-2020	Percent of total emissions in 2020
Electric utility – in-state generation	38.9	19.9	-19.1	-49%	16%

Figure 2 shows greenhouse gas emissions trends over time by sector from 2005-2020.

Figure 2: Greenhouse gas emissions (MMT CO_2e) by sector, 2005-2020



A comparison of the Minnesota greenhouse gas inventory and the EPA Inventory of U.S. Greenhouse Gas Emissions by State for Minnesota is included in Appendix B.

Approach to developing the PCAP

The state of Minnesota laid significant groundwork for climate action planning with Minnesota's Climate Action Framework, which served as a foundation for the PCAP. The framework was shaped by input from more than 3,000 Minnesotan's voices, 11 Tribal Nations that share Minnesota's geography, the Governor's Advisory Council on Climate Change, and the Climate Change Subcabinet. Opportunities for participation included:

- Public input via EngagementHQ, an online engagement platform where participants could read the draft framework materials, pose questions, and complete surveys to share their feedback
- Written comments submitted via email

The Climate Change Subcabinet and the Governor's Advisory Council on Climate Change jointly convened stakeholder workgroups organized around each of the chapters of the draft framework.

PCAP engagement audiences and methods

For the PCAP, the CPRG team continued coordinating with Tribal Nations and engaging municipalities, state agencies, interested organizations, and individuals to inform greenhouse gas emissions reduction measures, community benefits, and workforce elements. Engagement and coordination actions and approaches included:

- **Interagency teams:** The CPRG team convened an interagency project team to help identify priority greenhouse gas reduction measures in multiple sectors. Additionally, the team worked closely with the Interagency Climate Steering Team, Senior Leaders Coordinating Team, Tribal Coordination Team, and Climate Change Subcabinet.
- **Engagement HQ online engagement platform and GovDelivery email list:** The CPRG team established an Engagement HQ platform, email list of 500+ representatives from local governments, Tribes, and other interested parties, and other methods for communicating with interested parties about the project.
- **Webinars:** The CPRG team held 9 public webinars from August 2023 to February 2024 to spread the word about CPRG, help ensure eligible entities were aware of their eligibility, identify priority actions from community members and eligible entities, and publicly share drafts, answer questions, and seek feedback on work products.
- **Project idea solicitation:** The CPRG team solicited climate mitigation project ideas to inform the PCAP, accepting ideas through the Engagement HQ site, email, and an online form.
- **Tribal-state government-to-government coordination:** The CPRG team offered government-to-government coordination with federally recognized Tribes and hired a CPRG Tribal-State Coordinator to coordinate with Tribal Nations. This coordinator, along with the Tribal liaisons from agencies involved in CPRG met one-on-one and in groups with staff and leaders from Tribal Nations. The CPRG team also presented at weekly calls between the Minnesota Governor's Office and Tribal leadership. The CPRG team attended a government-to-government forum with Tribal leaders to present about the CPRG opportunity, discuss Tribal climate action priorities, and explore ways to share information and work together.
- **MPCA Environmental Justice Advisory Group:** The CPRG team convened meetings with the group's climate subcommittee for feedback on processes, measures, and LIDAC benefits analysis. Membership consists of a diverse group of people from various parts of the state with a variety of backgrounds and skills. The group advises MPCA on implementing the agency's environmental justice framework, provides feedback on its effectiveness, and offers suggestions for future improvements. These efforts ensured the CPRG team was aligning with the environmental justice policies delineated by the Justice40 Initiative.
- **Community-based organization meetings:** The CPRG team met with community-based organizations serving LIDACs to build relationships, share information on the state's PCAP process, and solicit feedback on the measures and processes.
- **MDH Health Equity staff:** The CPRG team met with Health Equity Network Coordinators and Healthy Equity Strategists from the Minnesota Department of Health to review proposed measures, analyze benefits and disbenefits, and make recommendations to improve benefits for LIDACs. The Minnesota Health Equity Networks collaborate to connect, strengthen, and amplify health equity efforts and community issues using a regional and relational

approach. The coordinators bring experience, knowledge, and relationships with local public health, Tribal public health, and community organizations to address long-standing health equity issues.

- **Coordination with other CPRG planning grant recipients:** MPCA communicated with the Metropolitan Council, Mille Lacs Band of Ojibwe, Midwest Tribal Energy Resources Association, and Shakopee Mdewakanton through the PCAP development process to share data and information, ensure PCAP coverage of off-reservation lands, and discuss collaboration.
- **Past engagement efforts and findings:** The CPRG team identified findings and outcomes from past community engagement efforts of relevant programs and initiatives led by other state agencies and local governmental units.
- **No wrong door – open, transparent, and frequent communication:** The CPRG team upheld a "no wrong door" approach and transparency in all engagement efforts. The CPRG team accepted stakeholder input through all means, including one-on-one meetings, emails, phone calls, public webinars, surveys, and virtual forums on the Engagement HQ site. The CPRG team publicly presented updates and posted outlines, drafts, presentation slides, and recorded webinars on the Engagement HQ site throughout the development of the PCAP measures and solicited feedback from a wide range of stakeholders. The team adhered to plain language principles to provide concise, understandable information to the public.

PCAP development process

At the forefront of the development process, the CPRG team applied central principles of the Justice40 Initiative to engage stakeholders and community involvement in order to address the intersectionality of underinvestment, environmental justice, and climate change on disproportionately impacted communities. MPCA offered a series of public webinars and facilitated coordination among state agencies, Tribal Nations, and stakeholders throughout the PCAP development process to develop and review priorities and proposed project ideas.

Summary of the PCAP development process:

- Climate Change Subcabinet goal teams identified greenhouse gas emission reduction measures in the Climate Action Framework and engaged sector stakeholders to indicate high-priority action categories. MPCA released these categories in a Draft Concepts document and solicited public feedback in October through an online engagement platform, in-person meetings with community groups, virtual meetings with state agencies, local governments, and interested individuals and organizations; as well as discussions with Tribal Nations.
- MPCA met with members of its Environmental Justice Advisory Group Climate Change Subcommittee at key points to collect feedback on the state's engagement and decision-making process and gather insights regarding potential measures and projects aimed at greenhouse gas emissions reductions, highlighting opportunities, gaps and concerns.
- MPCA opened a public survey to gather more specific project ideas within the priority categories. This survey garnered over 350 submissions from local governments, community-based organizations, state agencies, academic institutions, businesses, and interested individuals, spanning from general ideas to detailed project proposals. These proposed projects, as well as a coordination process with the 11 Tribal Nations that share Minnesota's geography, helped inform the measures that are now integrated into the PCAP.
- Using input from senior leaders at Climate Change Subcabinet agencies, Tribal Nations, and municipalities, MPCA narrowed the project list to develop draft PCAP measures that would be

implementable in the near-term, offered opportunities for greenhouse gas emissions reduction, and were not well covered by other funding opportunities. MPCA released a draft in early January for public comment.

- MPCA gathered over 100 comments on the draft PCAP through an online form, which included requests for adjustments to PCAP measures.

MPCA refined the PCAP using public input and strategic filtering to develop measures and analyses that reflect the opportunities and priorities of the state.

Ongoing engagement

Minnesota's climate work is grounded in engagement and equity. As part of this larger effort, the CPRG team will continue to consistently include diverse linguistic, cultural, institutional, geographic, and other perspectives throughout the CPRG program. In addition to the methods and approaches described above, the CPRG team and the state's interagency climate teams more broadly are committed to ongoing and meaningful engagement with Tribal Nations, the MPCA Environmental Justice Advisory Group, MDH Health Equity staff, municipalities, and interested individuals and organizations.

As part of this ongoing commitment, the CPRG team will work to engage diverse linguistic, cultural, institutional, geographic, and other perspectives during the development of the Comprehensive Climate Action Plan, with a particular focus on engaging LIDACs. The voices of diverse Minnesotans will be fundamental to climate planning and implementation as the state continues to develop climate projects, programs, and policies as part of CPRG and beyond. Any project or program funded by CPRG implementation or planning funding will include meaningful engagement to help shape the development of those projects or programs. The MPCA is committed to providing accessible content and engaging LIDACs and others on specific projects and programs relevant to their communities to foster collaboration, incorporate community driven priorities, and track program benefits and disbenefits.

Greenhouse gas reduction measures

Minnesota has ten priority measures for greenhouse gas reduction within four goal areas of the Climate Action Framework:

1. Clean transportation
   - 1.1. Accelerate the transition to low- and no-carbon fuels in vehicles and equipment
   - 1.2. Increase availability and adoption of clean travel options
2. Climate-smart natural and working lands
   - 2.1. Manage forests, grasslands, and wetlands for increased carbon sequestration and storage
   - 2.2. Accelerate soil health and nitrogen, livestock, and manure management practices that reduce greenhouse gas emissions and enhance carbon storage
   - 2.3. Invest in climate-smart local economies and emerging agricultural and forest technologies and products
3. Clean energy and efficient buildings
   - 3.1. Reduce greenhouse gas emissions from residential buildings by promoting energy efficiency, renewable energy, electrification, and lower-carbon design, materials, and fuels
   - 3.2. Reduce greenhouse gas emissions from commercial and public buildings by promoting energy efficiency, renewable energy, electrification, and lower-carbon design, materials, and fuels
4. Clean economy
   - 4.1. Increase industrial efficiency, transition to cleaner energy sources, and reduce process emissions; switch to climate-friendly refrigerants in commercial and industrial settings
   - 4.2. Develop cleaner fuel stocks and supporting infrastructure
   - 4.3. Promote waste prevention, reduction, and recycling

1. Clean transportation

1.1. Accelerate the transition to low- and no-carbon fuels in vehicles and equipment

Description

Increase adoption of light-duty electric vehicles and transition medium-duty, heavy-duty, and nonroad vehicles and equipment from diesel and gas to electricity or low-carbon fuels, with a focus on reducing co-pollutants in LIDACs.

Actions include:

- 1.1.1. Electrify light-duty vehicles and equipment, including sedans, light-duty trucks, maintenance vehicles, outdoor recreation-related vehicles, smaller machines, and groundskeeping equipment. Replace local, short-trip vehicles with lower-carbon alternatives, such as electric cargo bikes with or without trailers. Install supporting charging infrastructure. Provide planning, contracting, financial, technical, and workforce development assistance to facilitate this transition.

1.1.2. Improve equitable access to electric vehicle charging infrastructure by installing charging stations at multifamily housing sites, providing public chargers, and assisting low- and moderate-income households to charge vehicles at home. Focus on charging infrastructure and workforce development that would benefit LIDACs.

1.1.3. Transition fossil-fueled medium-duty, heavy-duty, and nonroad vehicles and engines away from fossil fuels toward low- and no-carbon-fueled alternatives, including but not limited to electricity, renewable natural gas, green hydrogen, green ammonia, and advanced biofuels. Vehicles and equipment include, but are not limited to, transit and school buses, heavy-duty and medium-duty trucks, terminal tractors, construction equipment, agricultural equipment, locomotives, ground and maritime freight equipment, landscaping and maintenance equipment, and generators. Plan and install supportive charging and fueling infrastructure at individual facilities to support fleet transition. Planning will involve workforce development for electric vehicle charging installation.

1.1.4. Plan and expand public charging infrastructure. Support regional coordination and workforce development for planning and building charging infrastructure, especially for medium- and heavy-duty electric vehicles.

Implementation

The implementing agency may provide technical and planning assistance and offer incentives such as rebates and grants to encourage the purchase of vehicles and equipment and the installation of charging and fueling infrastructure. Implementing agencies may use CPRG funding to develop plans and procure vehicles, equipment, and associated charging infrastructure in their fleets. The implementing agency would engage communities, especially LIDACs, Tribal Nations, and relevant stakeholders in the development of related programs, policies, and projects.

Implementing agency. Any of the following implementing agencies could use this measure:

- State agencies, including but not limited to MnDOT, MPCA, DNR, MDA, DEED and Department of Administration
- Tribal Nations
- Municipalities including, but not limited to, cities, counties, regional development organizations, and port authorities

Review of authority to implement. Implementing agencies have the authority necessary to implement the measure; however, approvals may be required from planning commissions and elected leadership for specific projects.

Implementation schedule and milestones. For existing programs, implementing agencies could build on relationships and networks, following established program cycles. For incentive-based actions such as grants, a tentative schedule could be to develop requests for proposals by the end of 2024, accept applications in early 2025, and begin implementing projects in late 2025. The grant cycle may be repeated, as funding allows.

For collaborative buildout of regional charging infrastructure, a planning phase would be necessary in 2025, followed by implementation of projects in 2026.

Geographic location. Statewide, with additional focus on vehicles and equipment that operate in LIDACs, especially where criteria and hazardous air pollutants are high, and on charging infrastructure that serves LIDACs. Fobr medium- and heavy-duty vehicles, additional focus on key regional corridors.

Metrics for tracking progress. Metrics may include number of registered electric vehicles, regranting projects funded and impacts, carbon intensity of transportation fuels, greenhouse gas emissions from transportation, and air quality.

The Minnesota 2022 Statewide Multimodal Transportation Plan establishes a goal to decrease greenhouse gas emissions from the transportation sector by 30% by 2025, 50% by 2030, 65% by 2035, and 80% by 2040, from a 2005 baseline.[28]

Intersection with other funding availability

Complementary funding sources include:

- Volkswagen settlement grants. Minnesota is using these funds to fund vehicle replacements and invest in electric vehicle charging stations.
- Federal and state-funded electric vehicle purchase rebates
- EPA's Clean School Bus program
- State electric school bus grants
- State grants to auto dealers to offset costs incurred to certify the dealer to sell electric vehicles
- Various electric utility programs
- Other local and Tribal funding sources may be available
- Complementary efforts funded by:
    - Diesel Emissions Reduction Act
    - Federal Highway Administration Congestion Mitigation and Air Quality Improvement Program
    - Carbon Reduction Program
    - Inflation Reduction Act Clean Ports
    - Federal Highway Administration Charging and Fueling Infrastructure Discretionary Grant
    - Inflation Reduction Act Alternative Fuel Vehicle Refueling Property Credit Direct Pay
    - Federal Highway Administration National Electric Vehicle Infrastructure program

Estimate of greenhouse gas emissions reductions

Near-term cumulative greenhouse gas emissions reductions (2025 to 2030): 3.5 MMT CO_2e

Long-term cumulative greenhouse gas emissions reductions (2025 to 2050): 76.7 MMT CO_2e

Methods and assumptions: Estimation methods are discussed in Appendix C.

LIDAC benefits analysis

Impacted LIDACs and existing climate risks, impacts, and vulnerabilities:

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[10] Minn. Department of Transportation. 2022. Statewide Multimodal Transportation Plan https://minnesotago.org/final-plans/smtp-final-plan-2022

- LIDACs in urban areas tend to have to higher traffic proximity, leading to greater exposures to traffic crashes, air pollution and noise pollution, and higher temperature levels, which increases risks of premature mortality and morbidity.[29,30,31]
- LIDACs are more likely to have higher rates of zero-car households, lower access to jobs, goods, services, greenspace, and higher transportation cost burden.[32]
- LIDACs experience barriers to electric vehicle uptake due to high upfront costs, technological barriers, and low access to charging options (e.g., street parking).

Estimated potential benefits and disbenefits of greenhouse gas emission reduction measures to LIDACs:

- Increased vehicle electrification in LIDACs would reduce localized air pollution and traffic-generated noise, supporting multiple health benefits including improvements in mental and cognitive development, reduction in respiratory and cardiovascular health risks, decreased asthma rates, and fewer hospital admissions.
- Additional school bus electrification co-benefits include gains in academic performance, decreased energy costs, and quieter, more comfortable ride.[33]

1.2 Increase availability and adoption of clean travel options

Description

Enhance the availability and adoption of clean travel options such as bicycling, walking, transit, and car-sharing as alternatives to single-occupancy vehicle use to promote health, provide equitable access to clean travel options, reduce vehicle miles traveled, and reduce noise, air, and water pollution.

Actions include:

1.2.1. Increase safety and accessibility for walking, biking, and rolling in communities, by deploying community-designed quick-build projects such as curb extensions to reduce street crossing distance or paths physically separated from vehicle traffic. Acquire land and/or rights of way for infrastructure.

1.2.2. Facilitate the adoption of e-bikes and e-cargo bikes through purchase incentives; mobility hubs; e-bike, scooter, and e-cargo bike-sharing systems; e-bike infrastructure (such as solar-powered shelters and separated paths); and charging networks. Increase adoption in LIDACs through navigator programs, convenient multimodal planning and payment applications, secure parking and charging facilities for e-bikes and e-cargo bikes, and strategic placement of bike-share sites, such as at multifamily residences.

1.2.3. Facilitate equitable access to transit and electric vehicle car-share programs in the Minneapolis-St. Paul-Bloomington metropolitan statistical area and in Greater Minnesota, including microtransit, on-demand transit models, and strategic car-share locations to serve LIDACs such as multifamily housing sites.

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[29] Roll and McNeil, "Race and Income Disparities in Pedestrian Injuries."
[30] Khreis et al., "The Health Impacts of Traffic-Related Exposures in Urban Areas."
[31] Pratt et al., "Traffic, Air Pollution, Minority and Socio-Economic Status."
[32] Fleming, "Social Equity Considerations in the New Age of Transportation: Electric, Automated, and Shared Mobility."
[33] Trajano, "It's Electric: Better Health and Academics Through Zero-Emission School Buses."

1.2.4. Establish electrified public, micro-, and/or on-demand transit on Tribal reservations.

1.2.5. Increase adoption through navigator programs and other efforts that assist people with low technology literacy.

1.2.6. Increase commercial transportation efficiency to reduce vehicle miles traveled via community waste hauler coordination.

Implementation

The implementing agency may provide technical and planning assistance; design and implement infrastructure projects within its jurisdiction; offer purchase incentives for e-bikes, e-cargo bikes, and scooters; organize transit, bike- and car-sharing, and navigator programs or contract for these services; and enact agreements with community waste haulers to coordinate routes that reduce vehicle miles traveled. The implementing agency may develop and fund programs to directly enact aspects of this measure. The implementing agency would engage communities, especially LIDACs, Tribal Nations, and relevant stakeholders in the development of related programs, policies, and projects.

Implementing agency. This measure could be utilized by any of the following implementing agencies:

- Tribal Nations
- State agencies, including MnDOT, MPCA, and MDH
- Municipalities including, but not limited to, cities, counties, regional development organizations, and port authorities

Review of authority to implement. Implementing agencies have the authority necessary to implement the measure; however, approvals may be required from planning commissions and elected leadership for specific projects.

Implementation schedule and milestones. Each action would require different implementation schedules and milestones; however, a general schedule may include a planning and public engagement phase in 2024 through 2025, followed by local approvals in the first half of 2026, and direct implementation by implementing agencies with the appropriate authority in mid-2026. Certain actions, such as navigator programs and quick-build projects, may follow an accelerated timeline.

Geographic location. Statewide, with additional focus on LIDACs to reduce co-pollutant emissions and provide greater access to walkable communities, e-bike programs, and electric vehicle car-sharing.

Metrics for tracking progress. Metrics include reduction in vehicle miles traveled, congestion mitigation, number of services available or projects funded, and usage statistics.

The Minnesota 2022 Statewide Multimodal Transportation Plan establishes a goal to decrease greenhouse gas emissions from the transportation sector by 30% by 2025, 50% by 2030, 65% by 2035, and 80% by 2040, from a 2005 baseline, and a goal for zero-emission vehicle registrations, increased job accessibility by bicycle and transit, and improved transit performance and service.[34]

Intersection with other funding availability

Complementary funding includes:

[34] Minn. Dept. of Transportation. 2022. Statewide Multimodal Transportation Plan https://minnesotago.org/final-plans/smtp-final-plan-2022

- State subsidy for e-bike purchase passed by the legislature in 2023, charging stations, and statewide health improvement initiatives
- Mix of state, local, private, and philanthropic funds for electric vehicle car-share programs
- MnDOT's Active Transportation Program
- MnDOT's Safe Routes to School Program
- Congestion Mitigation and Air Quality Improvement Program
- Federal Highway Administration (FHWA) formula Carbon Reduction Program
- Federal Transit Administration (FTA) Transit Operating Programs for rural and small urban systems
- Other local and Tribal funding sources may be available

Estimate of greenhouse gas emissions reductions

Near-term cumulative greenhouse gas emissions reductions (2025 to 2030): 3.5 MMT CO_2e

Long-term cumulative greenhouse gas emissions reductions (2025 to 2050): 16.1 MMT CO_2e

Methods and assumptions: Estimation methods are discussed in Appendix C.

LIDAC benefits analysis

Impacted LIDACs and existing climate risks, impacts, and vulnerabilities:

- LIDACs in urban areas tend to have to higher traffic proximity, leading to greater exposures to traffic crashes, air pollution and noise pollution, and higher temperature levels.[35,36,37]
- LIDACs are more likely to have higher rates of zero-car households, lower access to jobs, goods, services, greenspace, and higher transportation cost burden, which increases risks of financial insecurity, housing instability, and stress.[38]
- LIDACs experience barriers to electric vehicle uptake due to high upfront costs and low access to charging options (e.g., street parking).

Estimated potential benefits and disbenefits of greenhouse gas emission reduction measures to LIDACs:

- Benefits of electric vehicle car-sharing include decreased fuel and car maintenance costs, reduced transportation cost burden, improved transportation reliability and mobility.[39] As noted above, increased use of electric vehicles in LIDACs can result in physical and mental health benefits from improved air quality and reduced noise pollution.
- Benefits of improved walkability and increased access to e-bicycles include improved physical and mental health due from reductions in vehicle miles traveled, noise pollution, and air pollution.
- Benefits also include improved mobility and access to goods, services, and jobs, and lower transportation costs, which are all predictors of health outcomes.

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[35] Roll and McNeil, "Race and Income Disparities in Pedestrian Injuries."
[36] Khreis et al., "The Health Impacts of Traffic-Related Exposures in Urban Areas."
[37] Pratt et al., "Traffic, Air Pollution, Minority and Socio-Economic Status."
[38] Fleming, "Social Equity Considerations in the New Age of Transportation: Electric, Automated, and Shared Mobility."
[39] Johnson, "Feasibility Report: Electric Vehicle Car-Sharing Program for Use by Low and Mid Income Communities in North-Central Minnesota, USA."

2. Climate-smart natural and working lands

2.1. Manage forests, grasslands, and wetlands for increased carbon sequestration and storage

Description

Protect and restore peatlands, increase grassland habitat and revegetate corridors, and manage urban and community forests and forestlands on public and private lands to promote carbon sequestration, biodiversity, energy conservation, cooling, water quality, resilience to catastrophic wildfire and drought, and other benefits.

Actions include:

2.1.1. Restore peatlands impacted by legacy drainage and other hydrologic disturbances on private, public (including tax-forfeit or county-held lands and School Trust lands), and Tribal Nation lands aimed at acquiring, restoring, and enhancing peatlands. Maintain irrecoverable carbon stocks in peatlands through enhanced protective measures on public lands; deployment of conservation easements and other tools to reduce the risk of habitat fragmentation on private lands; and wider landscape level measures to create buffer zones to reduce threats to peatlands from altered hydrology and other upstream impacts.

2.1.2. Increase diverse grassland habitat by identifying and revegetating habitat corridors within solar sites, utility corridors, road rights-of way, waterways, and neighborhoods.

2.1.3. Manage urban and community forests, forestlands, and other plantings such as living snow fences for carbon sequestration through tree production and planting, maintenance of tree canopy, and protection of heritage trees. Focus on efforts to manage tree canopy in LIDACs for benefits such as energy savings, risk reduction, air pollution, and mitigation of urban heat island effect.

Implementation

The implementing agency may provide technical and planning assistance and offer financial incentives, such as tax incentives, cost-share, grants, and other forms of payment to manage, protect, and restore land to landowners and public entities. Alternatively, the implementing agency may develop and fund programs to directly enact aspects of this measure. The implementing agency would engage communities, especially LIDACs, Tribal Nations, and relevant stakeholders in the development of related programs, policies, and projects.

Implementing agency. This measure could be utilized by any of the following implementing agencies:

- Municipalities including, but not limited to, cities, counties, regional development organizations, and soil and water conservation districts
- Tribal Nations
- State agencies, including but not limited to the DNR, BWSR, MDA, MPCA, MnDOT, Department of Commerce, Public Utilities Commission, and MDH

Review of authority to implement. Implementing agencies have existing authority necessary to implement the measure on lands they manage; however, some actions may require land acquisition, management agreements, and easements. Additionally, approvals from planning commissions and elected leadership may be necessary for specific projects.

Implementation schedule and milestones. For existing programs, implementing agencies could build on relationships and networks, following established program cycles. For peatland and grassland projects, a possible implementation schedule could be to conduct planning, public outreach, and partner engagement in late 2024 and early 2025, hire contractors in mid-2025, and implement projects beginning in mid- to late-2025.

For forestry projects, implementing agencies could follow a similar schedule or accelerate implementation through local forestry initiatives.

Grant rounds could be managed on a regular cycle, which creates opportunities for continuous improvement and also allows new organizations to pursue the funding opportunity.

Geographic location. Statewide, with some additional focus on utility corridors, school trust lands, public lands, easements, regions where peat soils predominate, transition zones between pre-settlement prairie regions and forested regions, as well as areas where forest and peatland conversion to agriculture and pasture is prevalent.

Metrics for tracking progress. Metrics include acres restored, acres protected, and avoided conversion.

Minnesota's Climate Action Framework established a goal to increase by 25% the amount of carbon sequestered and stored annually in natural and working lands, compared to 2014-2018 average levels by 2035.[40]

Intersection with other funding availability

Complementary funding sources include:

- State funding for peatland easement acquisition and restoration ($9M for easements and $1.5M for inventory improvements and restoration awarded by 2023 Legislature), Habitat Friendly Utilities program, ReLeaf community forestry program, shade tree replacement, MDH Statewide Health Improvement Partnership (SHIP) initiatives, and canopy monitoring
- Complementary federal funding from the U.S. Department of Agriculture (USDA) and U.S. Department of Interior
- Other local and Tribal funding sources may be available

Estimate of greenhouse gas emissions reductions

Near-term cumulative greenhouse gas emissions reductions (2025 to 2030): 3.57 MMT CO_2e

Long-term cumulative greenhouse gas emissions reductions (2025 to 2050): 33.70 MMT CO_2e

Methods and assumptions: Estimation methods are discussed in Appendix C.

The greenhouse gas impacts of the specified actions are estimated individually and listed in Table 4.

[40] Minn. Climate Action Framework. 2022. https://climate.state.mn.us/minnesotas-climate-action-framework

Table 4. Potential greenhouse gas reductions that could result from large-scale implementation of various climate-smart land use changes and improved management practices

Action	Potential reductions by 2030 (MMT CO_2e)	Potential reductions by 2050 (MMT CO_2e)
Rewet cropped peatlands	0.302	6.237
Rewet pastured and partially drained peatlands	0.498	10.28
Establish high-diversity grasslands in road and utility rights of way	0.067	1.658
Establish high-diversity grasslands adjacent to waterways	0.008	0.207
Establish high-diversity grassland habitat in place of lawns in neighborhoods	0.021	0.523
Better manage existing forests	1.229	6.147
Increase and better manage urban and community forests	0.081	0.487
Increase trees on the landscape via windbreaks, shelter belts, living snow fences, etc.	1.360	8.160

LIDAC benefits analysis

Impacted LIDACs and existing climate risks, impacts, and vulnerabilities:

Due to racial residential segregation through explicit codification in laws and institutional practices, and historic disinvestment in segregated areas, urban LIDACs tend to have lower access to greenspace, and less tree coverage.[41,42,43] Inequities in greenspace and tree coverage exacerbate economic and health disparities, and amplify heat exposure. Amplified heat exposure due to urban heat islands can result in pronounced public health consequences, including heat stroke, dehydration, exacerbation of existing medical conditions, and increased mortality.[44,45]

In addition to heat exposure, inequitable greenspace access and tree coverage can worsen disparities in utility costs, violence, air quality, physical activity, and community connectivity, and many other social determinants of health.[46,47]

For the Tribal Nations that share Minnesota's geography, natural resources are of deep cultural and subsistence importance. As part of the treaties that ceded most of the land that is now Minnesota, the Anishinaabe and Dakota people retained rights to hunt, fish, and harvest from ceded lands and waters. The ability to exercise those treaty rights depends on clean water, air, and healthy ecosystems. Climate

[41] Kephart, "How Racial Residential Segregation Structures Access and Exposure to Greenness and Green Space."
[42] McDonald et al., "The Tree Cover and Temperature Disparity in US Urbanized Areas."
[43] "New Tool Helps Cities Preserve and Enhance Tree Canopy."
[44] Chakraborty et al., "Disproportionately Higher Exposure to Urban Heat in Lower-Income Neighborhoods."
[45] Sinha et al., "Modeling Lives Saved from Extreme Heat by Urban Tree Cover☆."
[46] Burley, "Green Infrastructure and Violence."
[47] Turner-Skoff and Cavender, "The Benefits of Trees for Livable and Sustainable Communities."

change disruption to these systems pose detrimental threats to the culture and lifeways of the Anishinaabe and Dakota people.[48]

Estimated potential benefits and disbenefits of greenhouse gas emission reduction measures to LIDACs:

Increasing greenspace and tree canopy coverage in LIDACs can have wide ranging benefits including reducing stress, improving mental health, increasing physical activity, reducing obesity rates, reducing asthma rates, improving social cohesion, reducing traffic speeds, reducing household expenditures on heating and cooling, reducing extreme heat exposure, and reducing neighborhood crime. [49]

Engaging communities in planning and implementation can increase the likelihood of long-term project success, empower communities and support career building opportunities and social cohesion.[50] Across the northern half of Minnesota, there is substantial overlap between large areas of peatland and LIDACs, including Tribal Nations and the 1854 Ceded Territory.[51] Peatland restoration, in partnership with Tribal communities, can advance Tribal communities' goals to increase carbon storage, reduce mercury methylation, and improve water quality. Data and research findings from this measure could be used by Tribal Nations for peatland management efforts on Tribal lands. Peatland restoration will mitigate flooding risks, and better protect groundwater and surface water quality.[52]

Tribal government staff have expressed interest and support for projects that protect and enhance carbon storage, reduce mercury methylation, and improve water quality; restoring peatlands advances those goals. Restoring peatlands in partnership with Tribal communities may help protect and restore culturally significant species. Protecting and restoring culturally significant species can have wide ranging benefits including improved cultural cohesion, improved financial security, and improved mental and physical health through preservation of subsistence harvesting traditions, spiritual relationships, ceremonies, language, and stories.[53,54]

Other potential benefits for LIDACs and Tribal communities include water security, preventing downstream flooding, fire risk reduction, decreased fish advisories, *manoomin* (wild rice) protection and restoration, relationship building with landowners and Tribal communities, and ecotourism.

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[48] Stults et al., "Climate Change Vulnerability Assessment and Adaptation Plan: 1854 Ceded Territory Including the Bois Forte, Fond Du Lac, and Grand Portage Reservations."
[49] Ulmer et al., "Multiple Health Benefits of Urban Tree Canopy."
[50] Ilieva et al., "The Socio-Cultural Benefits of Urban Agriculture," April 23, 2022.
[51] Histosols mapping tool and EJScreen mapping tool
[52] Workplan provided by Minnesota Department of Natural Resources (DNR) & Minnesota Board of Water and Soil Resources (BWSR)
[53] GLIFWC Climate Change Team, "Aanji-Bimaadiziimagak o'ow Aki."
[54] "Expanding the Narrative of Tribal Health: The Effects of Wild Rice Water Quality Rule Changes on Tribal Health."

2.2. Accelerate soil health and nitrogen, livestock, and manure management practices that reduce greenhouse gas emissions and enhance carbon storage

Description

Invest in climate-smart practices for soil health, manage nutrients to increase nitrogen use efficiency and reduce nitrous oxide emissions, and implement livestock and manure management practices that minimize nitrogen runoff and methane production.

Actions include:

2.2.1. Expand climate-smart practices for soil health, including cover crops, conservation tillage, agroforestry, prescribed grazing, silvopasture, transitioning marginal land to perennials, perennial crops, winter annual crops, and continuous living cover.

2.2.2. Support market development, specialized equipment needs, and other infrastructure needed for wide-scale adoption of climate-smart practices.

2.2.3. Implement nutrient management practices such as nitrification inhibitors, split nitrogen applications, and optimizing timing of fertilizer application, considering specific regional contexts for application timing and rates as appropriate.

2.2.4. Implement livestock management practices such grazing systems and feed management to reduce greenhouse gas emissions.

2.2.5. Reduce methane emissions through improved manure storage and handling. Specific practices include waste separation, waste storage facilities, as well as composting and anaerobic digestion facilities, both of which could accept diverse feedstocks.

2.2.6. Provide planning, workforce development, technical, and financial assistance, as necessary.

2.2.7. Develop a carbon intensity score registry and incentive program to accelerate adoption of climate-smart agricultural practices. The registry will be facilitated by a third-party entity and may be coordinated with other Midwestern states. A carbon intensity score registry links the carbon sequestration and emissions reduction benefits of sustainable and regenerative agricultural practices to the agricultural product, and they remain linked throughout the supply chain. The registry and incentive program achieves greenhouse gas reductions through market mechanisms that reward agricultural producers that lower their carbon intensity by using sustainable and regenerative agricultural practices.

2.2.8. Assist agricultural producers to evaluate their carbon intensity to allow them to get credit for implementing climate-smart agricultural practices.

Implementation

The implementing agency may offer incentives, such as grants, cost-share, tax incentives, and payments, for implementation of climate-smart agricultural practices. The agency may offer incentives for market development and offer technical assistance programs with planning, implementation, and evaluation. The implementing agency would engage communities, especially LIDACs, Tribal Nations, and relevant stakeholders in the development of related programs, policies, and projects.

Implementing agency. This measure could be utilized by any of the following implementing agencies:

- State agencies including MDA, MPCA, BWSR, and DEED
- Tribal Nations
- Municipalities including, but not limited to cities, counties, regional development organizations, and soil and water conservation districts

Review of authority to implement. Implementing agencies have existing authority necessary to implement the measure. Some projects, such as anaerobic digesters, may require environmental review, permitting, and other approvals.

Implementation schedule and milestones. For climate-smart agricultural practices, implementing agencies could expand existing programs and build on relationships and networks to expand adoption, following established program cycles. For new programs, a planning and engagement phase in late 2024 and early 2025 would be necessary to develop requests for proposals. The implementing agency could publish a request for proposals and accept applications during 2025 and funded projects could begin implementation beginning in late 2025 or 2026. Grant rounds could be managed on a regular cycle, which creates opportunities for continuous improvement and also allows new organizations to pursue the funding opportunity. For projects that require design and permitting (e.g., manure storage facilities), study, or development of a new framework, additional time may be needed before projects begin.

Geographic location. Statewide, with additional focus on food and farm systems, agricultural regions, areas of concentrated livestock operations with high nitrate levels in the ground water, drinking water supply management areas, areas of groundwater depletion, wastewater treatment facilities, hog or dairy farms, manure or food waste digestors, meat packaging facilities, and creameries.

Metrics for tracking progress. Metrics include greenhouse gas emissions reductions, carbon sequestration, and acres and projects enrolled.

Minnesota's Climate Action Framework[55] established two relevant goals:

- Reduce annual greenhouse gas emissions in the working lands sector by 25% from 2018 levels by 2035.
- Increase by 25% the amount of carbon sequestered and stored annually in natural and working lands, compared to 2014-2018 average levels by 2035.

Intersection with other funding availability

Complementary funding sources include:

- BWSR Soil Health Staffing and Delivery Grants
- BWSR Watershed-Based Implementation Funding
- MDA Continuous Living Cover Grant
- MDA Soil Health Equipment Grants
- MDA Minnesota Agricultural Water Quality Certification Program
- MDA Agricultural Growth, Research, and Innovation (AGRI) Livestock Investment Grant
- MDA Agricultural Growth, Research, and Innovation (AGRI) Value-Added Grant Program

[55] Minn. Climate Action Framework. 2022. https://climate.state.mn.us/minnesotas-climate-action-framework

- MDA Down Payment Assistance Grant
- MDA Emerging Farmer Technical Assistance Grant
- Minnesota Clean Water, Land and Legacy Amendment Funds
- Complementary federal funds including:
  - USDA NRCS Regional Conservation Partnership Program funds
  - USDA NRCS Environmental Quality Incentives Program (EQIP)
  - USDA Conservation Reserve Program
  - Inflation Reduction Act Investment Tax Credits and Production Tax Credits
  - Other federal conservation and stewardship programs
  - Other local and Tribal funding sources may be available

Estimate of greenhouse gas emissions reductions

Near-term cumulative greenhouse gas emissions reductions (2025 to 2030): 11.01 MMT AR4 CO_2e

Long-term cumulative greenhouse gas emissions reductions (2025 to 2050): 71.80 MMT AR4 CO_2e

The greenhouse gas impacts of the specified actions are estimated individually and listed in Table 5.

Table 5. Potential cumulative greenhouse gas reductions that could result from large-scale implementation of various climate-smart agricultural practices

Action	Potential reductions by 2030 (MMT CO_2e)	Potential reductions by 2050 (MMT CO_2e)
Agroforestry	0.275	1.651
Prescribed grazing	0.800	4.800
Silvopasture	0.437	2.622
Conservation tillage (full till to no-till)	0.648	3.241
Conservation tillage (full till to reduced till)	0.318	1.592
Perennial crops	0.939	4.695
Cover crops/winter annual crops	1.212	6.058
Nitrification inhibitors	2.758	13.788
Split nitrogen applications	1.025	5.124
Feed additives for ruminants	0.483	10.143
Composting manure and food scraps	1.013	7.762
Manure roofs and covers	0.306	1.530
Anaerobic digesters	0.800	8.800

Methods and assumptions. To estimate the total emissions reduction potential, we estimated the amount of acreage to which each practice could reasonably be applied by 2030, given the current crop and animal agriculture in the state and the readiness of various technologies and markets. We multiplied each acreage by emission factors from peer-reviewed scientific literature. We determined that 2,000,000 acres each of nitrification inhibitors and split nitrogen application could be implemented; 1,000,000 acres each of winter cover crops, no-till, reduced-till could be implemented; 500,000 acres of perennial crops within a crop rotation could be implemented; 200,000 acres of prescribed grazing could be implemented; and 100,000 acres each of agroforestry and silvopasture could be implemented. Complete estimation methods are discussed in Appendix C.

LIDAC benefits analysis

Impacted LIDACs and existing climate risks, impacts, and vulnerabilities:

Areas of southeastern Minnesota have unsafe concentrations of nitrate in groundwater. State agencies and local partners are working together to address this issue. Nitrate is a particular concern for those who get their drinking water from private wells in eight counties in southeastern Minnesota: Olmsted, Goodhue, Dodge, Wabasha, Fillmore, Mower, Winona, and Houston. These counties include LIDACs and some of the vulnerable townships may overlap with these LIDACs. Mitigation of nitrate contamination is costly and places disproportionate burdens on households that rely on private wells for drinking water. Costs are also higher per capita for small public water systems. Consuming too much nitrate can affect how blood carries oxygen and can cause methemoglobinemia.[56]

There is substantial room for manure applications to be handled better and protect health, especially by avoiding drinking water supply management areas and geologically sensitive recharge areas for private wells.[57]

While nitrate concerns have come to the forefront in southeastern Minnesota, Tribal Nations across the state are also impacted by agricultural practices on surrounding lands, resulting in loss of forest cover, increased nutrient runoff, and excessive groundwater consumption in some areas.

Estimated potential benefits and disbenefits of greenhouse gas emission reduction measures to LIDACs:[58]

If implemented in a way that prioritizes implementation in LIDACs, this measure would increase the likelihood of emerging farmers and low-income farmers benefitting from additional income and accessible technical assistance, as well as receiving grants.

Benefits of implementing soil health and nitrogen, livestock, and manure management practices in and around LIDACs include:

- Improved water quality through a reduction in nutrient runoff, sediment, soil loss, and phosphorous loss, which protects water recreation, fishing, and aquatic habitats.
- Improved soil health through soil structure and organic matter content, which is key for agricultural resiliency. Healthy soils better infiltrate precipitation, increase water-holding capacity, and maintain plant-available water during periods of dryness, which mitigates extreme weather events, and flooding, and protects food security.
- Increasing land access and economic opportunity by supporting emerging and beginning farmers to transition to climate-smart agricultural practices on owned or rented land.

Potential co-benefits of expanding organics management infrastructure such as composting and anaerobic digesters include reduced fossil fuel use, improved soil health, reduced nitrogen runoff, improved water quality, avoidance of the health and environmental harms from landfill leachates contaminating groundwater, and economic opportunities, including building a circular economy, construction job opportunities, and revenue for operators and municipalities.

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[56] Minn. Department of Health, "Nitrate in Drinking Water."
[57] MDH Hydrologist interview
[58] Benefits identified through workplans and discussions with MDA and MDH staff

Potential disbenefits and public concerns regarding anaerobic digesters include the risk of manure spill during transport, odors, and increases in truck traffic due to transport. The context specific design and placement of the anaerobic digester can minimize these disbenefits. For example, siting near manure and food scrap sources minimizes transport distances and spill risk, and replacing uncovered manure lagoons with enclosed facilities can reduce odors, rather than increase them. Anaerobic digester planning and placement should involve community engagement and strategies to avoid potential LIDAC disbenefits.

2.3. Invest in climate-smart local economies and emerging agricultural and forest technologies and products

Description

Build climate-smart local food systems, develop markets for long-lived wood products and waste wood, and produce and use biochar.

Actions include:

2.3.1. Build climate-smart local food systems that reduce greenhouse gas emissions from food production, processing, packaging, transportation, storage, retail, and food preparation. Offer planning, technical, and financial assistance; community engagement and education; and workforce development to support implementation.

2.3.2. Coordinate with Tribal governments and grants to Tribal Nations to implement climate-smart food systems projects that reduce greenhouse gas emissions while advancing indigenous food sovereignty.

2.3.3. Expand funding for projects that buy local food from disadvantaged and emerging farmers, distribute food to underserved communities and provide financial and technical assistance to local food producers.

2.3.4. Develop markets for long-lived wood products to store more carbon, such as construction lumber and furniture. Incentivize beneficial uses for waste wood, such as millwork, mulch, and biochar. Support workforce development planning and resources for new industries.

2.3.5. Promote the production and use of biochar from wood waste and other sources for various environmental and economic benefits, including mitigation of landfill methane, soil health improvement, carbon offset credits, and remediation of soil contamination. Support workforce development planning and resources for this new industry.

Implementation

The implementing agency may provide technical and planning assistance and offer grants and other incentives for resources, market development, and workforce development. Alternatively, the implementing agency may develop and fund programs or projects to directly enact aspects of this measure. The implementing agency would engage communities, especially LIDACs, Tribal Nations, and relevant stakeholders in the development of related programs, policies, and projects.

Implementing agency. This measure could be utilized by any of the following implementing agencies:

- State agencies including DNR, MPCA, MnDOT, MDH, MDA, DEED and Department of Corrections
- Tribal Nations

- Municipalities including, but not limited to, cities, counties, and regional development organizations

Review of authority to implement. Implementing agencies have existing authority necessary to implement the measure. Some projects, such as biochar production facilities, may require environmental review, permitting, or other approval processes.

Implementation schedule and milestones. For existing programs, implementing agencies could build on relationships and networks, following established program cycles. For new programs an implementation schedule could look like: Conduct planning and engagement in late 2024 and early 2025, developing requests for proposals and accepting proposals through mid-2025. Award funds in late 2025 or 2026 and begin implementation in 2026. Grant rounds could be managed on a regular cycle, which creates opportunities for continuous improvement and also allows new organizations to pursue the funding opportunity. Some projects may require additional time for permitting and standards development before implementation.

Biochar industry standards to ensure quality and reliable products for users could be developed to support the expansion of the production and use of biochar. Standards could be developed in late-2024 through early 2025.

Geographic locations. Statewide, with additional focus on LIDACs.

Metrics for tracking progress. Metrics may include greenhouse gas emissions reductions, carbon sequestration, projects enrolled, waste redirected and avoided, food rescued, and methane captured.

Minnesota's Climate Action Framework established a goal to increase by 25% the amount of carbon sequestered and stored annually in natural and working lands, compared to 2014-2018 average levels by 2035.[59] However, actions in this section will reduce emissions accounted for in the agriculture, waste, transportation, and energy sectors.

Intersection with other funding availability

Complementary funding sources include:

- MDA Local Food Purchase Assistance Program
- The Good Acre's Local Emergency Assistance Farmer Fund (LEAFF)
- State funding for woodland owners
- Minnesota Forestry Association Call Before You Cut Program
- Complementary federal funds including:
  - USDA Environmental Quality Incentives Program (EQIP)
  - USDA Conservation Stewardship Program
  - Federal funding for woodland owners
  - Other local and Tribal funding sources may be available

Estimate of greenhouse gas emissions reductions

Near-term cumulative greenhouse gas emissions reductions (2025 to 2030): 4.8 MMT CO_2e

[59] Minn. Climate Action Framework. 2022. https://climate.state.mn.us/minnesotas-climate-action-framework

Long-term cumulative greenhouse gas emissions reductions (2025 to 2050): 66.2 MMT CO_2e

Methods and assumptions. Estimation methods are discussed in Appendix C.

LIDAC benefits analysis

Impacted LIDACs and existing climate risks, impacts, and vulnerabilities:

Food systems impact the affordability, availability, access, quality, stability, cultural acceptability, and healthfulness of the food environments in LIDACs. Strong evidence ties racial and socioeconomic disparities to inequities in food security, diet quality and healthfulness, obesity, and diet-related disease.[60]

Estimated potential benefits and disbenefits of greenhouse gas emission reduction measures to LIDACs:

For build local food systems projects:

- Improved coordination and efficiencies of local and regional food systems can support financial security and economic mobility for small and mid-sized local food producers.
- Building local food systems can improve food security and healthy, culturally acceptable food access in LIDACs, thereby improving overall physical and mental health and reducing diet-related illness and mortality.
- Expansion of community-based agriculture, especially when co-created with LIDACs, can produce wide-ranging community level co-benefits, including engaged and cohesive communities, reduced ethnocentrism, multicultural integration, increased civic engagement, self-determination, strengthened cultural identity, improved mental health, decreased stress, increased physical activity, healthy nutrition knowledge, improved community safety, and increased access to greenspace.[61]

For production and use biochar projects:

Biochar-amended soils enhance crop growth and yield via several mechanisms: expanded plant nutrient and water availability through increased use efficiencies, improved soil quality, and suppression of soil and plant diseases. Reducing the amounts of waste diverted to landfills, and the associated adverse environmental impacts of landfills, tends to bring particular benefits to LIDACS because landfills have been shown to tend to be co-located with LIDACs.[62]

Biochar composition and properties vary considerably with feedstock and pyrolysis conditions. Improper processes and preparation methods could result in harmful components, including environmentally persistent free radicals, dioxins, and per- and polyfluoroalkyl substances (PFAS).[63] Incorporating research and developing guidelines and quality standards will help growers use biochar safely and effectively.[64]

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[60] Neff et al., "Food Systems and Public Health Disparities."
[61] Ilieva et al., "The Socio-Cultural Benefits of Urban Agriculture," April 23, 2022.
[62] Cannon, 2020. "Examining Rural Environmental Injustice: An Analysis of Ruralness, Class, Race, and Gender On the Presence of Landfills Across the United States." Journal of Rural and Community Development, 15(1), 89-114.
[63] Xiang et al., "Potential Hazards of Biochar."
[64] Stakeholder input

3. Clean energy and efficient buildings

3.1. Reduce greenhouse gas emissions from residential buildings by promoting energy efficiency, renewable energy, electrification, and lower-carbon design, materials, and fuels

Description

Accelerate home decarbonization and clean indoor air initiatives through a combination of technologies and strategies by using incentives, design, and navigation support, focusing efforts in LIDACs.

Actions include:

3.1.1. Decarbonize residential buildings through voluntary programs by combining multiple technologies and approaches, including energy efficiency, renewable energy and fuels, refrigerant replacement, and electrification of cooking, heating, clothes drying, and hot water heating. For example, implement service panel upgrades and technologies that improve energy efficiency and reduce emissions such as heat pumps. Include networked geothermal systems, which could include residential and commercial buildings.

3.1.2. Increase access to home decarbonization resources through tiered financial incentives, rebates, pre-weatherization assistance, home energy audits, healthy home assessments, efficiency retrofitting, and workforce training for weatherization and electrification.

3.1.3. Expand energy navigator programs to serve communities across the state. Focus efforts specifically on disadvantaged residents living in manufactured home parks, public housing, rental units, reservations, and affordable multi-family and single-family homes.

3.1.4. Conduct community-scale decarbonization block-by-block to reach the residents that will benefit most from energy savings and improvement of indoor air quality. Promote community involvement in planning for residential decarbonization. Install microgrid technology tailored to local community needs. Install system upgrades, such as transformers, that are necessary to electrify specific LIDAC communities.

3.1.5. Design new buildings using green building principles, energy sources, materials, and techniques.

3.1.6. Pair decarbonization with clean indoor air strategies, especially in LIDAC areas with high criteria air pollutants and hazardous air pollutants.

3.1.7. Conduct pre-weatherization work to enable Weatherization Assistance Program activities.

3.1.8. Incorporate climate resiliency aspects to prepare homes and residents to withstand climate impacts. For example, install heat pump cooling and rooftop solar and battery storage.

3.1.9. Educate residents about residential decarbonization technologies and strategies through a variety of methods, including demonstration sites.

3.1.10. Engage with other states, sector stakeholders, members of the public, and decision makers to share strategies, learn from other efforts, and identify ways to enhance and expand efforts.

Implementation

The implementing agency may provide technical, workforce development, and planning assistance and offer grants, loans, tax rebates and credits, and other incentives to facilitate implementation of strategies. Alternatively, the implementing agency may develop and fund programs or projects to directly enact aspects of this measure for public buildings. The agency may establish and expand navigator and educational programs to enable expanded participation and create learning collaborations among jurisdictions to accelerate implementation of residential decarbonization. The implementing agency would engage communities, especially LIDACs, Tribal Nations, and relevant stakeholders in the development of related programs, policies, and projects.

Implementing agency. This measure could be utilized by any of the following implementing agencies:

- State agencies including MPCA, Minnesota Housing, MDA, DEED, Department of Commerce
- Municipalities including, but not limited to, cites, counties, and regional development organizations
- Tribal Nations

Review of authority to implement. Implementing agencies have existing authority necessary to implement the measure. Some projects may require local permits.

Implementation schedule and milestones. Implementation would depend on the scale and scope of work. For existing programs, implementing agencies could build on relationships and networks, following established program cycles. A tentative schedule for residential decarbonization programs is as follows: conduct planning and engagement in late 2024 to early 2025, develop requests for proposals for third-party implementers in mid-2025, disburse funds in late 2025 or 2026, and begin implementing projects in 2026. Grant rounds could be managed on a regular cycle, which creates opportunities for continuous improvement and also allows new organizations to pursue the funding opportunity. Actions that may be implemented through existing programs could have accelerated timelines.

Geographic location: Statewide, with a focus on LIDACs.

Metrics for tracking progress. Metrics may include greenhouse gas emissions reductions, energy consumption, appliances replaced, homes enrolled, new construction meeting standards, engagement, and infrastructure installed.

Minnesota's Climate Action Framework established related goals:[65]

- By 2035, reduce greenhouse gas emissions from existing buildings by 50% compared to 2005 levels.
- By 2030, reduce energy use by 10% compared to 2005 levels.

Intersection with other funding availability

Complementary funding sources include:

- Minnesota pre-weatherization program
- Minnesota Climate Innovation Finance Authority
- Minnesota Department of Commerce Conservation Improvement Program

[65] Minn. Climate Action Framework. 2022. https://climate.state.mn.us/minnesotas-climate-action-framework

- MPCA Project Stove Swap
- Minnesota Housing Impact Fund
- Minnesota Housing Rehab Loan Program
- Minnesota Housing Home Improvement Fix-Up Fund
- Minnesota Housing Consolidated Request for Proposals
- Minnesota Housing Publicly Owned Housing Program
- Minnesota Housing Rental Rehabilitation Deferred Loan
- Minnesota Housing Community Stabilization Program
- Rebate and incentive programs offered by electric and gas utilities
- Local funding sources for building financing and cost-share, such as Minneapolis 0% loan financing for single-family homes and Minneapolis Green Cost Share for designated multi-family Naturally Occurring Affordable Housing (NOAH)
- Xcel Partners in Energy Program
- Complementary federal funding, including:
  - Department of Energy Buildings Upgrade Prize
  - EPA Environmental Justice Collaborative Problem Solving Grant
  - EPA Solar for All
  - Inflation Reduction Act rebates and credits for home energy upgrades
  - Federal weatherization assistance program
  - Inflation Reduction Act Direct Pay
  - Other local and Tribal funding sources may be available

Estimate of greenhouse gas emissions reductions

Near-term cumulative greenhouse gas emissions reductions (2025 to 2030): 1.9 MMT CO_2e

Long-term cumulative greenhouse gas emissions reductions (2025 to 2050): 58.4 MMT CO_2e

Methods and assumptions. Estimation methods are discussed in Appendix C.

LIDAC benefits analysis

Impacted LIDACs and existing climate risks, impacts, and vulnerabilities:

LIDACs face a range of climate vulnerabilities related to residential conditions including heat risk disparities,[66] high energy cost burden, and poor indoor air quality, all of which are important predictors of health.[67,68,69] Weatherization and other energy efficiency programs can mitigate these conditions but often have limited reach within LIDACs due to high upfront cost, language, time, and other barriers such as split incentives between property owners and renters.[70, 71]

[66] Gabbe, Mallen, and Varni, "Housing and Urban Heat."
[67] Siddique et al., "Beyond the Outdoors."
[68] Ferguson et al., "Exposure to Indoor Air Pollution across Socio-Economic Groups in High-Income Countries."
[69] Tsoulou et al., "Residential Indoor Air Quality Interventions through a Social-ecological Systems Lens."
[70] MDH Health Equity Network Coordinator meeting
[71] Xu and Chen, "Energy Efficiency and Energy Justice for U.S. Low-Income Households."

The threat of extreme heat exposure in the summer months is rising. Heat exposure has pronounced public health consequences, including heat stroke, dehydration, exacerbation of existing medical conditions, and increased premature mortality.[72]

Estimated potential benefits and disbenefits of greenhouse gas emission reduction measures to LIDACs:

Benefits to upgrading correctional facilities include reduced mortality, heat stroke, respiratory illnesses and lung diseases, reduced healthcare costs, reduced spread of illness and disease, and improved mental health for inmates and staff.

Navigator programs in partnership with community-based partners will be important to help overcome knowledge, access, language, and trust barriers to increase LIDAC participation in energy efficiency, weatherization and renewable opportunities.[73] Increasing access and participation in these programs will have numerous co-benefits for LIDACs statewide including affordable energy costs, improved energy security, improved financial security, increased resilience to climate change, reducing extreme heat-induced health risks, and improved health through reductions in indoor air pollutants.

3.2. Reduce greenhouse gas emissions from commercial and public buildings by promoting energy efficiency, renewable energy, electrification, and lower-carbon design, materials, and fuels

Description

Accelerate commercial and public building decarbonization through energy efficiency, renewable energy, and electrification; expand and improve district heating and cooling; implement local geothermal networks to reduce greenhouse gas emissions; and support workforce development, especially in LIDACs.

Buildings include, but are not limited to schools, government buildings, commercial properties, small business districts, hospitals and health care facilities, university buildings, mixed use developments including residential, resiliency hubs, community centers, and ice arenas and other recreational buildings.

Actions include:

3.2.1 Decarbonize existing commercial and public buildings by combining multiple technologies and approaches including: energy efficiency, energy recovery, energy storage, renewable energy and fuels, refrigerant replacement, and electrification. Eligible activities include, but are not limited to energy audits, HVAC and electrical upgrades, solar panel and battery installations, transitioning to low-temperature water heating systems, local geothermal networks, and district heating and cooling systems.

3.2.2 Pair decarbonization with clean indoor air strategies and climate resiliency.

3.2.3 Design new buildings that leverage third-party verified certification platforms, such as LEED and SB 2030, using green building principles, energy sources, materials, and techniques.

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[72] Chakraborty et al., "Disproportionately Higher Exposure to Urban Heat in Lower-Income Neighborhoods."
[73] Stakeholder input

3.2.4 Engage with other states, sector stakeholders, members of the public, and decision-makers to share strategies, learn from other efforts, and identify ways to enhance and expand efforts.

3.2.5 Educate and assist building owners and renters (about commercial and public building decarbonization technologies and strategies through a variety of methods, including demonstration sites.

3.2.6 Work with small businesses to take action to decarbonize their business and its activities.

Implementation

The implementing agency may provide technical and planning assistance and offer grants, loans, tax rebates and credits, and other incentives to facilitate implementation of strategies. Alternatively, the implementing agency may develop and fund programs or projects to directly enact aspects of this measure for public buildings. The agency may establish a navigator and educational programs to enable expanded participation and collaborate with other jurisdictions to exchange information. The implementing agency would engage communities, especially LIDACs, Tribal Nations, and relevant stakeholders in the development of related programs, policies, and projects.

Implementing agency. This measure could be utilized by any of the following implementing agencies:

- State agencies, including the Department of Commerce, Department of Corrections, Department of Human Services, Department of Veterans Affairs, DEED, Minnesota Housing, MPCA, and Department of Administration
- Municipalities, including, but not limited to, cities, counties, and regional development organizations
- Tribal Nations

Review of authority to implement. Implementing agencies have authority necessary to implement the measure. Some projects may require local permits and approvals.

Implementation schedule and milestones. Implementation would depend on the scale and scope of work. For existing programs, implementing agencies could build on relationships and networks, following established program cycles. A tentative schedule for commercial and public building decarbonization programs is as follows: conduct planning and engagement in late 2024 to early 2025, develop requests for proposals for third-party implementers in mid-2025, disburse funds in late 2025 or 2026, and begin implementing projects in 2026. Grant rounds could be managed on a regular cycle, which creates opportunities for continuous improvement and also allows new organizations to pursue the funding opportunity. Actions that may be implemented through existing programs could have accelerated timelines.

Geographic location: Statewide, with a focus on LIDACs.

Metrics for tracking progress. Metrics may include greenhouse gas reductions, commercial and public buildings enrolled, equipment installations, energy consumption, and engagement.

Minnesota's Climate Action Framework established related goals:[74]

[74] Minn. Climate Action Framework. 2022. https://climate.state.mn.us/minnesotas-climate-action-framework

- By 2035, reduce greenhouse gas emissions from existing buildings by 50% compared to 2005 levels.
- By 2030, reduce energy use by 10% compared to 2005 levels.

Intersection with other funding availability

Complementary funding sources include:

- Minnesota Climate Innovation Finance Authority
- Minnesota Department of Commerce school building controls grants
- Minnesota Department of Commerce Conservation Improvement Program
- Minnesota Housing Publicly Owned Housing Program
- Utility rebates from electric and natural gas utilities
- Proposed Xcel Energy Community Ground Source Heat Pump demonstration project
- Jobs and business development programs, including community development corporations, community economic development, and economic development agencies
- Complementary federal funding including:
  - Inflation Reduction Act 179D Commercial Building Energy-Efficiency Tax Deduction
  - Inflation Reduction Act Direct Pay
  - USDA Small Community Facilities Grant
  - USDA Rural Development Funds
  - Other local and Tribal funding sources may be available

Estimate of the quantifiable greenhouse gas emissions reductions

Near-term cumulative greenhouse gas emissions reductions (2025 to 2030): 1.4 MMT CO_2e

Long-term cumulative greenhouse gas emissions reductions (2025 to 2050): 48.0 MMT CO_2e

Methods and assumptions. Estimation methods are discussed in Appendix C.

LIDAC benefits analysis

Impacted LIDACs and existing climate risks, impacts, and vulnerabilities:

The threat of extreme heat exposure in the summer months is rising. Heat exposure has pronounced public health consequences, including heat stroke, dehydration, exacerbation of existing medical conditions, and increased premature mortality.[75]

High temperatures correlate with increased violence among the incarcerated.[76] Nine Minnesota correctional facilities do not have air conditioning. In 2023, record breaking heat led to staffing shortages and an inmate protest against the conditions at a Stillwater correctional facility.[77] As temperatures rise with climate change, extreme heat poses increasing risks to the health and safety of inmates and staff.

[75] Chakraborty et al., "Disproportionately Higher Exposure to Urban Heat in Lower-Income Neighborhoods."
[76] Mukherjee and Sanders, "The Causal Effect of Heat on Violence."
[77] Yang, "People in Prison Struggle to Survive Unrelenting Heat without Air Conditioning."

In addition to correctional facilities, Minnesota is responsible for housing people in state hospitals and veterans homes. Many of these facilities are aging and could substantially reduce their greenhouse gas emissions through deep energy retrofits while at the same time improving the air quality, usability, and longevity of these facilities.

Potential benefits and disbenefits of greenhouse gas emission reduction measures to LIDACs:

- Energy-efficient community centers operating as cooling centers can protect LIDACs from heat exposure related health outcomes.
- Energy-efficient public buildings are more cost-effective and can help to reduce the tax burden and costs for water services.
- Projects to accelerate energy efficiency, decarbonization, and electrification of commercial buildings in LIDACs can reduce operation and maintenance costs, increase productivity and economic mobility for disadvantaged business enterprises, improve working environments (e.g., air quality, temperature control, reduced noise, improved lighting), and job creation. Achieving LIDAC benefits will require prioritization of commercial buildings in LIDACs.

4. Clean economy

4.1. Increase industrial efficiency, transition to cleaner energy sources, and reduce process emissions; switch to climate-friendly refrigerants in commercial and industrial settings

Description

Transition industrial buildings and processes to clean energy sources, improve energy efficiency, expand energy recovery from wastewater and waste heat, and replace high-global warming potential refrigerants with climate-smart refrigerants in commercial and industrial settings.

Actions include:

4.1.1. Transition to clean industrial energy sources, materials, processes and products by replacing or upgrading coal, natural gas boilers and heat systems with electric boilers, heat pumps, heat recovery, renewable natural gas, green hydrogen, green ammonia, or other renewable fuels and advanced technologies.

4.1.2. Incorporate anaerobic digestion into new or existing industrial facilities, ensuring the on-site or distributed use of renewable biogas as a displacement for fossil fuels.

4.1.3. Upgrade equipment to use low-global warming potential refrigerants in commercial and industrial settings.

4.1.4. Evaluate and implement energy efficiency upgrades.

4.1.5. Expand energy and heat recovery from wastewater and waste heat, implementing measures including, but not limited to, district heating, combined heat and power, and anaerobic digestion.

4.1.6. Provide technical and financial assistance to businesses to reduce emissions. Evaluate industrial uses and work with businesses to reduce the use of fossil fuels.

4.1.7. Expand workforce training and development programs for energy-efficiency and renewable energy services and the design, installation, and operation of advanced technologies.

4.1.8. Provide technical and financial assistance for small business owners and municipalities to advance climate actions in this sector.

4.1.9. Reduce process emissions by changing product specifications and production processes to those that reduce embodied carbon, for example, lower-temperature asphalt production and direct reduced iron. Support development of markets for these products.

4.1.10. Provide focused technical assistance and financial tools to achieve significant reductions from the state's top industrial emitters.

4.1.11. Provide technical assistance and financial tools to support targeted action across specific types of industrial facilities, such as food processing.

Implementation

The implementing agency may provide technical and planning assistance and offer incentives, such as grants, loans, tax credits, and financing to support assessments, design, retrofitting, and construction of facilities. The agency may directly fund improvements to public facilities and equipment in its jurisdiction. The implementing agency would engage communities, especially LIDACs, Tribal Nations, and relevant stakeholders in the development of related programs, policies, and projects.

Implementing agency. This measure could be utilized by any of the following implementing agencies:

- State agencies including the Department of Commerce, MPCA, DEED, and MnCIFA
- Tribal Nations
- Municipalities including, but not limited to, cities, counties, regional development organizations, and port authorities

Review of authority to implement. Implementing agencies have existing authority necessary to implement the measure; however, barriers exist for implementing waste heat recovery from wastewater treatment plants. Permitting and approvals may be required for specific projects.

Milestones for obtaining implementing authority. Draft legislation is being discussed for the 2024 session to clarify state statutes and remove hurdles to recovering waste heat from wastewater treatment plants. The Minnesota Legislature meets annually so authorities not granted in a given session could be pursued the following year.

Implementation schedule and milestones. A tentative schedule for establishing an industrial program is as follows: conduct hiring, planning, and engagement in late 2024 to early 2025, develop requests for proposals in mid-2025, select grantees and disburse funds in late 2025 or 2026, and begin implementing projects in 2026. Grant rounds could be managed on a regular cycle, which creates opportunities for continuous improvement and also allows new organizations to pursue the funding opportunity. Some projects may require feasibility studies, design, permitting, and environmental review, which would add to the timeline.

Geographic location: Statewide, with a focus on LIDACs.

Metrics for tracking progress. Metrics may include greenhouse gas emissions, energy consumption, energy efficiency, industrial partners enrolled and projects completed, and engagement.

Minnesota's Climate Action Framework established related goals: [78]

- By 2030, reduce thermal greenhouse gas emissions by at least 20%, compared to 2005 levels.
- By 2030, reduce energy use by 10% and total waste heat and waste electricity by 15%, compared to 2005 levels.

Intersection with other funding availability

Complementary funding sources include:

- MPCA Small Business Environmental Improvement Loan Program
- Utility conservation improvement programs
- Complementary federal funding, including Department of Energy planning and engineering grant ($700K) for Duluth district heating system tied into the wastewater treatment plant
- Other local and Tribal funding sources may be available

Estimate of greenhouse gas emissions reductions

Near-term cumulative greenhouse gas emissions reductions (2025 to 2030): 8.9 MMT CO_2e

Long-term cumulative greenhouse gas emissions reductions (2025 to 2050): 73.5 MMT CO_2e

Methods and assumptions. Estimation methods are discussed in Appendix C. Minnesota's Climate action framework established related goals: [79]

- By 2030, reduce thermal greenhouse gas emissions by at least 20%, compared to 2005 levels.
- By 2030, reduce energy use by 10% and total waste heat and waste electricity by 15%, compared to 2005 levels.

LIDAC benefits analysis

Impacted LIDACs and existing climate risks, impacts, and vulnerabilities:

LIDACs are more likely to be near industrial areas and be exposed to environmental hazards such as fine particulates ($PM_{2.5}$), diesel particulate matter, toxic releases to air, and traffic.[80]

Potential benefits and disbenefits of greenhouse gas emission reduction measures to LIDACs:

- For projects that increase alternative energy use with diesel generator retirements, cogeneration, thermal storage, expand and improve district heating infrastructure in LIDACs near industrial areas with current high levels of $PM_{2.5}$, diesel particulate matter, toxic releases to air, and proximity to traffic, benefits may include reduced localized air and noise pollution, and energy savings passed on to consumers.
- For projects that expand energy recovery from wastewater and waste heat, benefits may include offsetting natural gas use within LIDAC communities resulting in reduced emissions, reductions in energy costs, and reductions in heat island effect due to less industrial heat/emissions dissipated into the environment/surrounding communities.
- If projects incorporate workforce development in LIDACs for implementation, communities could benefit from job creation.

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[78] Minn. Climate Action Framework. 2022. https://climate.state.mn.us/minnesotas-climate-action-framework
[79] Minn. Climate Action Framework. 2022. https://climate.state.mn.us/minnesotas-climate-action-framework
[80] Mohai et al., "Racial and Socioeconomic Disparities in Residential Proximity to Polluting Industrial Facilities."

4.2. Develop cleaner fuel stocks and supporting infrastructure

Description

Generate renewable natural gas from anaerobic digestion of waste products and landfill gas capture, build a low-carbon aviation fuel supply chain, and produce green hydrogen, ammonia, and fertilizer.

Actions include:

4.2.1. Generate renewable natural gas from anaerobic digestion and landfill gas capture, supporting facilities to transform organic waste into renewable energy, providing grants for methane digesters in feedlots, and creating programs to encourage anaerobic digestor development for renewable natural gas and fuels.

4.2.2. Build a supply chain for low-carbon feedstocks that supports decarbonization of aviation fuel

4.2.3. Develop a regulatory framework for carbon sequestration pipelines and hydrogen fuel in Minnesota.

4.2.4. Produce green hydrogen, ammonia, and fertilizer by leveraging state funding for green hydrogen hubs, creating grant programs for manufacturing green fertilizers, and establishing production-based incentives for green ammonia.

4.2.5. Provide planning, workforce development, technical, and financial assistance, as necessary.

Implementation

The implementing agency may provide technical and planning assistance and offer incentives, such as grants, tax credits, and financing to support assessments, design, retrofitting, and construction of facilities. Alternatively, the implementing agency may directly fund a publicly owned facility. The implementing agency would engage communities, especially LIDACs, Tribal Nations, and relevant stakeholders in the development of related programs, policies, and projects.

Implementing agency. This measure could be utilized by any of the following implementing agencies:

- State agencies including MDA, MPCA, DNR, MDH, Public Utilities Commission, Department of Commerce, MnDOT, DEED and Environmental Quality Board
- Municipalities including, but not limited to, cities, counties, and regional development organizations
- Tribal Nations

Review of authority to implement. There is existing authority for permitting of anaerobic digesters and pipelines for carbon dioxide and certain nonpetroleum gas products. Some economic aspects of hydrogen production are already regulated on a state level; however, additional regulatory frameworks for carbon sequestration, and hydrogen production would be needed.

Milestones for obtaining implementing authority. The needed regulatory frameworks could be developed in two to three years, depending on the need for legislative action and the extent of rulemaking required.

Implementation schedule and milestones. For anaerobic digesters and landfill gas capture, hiring and planning for a grant program could begin in 2024, with development of a request for proposals ready in 2025. The implementing agency could publish a request for proposals and accept applications **in** 2025 and award funds in late 2025. Grant rounds could be managed on a regular cycle, which creates

opportunities for continuous improvement and also allows new organizations to pursue the funding opportunity. Projects could begin to be implemented in 2026. Design and permitting of facilities may extend this timeline.

For actions that require regulatory action, the implementing agency could seek legislative action in early 2025, followed by 18-24 months of rulemaking. Requests for proposals could then be developed in early- to mid-2027, with projects awarded funds in late 2027 and implementation beginning in 2028. The Minnesota Legislature meets annually so authorities not granted in a given session could be pursued the following year.

Geographic location. Statewide, with additional focus on benefiting LIDACs through jobs and economic development.

Metrics for tracking progress. Metrics may include projects proposed and operating, fuel and energy generated, greenhouse gas emissions avoided.

Intersection with other funding availability

Complementary funding sources include:

- Department of Energy Heartland Hydrogen Hub
- MnCIFA
- MDA Green Fertilizer Grants
- Minnesota Sustainable Aviation Fuel Tax Credit
- Inflation Reduction Act tax credits
- Bond financing
- Other local and Tribal funding sources may be available

Estimate of the quantifiable greenhouse gas emissions reductions

Near-term cumulative greenhouse gas emissions reductions (2025 to 2030): 2.2 MMT CO_2e

Long-term cumulative greenhouse gas emissions reductions (2025 to 2050): 53.4 MMT CO_2e

Methods and assumptions. Estimation methods are discussed in Appendix C.

LIDAC benefits analysis

Impacted LIDACs and existing climate risks, impacts, and vulnerabilities:

Landfills are linked to major forms of environmental harms, such as groundwater contamination, production of greenhouse gases, and accumulation of toxins in human and natural systems. The presence of landfills has been shown to be co-located in LIDACs.[81]

Potential benefits and disbenefits of greenhouse gas emission reduction measures to LIDACs:[82]

Potential benefits of generating renewable natural gas from anaerobic digestion and landfill gas capture include reduced fossil fuel use, improved soil health, reduced nitrogen runoff, improved water quality, reduced landfill expansion and avoidance of the health and environmental harms from landfill leachates

[81] Cannon, "Examining Rural Environmental Injustice: An Analysis of Ruralness, Class, Race, and Gender On the Presence of Landfills Across the United States."

[82] Benefits and disbenefits identified through workplans and discussions with MDA and MDH staff

contaminating groundwater, and economic opportunities, including building a circular economy, construction job opportunities, and revenue for operators and municipalities.

Potential disbenefits and public concerns identified regarding anaerobic digesters include the risk of manure spill during transport, odors, and increases in truck traffic due to transport. The context specific design and placement of anaerobic digesters can minimize these disbenefits. For example, siting facilities near manure and food scrap sources minimizes transport distances and spill risk, and replacing uncovered manure lagoons with enclosed facilities can reduce odors, rather than increase them. Anaerobic digester planning and placement should involve community engagement and strategies to avoid potential LIDAC disbenefits.

4.3. Promote waste prevention, reduction, and recycling

Description

Reduce greenhouse gas emissions by preventing waste, waste management, increasing opportunities for reuse and recycling, and promoting zero waste practices, a circular economy, and climate-smart development.

Actions include:

4.3.1 Reduce methane emissions from food waste via waste prevention strategies (e.g., meal planning, consumer education campaigns, proper food storage, upcycling of food to new products, the use of food inventory software, and surplus food donation), dehydrating or processing food scraps for animal feed, composting, or other means.

4.3.2 Support source-separated organics collection and processing infrastructure.

4.3.3 Increase access to organics collection in LIDACs, especially in multifamily dwellings.

4.3.4 Support markets, collection, processing infrastructure for recyclable materials (including finished compost) and products made with recycled materials, especially in Greater Minnesota, as well as workforce development.

4.3.5 Implement policies to reduce waste, such as through Extended Producer Responsibility and the elimination of single use plastics and plastics materials that cannot be recycled locally.

4.3.6 Offer grants to promote waste prevention, reuse, and recycling and for sustainable procurement. Work with industries to develop and implement plans for waste reduction, such as the tourism and hospitality industries. Promote education and financial analysis tools to calculate total cost of ownership when procuring goods and services.

4.3.7 Support businesses in the development of new products that incorporate recycled materials, promote a circular economy, and minimize the impact of waste.

Implementation

The implementing agency may provide technical and planning assistance and offer grants, loans, tax rebates and credits, and other incentives to facilitate implementation of strategies. Alternatively, the implementing agency may develop and fund programs or projects to directly enact aspects of this measure for public facilities and lands. The agency may establish programs and projects to address aspects of this measure, such as public education and awareness campaigns. The implementing agency would engage communities, especially LIDACs, Tribal Nations, and relevant stakeholders in the development of related programs, policies, and projects.

Implementing agency. This measure could be utilized by any of the following implementing agencies:

- Tribal Nations
- State agencies, including MPCA, MDA, MDH, Board of Animal Health, and DEED
- Municipalities including, but not limited to, cities, counties, and regional development organizations

Review of authority to implement. Implementing agencies have the authority to implement programs and projects for education, grants, and county solid waste plans. Specific programming such as extended producer responsibility, requesting additional grant funds, or creating new policies that require entities to follow new procedures would require legislative action. This would require the state legislature to pass bills, in order for the bill to apply to the whole state, or a local unit of government to pass a bill, which would only impact that area. At this time there is legislation for reducing the amount of packaging materials in MInnesota. However, it is unclear if this will be passed this legislative session. The Right to Repair bill was passed in Minnesota during the last session which will make reusing and repairing products much easier. Over $20 million in funding was also passed for sustainable materials and solid waste management programs to reduce greenhouse gas emissions. Enacting new policies would require approvals.

Milestones for obtaining implementing authority. Implementing agencies could seek appropriate authorities from the Minnesota Legislature during the 2024 or 2025 Legislative Sessions. The Minnesota Legislature meets annually so authorities not granted in a given session could be pursued the following year. If local authority is needed for policies, these approvals could be obtained on a faster timeline.

Implementation schedule and milestones. For existing programs, implementing agencies could build on relationships and networks, following established program cycles. For new programs, a planning and engagement phase in late 2024 and early 2025 would be necessary to develop requests for proposals. The implementing agency could publish a request for proposals and accept applications in 2025 and funded project could begin implementation in late 2025 or 2026. Grant rounds could be managed on a regular cycle, which creates opportunities for continuous improvement and also allows new organizations to pursue the funding opportunity. For projects that require design and permitting, study, or policy development, additional time may be needed before projects begin.

Geographic location. Statewide, with additional focus on LIDACs.

Metrics for tracking progress. Metrics may include greenhouse gas emissions reduced, waste recycled or composted, waste reduction, recycling capacity, food recovery and diversion, projects implemented, and engagement.

Related goals include:[83]

- Reduce waste production in the Twin Cities metropolitan area in 2030 by 15% compared to current projections.
- Establish curbside organics collection in all cities with a population greater than 5,000 by 2030.
- Each of the seven counties in the Twin Cities metropolitan area must recycle a minimum of 75% (by weight) of total municipal solid waste they generate by 2030.

[83] MPCA. Metropolitan Solid Waste Management Policy Plan 2022-2042. https://www.pca.state.mn.us/sites/default/files/w-sw7-22.pdf

- Each of the Greater Minnesota counties must recycle a minimum of 35% (by weight) of total municipal solid waste they generate by 2030.

Intersection with other funding availability

Complementary funding sources include:

- MPCA Prevention of Wasted Food Grants
- MPCA Environmental Assistance Loans
- The Governor's Select Committee on Recycling and the Environment (SCORE) funds
- MDH Statewide Health Improvement Partnership funds
- Other local and Tribal funding sources may be available

Estimate of the quantifiable greenhouse gas emissions reductions

Near-term cumulative greenhouse gas emissions reductions (2025 to 2030): 7.02 MMT CO_2e

Long-term cumulative greenhouse gas emissions reductions (2025 to 2050): 35.08 MMT CO_2e

Methods and assumptions. Estimation methods are discussed in Appendix C.

- Reduce waste production in the Metro Area by 15% compared to current projections.
- Establish curbside organics collection in all cities with a population greater than 5,000 by 2030.
- Each of the seven counties in the Metro Area must recycle a minimum of 75% (by weight) of total municipal solid waste they generate by 2030.
- Each of the Greater Minnesota counties must recycle a minimum of 35% (by weight) of total municipal solid waste they generate by 2030.

LIDAC benefits analysis

Impacted LIDACs and existing climate risks, impacts, and vulnerabilities:

Landfills are linked to major forms of environmental harms, such as groundwater contamination, production of greenhouse gases, and accumulation of toxins in human and natural systems. The presence of landfills has been shown to be co-located in LIDACs.[84]

Food security insecurity affects LIDACs across the state and since the outset of the COVID-19 pandemic, food insecurity has been volatile, surging by as much as 40% in some communities.[85] Meanwhile, up to 40% of the entire food supply is lost or wasted in the United States, which contributes to negative environmental, economic, and social outcomes.[86]

Potential benefits and disbenefits of greenhouse gas emission reduction measures to LIDACs:[87]

Potential benefits of waste prevention, reduction, and recycling include community empowerment and engagement in climate solutions, reduced fossil fuel use, improved soil health, reduced nitrogen runoff, improved water quality, reduced landfill expansion and avoidance of the health and environmental harms from landfill leachates contaminating groundwater, decreased waste collection fees through

[84] Cannon, "Examining Rural Environmental Injustice: An Analysis of Ruralness, Class, Race, and Gender On the Presence of Landfills Across the United States."
[85] Healthy Foods, Healthy Lives Institute, University of Minnesota, "Food Security Dashboard."
[86] Chen, "Examining Contributors and Solutions to Prevent and Manage Food Waste in Households with Low Incomes and the Emergency Food System within the U.S."
[87] Benefits identified through workplans and discussions with MDA and MDH staff

participation in the food scrap collections, and economic opportunities, including building a circular economy, construction job opportunities, and revenue for operators and municipalities.

Community empowerment and engagement in climate solutions: Reducing food waste presents an opportunity to address food security and healthy food access in LIDACs. Improved food security and healthy food access are predictors of a wide range of health outcomes.

Appendix A – Minnesota greenhouse gas emissions 2005-2020

REPORT TO THE LEGISLATURE
JANUARY 2023

Greenhouse gas emissions in Minnesota 2005-2020

Biennial report to the Legislature tracking the state's contribution to emissions contributing to climate change.

MINNESOTA

Pollution Control Agency
Department of Commerce

Summary

Progress and opportunities to address climate change

A summary of Minnesota's greenhouse gas emissions

Minnesota is on track to meet greenhouse gas reduction goals for the first time.

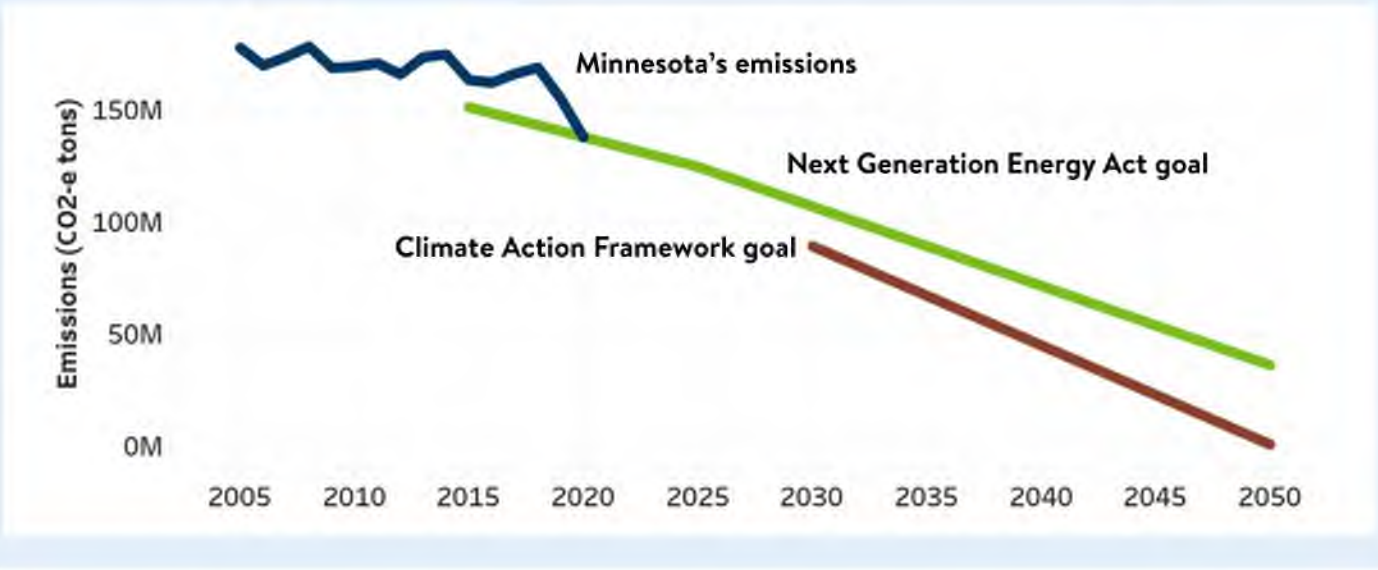
Efforts from individuals, businesses, and local governments as well as the COVID pandemic resulted in a sharp decline greenhouse gas (GHG) emissions in Minnesota. Minnesota's GHG emissions declined 23% between 2005 and 2020. If current trends continue, the state is on track to meet our goal of reducing emissions 30% by 2025. That goal was established in the bipartisan Next Generation Energy Act in 2007.

In 2022, Governor Tim Walz and Lt. Governor Peggy Flanagan rolled out Minnesota's Climate Action Framework that updates Minnesota's climate goals to reduce emissions 50% by 2030 and achieve net-zero emissions by 2050.

Decline in GHGs across all industry sectors 2005-2020

23%

GHG emissions 2005–2020 and goals from the Next Generation Energy Act and Climate Action Framework



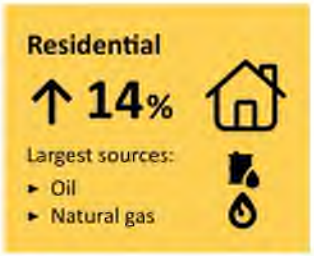
MINNESOTA

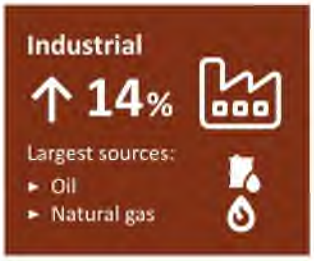
GHG emissions by sector 2005-2020

Transportation remains largest source of GHG emissions in Minnesota. Transportation accounts for approximately 25% of the state's GHG emissions. While GHG emissions in the transportation sector have fallen 18% since 2005, most of that decrease is attributed to the reduction in aviation and vehicle usage during the pandemic.

Forests continue to offset agriculture emissions through carbon sequestration. This is important because the overall agriculture, forestry, and land use sector has become the second largest source of emissions as electrical generation emissions have declined. Emissions from manure and fertilizer use have increased since 2005.

Electricity generation is a Minnesota success story. Since 2005, emissions from the electricity generation sector have declined by 54%. The significant decrease is mainly a result of producing electricity from renewable sources like wind and solar instead of coal.





Emissions from homes and industrial facilities continue to rise. Emissions from Minnesota's homes and industrial facilities have risen 14%, due to the continued use of oil and natural gas to heat and operate.

Our path forward: Minnesota's Climate Action Framework

The Minnesota's Climate Action Framework sets a vision for how our state will address and prepare for climate change. It identifies near-term actions we must take to achieve our long-term vision of a carbon-neutral, resilient, and equitable future for Minnesota.

The Framework is organized around six climate action goals with specific steps and progress measures to guide and evaluate our work.

Clean transportation

Climate-smart natural and working lands

Resilient communities

Clean energy and efficient buildings

Healthy lives and communities

Clean economy

Contact Tom Johnson, Legislative Director
651-757-2031 Tom.E.Johnson@state.mn.us

MINNESOTA

Legislative charge

Minn. Stat. § 216H.02 Greenhouse gas emissions control.

Subd. 1. Greenhouse gas emissions-reduction goal. It is the goal of the state to reduce statewide greenhouse gas emissions across all sectors producing those emissions to a level at least 15% below 2005 levels by 2015, to a level at least 30% below 2005 levels by 2025, and to a level at least 80% below 2005 levels by 2050. The levels shall be reviewed based on the climate change action plan study.

Minn. Stat. § 216H.07 Emissions-reduction attainment; policy development process.

Subd. 3. Biennial report. (a) By January 15 of each odd-numbered year, the commissioners of commerce and the Pollution Control Agency shall jointly report to the chairs and ranking minority members of the legislative committees with primary policy jurisdiction over energy and environmental issues the most recent and best available evidence identifying the level of reductions already achieved and the level necessary to achieve the reductions timetable in section 216H.02. (b) The report must be in easily understood nontechnical terms.

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This report is available in alternative formats upon request, and online at www.pca.state.mn.us.

Contents

Introduction

Climate change is here and now. Damaging storms and floods have increased in frequency, and our winters are warming fast, reducing lake ice coverage across the state by 10 to 14 days over the past 50 years. Beloved Northwoods trees like spruce, aspen, and birch are expected to leave Minnesota over the next 80 years if we continue to change our climate.

More information about climate trends and the impacts of climate change is available from the Department of Natural Resources www.dnr.state.mn.us/climate

These changes are caused by human activities that release greenhouse gases (GHGs). This emissions inventory summarizes what we know about GHG emissions in Minnesota, including the major sources and trends over time. Tracking GHG emissions and identifying their sources are two important ways that state government can help Minnesotans understand our changing climate and respond accordingly.

To guide our response to climate change, the State of Minnesota has developed a Climate Action Framework mn.gov/framework. The Framework identifies immediate, near-term actions to reduce climate pollution and prepare Minnesota communities for the impacts of climate change. It also sets new goals for Minnesota to reduce GHG emissions by 50% by 2030 and achieve net-zero emissions by 2050. Analyzing Minnesota's emissions through this inventory allows us to track progress on the framework goals and focus actions for maximum impact to address climate change.

This inventory documents Minnesota's GHG emissions from 2005 through 2020 and shows the impact of actions taken by individuals, organizations, and governments across Minnesota. The COVID-19 pandemic changed how Minnesotans lived and worked in 2020, further reducing emissions, but emissions were trending downward, even before the lifestyle shifts caused by the pandemic. Future years' data will show whether these are sustained trends or if some emissions bounced back when COVID-19 restrictions were eased. While there is much work ahead of Minnesota to meet our climate goals, this inventory demonstrates that collaborative action works.

Evaluating greenhouse gas emissions

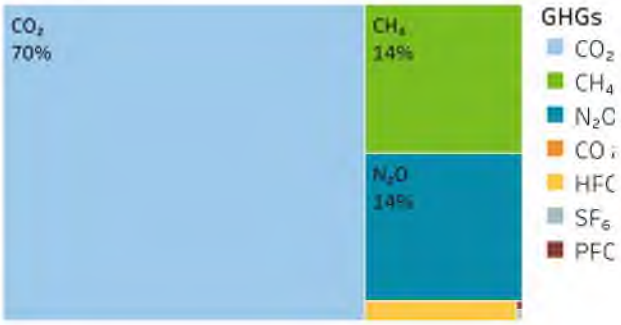
GHGs are gases that warm the atmosphere and surface of the planet. Human activity increases the amount of GHGs in the atmosphere, leading to changes in Earth's climate. The primary GHGs are carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), sulfur hexafluoride (SF_6), and two types of compounds called hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

GHGs come from a variety of sources:

- Fossil fuel combustion is responsible for most carbon dioxide emissions in Minnesota and the United States. The majority of fossil fuels used today generate electricity and fuel vehicles.
- Animal agriculture is responsible for most methane emissions in Minnesota, and the anaerobic decomposition of organic material also emits methane.
- Agricultural nutrient management practices, including fertilizer application and subsequent mineralization, cause over 50% of nitrous oxide emissions.
- Most hydrofluorocarbon emissions are from refrigerants, such as air conditioners in vehicles and buildings.
- Perfluorocarbons and sulfur hexafluoride account for a small portion of GHG emissions and are emitted from technical applications like semiconductor manufacturing and electricity transmission.

Carbon dioxide is the most abundant GHG and has the most significant effect on our climate. In Minnesota, CO_2 emissions account for most GHG emissions, followed by methane and nitrous oxide. Other GHGs are emitted in smaller amounts but can trap heat more effectively than carbon dioxide, and some stay in our atmosphere for a very long time.

Net 2020 GHG emissions in Minnesota by gas, in CO_2-equivalent tons (includes carbon storage)



Global warming potential (GWP) is a relative measure of how much heat a GHG traps in the atmosphere. To compare different emissions and pollutants, we use the effect of carbon dioxide on our climate as a standard reference. In this report, emissions are reported as carbon dioxide-equivalent (CO_2-e) tons, meaning emissions are stated in relative terms that reflect their impact on global temperatures.

Primary GHGs, their 100-yr global warming potentials, and their persistence in Earth's atmosphere

Greenhouse gas	Global warming potential	Persistence in Earth's atmosphere
Carbon dioxide (CO_2)	1	Variable, up to thousands of years
Nitrous oxide (N_2O)	298	114 years
Methane (CH_4)	25	12 years
Sulfur hexafluoride (SF_6)	22,800	3,200 years
Hydrofluorocarbons (HFCs)	Up to 14,800	Up to 270 years
Perfluorocarbons (PFCs)	Up to 12,200	2,600 to 50,000 years

Source: IPCC Fourth Assessment Report, Working Group 1 Chapter 2

Tracking Minnesota's emission reduction progress

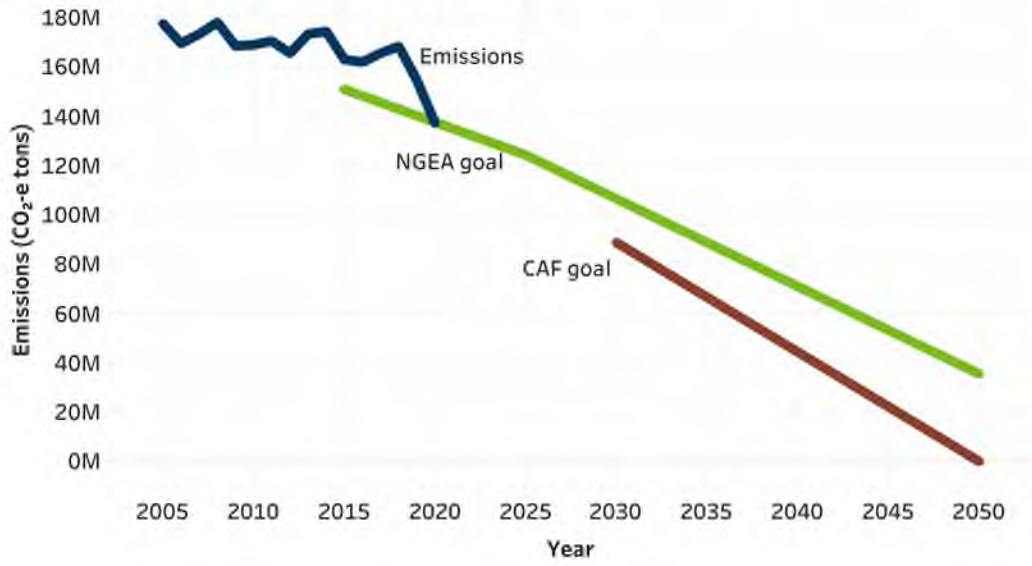
In 2007, the Minnesota Legislature passed the Next Generation Energy Act (NGEA), setting goals to reduce our GHG emissions in the state compared to our emissions in 2005.[1] The NGEA goals – based on the best science at the time – are to reduce emissions by 15% by 2015, 30% by 2025, and 80% by 2050. Today, science tells us that we must go farther, faster. To address this reality, Minnesota's Climate Action Framework includes additional goals to reduce GHG emissions by 50% by 2030 and achieve net-zero emissions by 2050.

Minnesota did not reach the NGEA goal of reducing emissions by 15% by 2015, but between 2005 and 2020, Minnesota's GHG emissions fell by 23%, putting us on track to meet future goals if we maintain current trends. Changes in electricity generation have resulted in significant emission reductions from the power generation sector and are the most significant contributor to statewide emission reductions.

The year 2020 was unusual as individuals, organizations, and governments took action to reduce the impacts of the COVID-19 pandemic. These actions caused disruptions across all parts of the economy and thus impacted Minnesota's GHG emissions in unique ways. Due to the unusual nature of 2020, this report is cautious in interpreting trends with a 2020 endpoint. All economic sectors had declining emissions between 2019-2020. While the pandemic certainly impacted those results, emissions across many sectors were already declining between 2018-2019. The declines between 2018-2019 may indicate longer-term trends, but it is too soon to tell. Future years' data will show whether these are lasting trends.

Recent emission reductions show that collaborative action can get us on track to achieve our Next Generation Energy Act goals and reach net-zero emissions by 2050. However, much work is ahead to achieve these ambitious but necessary goals.

Minnesota's GHG emissions 2005-2020 and goals from the Next Generation Energy Act and Climate Action Framework



[1] Data revisions and changes in methodology can cause the baseline to change, but continuity is provided when making relative year-to-year emissions comparisons.

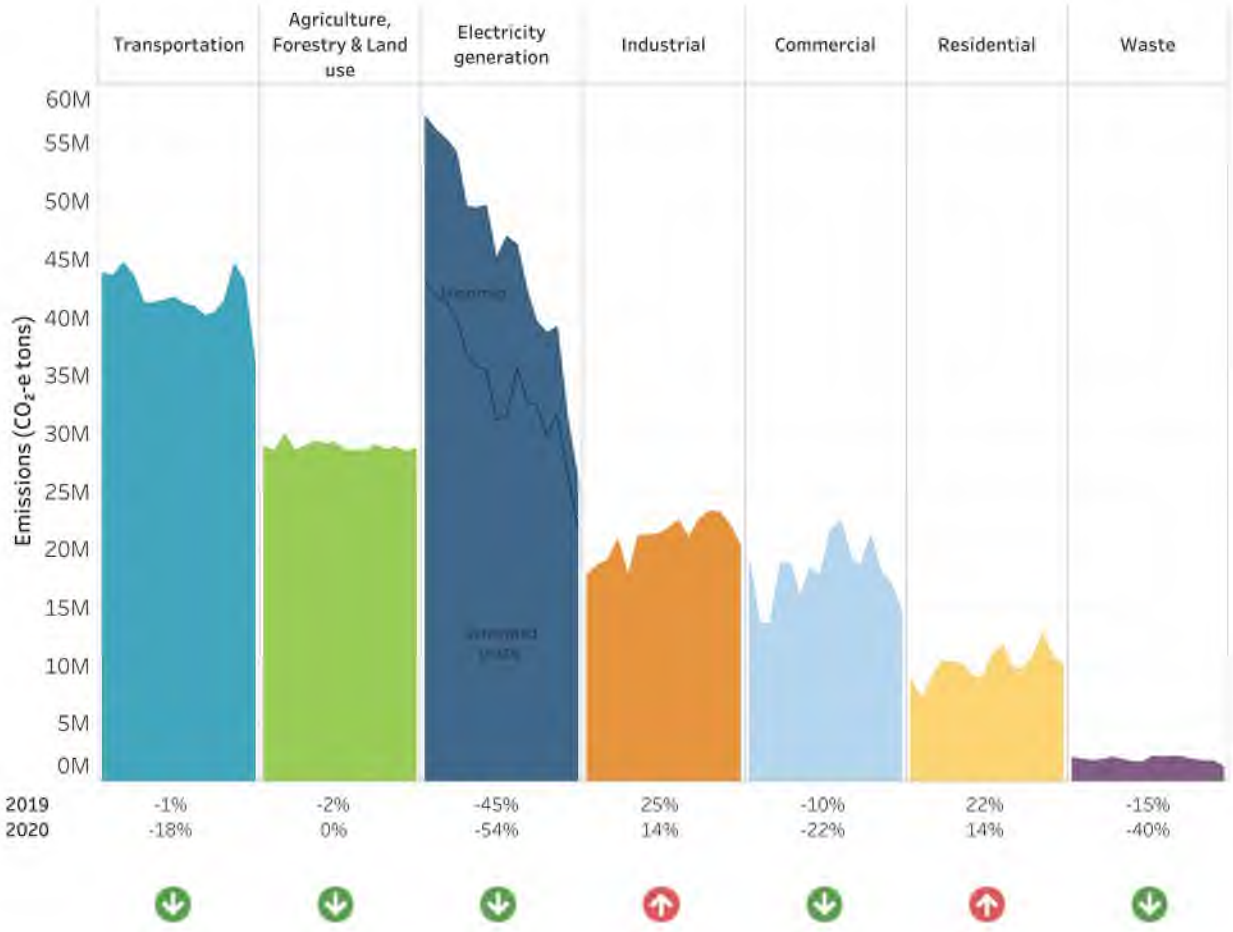
Greenhouse gas emissions across sectors

This section outlines changes to GHG emissions across seven economic sectors in Minnesota: transportation, electricity generation, agriculture and forestry, industrial, residential, commercial, and waste.

Interactive GHG emission dashboards are available at https://www.pca.state.mn.us

Minnesota's GHG emissions across economic sectors, 2005-2020, ranked by net emissions.

The dark line in the column for the electricity generation sector represents the division between emissions from electricity generated in Minnesota (below the line) and emissions from imported electricity (above the line). The percent change from 2005 is shown beneath the charts for 2019 and 2020, with an arrow indicating the 2020 change compared to 2005.



Transportation

Minnesota's largest source of GHG emissions is the transportation sector, accounting for about one-quarter of the state's total emissions. GHG emissions from transportation have decreased by about 18% since 2005. A significant decrease in aviation and vehicle miles traveled during the COVID-19 pandemic played a prominent role in the emissions reduction in 2020.

Methods to measure vehicle miles traveled and types of vehicles on our roads have changed over time. This means that we understand current transportation activity much better than we did in the past, and it also means that there is more uncertainty in estimates for past years. However, our emissions trend is similar to other published estimates, such as the U.S. Environmental Protection Agency (EPA) state inventory.

Emissions sources in the transportation sector include:

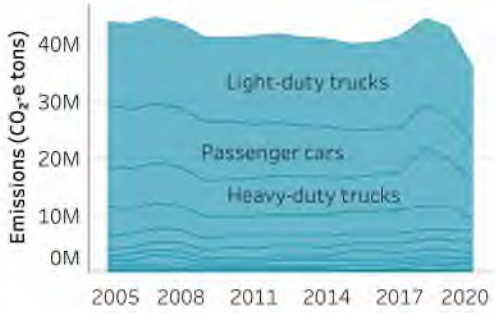
- on-road vehicles
- airplanes and other aviation equipment
- trains
- vehicle air conditioning units
- natural gas transmission pipelines

Our personal choices have a significant impact on emissions, especially when it comes to how we move around. Within the transportation sector, passenger vehicles, light-duty trucks (including SUVs), and medium- to heavy-duty trucks produce more than 70% of emissions.

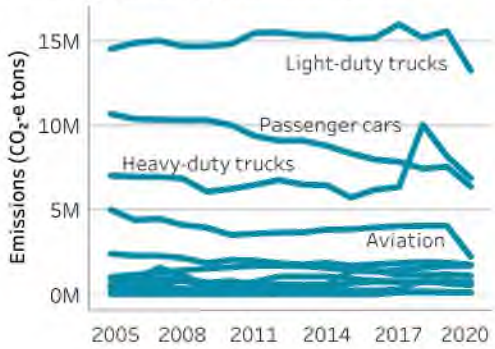
Stronger vehicle emissions standards at the federal level have lowered vehicle GHG emissions generally. However, the long-term consumer trend of choosing larger vehicles and the general trend of more miles driven (except during the pandemic) prevent more significant emissions reductions in this sector. Continued investment in cleaner vehicles and transportation options, including transit, biking, walking, and rolling, is critical to continuing the trend of emission reductions in this sector.

Transportation sector: 2005 to 2020

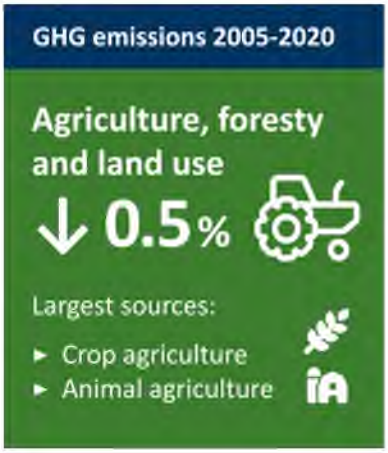
Total greenhouse gas emissions



Trends in greenhouse gas emission sources



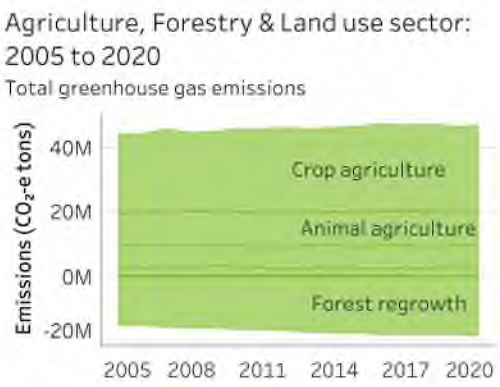
Agriculture, forestry, and land use

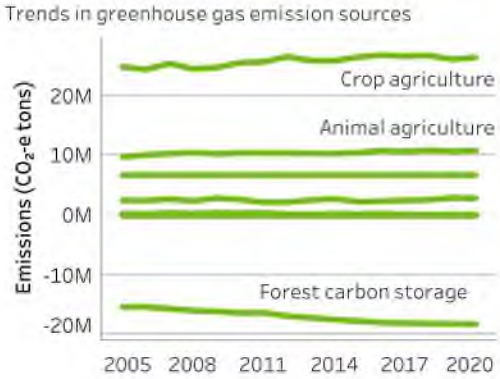


This sector groups together activities on natural and working landscapes. Some of these activities, like growing forests and grasslands, absorb and store carbon, offsetting the total amount of GHG emissions within this sector from growing crops and raising animals. Compared to the 2005 baseline, net emissions, considering both the sources and sinks of carbon, are flat, but both gross emissions and carbon sequestration have increased.

Emissions sources in the agriculture and land use sector include:

- livestock
- animal feedlots
- manure
- fertilizer
- crop cultivation practices
- anaerobic decomposition of material in lakes, rivers, and streams
- related fuel combustion of off-road implements, like tractors and combines





Agricultural practices in Minnesota are responsible for most nitrous oxide and methane emissions, two GHGs with higher GWP than carbon dioxide.

Nitrous oxide emissions from crop agriculture increased by approximately 9% from 2005 to 2020. The largest source of nitrous oxide emissions in Minnesota is nutrient management, which includes fertilizer use, mineralization, and runoff. The increase from 2005 to 2020 was due to increases in emissions from a variety of agricultural sources, including nutrient application, crop residues, and runoff. Animal agriculture also produces nitrous oxide from manure.

Animal agriculture is Minnesota's largest source of methane emissions, specifically from manure management and cattle digestion. Methane emissions from animal agriculture increased by 10% between 2005 and 2020. Lakes, rivers, and reservoirs are other significant sources of methane emissions. Plant material and fertilizers that enhance plant growth and productivity collect in waterbodies, and CH_4 is emitted during the anaerobic decomposition of organic matter. The CH_4 emissions from these biological systems are counted in the GHG inventory because methane, though short-lived, causes warming in our atmosphere before oxidizing into CO_2 and re-entering the carbon cycle.

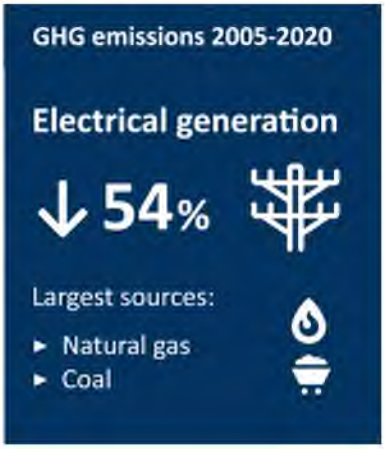
Carbon sequestration in forest regrowth is a significant offset in this sector, as forests can act as carbon sinks or storage. Carbon is sequestered in our forests as they grow. Estimation methods for sequestered forest carbon have changed since the last inventory to reflect the current best practices and are described in the appendix to this report. The updated method to estimate sequestered forest carbon has also been applied to prior years to ensure consistency over the years of the inventory.

Policy, economic factors, and voluntary actions have begun to drive down emissions from the electricity generation and transportation sectors, while emissions from agriculture have remained relatively steady since 2005. The reductions in other sectors have left the agriculture, forestry, and land use sector as Minnesota's second-largest emitter of GHGs, and also our largest sink of GHGs. This sector also is one of the biggest opportunities for achieving emission reductions and carbon sequestration, as many practices that land managers use to improve water quality and soil health also reduce emissions and sequester carbon. More investment is needed in this sector to support emission reductions and increase carbon sequestration and storage. Minnesota's Climate Action Framework identifies specific priorities for this sector to reduce emissions, store carbon, and improve our ability to understand the emissions from the sector.

Electricity generation

Electricity generation is the third largest source of GHG emissions in Minnesota. Burning fossil fuels, especially coal, to generate electricity for Minnesotans, whether produced in-state or out-of-state, is the primary source of GHG emissions from this sector. Other small sources include:

- methane from coal storage
- the breakdown of organic matter in the sediments found in hydroelectric reservoirs
- carbon dioxide from flue-gas desulfurization
- sulfur hexafluoride from electricity transmission and distribution



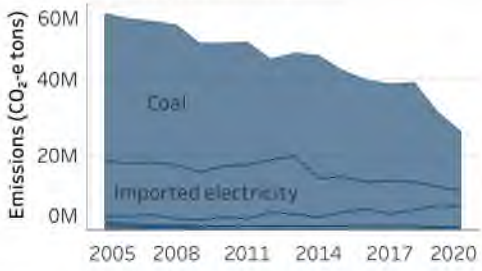
Since 2005, emissions from the electricity generation sector have declined by 54%. The significant decrease is mainly a result of the transition away from coal toward renewable energy to generate electricity. Previously, Minnesota's electricity generation sector was the largest source of GHG emissions. This sector has achieved the most emission reductions since 2005.

As required by the Next Generation Energy Act, this report measures total GHG emissions from electricity generation, including emissions from electricity generated at facilities within the state (in-state generation) and electricity used here in Minnesota that is generated outside of our state borders (imported). Emissions from in-state generation fell nearly 50% from 2005 to 2020, reflecting efforts by Minnesota's electric utilities to create a cleaner, lower-carbon electrical grid.

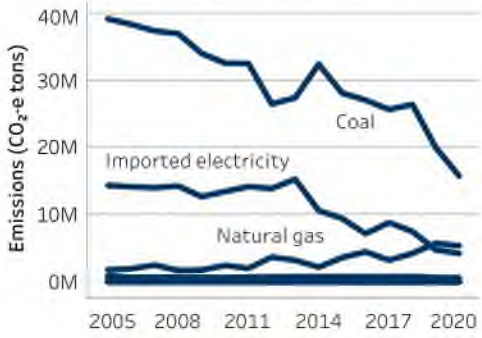
Emissions per kilowatt-hour from electricity imported from the regional electrical grid are higher than in-state generation because some neighboring states haven't reduced their emissions as much as Minnesota. The amount of electricity imported into Minnesota continues to decrease as in-state generation increases, reducing the amount of estimated imported electricity and associated GHG emissions.

Electricity generation sector: 2005 to 2020

Total greenhouse gas emissions



Trends in greenhouse gas emission sources



Continued emission reductions in the electricity generation sector are planned with future closures of coal plants. Achieving emission reductions in this sector is also important to help other sectors, such as transportation, residential, commercial, and industrial, reduce emissions through electrification. Continued focus on thoughtful planning for this transition to support reliability along with emission reductions is vital to achieving economy-wide GHG emission reduction goals.

Industrial

The industrial sector includes direct emissions from industrial facilities, processes, and fuel combustion. While this sector has increased emissions by 14% overall since 2005, in recent years, it has begun to experience emission reductions.

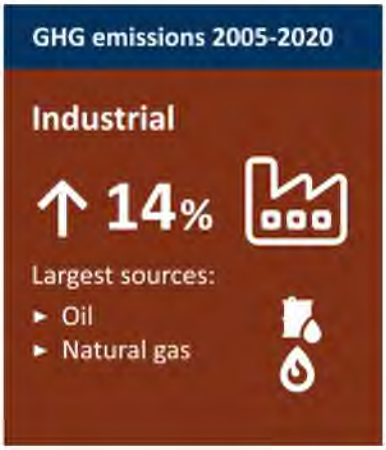
Emissions sources in the industrial sector include:

- fossil-fuel combustion
- taconite processing
- petroleum refining
- magnesium casting
- lead recycling
- peat mining
- industrial wastewater treatment
- solvent use
- manufacturing of steel, glass, insulating foam, and semiconductors

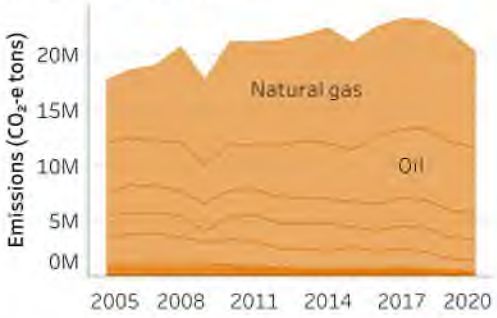
Although recent emissions are declining, emissions from the industrial sector increased by about 2.5 million tons from 2005 to 2020. Within the industrial sector, coal use has continued to decline steadily, and natural gas use has increased since 2005 but has declined from a peak in 2014.

GHG emissions from this sector have declined since a peak in 2018, but more is needed to achieve the reductions needed to meet the Next Generation Energy Act goals. The pandemic likely forced changes that reduced emissions in 2020; however, some of the changes that caused emissions to fall may persist.

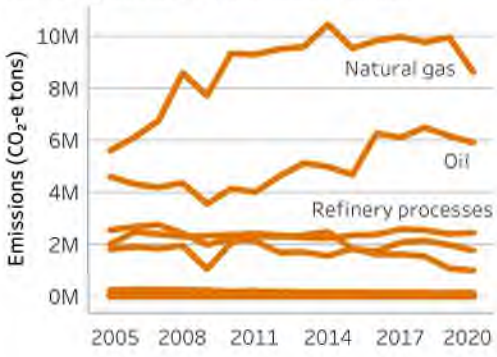
The Climate Action Framework includes a focus on transforming Minnesota's economy through innovation. With federal funding and assistance, industrial businesses can be national leaders in changing operations and using greener fuels to reduce GHG emissions.



Industrial sector: 2005 to 2020
Total greenhouse gas emissions



Trends in greenhouse gas emission sources



Residential

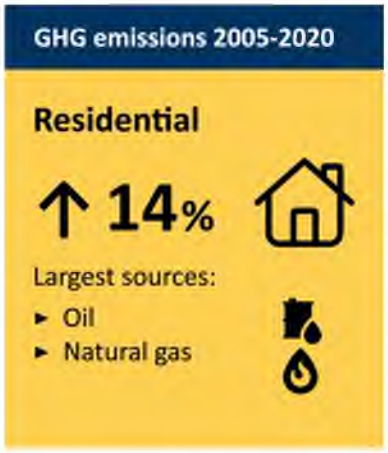
The residential sector includes products used in homes, direct combustion of fuel for heating and appliances, and carbon stored in structural materials. Relative to 2005, net emissions from the residential sector rose by 14%, but in recent years, it has begun to experience some emission reductions.

Emissions sources in the residential sector include:

- fossil-fuel combustion for heating and in-home appliances, such as furnaces that run on natural gas
- home-product use
- food additives
- refrigerant leakage from air conditioners and refrigerators
- fertilizer use

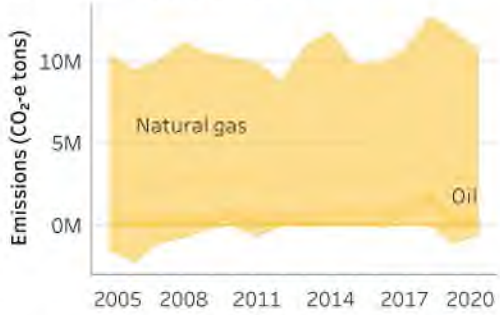
The residential sector does not include emissions from electricity use in residences – these emissions are captured in the electricity generation sector. Also, this category contains carbon stored in wood construction materials. Over the lifetime of a house, carbon is sequestered, effectively removed from the atmosphere and carbon cycle, which offsets some emissions.

The largest residential emissions source is natural gas used for home heating and appliances. Weather influences the need for heating, but switching to technologies like solar furnaces, geothermal heat pumps, electric appliances, and high-efficiency furnaces to reduce emissions from homes. The Climate Action Framework includes initiatives to renovate older buildings, replace natural gas home appliances with electric models, and improve the insulation in housing.



Residential sector: 2005 to 2020

Total greenhouse gas emissions



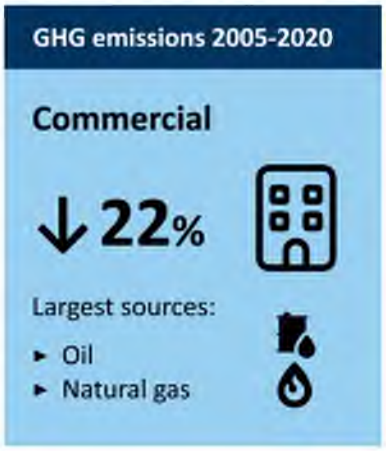
Trends in greenhouse gas emission sources

Commercial

The commercial sector includes activities, products, and combustion in buildings that house businesses, governments, and institutional sources, such as schools, corrections facilities, or state hospitals. Relative to 2005, emissions from the commercial sector were 22% below the 2005 baseline.

Emissions sources in this sector include:

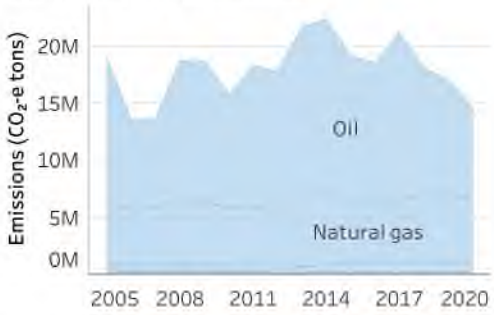
- fossil-fuel combustion
- solvent use
- air conditioning
- medical N_2O emissions



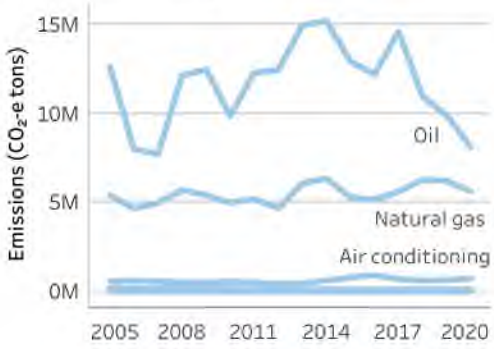
The decrease in emissions from the commercial sector was driven, at least in part, by the declining use of oil and natural gas, which peaked in 2014. Emissions from air conditioning and refrigeration chemical leakage increased. Continued investments in energy efficiency, electrification, and building efficiency, will help commercial and institutional sources reduce their fossil fuel use and energy consumption. The scheduled phase down of high global warming potential HFC refrigerants will also reduce GHG emissions.

Commercial sector: 2005 to 2020

Total greenhouse gas emissions



Trends in greenhouse gas emission sources



Waste

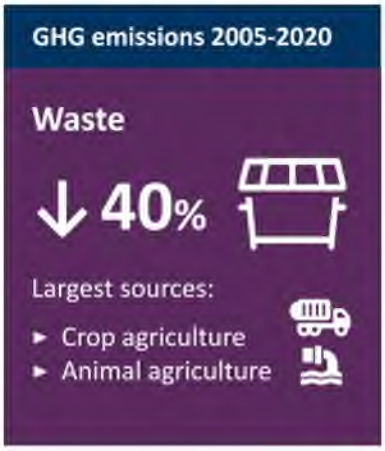
The waste sector produces about 1% of GHG emissions annually in Minnesota. Compared to the 2005 baseline, GHG emissions from the waste sector have decreased by about 40%.

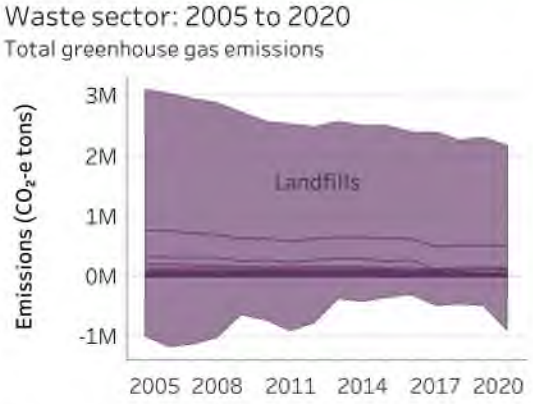
Emissions sources in the waste sector include:

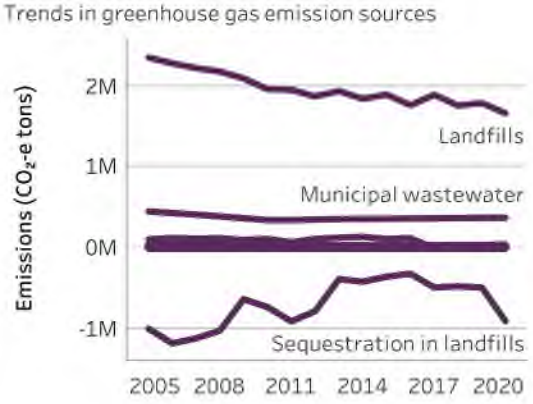
- energy use in waste processing
- incinerator fuels
- waste incineration
- methane from landfill gas and wastewater treatment

Carbon is stored or sequestered from the atmosphere as wood waste in demolition and construction landfills, which offsets other waste emissions. Today, less wood waste is landfilled than it was in the past, so carbon sequestration in landfills has declined, leading to a lower emissions offset.

Gradually decreasing methane emissions from landfills are driving the overall GHG reduction trend in this sector. Declining methane emissions are due to a combination of factors, partly the aging of waste in open landfills – older waste emits less methane as the organic fraction decomposes and becomes more stable. Also, gas capture technologies used at landfills reduce emissions of methane, either combusting it in a flare or using it to produce usable energy. As the administrator of the state's closed landfill program, the Minnesota Pollution Control Agency (MPCA) is working to address methane emissions from these facilities.



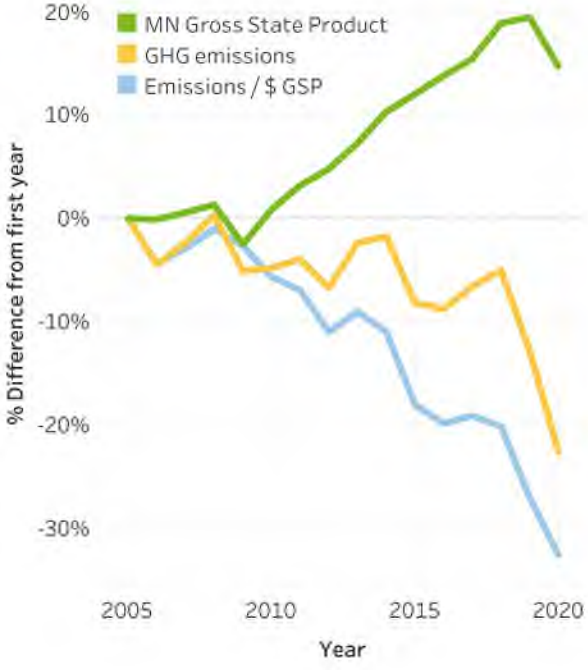




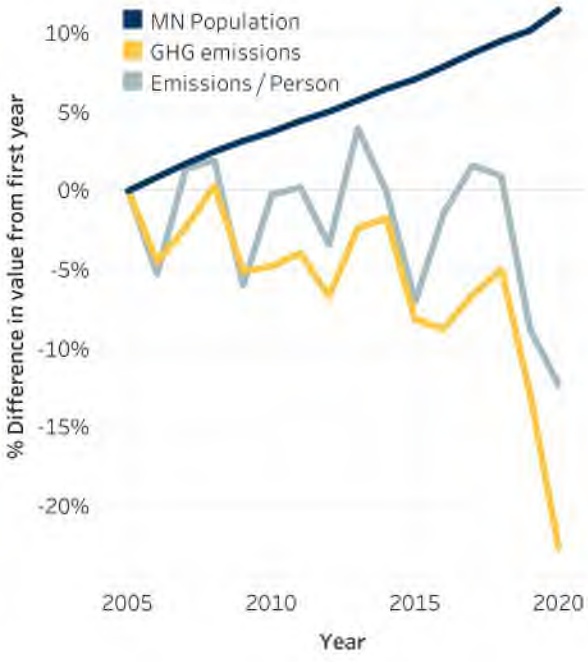
Greenhouse gas emissions and our economy

Measuring the amount of GHG emissions compared to other economic indicators is one way to understand how GHG emissions relate to the state's economy. Trends show that Minnesota has begun disconnecting economic growth from GHG emissions. Minnesota's gross state product has grown since 2005, while GHG emissions have generally decreased, demonstrating that the state economy can grow without necessarily increasing GHG emissions. Similarly, Minnesota's generally decreasing GHG emissions show that population growth can occur while reducing GHG emissions. Though the population in Minnesota is increasing, there is a net decrease in emissions per person. The Climate Action Framework includes initiatives that will help Minnesota continue to grow with a clean economy.

Minnesota's GHG emissions per dollar gross state product (GSP), 2005-2020.



Minnesota's GHG emissions per capita, 2005-2020.



Our Path Forward: Minnesota's Climate Action Framework

In September of 2022, Minnesota's Climate Action Framework was released. The Framework, developed with input from 3,000+ Minnesotans, sets a vision for how the state will address and prepare for climate change. It identifies near-term actions we must take to achieve the long-term vision of **a carbon-neutral, resilient, and equitable future for Minnesota**.

The Framework is organized around six climate action goals with specific steps and progress measures to guide and evaluate our work.

- **Clean transportation**
  Transportation represents the greatest opportunity to reduce climate pollution. The Framework's goal is to connect and serve all people through a safe, equitable, and sustainable transportation system.
- **Climate-smart natural and working lands**
  Minnesota can manage natural and working lands to address climate change by absorbing and storing carbon, reducing emissions, and sustaining local economies.
- **Resilient communities**
  Communities experience the impacts of climate change differently, and solutions must be tailored to local needs. The state can prepare communities with the resources they need to plan and build a more resilient future for themselves.
- **Clean energy and efficient buildings**
  Minnesotans can benefit from investments in clean energy and energy efficiency that will create jobs, lower energy costs, and contribute to a more stable climate.
- **Healthy lives and communities**
  Changes in Minnesota's climate threaten the health of every community, but not everyone experiences these impacts equally. The Framework's goal is to protect the health and well-being of all Minnesotans in the face of climate change.
- **Clean economy**
  Transitioning to a cleaner economy must include solutions that benefit everyone. Minnesota will build an economy that addresses climate change and equitably provides family-sustaining job opportunities.

The Framework will guide the state of Minnesota's priorities for addressing climate change in the coming years. Actions identified in the document will be developed into new policies, programs, and grants to reduce our greenhouse gas emissions.

Learn more about our next steps to tackle climate change and how you fit into this work by visiting **mn.gov/framework**.

Climate policy leadership

Ongoing state-led efforts will support GHG emission reductions in the coming years. These actions aim to accelerate our downward emissions trends to achieve our long-term goals of reducing GHGs 50% by 2030 and net zero emissions by 2050. The state is an important leader in this work, but must collaborate with businesses, other levels of government, nonprofit organizations, and individuals to achieve the Framework's goals. This section highlights a few key areas of state leadership.

Decarbonizing electricity

Minnesota's work on clean energy shows that GHG emissions can be reduced cost-effectively while meeting the energy needs of a growing economy. The electricity generation sector's steep reductions in GHG emissions in Minnesota have resulted from policies to reduce demand for electricity and shift generation to cleaner energy sources. These policies have worked with market forces that make many renewable resources more cost-effective than coal facilities.

In Minnesota and surrounding states, utilities continue to close coal plants and replace that power generation with a mix of renewables supported by natural gas. Several electricity generating facilities, especially those powered by coal, have either recently retired or are planned to be retired soon.

The Infrastructure Investment and Jobs Act and Inflation Reduction Act are two recent federal laws that will direct significant funding towards actions to reduce GHG emissions. Minnesota state agencies will use the Climate Action Framework to guide direction and prioritizing of these funds, with focuses on equitable access to funding, quality jobs, healthy communities and environment, and GHG emission reductions. This investment will support substantial progress towards achieving our climate change goals.

Utility-owned coal-fired electricity generating units in Minnesota (as of December 2022)

Facility	Size (MW)	Status
Hibbing Public Utilities Commission		
Hibbing 3	10	Standby/backup: available for service but not normally used
Hibbing 5	20	Standby/backup: available for service but not normally used
Hibbing 6	6	Standby/backup: available for service but not normally used
Minnesota Power		
Boswell unit 3	365	Operating: Cease coal-fired operations by year-end 2029
Boswell unit 4	558	Operating: Proposed to cease coal-fired operations by 2035
Taconite Harbor Energy Center unit 1	75	Retired
Taconite Harbor Energy Center unit 2	75	Retired
Otter Tail Power Company		
Hoot Lake 2	54	Retired
Hoot Lake 3	75	Retired
Xcel Energy		
Sherburne County 1	680	Operating: full retirement by 2026
Sherburne County 2	682	Operating: full retirement by 2023
Sherburne County 3	876	Operating: full retirement by 2030
Allen S King	511	Operating: full retirement by 2028

Future emissions reductions in Minnesota's power sector depend on resources entering the regional market as utilities retire aging power plants and bring new sources of electricity into service. Current utility plans show a transition to an energy mix that is over 75% carbon-free by 2034.[2] However, transmission capacity limits could slow the region's long-term growth of wind and solar energy development. The Minnesota Department of Commerce and the Minnesota Public Utilities Commission (PUC) continue to advocate for the state's interest in regional and federal forums to improve long-range regional transmission planning for a reliable and affordable transition to a decarbonized economy.

Supporting clean buildings and industry

Natural Gas Innovation Act (NGIA)

Passed in 2021 with strong bipartisan support, the Natural Gas Innovation Act (NGIA) creates a regulatory pathway to help Minnesota's natural gas utilities invest in innovative clean-energy resources and technologies. These resources could include electrification, renewable natural gas, biogas, green hydrogen, energy efficiency, carbon capture, district heating systems, or other resources. These resources offer the potential to reduce emissions, diversify Minnesota's energy supply, improve waste management, and support job creation and economic development throughout the state. The PUC has approved the framework to assess resource carbon intensity and cost-effectiveness within NGIA. Utilities are currently developing 5-year plans to be filed in 2023 for review and approval by the PUC. If done right, the NGIA can decrease GHG emissions from sectors that have been the hardest to decarbonize.

Energy Conservation & Optimization Act (ECO)

The 2021 Energy Conservation & Optimization Act (ECO) modernizes the Conservation Improvement Program (CIP) framework by allowing utilities to optimize energy use and delivery with load management and efficient fuel-switching programs. Fuel-switching measures must reduce energy usage and GHG emissions, be cost-effective, and improve the utility system load factor, compared to the displaced fuel source. ECO also raises the energy savings goals for the state's electric investor-owned utilities (IOUs), more than doubles the low-income spending requirement for all IOUs, provides greater planning flexibility for municipal and cooperative utilities, and includes activities to improve energy efficiency for public schools. Since the passage of ECO, the Minnesota Department of Commerce has focused on working with Minnesota stakeholders to develop the guidance and methodologies utilities need to deliver innovative and cost-effective CIP programs. Implementation of ECO-related programs will start in 2023.

Minnesota Efficient Technology Accelerator (META)

The Minnesota Efficient Technology Accelerator (META), working under the umbrella of the Conservation Improvement Program, supports programs that accelerate deployment and reduce the cost of emerging innovative technologies. META activities may include strategic initiatives with technology manufacturers to improve the efficiency and performance of products, as well as with equipment installers and other key actors in the technology supply chain. Benefits of activities expected from META include cost-effective energy savings for Minnesota utilities, lower bills for utility customers, enhanced employment opportunities in Minnesota, and avoidance of greenhouse gas emissions. The Center for Energy and Environment will begin implementing an approved 5-year META plan in 2023.

[2] Based on Xcel, Minnesota Power, OtterTail Power, and Great River Energy resource plans and announced retirements as of October 2022.

Advancing transportation options

National Electric Vehicle Infrastructure Program

The federal National Electric Vehicle Infrastructure (NEVI) program funds states to build electric vehicle charging infrastructure along highway corridors. The NEVI program provides $68 million to Minnesota and requires a $17 million match. The Minnesota Electric Vehicle Infrastructure Plan describes how Minnesota will spend the first year of NEVI Program funds. Minnesota's plan identifies potential exits along the I-35 and I-94 Alternative Fuels Corridors for fast charger installation. The Minnesota Department of Transportation (MnDOT) will conduct site feasibility analyses and manage a competitive site selection process in 2023 to install fast chargers at 16 sites. Minnesotans can expect to see the first round of fast chargers installed with NEVI funds by the end of 2024.

VW Settlement Grants

The Volkswagen Corporation (VW) violated air pollution standards for its diesel cars and sport utility vehicles. As part of the national legal settlement, Minnesota received $47 million to spend on projects to replace older, more polluting diesel vehicles and install electric vehicle charging infrastructure. The MPCA has invested $5 million from the VW Settlement fund in EV charging. Grants have funded 60 stations statewide, bringing the total miles of EV charging corridors to 3,600 miles. All stations from the first two phases of funding will be installed by early 2024. Between 2024 and 2027, there will be $1.76 million available for additional EV charging grants.

Active Transportation Program

MnDOT's Active Transportation Program envisions a state where all people can access safe and convenient active transportation where they live, work, and play. This year, thirteen cities and counties are receiving help with plans for walking and biking, and two communities are receiving assistance with quick-build or demonstration projects. Successful applicants in the Active Transportation Program receive support from a qualified consultant team. Each plan creates a road map for improvements through grants or community-led initiatives. Quick-build or demonstration projects assist communities in creating a concept and implementing a short-term change to a street in the community. Projects will begin being installed in 2023.

Climate-smart natural and working lands

Innovative technology to create renewable fuel

Deploying innovative technologies and increasing the adoption of climate-smart practices in Minnesota's agricultural sector holds tremendous opportunity for reducing GHG emissions, increasing carbon sequestration, and offsetting fossil fuel usage. Minnesota farmers are already using technologies like anaerobic digestion to treat livestock manure and other agricultural wastes. Anaerobic digestion reduces methane emissions from manure and creates renewable biogas that can be used on-site and lowers electricity and fossil fuel natural gas usage. Minnesota currently has three industrial-scale anaerobic digesters that remove impurities from biogas and convert it to renewable natural gas that is injected into natural gas pipelines for distribution for off-farm users. There is significant potential for expanding anaerobic digestion in Minnesota through implementing the Natural Gas Innovation Act, funding from the Minnesota Department of Agriculture's (MDA) Methane Digester Loan Program and Advanced Biofuel Incentive Program, payments through Low Carbon Fuel Standards, and federal funding available through the Inflation Reduction Act.

Soil health, water quality and carbon markets

Soil health activities mitigate climate change in several ways. Enhanced nitrogen and manure management can reduce both nitrous oxide and methane. Continuous living cover can store carbon in

the soil and decrease nitrogen fertilizer use. Investments comprehensively incentivize soil health practices that address climate resilience and adaptation on the farm, within Minnesota agri-businesses, and in broader agricultural market activities. On-farm activities include grant and loan funding to implement soil health activities. Agri-business funding assists with developing and enhancing markets for continuous living cover, encourages broader markets for climate-smart goods and services, and assists farmers as they consider carbon markets.

The Minnesota Agricultural Water Quality Certification Program (MAWQCP) promotes and quantifies the climate benefits of water quality and soil health practices that MAWQCP-certified farms implement. MAWQCP further accelerates the adoption of climate-smart practices through the program's Climate Smart Farm endorsement, which includes climate incentive payments to facilitate farmers' voluntary entry into carbon markets or public programs. MDA anticipates continuing and expanding programs that build climate-smart activities, including MAWQCP, Agriculture Best Management Practices loans, soil health grants, continuous living cover grants, Forever Green Initiative grants, groundwater nitrate research, technical assistance, and financial assistance.

State investment to increase seedling production at the State Forest Nursery

In 2021, the state legislature appropriated $2.5 million to the Minnesota Department of Natural Resources (DNR) to increase seedling production at the State Forest Nursery. The DNR put these funds to work by purchasing additional equipment and boosting procurement of seeds and cones. Increasing seedling production will accelerate sustainable forestry strategies that generate multiple benefits, including carbon sequestration. For example, high-quality seedlings are essential for replanting forests after harvest on public and private lands each year – a practice that promotes carbon sequestration in working forests. More seedlings are needed to increase forestlands – planting trees on formerly forested open lands – which also increases forest carbon sequestration. However, this one-time investment is only a start. Additional funding for procuring greater quantities of seeds, updating aging buildings and facilities, and developing a trained workforce is critical to sustained increases in seedling production.

Waste

Prevention of wasted food and food rescue

The MPCA received $1 million to award grants to organizations working to prevent food from going to waste or rescue food for donation. These funds are focused on prevention and rescue, and they cannot be used for waste management efforts (e.g., composting) to maximize the impact on GHG reduction. Reducing food waste both reduces emissions from Minnesota's waste sector and also emissions from the production and transportation of food, whether those emissions occur in Minnesota or outside of the state. To date, the MPCA has executed grant agreements for two rounds of grants, awarding eight projects. These grant funds support projects that reduce GHG emissions and increase food security for Minnesotans.

Solid Waste Management Act

Recycling in Minnesota has significant benefits in reducing greenhouse gas emissions. Making a product from recycled material generally uses up to 90% less energy than virgin material. The MPCA supports recycling in several ways. Numerous recycling grants pass money through to local government programs and private companies. The Recycling Education Committee helps haulers, counties, and cities get information to residents about the right way to recycle and decrease contamination. Dedicated staff work on developing new recycling markets so that recyclable materials maintain a fair price in the marketplace. In 2020, Minnesotans recycled 1.8 million tons of paper, plastic, aluminum, steel, and glass.

Conclusion

Minnesota's work to reduce climate pollution is paying off. The state has successfully reduced emissions approximately 23% since 2005 and we are closer than ever to meeting our Next Generation Energy Act goal of reducing emissions 30% by 2025. Individuals, organizations, and governments across Minnesota are taking steps to reduce climate pollution. This inventory shows these actions are working. During the pandemic, emissions declined across all sectors of the state's economy. However, emissions from key sectors like transportation, industry, and power generation were already trending downward in 2018 and 2019.

There is still significant work ahead to meet Minnesota's long-term goals. Minnesota's Climate Action Framework sets new GHG reduction goals for the state, based on the best available science. This includes reducing GHG emissions by 50% by 2030 and achieving net-zero emissions by 2050. To meet these goals, the state has put forward a roadmap of actions that will reduce greenhouse gas pollution in the form of Minnesota's Climate Action Framework. Visit mn.gov/framework for more information.

Appendix: Methodology

Greenhouse gas emission inventory

The GHG inventory reports progress toward statutory goals and provides information with high confidence and transparency. The long record of emissions and high level of data disaggregation using the best available data and methods based on EPA and Intergovernmental Panel on Climate Change (IPCC) recommendations helps ensure that the inventory is complete, consistent, transparent, accurate, and relevant.

Minnesota's state-level emission reduction goals are expressed as percentage reductions from estimated emissions in a historical baseline year (2005). Like most GHG inventories, the Minnesota GHG inventory has undergone substantial revisions since it was first built. It is in a state of continuous revisions as methods and data improve, and new emission sources are incorporated. These changes are applied to all inventory years to ensure consistency, including the 2005 baseline year. Developing a consistent time series of emissions estimates is essential to measure progress.

Not all emissions are included in statewide emission totals. Only those sources which can be included in the baseline year are evaluated. While ideally, all sources of GHG emissions from Minnesota would be inventoried and tracked, in practice, the inventory includes only those sources for which there exists a well-developed scientific understanding of the physical and biological processes involved in the production and emission of GHGs. Protocols or methods must exist, and data must be available to support estimation.

Only emissions that occur within the geographical borders of the state are estimated, with two exceptions. Our estimate includes net electricity imports to meet Minnesota's electricity demand, which exceeds in-state electricity production. Emissions from the combustion of aviation fuel purchased in Minnesota but not necessarily combusted within Minnesota air space are also included.

GHG inventory protocols require accounting for photosynthetically-removed carbon dioxide stored in biomass in forests, landfills, and structures. Long-term storage of wood-carbon in residential structures and demolition and construction landfills is included in statewide GHG emission totals as sequestration because the materials will remain as carbon stores for a long time. Forest carbon fluxes are included from forest land that remains forest land and land converted to forest land following the EPA state methodology report (2022). Other land use and land use change emissions and sequestration are not yet included in the inventory but may be incorporated in the future.

Emissions are estimated from 1970 to 2020, though presented here in an abbreviated timeline. With a few exceptions, the methods used to develop these estimates are derived from the following sources:

- U.S. Environmental Protection Agency (2022) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020.
- U.S. Environmental Protection Agency (2022) Methodology Report: Inventory of U.S. Greenhouse Gas Emissions and Sinks by State: 1990-2020.
- Intergovernmental Panel on Climate Change (2006) IPCC Guidelines for National Greenhouse Gas Inventories. Vol. 1-4.
- Intergovernmental Panel on Climate Change (2019) 2019 Refinement to the 2006 IPCC Guidelines on National Greenhouse Gas Inventories.
- Radian Corporation (1996) Methane emissions from the natural gas industry. Vol. 1-15. Prepared for the U.S. Environmental Protection Agency and the Gas Research Institute.

- California Air Resources Board, et al. (2010) Local government operations protocol for the quantification and reporting of greenhouse gas emissions inventories, version 1.1.
- The Climate Registry (2008) General reporting protocol, version 1.1.
- Minnesota Pollution Control Agency (2012) Greenhouse gas emissions in Minnesota: 1970-2008.

Changes in methods and data sources

The methods used to develop the emission estimates are generally consistent from year to year, and changes made since the last report are discussed here.

Data collection methods implemented by MnDOT improved our understanding of vehicle miles traveled and the breakdown of miles traveled by vehicle types, but it is only available for recent years. Comparisons to 2005 details are less accurate, but the trend in emissions is reflected in other inventories and still useful for tracking overall progress.

Since the last report, significant changes have been made to estimate forest carbon sequestration. The DNR recommended using forest carbon data produced by the U.S. Department of Agriculture Forest Inventory and Analysis and published in the Environmental Protection Agency Inventory of U.S. Greenhouse Gas Emissions and Sinks by State: 1990-2020.

Uncertainty of estimates and opportunities for improvements

It is difficult to calculate the precise amounts of GHG emissions; however, getting a reasonable estimate is still helpful in understanding the general scope of emissions.

Several methods and data sources are used to estimate emissions from each activity within a sector to get a comprehensive view. Some of the methods for generating the estimates are very detailed and are the result of site-specific measurements for both activity and emissions, while others are based on the use of a model with only general data to characterize the source of emissions.

The accuracy of data for different economic sectors can vary:

- Economic sectors that use fossil fuel combustion, such as electricity generation and heating, have low uncertainty, especially when aggregated to state totals because the activity is regulated and tracked.
- Emissions from on-road transportation are estimated using the MOVES model, which depends on vehicle population data and vehicle miles traveled.
- Methane generated from municipal solid waste in landfills is modeled. There is some uncertainty from data inputs and the model's underlying equations and assumptions.
- Emissions and sequestration from agriculture, forestry, and land use have a higher degree of uncertainty due to the multitude of factors influencing biological processes and the difficulty of obtaining accurate, relevant detailed information.

Within the scope of natural and working lands, there has been significant scientific development and growth in data collection because our lands offer ways to manage emissions and store carbon. As we implement new policies and change practices, it can be challenging to reflect those actions in the inventory calculations. As a result of the Climate Action Framework, teams of specialists, including state agency staff, academics and representatives from the agricultural sector, have begun to focus on this issue in Minnesota, and we plan to incorporate their recommendations into the state GHG inventory where possible. An example is to include any offsetting or reduction in emissions achieved through climate-smart practices such as cover crop, continuous living cover establishment, and nitrogen fertilizer management. While the extent of such practices is difficult to assess, an estimate of CO_2-equivalent reductions due to conservation practices funded through state cost-share and grants in 2022 indicated reductions of over 450,000 tons CO_2-e per year.

Appendix B – Comparison of the 2020 Minnesota and EPA state inventory estimates

A requirement of the CPRG program is to produce an inventory of state greenhouse gas emissions. States may use independently produced inventory data if compared to the state data in the EPA's *Inventory of US Greenhouse Gas Emissions and Sinks by State*[88] or use the EPA's State Inventory Tool. Since the MPCA produces an inventory of greenhouse gas emissions regularly, a comparison of estimates follows.

The EPA inventory used the IPCC AR5 global warming potentials and metric tons, and the MPCA 2020 inventory used short tons and the IPCC AR4 global warming potentials, so the MPCA inventory units and conversions had to be adjusted to be comparable. Therefore, the emission estimates for comparison here differ from the legislative report in Appendix A, but they are dimensionally equivalent.

Our definitions of sectors and data are often why the MPCA emissions estimates differ from EPA state estimates. The following discussion covers the similarities and differences between the two inventory systems. When the difference between estimates is greater than 10%, we tried to understand and explain the reasons for significant differences.

Transportation

The MPCA inventory estimates 32.7 MMT CO_2e from the transportation sector. This is a 17%, or 5.5 MMT CO_2e, difference from the EPA inventory estimate of 27.2 MMT CO_2e.

EPA breaks the transportation sector inventory into four subsections:

- CO_2 from fossil fuel combustion
- Substitution of ozone-depleting substances
- Mobile combustion
- Non-energy use of fuels

It is difficult to compare the subsections between the two reports without further breakdowns of the sources included in each. However, the *Inventory of U.S. Greenhouse Gas Emissions and Sinks by State*[89] and the *Methodology Report: Inventory of U.S. Greenhouse Gas Emissions and Sinks by State: 1990-2021*[90] indicate there may be some appropriate adjustments for direct comparison.

- Emissions due to natural gas transmission and distribution are included in the transportation sector of the MPCA inventory (1.15 MMT CO_2e). The EPA inventory includes this as part of the natural gas systems in the industrial sector.
- Non-highway emissions in the transportation sector of the EPA inventory include aviation, rail, and marine sources. The MPCA inventory non-highway category also includes military and other off-highway source estimates. A direct comparison of these categories is not possible with the

[88] EPA. https://www.epa.gov/ghgemissions/methodology-report-inventory-us-greenhouse-gas-emissions-and-sinks-state-1990-2021
[89] EPA. https://www.epa.gov/ghgemissions/state-ghg-emissions-and-removals
[90] EPA. https://www.epa.gov/ghgemissions/methodology-report-inventory-us-greenhouse-gas-emissions-and-sinks-state-1990-2021

information available. In the national inventory, the EPA estimates military aircraft and naval fuels for international bunker fuels, but these are not included in the national total. The MPCA estimates for military and other emissions are derived from the U.S. Energy Information Administration (2020) Fuel Oil and Kerosene Sales at the state level for distillate and residential fuel oil. Removing these estimates from the MPCA total is appropriate for comparison purposes.

- Finally, the methodology of the two inventories is different. EPA estimates fuel consumption nationally and then allocates fuel consumption to the states based on the percentage of fuel use by state from the U.S. Department of Transportation's Federal Highway Administration Highway (FHWA) statistics data (tables MF-225 and MF-226). MPCA uses Motor Vehicle Emission Simulator (MOVES) to estimate greenhouse gas emissions for the transportation sector. Though both inventories use FHWA data and MOVES, EPA determines national estimates and uses FHWA data to allocate emissions to the states, while MPCA derives statewide estimates based on vehicle miles traveled, reported to FHWA from the Minnesota Department of Transportation.

Forestry

Using EPA's state-level datasets to estimate the net flux of CO_2e from forests could yield different estimates, depending on which of EPA's tree-related land use, land use change, and forestry (LULUCF) categories are included.

- Forest land remaining forest land represents -12.64 MMT CO_2e
- Land converted to forest land represents -3.39 MMT CO_2e
- Settlements remaining settlements: tree biomass represents -0.866 MMT CO_2e

In the most recent version of Minnesota's statewide inventory, we considered only forest land remaining forest land and land converted to forest land for a total flux of -16.03 MMT CO_2e (-17.67 million short tons CO_2e). If tree biomass from land in settlement remaining in settlement were included, the total would be 16.9 MMT CO_2e (18.63 million short tons CO_2e).

There are no contemporaneous estimates for Minnesota's statewide carbon flux from forestry that differ from the EPA methodology. In previous versions of Minnesota's greenhouse gas inventory, an in-house method was used but has since been replaced by the EPA's more accurate and comprehensive methodology and results. The federal default values are empirically derived and should yield the most accurate assessment of forest land available for Minnesota. It should be noted that the EPA data published in 2022 was used for our most recent statewide greenhouse gas inventory. As discussed above, carbon fluxes for forests were less negative (revised upward) in the 2023 version. Our most recent statewide inventory reported -18.24 million short tons of CO_2e, as opposed to -17.64 million short tons of CO_2e, but using different versions of EPA data explains these differences.

One limitation of the EPA method is the lack of accounting for carbon associated with trees outside of some land use types, such as in agricultural settings (orchards, tree-intercropping, silvopasture, windbreaks, and shelterbreaks) and riparian zones.

Minnesota's current greenhouse gas inventory does not incorporate land-use estimates beyond forests, histosols in agricultural use, and inland waters, so it does not account for trees outside of the forest remaining forest and land converted to forest land use types. As mentioned previously, the EPA estimates carbon associated with trees in settlements. Minnesota's inventory could incorporate these settlement trees, but doing so without full implementation of other carbon fluxes associated with

settlement areas (and all land use and land use change categories) would skew Minnesota's accounting to overcount sequestration relative to emissions fluxes.

Finally, the EPA estimates carbon stored in harvested wood products at a national scale but not at the level of individual states. Our current greenhouse gas inventory estimates carbon storage in wood products used in housing and in construction and demolition landfills, but ignores other wood-based products and disposal of any such products in municipal solid waste landfills. We look forward to a centralized method for state-level downscaled data from the EPA in future iterations, which would replace our currently incomplete assessment of carbon stored in harvested wood products.

Minnesota's greenhouse gas inventory is organized differently than the EPA's regarding LULUCF. Instead of grouping greenhouse gas fluxes into LULUCF and agriculture sectors, Minnesota has historically grouped the accounting for natural and working lands (NWL) into a single agriculture, forestry, and land use sector. In 2020, Minnesota's NWL category represented a net flux of 22.97 MMT CO_2e. Combining EPA's LULUCF (-10.2 MMT CO_2e) and agriculture (26.7 MMT CO_2e) sectors for Minnesota results in a total of 16.5 MMT CO_2e, approximately 7.5 MMT CO_2e less than Minnesota's estimate. That said, there are still components of Minnesota's NWL category that are land use and land use change related and comparable to EPA's LULUCF sector. We detail those relevant components here.

Cultivated histosols (10 MMT CO_2e) corresponds incompletely to multiple EPA categories: croplands remaining croplands, land converted to croplands, grasslands remaining grasslands, and land converted to grasslands. These EPA categories total 5.46 MMT CO_2e. Minnesota's cultivated histosols category also partially overlaps with EPA's N_2O from agricultural soil management in the agriculture sector but only represents a small N_2O flux compared to other N_2O-related categories in Minnesota's inventory. Minnesota's cultivated histosol data comes from the DAYCENT model. Minnesota's inventory currently does not estimate carbon fluxes due to agriculture on mineral soils, while the EPA's shows agriculture on mineral soils to generally be a carbon sink due to things like increased adoption of conservation tillage and CRP enrollment, and likely explains at least some of the difference between Minnesota's and EPA's estimates for these sectors.

Rivers and streams (1.93 MMT CO_2e) and Reservoirs and lakes (1.15 MMT CO_2e) correspond incompletely to EPA's wetlands remaining wetlands and lands converted to wetlands sector (totaling 0.106 MMT CO_2e). Both inventories are missing fluxes from intact peatlands. Minnesota's inventory includes fluxes from lakes, which the EPA does not.

Prescribed burning and wildfire (0.03 MMT CO_2e) are included in Minnesota's inventory but are not explicitly included in EPA's inventory. Instead, EPA implicitly includes the effects of burning on various stores of carbon in grasslands and forests via measurements taken as part of the Natural Resources Inventory (NRI) and Forest Inventory Analysis (FIA). Ultimately, Minnesota's values in these categories are so small as to be unimportant.

Minnesota also estimates emissions caused by N mineralization and N fixation (total 4.18 MMT CO_2e). Both terms, however, sum the estimates from crop agriculture, grazing lands, and non-agricultural lands, so it is difficult to disentangle these from EPA's N_2O from agricultural soil management category, which is a much more comprehensive accounting of N_2O, but only within agricultural land use. EPA's N_2O from agricultural soil management source has other correlates in Minnesota's NWL category of our inventory.

Minnesota lacks estimates that correspond to EPA's settlements remaining settlements and land converted to settlements land use categories, which are a net source of 0.625 MMT CO_2e, per the EPA.

Agriculture

Minnesota combines agricultural and land use, land use change, and forestry (LULUCF) fluxes into a single natural and working lands category (NWL). Minnesota's agricultural components of NWL are cultivated histosols (10.0 MMT CO_2e), crop residues (2.27 MMT CO_2e), manure soil application (0.54 MMT CO_2e), fertilizer (3.43 MMT CO_2e), N mineralization (4.01 MMT CO_2e), N fixation (0.17 MMT CO_2e), N deposition (0.90 MMT CO_2e), N runoff (2.52 MMT CO_2e), feedlots (1.32 MMT CO_2e), manure management (2.78 MMT CO_2e), ruminants (5.21 MMT CO_2e), petroleum-based fuel consumption (2.58 MMT CO_2e), urea application (0.57 MMT CO_2e), wild rice cultivation (0.09 MMT CO_2e), field liming (0.01 MMT CO_2e), and agricultural burning of residues (0.03 MMT CO_2e). Minnesota also has methods to calculate coal, natural gas, and other fossil fuels, totaling less than 0.01 MMT CO_2e in 2020. Summing all of these equals 36.43 MMT CO_2e, which is 9.73 MMT CO_2e greater (36%) than EPA's Agriculture sector total for 2020 (26.7 MMT CO_2e).

Most agriculture-related components of Minnesota's NWL category map directly onto EPA's Agriculture sector components. However, Minnesota's cultivated histosols line item combines elements of EPA's LULUCF: Cropland and Grasslands categories and the Agriculture: N_2O from Agricultural Soil Management category and is more difficult to compare directly.

We expect Minnesota's total to be greater because of the inclusion of LULUCF-related emissions embedded in the cultivated histosols category, but it is difficult to disentangle the magnitude. EPA estimates emissions of croplands remaining croplands, lands converted to croplands, grasslands remaining grasslands, and lands converted to grasslands at 2.54, 1.62, 1.78, and -0.41 MMT CO_2e, respectively, for a total of 5.53 MMT CO_2e. Subtracting these values from Minnesota's agriculture total leaves Minnesota with an estimate that is 4.2 MMT CO_2e greater than EPA's for 2020.

In its most recent form, Minnesota's greenhouse gas inventory does not include any estimates of soil carbon changes occurring in mineral soils. EPA uses a Tier 3 method (DAYCENT model) to estimate this flux and found that mineral soils sequestered an estimated 32.9 MMT CO_2e at the national level in 2020.

Although the itemization between organic and mineral soils is not available from the EPA at the state level, if Minnesota were to include mineral soil carbon fluxes, the net emissions from the agriculture sector would likely be in closer agreement, though it is difficult to say exactly how close they would be without gathering DAYCENT results for Minnesota.

Several agricultural line items in Minnesota's inventory map onto EPA line items in a one-to-one fashion. Of those, all line items are within 10% of EPA's estimates, or their difference is less than 0.1 MMT CO_2e. Minnesota uses several categories to represent N_2O from agricultural soil management (mineralization, fixation, deposition, runoff, manure soil application, fertilizer, and a small piece of cultivated histosols). Minnesota also has line items for manure management (CH_4) and Feedlots (N_2O), whereas EPA estimates both gasses under the manure management line item. Finally, Minnesota estimates emissions from coal, oil, natural gas, and other fossil fuels, while EPA estimates emissions from CO_2 from fossil fuel combustion, mobile combustion, and stationary combustion. In all three of these sets of groupings, the totals for Minnesota and EPA are within 10% of each other.

Industrial

The MPCA inventory estimates 18.41 MMT CO_2e from the industrial sector in 2020. This is 37% less than the 29.17 MMT CO_2e estimated in the EPA inventory for 2020.

The EPA inventory breaks the industrial sector down into the following sources categories (sources with no number for the Minnesota level inventory have been excluded from this list):

- CO_2 from Fossil Fuel Combustion
- Natural Gas Systems
- Non-Energy Use of Fuels
- Petroleum Systems
- Iron and Steel Production
- Substitution of Ozone Depleting Substances
- Wastewater Treatment
- Urea Consumption for Non-Agricultural Purposes
- Mobile Combustion
- Carbon Dioxide Consumption
- Electronics Industry
- N_2O from Product Uses
- Stationary Combustion
- Other Process Uses of Carbonates
- Glass Production
- Magnesium Production and Processing
- Lead Production
- Landfills (Industrial)
- Carbide Production and Consumption

The MPCA inventory breaks the industrial sector down into the following source categories:

- Energy, by fuel type
- Coal storage
- Oil refining
- Peat mining/use
- Industrial wastewater treatment
- Taconite induration
- Refinery processes
- Steel production
- Glass manufacturing
- Secondary lead production
- Paraffinic wax consumption
- Industrial solvent release
- Other industrial volatile organic compounds (VOC) and Toxic Release Inventory (TRI) releases
- Other industrial processes
- Industrial refrigeration
- Solvent use
- Semiconductor manufacture
- Magnesium casting

In addition, the MPCA waste sector contains emissions from industrial landfills. The EPA inventory includes these emissions in the industrial sector. These emissions have been counted in the industrial sector for this comparison.

As seen above, the breakdown in the specific sources for each sector is quite different between the two inventories. This makes comparing the two difficult and reduces the validity of any comparisons between them.

The most significant difference between the two appears in the iron and steel production source in the EPA inventory. The closest matching sources in the MPCA inventory are the steel production and taconite induration sources. Based on Greenhouse Gas Reporting Program (GHGRP) data, the EPA estimates emissions from iron and steel production to be 14.02 MMT CO_2e in 2020, which is over 75% of the total emissions in the industrial sector in the MPCA inventory. The MPCA inventory taconite induration and steel production sources, based on production data and criteria air emissions reporting, are estimated to have emitted 1.62 MMT CO_2e. The MPCA inventory estimates for taconite production emissions are calculated based on data in production reports made to the Minnesota Department of Revenue. We have high confidence in the underlying data and emissions estimates from various induration methods.

Without knowing the source of the underlying numbers for the EPA inventory, we are not able to determine the source of this difference in estimates. We are not able to locate the complete data the EPA used to estimate the 14.02 MMT CO_2e of emissions from the iron and steel production source. Using the Minnesota 2020 data in the Facility Level Information on Greenhouse Gases Tool, the total sum of all facilities in the iron and steel production sector is only 2.5 MMT CO_2e.[91] This is closer to the MPCA inventory estimate of 1.62 MMT CO_2e, which only includes process emissions. Fuel combustion emissions are reported at industrial sector level totals and can be traced to individual facilities, but are not organized this way in regular reporting.

Another source of difference between the estimated emissions is in the accounting of emissions from natural gas systems. In the EPA inventory, these emissions are included in the industrial sector. In the MPCA inventory, any emissions related to natural gas transportation are included in the transportation sector. This accounts for 1.38 MMT CO_2e.

Additionally, it is possible the MPCA inventory estimate is low due to a lack of data for industrial processes using HFCs, PFCs, and SF_6. The total emissions from industrial processes might be as much as 0.9 MMT CO_2e below actual levels.

Commercial and waste

The MPCA inventory estimated 14.67 MMT CO_2e from the commercial and waste sectors in 2020. This is 60% more than the 8.76 MMT CO_2e estimated in the EPA inventory for 2020.

The EPA inventory structure includes landfill and wastewater emission sources in the commercial sector, whereas the MPCA inventory structure separates waste activity emissions into its own economic sector. The MPCA commercial and waste sectors were combined for comparison.

The EPA inventory breaks the commercial sector down into the following source categories:

- CO_2 from Fossil Fuel Combustion
- Landfills (Municipal)
- Substitution of Ozone-Depleting Substances
- Wastewater Treatment
- Composting
- Stationary Combustion
- Anaerobic Digestion at Biogas Facilities

The MPCA inventory breaks the commercial sector down into the following source categories:

- Energy, by fuel types
- Medical uses
- Limestone use
- Solvent uses
- Air conditioning and space cooling

[91] FLIGHT, stored at https://ghgdata.epa.gov/ghgp/main.do

The MPCA inventory breaks the waste sector down into the following source categories:

- Sludge incineration
- Natural gas
- Distillate fuel oil
- Landfill Operations
- Yard Waste Reprocessing
- MRF
- RDF Processing
- LFG Combustion/Flaring
- Rural Open Burning
- Medical Waste Incineration
- Municipal Wastewater
- Yard waste composting
- Biosolids Land Application
- MMSW Landfills
- Industrial Landfills
- Sequestration in demolition/construction landfills

The industrial landfills source in the MPCA inventory waste sector is compared as part of the Industrial sector to align with the EPA inventory industrial sector.

As seen above, the breakdown in the specific sources for each sector is quite different between the two inventories. This makes comparing the two difficult and reduces the validity of any comparisons.

The most significant difference between the two sectors is the difference in CO_2e emitted from fossil fuel combustion. This correlates to the CO_2 from fossil fuel combustion, stationary combustion, and fossil fuel combustion: other greenhouse gases in the EPA inventory. The EPA estimates 6.55 MMT CO_2e in 2020 from these sources, while the MPCA inventory estimates 12.48 MMT CO_2e.

The majority of the emissions from the 12.48 MMT CO_2e fossil fuel combustion for the MPCA inventory are from CO_2 from the combustion of petroleum-based fuel (7.33 MMT CO_2e) and natural gas (5.09 MMT CO_2e). The MPCA inventory obtains consumption estimates for these fuels from the Department of Energy, Energy Information Administration through the Natural Gas Annual and the State Energy Data System (SEDS), and we are confident in the data and results produced.

According to the methodology report for the EPA inventory, the EPA uses similar sources for data, including SEDS and the Monthly Energy Review from the EIA. However, without the underlying calculations, it is difficult to determine where the differences in consumption estimates, emissions calculations, or emissions allocation occur.

Electricity generation

The MPCA inventory estimates 23.74 MMT CO_2e from the electricity generation sector in 2020. This is 14% higher than the EPA inventory estimate of 20.34 MMT CO_2e. However, the EPA inventory does not include imported electricity necessary to meet Minnesota's demand that exceeds in-state electricity generation. Removing imported electricity from the MPCA inventory results in an estimated 19.87 MMT CO_2e for 2020, which is 2% less than the EPA's estimate. No additional explanation is necessary since this difference is less than 10%.

Residential

The MPCA inventory estimates 9.12 MMT CO_2e from the residential sector in 2020. This is 8% less than the 9.84 MMT CO_2e estimated in the EPA inventory for 2020. No additional explanation is necessary since this difference is less than 10%.

Appendix C – Greenhouse gas estimation methods for PCAP measures

The Energy Policy Simulator[92] scenario created for the Minnesota Climate Action Framework[93] is the baseline for activities across the state. That scenario contains enacted policies such as the 2040 clean energy goal and renewable energy standards. That scenario was modified as described below for our priority activities for the PCAP greenhouse gas analysis.

The MPCA used policy levers provided by the Energy Policy Simulator tool. Sometimes we had to use policies to *represent* categories of activities even if the policy itself is not proposed in Minnesota's PCAP or Climate Action Framework. This methods document describes those translations.

Other tools supplemented the Energy Policy Simulator analysis. All estimates within the Climate Smart Natural and Working Lands category were derived from peer-reviewed literature, Minnesota-specific market data, and resources published by the US government (e.g., EPA, USDA, USFS). Scenarios such as adoption rates of new technologies were determined by expert opinion.

1. Clean transportation

The Electric Vehicle Sales Standard policy was used to represent the accelerated transition to zero-emission vehicles in Measure 1.1. The policy is parameterized with the assumption that 75% of passenger vehicles, light-duty commercial vehicles, buses, and heavy- and medium-duty trucks sold in 2050 are electric, and 5% of rail and marine cargo vessel sales are electric. The implementation schedule is based on the Statewide Multimodal Transportation Plan,[94] and the impact on vehicle sales is shown in Table 6. The use of this simulator policy does not mean that Minnesota will further pursue an electric vehicle sales standard beyond the adoption of its current Clean Cars Minnesota standards.

Table 6: Electric vehicle sales standard parameters and implementation schedule

Parameter	2025	2030	2035	2040	2050
% of progress toward implementation of sales standard	30%	50%	65%	80%	100%
% of total on-road vehicle sales that are electric vehicles	22.5%	37.5%	48.8%	60%	75%
% of total rail and marine cargo vessel sales are electric	1.5%	2.5%	3.25%	4%	5%

A low-carbon fuel standard policy was used to represent a transition in Measure 1.1 and Measure 1.2 to low-carbon fuels and the adoption of lower-carbon vehicles and equipment that reduce the overall carbon emissions from transportation 15% by 2050. The implementation schedule is a 7.5% emission reduction achieved by 2030 and a 15% emission reduction achieved in 2050. The use of this simulator policy does not indicate that Minnesota will pursue a fuel standard, and was used only to the extent that the simulator was able to represent the impact of a transition toward lower-carbon intensity fuels by choice.

[92] Energy Innovation and RMI. 2003. Energy Policy Simulator v.3.4.3. https://energypolicy.solutions/simulator/minnesota/en
[93] Minn. Climate Action Framework. 2022. https://climate.state.mn.us/minnesotas-climate-action-framework
[94] Minn. Department of Transportation. 2022. Statewide Multimodal Transportation Plan https://minnesotago.org/final-plans/smtp-final-plan-2022

Mode shifting represents the decrease in vehicle miles traveled per capita in Measure 1.2. The implementation schedule necessary to align the model with the Statewide Multimodal Transportation Plan goals is shown in Table 7.

Table 7: Mode shifting implementation schedule to meet goals

Parameter	2025	2030	2035	2040	2050
% of progress toward 2050 goal to achieve interim goals	20%	40%	55%	70%	100%
% decrease in vehicle miles traveled	4%	8%	11%	14%	20%

Other transportation sector policies set in the baseline model are:

- A rebate for electric passenger vehicles at 1% of the vehicle purchase price from 2024-2040
- A fuel economy standard aligned with current proposed rates

2. Climate-smart natural and working lands

Peatlands: Approximately 279,000 acres of Minnesota peatlands on public lands and 395,000 acres on private lands have been impacted by past efforts to drain the land for agricultural and other purposes; many of these drained peatlands have since been "abandoned" and transferred to local or state ownership. We assumed that 100,000 acres could be reestablished at a rate of 25,000 acres every five years, starting in 2027 and finishing in 2042. In each of those cohorts, 10,000 acres would be converted from partially drained peatlands, 7,500 acres from crop agriculture, and 7,500 from pasture. Emission factors were derived from peer-reviewed meta-analyses.[95]

Grassland corridors: Minnesota Department of Transportation manages over 175,000 acres of roadside. Counties and townships manage at least 400,000 acres of roadside. We assumed that 200,000 acres of roadside could be converted from low diversity plantings to high diversity grassland habitats. We assumed that 25,000 acres of waterways could be upgraded from low diversity plantings to high diversity grassland habitat. Finally, Minnesota has 1.7 million acres of urban area according to the National Resources Inventory. We assumed that 2% of this total area (34,000 acres) could be converted from lawns to high diversity grasslands in five cohorts, starting in 2027 and finishing in 2045. Emission factors were all derived from peer-reviewed meta-analyses.[96]

Forests: Minnesota currently has about 17 million acres of forest, many of which are well managed. We assumed that optimal management of all current forest acreage may increase sequestration rates by 2% for the state compared to 2021 rates, as determined by the EPA.[97] Minnesota's urban and community forests sequester a net of 203.5 tons annually.[98] We assumed that additional planting and management could result in a 10% increase in sequestration starting in 2026. We did not estimate greenhouse gas reductions stemming from reduced heating and cooling expenses as a result of additional urban trees. Finally, according to the EPA greenhouse gas inventory, Minnesota lands converted to forest sequesters 3.4 MMT CO_2e per year. We assumed that aggressive establishment of windbreaks, living snow fences, and shelterbreaks starting in 2026 could result in similar land use related changes and carbon sequestration, even though these new stands may not meet the EPA's definition of forest land due to

[95] (Ciborowski 2022 and citations therein)
[96] (Ciborowski, 2022; Yang et al., 2019)
[97] (EPA, 2023).
[98] Nowak et al., 2013

their small areas or linear shapes. We assumed 10% of existing flux due to lands converted to forest could be replicated in these tree plantings.

Agricultural practices: We considered seven agricultural practices aimed at sequestering carbon and improving soil health. All emission factors were derived from meta-analyses and other peer reviewed literature.[99] Regarding agroforestry, we assumed that 100,000 acres of Minnesota's current 21.8 million acres of cropland could be established starting in 2026. Regarding optimized prescribed grazing, we assumed that 200,000 of Minnesota's existing >1,000,000 acres of pasture could be implemented starting in 2026. Regarding silvopasture, we assumed that 100,000 of Minnesota's existing >1,000,000 acres of pasture could be implemented starting in 2026. Regarding winter cover crops, no-till practice, reduced tillage practices, and perennial cropping, we assumed each practice could be applied to 1,000,000 acres, either separately or on shared acreage.

Nutrient management: Regarding split nitrogen applications and nitrification inhibitors, we assumed both practices could be applied to 2,000,000 acres, either separately or on shared acreage. Emission factors were derived from peer reviewed publications.[100]

Feed additives: We assumed that feed additives could reduce methane emissions from enteric fermentation by 50% for 20% of the ruminants in the state. The EPA estimates that enteric fermentation generated 4.83 MMT of CO_2e in Minnesota during 2020, so feed additives could reduce total emissions by 0.483 MMT CO_2e per year. These additives are not yet market ready, so we assumed full adoption of this scenario beginning in 2029. The change in emissions was based on a review by Palangi and Lackner (2022).

Manure and food waste storage utilization: Minnesota is home to large populations of swine, dairy, beef, and poultry, which together produce about 100 million tons of manure per year. Minnesota also has large organic waste streams related to food and beverage industries and wastewater treatment facilities. Estimating emissions reductions due to anaerobic digestion, composting, lagoon covers, flaring, manure drying, and other manure and organic waste management activities is especially difficult because outcomes vary by livestock species, feedstocks, scale, and many site-specific considerations. Regarding anaerobic digestors, based on publicly available data on anaerobic digesters in Minnesota and Wisconsin,[101] we assumed that 20 medium-sized, on-farm or regional anaerobic digesters could be operational by 2028. On average, each digester would offset 20,000 metric tons of CO_2e annually.

Regarding industrial composting, we assumed that half of organic materials currently sent to landfills (210 of 420 metric tons) in Minnesota could be diverted to compost.[102] We used EPA's Waste Reduction Model (WARM) model to determine the greenhouse gas impacts of this change. Regarding manure, we assumed that 10% of the current manure in the state could be diverted to compost, which reduces methane emissions by about 50%, with significant variability based on season and management, as well as varied impacts on N_2O emissions.[103] Manure separation benefits are included in the calculation of manure composting; we did not calculate additional potential benefits of waste separation in isolation to avoid double counting of emissions reductions. We assumed that both food and manure composting could be fully operational by 2027.

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[99] (Ciborowski 2022 and citations therein)
[100] (Ciborowski 2022 and citations therein)
[101] USDA, AgSTAR https://www.epa.gov/agstar/livestock-anaerobic-digester-database
[102] MPCA 2019/2020 Food Waste Generation And Composition Study Analysis, available at https://www.pca.state.mn.us/sites/default/files/w-sw1-67.pdf and MPCA SCORE Report, available at https://www.pca.state.mn.us/air-water-land-climate/understanding-solid-waste
[103] (Peterson et al., 2013)

Regarding manure storage covers, we assumed that an additional 10% of the state's existing manure could be switched from uncovered lagoons to covered lagoons. Covers include a diverse set of materials and practices, with varied impacts on methane production, so we conservatively assume that covers can reduce methane production by 15%.[104]

Biochar: We assumed that at a rate of 15,000 tons per acre, 50,000 acres of croplands could be augmented with biochar in cohorts of 10,000 acres every three years, starting in 2026 and ending in 2038. Emission factors were derived from meta-analyses and other peer-reviewed literature.[105]

Anaerobic digesters for industrial food processing waste: We assumed that the average anaerobic digester can process 11,440 tons of waste and that 0.75 metric tons of CO_2e is avoided for every ton of food waste anaerobically digested.[106,107] We assumed one industrial food processing facility would have an anaerobic digester operating beginning in 2028 and two more would be operational in 2030.

3. Clean energy and efficient buildings

For Measures 3.1 and 3.2, the same model settings were applied for residential (urban and rural) and commercial buildings. However, residential and commercial buildings were modeled separately in the Energy Policy Simulator to isolate the greenhouse gas reductions from policies targeting different building types. The results from running these building categories separately are very similar, but not equal to, modeling the complete set of policies together.

A building energy efficiency standard on new components for new and existing buildings represents actions under Measure 3.1 and Measure 3.2. The model was set with a 10% reduction in energy use in 2030 and a 25% reduction in energy use in 2050 for all commercial and residential buildings and all components, including heating, cooling and ventilation, envelope, lighting, appliances, and other elements.

Building component electrification represents actions under Measure 3.1 and Measure 3.2. The model was set to increase the share of newly-sold electric appliances and heating systems to 85% by 2050.

Weatherization and retrofitting of existing buildings was set to improve 20% of currently existing residential and commercial buildings by 2050, which will address about half of the current buildings predicted to survive to 2050, representing actions under Measure 3.1 and Measure 3.2.

4. Clean economy

The transition to cleaner energy in the industrial sector in Measure 4.1 is modeled with 40% of fuel shifted to electricity in all industry categories by 2050.

Waste heat recovery in Measure 4.1 is modeled where 15% of the total state potential is achieved in 2030[108] and 50% of the total state potential is achieved by 2050.

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[104] (Veltman et al., 2018)
[105] (Ciborowski 2022).
[106] EPA. 2021. Anaerobic Digestion Facilities Processing Food Waste on the United States 2019. https://www.epa.gov/system/files/documents/2023-04/Anaerobic_Digestion_Facilities_Processing_Food_Waste_in_the_United_States_2019_20230404_508.pdf
[107] ReFED Insights Engine https://insights.refed.org/
[108] Minn. Climate Action Framework. 2022. https://climate.state.mn.us/minnesotas-climate-action-framework

Increasing energy efficiency in all industrial categories in Measure 4.1 is modeled with a 10% reduction in energy use in 2030[109] and a 20% reduction in energy use in 2050. The potential of efficiency improvements from system design is modeled as accomplishing 50% of system design changes by 2050. To describe replacing inefficient, older industrial facilities with new technologies, facilities are retired early in the model, with 5% retiring by 2030 and 20% retiring by 2050.

Measure 4.1 includes many options to reduce the use of high global warming potential (HGWP) fluorinated refrigerant gases, also known as F-gases. F-gas substitution is modeled on an implementation schedule where 50% of F-gases are replaced with less-harmful gases by 2030, and 100% are substituted by 2050. F-gas recovery and destruction are modeled on an implementation schedule where 50% of F-gases are recovered by 2030, and 100% are recovered by 2050. F-gas maintenance and repairs to reduce leaks is modeled with an implementation schedule of 50% of leaks addressed by 2030 and 100% of leaks addressed by 2050.

The potential impact of developing clean fuel stocks in Measure 4.2 is modeled within multiple policies. Hydrogen production for off-site use is shifted to 100% electrolysis production by 2050.[110] The EPS tool does not have the capability to designate new fuel production. Increasing the demand response capacity of the grid integrates more clean electricity and is modeled at 80% of the potential achieved by 2050. Increasing the grid transmission capacity by 20% by 2050 is also modeled. The increases in efficiency and reductions in energy use in other areas could be accomplished by the types of alternative fuels described.

Methane capture and destruction from the waste and wastewater treatment sectors is modeled for Measure 4.2 as achieving 50% of the state potential by 2050.

Measure 4.3 was modeled using waste prevention solutions from the ReFED[111] tool for Minnesota. Emissions impacts modeled in ReFED are from implementing manufacturing byproduct utilization, manufacturing line optimization, food service temperature monitoring, food service waste tracking, consumer education campaigns, package design, trayless packaging, centralized composting, conversion for livestock feed, and all food rescue opportunities.

[109] Minn. Climate Action Framework. 2022. https://climate.state.mn.us/minnesotas-climate-action-framework
[110] This policy does not impact on-site production and consumption.
[111] ReFED Insights Engine https://insights.refed.org/

Appendix D – LIDAC census tracts in Minnesota

The following table lists the census tracts that qualify as LIDACs based on the Climate Justice Economic Screening Tool, which includes tracts that qualify as LIDACs using the CEJST Categories of Burden as well as the additional areas that qualify based on being above the 90th percentile for one or more EJScreen Supplemental Indices. All Tribal areas are considered LIDACs, as well. Because EJScreen uses census block groups (not census tracts) and because Tribal boundaries don't align with census tract boundaries, some tracts on the list are partly, but not fully, comprised of LIDAC areas.

Table 8: Minnesota census tracts that qualify as LIDACs (based on census tract classifications in the 2010 Census)

Census tract 2010 ID	County
27001770100	Aitkin County
27001770300	Aitkin County
27001770400	Aitkin County
27003050807	Anoka County
27003050901	Anoka County
27003051304	Anoka County
27003051501	Anoka County
27005450100	Becker County
27005450500	Becker County
27005940000	Becker County
27007450500	Beltrami County
27007450702	Beltrami County
27007940001	Beltrami County
27007940002	Beltrami County
27011950300	Big Stone County
27013171202	Blue Earth County
27017070100	Carlton County
27017940000	Carlton County
27021940001	Cass County
27021940002	Cass County
27021960100	Cass County
27021960200	Cass County
27021960600	Cass County
27021960700	Cass County
27027020202	Clay County
27029000200	Clearwater County
27029000300	Clearwater County
27031480100	Cook County
27033270100	Cottonwood County
27033270400	Cottonwood County
27035951000	Crow Wing County
27035951100	Crow Wing County
27035951200	Crow Wing County
27037060105	Dakota County
27037060711	Dakota County
27045960500	Fillmore County
27047180600	Freeborn County
27047180800	Freeborn County
27047180900	Freeborn County
27049080200	Goodhue County
27051070100	Grant County
27053000102	Hennepin County
27053001700	Hennepin County
27053002200	Hennepin County
27053002700	Hennepin County
27053003300	Hennepin County
27053005901	Hennepin County
27053005902	Hennepin County
27053007801	Hennepin County
27053008200	Hennepin County
27053008300	Hennepin County
27053008400	Hennepin County
27053008500	Hennepin County
27053009500	Hennepin County
27053012003	Hennepin County
27053020200	Hennepin County
27053020301	Hennepin County
27053020304	Hennepin County
27053021502	Hennepin County
27053024802	Hennepin County
27053024903	Hennepin County
27053026809	Hennepin County
27053026819	Hennepin County
27053100400	Hennepin County
27053100700	Hennepin County
27053100800	Hennepin County

Census tract 2010 ID	County
27053100900	Hennepin County
27053101300	Hennepin County
27053101600	Hennepin County
27053101800	Hennepin County
27053102000	Hennepin County
27053102100	Hennepin County
27053102300	Hennepin County
27053102500	Hennepin County
27053102800	Hennepin County
27053102900	Hennepin County
27053103400	Hennepin County
27053104100	Hennepin County
27053104400	Hennepin County
27053104800	Hennepin County
27053104900	Hennepin County
27053105700	Hennepin County
27053106000	Hennepin County
27053106200	Hennepin County
27053106400	Hennepin County
27053107000	Hennepin County
27053107400	Hennepin County
27053108600	Hennepin County
27053109400	Hennepin County
27053110000	Hennepin County
27053125700	Hennepin County
27053125800	Hennepin County
27053125900	Hennepin County
27053126000	Hennepin County
27053980000	Hennepin County
27057070100	Hubbard County
27057070600	Hubbard County
27061480100	Itasca County
27061940000	Itasca County
27067770900	Kandiyohi County
27067780500	Kandiyohi County
27067780800	Kandiyohi County
27069090100	Kittson County
27071790300	Koochiching County
27071790500	Koochiching County
27077460300	Lake of the Woods County
27077460400	Lake of the Woods County
27083360500	Lyon County
27083360700	Lyon County
27085950700	McLeod County
27087940100	Mahnomen County
27087940300	Mahnomen County
27091790600	Martin County
27095970100	Mille Lacs County
27095970200	Mille Lacs County
27095970300	Mille Lacs County
27097780100	Morrison County
27097780600	Morrison County
27099000100	Mower County
27099000300	Mower County
27099000410	Mower County
27099000800	Mower County
27105105400	Nobles County
27105105500	Nobles County
27105105600	Nobles County
27109000100	Olmsted County
27109000200	Olmsted County
27109000300	Olmsted County
27111960300	Otter Tail County
27111960500	Otter Tail County
27111960900	Otter Tail County
27111961300	Otter Tail County
27115950400	Pine County
27115950500	Pine County
27119020200	Polk County
27119020700	Polk County
27123030400	Ramsey County
27123030500	Ramsey County
27123030601	Ramsey County
27123030704	Ramsey County
27123030800	Ramsey County
27123030900	Ramsey County
27123031000	Ramsey County
27123031100	Ramsey County
27123031300	Ramsey County
27123031400	Ramsey County
27123031500	Ramsey County
27123031600	Ramsey County
27123031701	Ramsey County
27123031702	Ramsey County

Census tract 2010 ID	County
27123031801	Ramsey County
27123031802	Ramsey County
27123032400	Ramsey County
27123032500	Ramsey County
27123032600	Ramsey County
27123032700	Ramsey County
27123033000	Ramsey County
27123033100	Ramsey County
27123033400	Ramsey County
27123033500	Ramsey County
27123033600	Ramsey County
27123033700	Ramsey County
27123033900	Ramsey County
27123034400	Ramsey County
27123034500	Ramsey County
27123034601	Ramsey County
27123034602	Ramsey County
27123034701	Ramsey County
27123035900	Ramsey County
27123036100	Ramsey County
27123037100	Ramsey County
27123037403	Ramsey County
27123037602	Ramsey County
27123040901	Ramsey County
27123040902	Ramsey County
27123042800	Ramsey County
27127750100	Redwood County
27127750300	Redwood County
27131070800	Rice County
27131070901	Rice County
27131070902	Rice County
27135970400	Roseau County
27137001400	St. Louis County
27137001600	St. Louis County
27137001700	St. Louis County
27137001800	St. Louis County
27137001900	St. Louis County
27137003300	St. Louis County
27137003700	St. Louis County
27137003800	St. Louis County
27137011200	St. Louis County
27137012200	St. Louis County
27137012400	St. Louis County
27137013000	St. Louis County
27137013100	St. Louis County
27137013800	St. Louis County
27137015500	St. Louis County
27137015600	St. Louis County
27139080302	Scott County
27139080400	Scott County
27139080903	Scott County
27139080905	Scott County
27145000302	Stearns County
27145000500	Stearns County
27145000801	Stearns County
27145011500	Stearns County
27147960400	Steele County
27151960200	Swift County
27151960400	Swift County
27153790100	Todd County
27153790200	Todd County
27153790300	Todd County
27153790600	Todd County
27159480300	Wadena County
27161790500	Waseca County
27173970100	Yellow Medicine County

State of Illinois

PRIORITY CLIMATE ACTION PLAN

Illinois Environmental Protection Agency

March 1, 2024

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RMI

2R Group

Definitions and Acronyms

Climate and Equitable Jobs Act (CEJA): an Illinois law which, among other things, set a statewide target of 100% clean energy by 2050. It was passed by the General Assembly and signed into law by Governor Pritzker on September 15, 2021.

Comprehensive Climate Action Plan (CCAP): a narrative report that provides an overview of the grantees' significant GHG sources/sinks and sectors, establishes near-term and long-term GHG emission reduction goals, and provides strategies and identifies measures that address the highest priority sectors to help the grantees meet those goals.

Greenhouse gas (GHG) inventory: a list of emission sources and sinks and the associated emissions quantified using standard methods.

Inflation Reduction Act (IRA): a 2022 federal law which supports clean energy and climate investments.

Low Income / Disadvantaged Communities (LIDACs): communities with residents that have low incomes, limited access to resources, and disproportionate exposure to environmental or climate burdens. Although the Inflation Reduction Act does not formally define LIDACs, EPA strongly recommends grantees use the Climate and Economic Justice Screening Tool and the Environmental Justice Screening and Mapping Tool to identify LIDACs in their communities. These tools identify LIDACs by assessing indicators for categories of burden: air quality, climate change, energy, environmental hazards, health, housing, legacy pollution, transportation, water and wastewater, and workforce development.

MTCO2e: metric tons of carbon dioxide equivalent.

MMTCO2e: million metric tons of carbon dioxide equivalent.

Priority Climate Action Plan (PCAP): a narrative report that includes a focused list of near-term, high-priority, and implementation-ready measures to reduce GHG pollution and an analysis of GHG emissions reductions.

SIT: US EPA's State Inventory Tool.

US EPA: United States Environmental Protection Agency.

US EIA: United States Energy Information Administration.

Table of Contents

Executive Summary

Illinois has already been hard at work to address the problem of climate change.

The centerpiece of that work is the Climate and Equitable Jobs Act (CEJA), signed into law in 2021, which commits the state to 100% carbon-free power by 2045 while also supporting energy efficiency, electric vehicles, and building electrification, and reforming utility planning and regulation.

The state has been a national leader on climate:

- Governor Pritzker signed an executive order in 2019 committing the state to the principles of the Paris Climate Agreement.
- The Illinois Capital Development Board will approve the state's first-ever stretch energy code in June 2024.
- The Illinois Commerce Commission is set to begin proceedings on the Future of Gas, to explore pathways towards a decarbonized buildings sector, in the first half of 2024.
- Since being named the Climate Bank in CEJA, the Illinois Finance Authority, in partnership with the Illinois Environmental Protection Agency, mobilized approximately $627 million in private capital for climate finance projects, 54% of which are in or benefit low-income and disadvantaged communities.
- The state has set a goal of having 1 million electric vehicles on the road by 2030.

Emissions

Illinois' annual greenhouse gas emissions today are estimated at 228 MMTCO2e, with transportation (60 MMTCO2e) accounting for the largest share, followed by power (52 MMTCO2e). This represents a nearly 20% decline from 2005 emissions, which were 283.6 MMTCO2e. Power was the largest sector by emissions in 2005 with 94 MMTCO2e, and also saw by far the biggest decline of any sector between 2005 and 2021. The second-largest source of emissions in 2005 was transportation with 72 MMTCO2e.

Meeting Illinois' commitment to the Paris Climate Agreement would require cutting emissions about 39% from current levels to 139 MMTCO2e.

PCAP

This Priority Climate Action Plan (PCAP) proposes a path towards broad emissions reductions in every large-emitting sector of the economy. It also explores specific series of potential actions within those measures, with an emphasis on filling gaps in existing federal and state programs, and catalyzing projects that also leverage other sources of funding. Nearly all measures explore the workforce development efforts that will be necessary to achieve them, and the benefits they can provide to low-income and disadvantaged communities (LIDACs).

The Plan also draws from and builds upon the work of many entities in our state that have developed their own climate action plans: the City of Chicago, the Chicago metropolitan region, the Illinois Department of Natural Resources, and the University of Illinois in both Chicago and Urbana-Champaign.

Introduction

CPRG overview

The U.S. Environmental Protection Agency (EPA) Climate Pollution Reduction Grant (CPRG) program provides funding for states to develop and implement climate action plans that aim to reduce greenhouse gas (GHG) emissions.

Under the planning phase of CPRG, the U.S. EPA has provided funds to interested states, metropolitan areas, tribes and territories to design climate action plans that incorporate a variety of measures to reduce GHG emissions. A Priority Climate Action Plan must be submitted to USEPA by March 1, 2024, with a Comprehensive Climate Action Plan due two years after the planning grant award.

Additional information on the PCAP process can be found in EPA's CPRG: Formula Grants for Planning, Program Guidance for States, Municipalities, and Air Control Agencies.

Illinois Approach

The State of Illinois recognizes the harm that climate change causes to its people and to those who live outside its borders. It recognizes that climate change is primarily caused by humans and by the burning of fossil fuels, and that the harms from pollution and climate change are disproportionately borne by our most vulnerable people and communities.

Addressing the problem of climate change is urgent and necessary to protect the health and well-being of our people. It is necessary to protect our livelihoods, our economy, our rich farmlands, our vibrant cities, and our natural wonders.

Our actions to address climate change not only help us to avoid the bad, but to promote the good: creating jobs and opportunities, growing the clean energy economy in our state, and leaving us with cleaner air to breathe and water to drink.

Despite our progress, there is still much work to be done to meet the goals of the Paris Agreement and avoid the worst impacts of climate change. Rising to this challenge will require resources, and extensive collaboration between states, municipalities, and the federal government.

We hope this plan can be a tool to coordinate and catalyze climate action in businesses and communities across our state, and to unlock critical opportunities for climate action that we could not pursue alone without the support of federal Climate Pollution Reduction Grant resources.

How to read this Priority Climate Action Plan

The Priority Climate Action Plan includes the following main components:

- **Greenhouse Gas (GHG) Inventory:** An analysis of Illinois' existing GHG emissions by sector.
- **Priority GHG Reduction Measures:** A detailed description of proposed priority measures and initiatives to meet gaps in achieving the state's climate and equity goals.
- **Low Income / Disadvantaged Community Benefits Analysis:** An overview of the process to identify LIDACs and Climate Impacts and Risks, engage with LIDACs to understand community priorities, and estimate potential benefits of GHG emission reduction measures to LIDACs.
- **Review of Authority to Implement**: A summary of the analysis of the authority to implement the proposals contained within each Priority GHG Reduction Measure.
- **Intersection with Other Funding Availability**: A summary of the analysis of the intersection with other state, utility, and federal funding opportunities for each Priority GHG Reduction Measure.
- **Workforce Planning Analysis**: A summary of the workforce development components of the Priority GHG Reduction Measures.

The bulk of the Plan includes detailed description of Priority GHG Reduction Measures. Included in the Priority Climate Action Plan are five Priority GHG Reduction Measures: Clean & Efficient Buildings, Clean Transportation & Freight, Clean Industry, Clean Agriculture, and Clean Power.

Each measure is organized to provide information on:

1. A measure summary with a description of need identified by stakeholders
2. Topline Outputs and Greenhouse Gas Emission Reduction Estimates
3. Implementing Authority
4. Implementing Agencies
5. A list of distinct Measure Initiatives that include:
    a. A summary of the initiative
    b. Initiative elements
    c. An analysis of complementary funding
    d. A projected implementation schedule and milestones
6. Geographic Location
7. A summary of complementary funding sources
8. Metrics for Tracking Progress

Development of the Priority Climate Action Plan

This Priority Climate Action Plan was developed by the Illinois Environmental Protection Agency to specifically address the obstacles and challenges in meeting the state's GHG emission reduction targets, co-pollutant targets and goals, and community benefits goals, by targeting gaps in funding for critical pathways to achieve those goals.

The scope of this plan encompasses all major greenhouse-gas emitting sectors: power, transportation, buildings, industry, and agriculture.

Building on the Legacy of CEJA

The plan builds upon extensive work already done in the state to identify and pursue climate action, including the Climate and Equitable Jobs Act, which included months of stakeholder process around electricity generation, energy efficiency, utility planning and regulation, just transition, and incorporating equity and environmental justice considerations into climate action; several workshop processes convened by the Illinois Commerce Commission, including Multi-Year Integrated Grid Plan Workshops, Beneficial Electrification Workshops; and several stakeholder outreach processes convened by the Illinois Finance Authority, on topics including electric vehicles, energy efficiency, distributed generation, and building electrification.

Coordination across Government

The plan was developed in coordination with many agencies within the state including the Illinois Finance Authority / Illinois Climate Bank, Illinois Department of Commerce and Economic Opportunity, the Illinois Department of Transportation, the Illinois Department of Agriculture, the Illinois Finance Authority and the Illinois Department of Natural Resources.

The state consulted extensively with local and municipal entities including the City of Chicago, the Chicago Metropolitan Agency for Planning, the Metropolitan Mayors Caucus, and others.

Rooted in Stakeholder Consultation

Development of the plan also included consultation on the CPRG with multiple stakeholders, including: community organizations, including organizations representing disadvantaged communities; non-governmental organizations with expertise in climate mitigation; private businesses; higher education institutions; and trade associations.

To identify market barriers to the equitable GHG emission reductions in Illinois, the Illinois Climate Bank, in partnership with other state agencies, held a series of stakeholder meetings, small group meetings and workshops, and virtual presentations, throughout 2023 and early 2024, with more than 150 different entities to get a broad perspective on market gaps.

In 2023, the state collected stakeholder inputs through Climate and Equity Surveys to gain additional perspectives on program design under CPRG, GGRF, and complementary federal funding opportunities.

The stakeholder engagement produced valuable data on continued barriers to low-income and disadvantaged community participation in and benefit from climate and clean energy strategies that could be addressed through additional funding and thoughtfully-designed programs. Key market gaps identified included:

- the high number of walk-aways from low-income single-family and multi-family households due to the need for health & safety upgrades, such as roof repair, mold and asbestos abatement, or electrical upgrades;
- the lack of low-cost, easy-to-access finance for low-income households and the desire to create long-term wealth-building opportunities through solar;
- reliability and resiliency risks for the most vulnerable during extreme weather/outages;
- the high demand for low-income community solar projects that reach program capacity;
- challenges for community-driven community solar projects to compete with national developers;
- difficulty by developers in braiding and coordinating different funding streams;
- difficulty by small, DBEs to access capital and expand beyond a cash businesses; and
- a lack of trust in the marketplace driven by more than a decade of bad actors in the retail electric supply market.

In late 2023, Illinois EPA created an area on its website for individuals and stakeholders to share information and solicit feedback about the PCAP and CPRG, through which staff received and responded to many additional public comments.

Also in late 2023, Illinois EPA collaborated with partners from the Chicago MSA, the Metropolitan Mayors Caucus (MMC) and Chicago Metropolitan Agency for Planning (CMAP), to present a virtual CPRG Town Hall. The session offered over 175 attendees information about the CPRG process and the state and MSA approaches to developing priority measures; the panelists included representatives from Illinois EPA, MMC, CMAP, the City of Chicago, and the Northwest Indiana Regional Planning Commission.

In early 2024, Illinois EPA held two online public listening sessions to solicit feedback on the draft Plan. One was held during the work day and another was held in the evening to facilitate attendance by community leaders and people with work obligations. More than 130 people participated in the two public listening sessions on the draft Plan.

Greenhouse Gas (GHG) Inventory

Scope, Accounting, and Methodology

The greenhouse gas inventory for Illinois presented here was created using US EPA's State Inventory Tool (SIT). Detailed methodology of the tool's accounting methods are available in the tool's user guides, available on US EPA's website. The data was drawn from the sources directed by the tool.

The inventory is broken out by sector and gas, and includes emissions from the following areas:

1. CO2 from Fossil Fuel Combustion
2. CO2 from Electricity Consumption
3. Stationary Combustion
4. Mobile Combustion
5. Coal Mining
6. Natural Gas and Oil Systems
7. Industrial Processes
8. Agriculture
9. Land Use, Land-Use Change, and Forestry
10. Municipal Solid Waste
11. Wastewater

The comprehensive inventory produced by the SIT is an Excel file that should be available wherever this document is posted. If you cannot locate this file, contact epa.cprg@illinois.gov.

Base Year and Current Emissions

Emissions for the base year and current estimated emissions are in the sections to follow.

The state's primary economy-wide greenhouse gas target is its commitment to the Paris Climate Agreement. 2005 is a "base year" insofar as it determines the emissions reductions necessary by 2030 for the state to fulfill this commitment.

GHG emissions reductions for measures in this Plan were calculated using RMI's Energy Policy Simulator, unless otherwise noted. The emissions methodology from the SIT varies slightly from the business as usual case in the Energy Policy Simulator. The emissions derived from the SIT methodology for 2021 show 228 MMTCO2e whereas the Energy Policy Simulator shows 239.9 MMTCO2e for that year, declining to 230.9 MMTCO2e in 2022.

This has no practical impact on the emissions reductions estimates for the measures, because they are all forward-looking. Emissions reductions are expressed as a reduction from the business-as-usual emissions case in the Energy Policy Simulator, and begin measuring reductions against that case beginning in 2025 – not against 2005 or any other past levels. Measuring against a past baseline would be misleading because, in many cases, even the business-as-usual case today represents a reduction from 2005-level emissions. Accurate representation of measures' impact requires measuring against business as usual, and that is the approach here.

Organization of GHG Inventory and Charts

This section includes tables with high-level summaries of state emissions by sector. Indirect CO2 from electricity consumption is listed, but not included in the total, in keeping with the methodology of the US EPA SIT. The "Energy" section as calculated in the SIT is broken out by individual sectors: Residential, Commercial, Industrial, Transportation, and Electric Utilities. "Other Fossil Fuels" includes non-CO2 GHGs from Stationary Combustion and Mobile Combustion, Coal Mining, and Natural Gas and Oil Systems.

This section includes charts that display a breakdown of emissions by sector. While it uses data from the SIT unless otherwise noted, for ease of comprehension, it groups together industrial and industrial process emissions as "industry," and residential and commercial emissions as "buildings." These charts exclude indirect CO2 from Electricity Consumption, per SIT methodology.

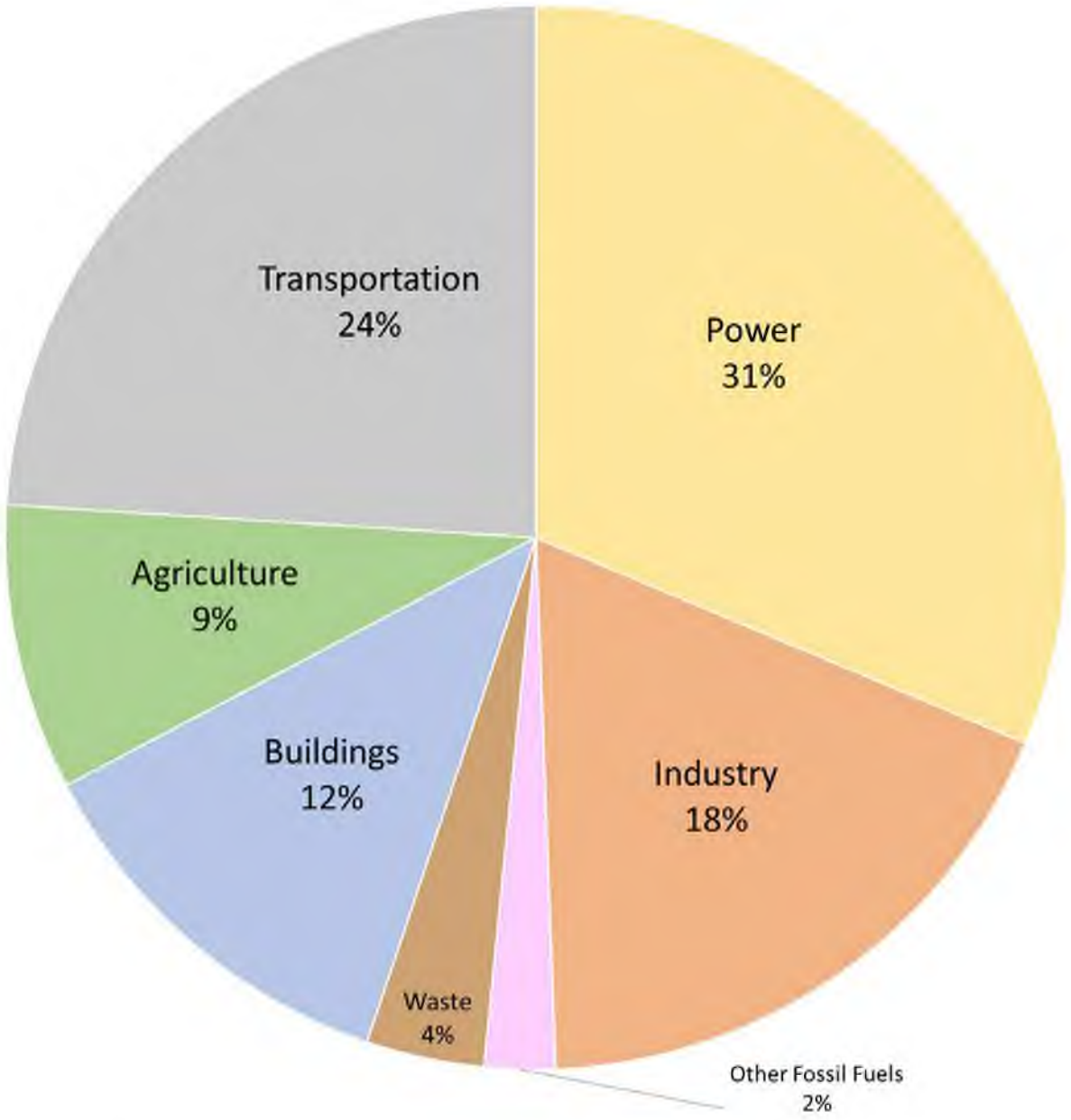
2005 GHG Emissions: Base for Paris Target

2005 emissions were 283.62 MMTCO2e and were relatively representative for the era. They are used to calculate 2030 emissions goals under the Paris Climate Agreement, to which Illinois has committed.

Table 1: 2005 GHG emissions, by sector

Sector	Emissions in MMTCO2e	Percentage
Transportation	72.47	31.21%
Electric Utilities	94.49	40.69%
Industrial	42.82	18.44%
Industrial Processes	11.77	5.07%
Residential	24.76	10.66%
Commercial	11.85	5.10%
Agriculture	26.23	11.29%
Other Fossil Fuels	6.51	2.80%
Waste	10.83	4.67%
Land Use, Land-use Change, and Forestry (LULUCF)	-18.10	-7.80%
Total	***283.62***	
Indirect CO2 from Electricity Consumption	*79.14*	

Figure 1: 2005 GHG emissions, by percentage and sector



For simplicity, industrial and industrial process emissions are combined as "industry," and residential and commercial emissions are combined as "buildings" above. Emissions from Land Use, Land-use Change, and Forestry (LULUCF) are excluded.

Current GHG Emissions: Base for Reduction Calculations

Current greenhouse gas emissions are estimated for 2021 below. US EPA SIT output concludes with 2020, but this inventory estimates 2021 for "current" emissions in order to avoid a potentially skewed picture of emissions in 2020 resulting from the COVID-19 pandemic. 2020 was not a representative year for emissions in most sectors. Per US EIA, energy consumption fell a record 7% that year, and state emissions data shows that many sectors' emissions were between 20 and 40 percent lower than recent years. Illinois' energy emissions grew more than 10% between 2020 and 2021, and it is likely that other sectors similarly rebounded.

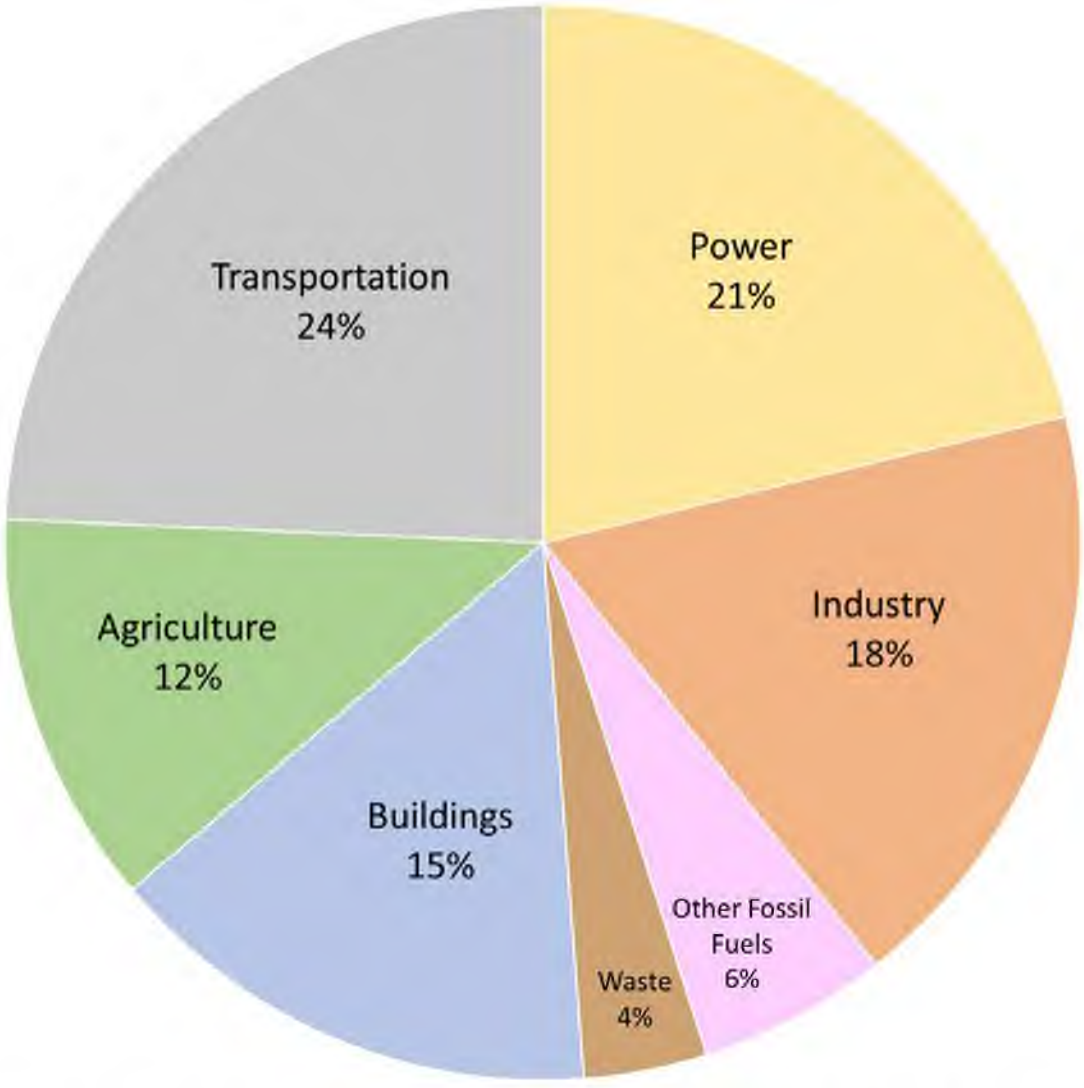
2021 US Energy Information Administration data for state carbon dioxide emissions from fossil fuels was available at the time this plan was developed. This dataset is the same one used by SIT, so the 2021 emissions remain methodologically consistent with all other years. Emissions for transportation, electric utilities, industrial, residential, and commercial sectors below are taken from this dataset, representing nearly 80% of the 2021 figure below.

Emissions for industrial processes, agriculture, other fossil fuels, waste; land use, land-use change, and forestry; and Indirect CO2 from Electricity Consumption were taken from an average of the inventory emissions from 2016-2019.

Table 2: 2021 GHG emissions inventory, by sector

Sector	Emissions in MMTCO2e	Percentage
Transportation	60.06	25.86%
Electric Utilities	52.43	22.58%
Industrial	34.55	14.88%
Industrial Processes	10.34	4.45%
Residential	22.99	9.90%
Commercial	14.21	6.12%
Agriculture	29.30	12.62%
Other Fossil Fuels	9.88	6.07%
Waste	9.17	3.95%
Land Use, Land-use Change, and Forestry (LULUCF)	-14.92	-6.43%
Total	***228.01***	
Indirect CO2 from Electricity Consumption	*49.27*	-

Figure 2: 2021 GHG emissions, by percentage and sector



For simplicity, industrial and industrial process emissions are combined as "industry," and residential and commercial emissions are combined as "buildings" above. Emissions from Land Use, Land-use Change, and Forestry (LULUCF) are excluded

Existing State GHG Reduction Targets and Policies

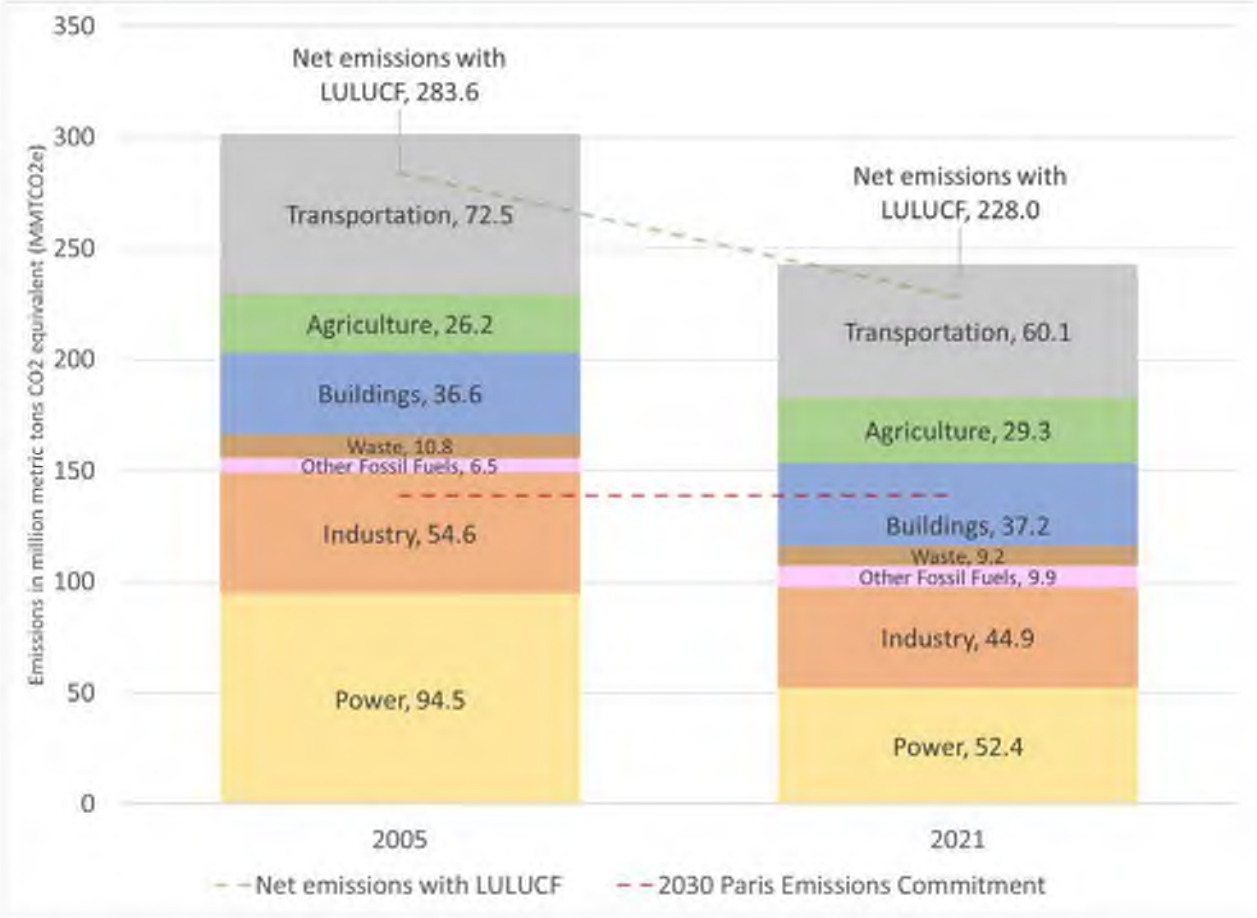
Illinois has two primary, existing greenhouse gas (GHG) reduction targets.

- First, the state is committed to the principles and goals of the Paris Climate Agreement, as established in Executive Order 2019-06. Practically speaking, this means adhering to the United States' emissions target under the agreement: reducing greenhouse gas emissions 50-52% below 2005 levels by 2030, and to net zero no later than 2050.
- Second, under Public Act 102-0662, colloquially known as the Climate and Equitable Jobs Act ("CEJA"), it is the policy of the state to rapidly transition to 100% clean energy by 2050. Among other policies intended to achieve this target, the bill includes a binding emissions reductions schedule for the power sector, which is described in detail in 415 ILCS 5/9.15 in the Illinois Compiled Statutes. These emissions reductions will proceed unless implementing them would reduce reliability or resource adequacy below acceptable levels.

Using 2005 emissions as calculated in this inventory as a base year, and given a 50-52% emissions reduction in keeping with the United States' nationally determined contribution (NDC) under the Paris Agreement, **the state's commitment to the Paris Agreement means reaching annual emissions between 136.1 and 141.8 MMTCO2e per year by 2030.**

This plan contains a number of additional, sector-based measures. Potential emissions reductions proposed in these measures do not constitute not binding commitments or mandates. They represent identified opportunities and pathways for emissions reductions that may serve as tools for Illinois to achieve its climate goals as articulated in Executive Order 2019-06 and elsewhere. The ability for Illinois to realize these targets will depend on many factors including economic trends, consumer behavior, receipt of federal funding, cost reductions in clean energy technologies, market and supply chain development, and development of private and public infrastructure.

Figure 3: 2005 and 2021 GHG emissions comparison, including Paris commitment, in MMTCO2e



Emissions above are expressed in total MMTCO2e, not as percentages.

The upper dotted line in green shows net emissions for each year, including sinks from Land Use, Land-use Change, and Forestry (LULUCF), which account for -18.1 MMTCO2e in 2005 and -14.9 MMTCO2e in 2021.

The lower dotted line in red shows the 2030 emissions target in the Paris Climate Agreement: 139 MMTCO2e (a 51% reduction from 2005 levels).

Priority GHG Reduction Measures

Based on essential information gathered during the statewide stakeholder engagement process on obstacles, challenges, and gaps in equitable climate progress, the Illinois Environmental Protection Agency has put together a collection of Priority GHG Reduction Measures that:

- Make demonstrable progress on climate;
- Prioritize reductions in criteria pollutants, particularly in disadvantaged communities;
- Are not funded through other state, utility, or federal initiatives;
- Can be implemented quickly and without significant legislative or regulatory change;
- Establish replicable models that can support market liftoff; and
- Generate additional community benefits

The Priority GHG Reduction measures, as detailed in the sections below, are the following:

1. Clean & Efficient Buildings
2. Clean Transportation & Freight
3. Clean Industry
4. Clean Agriculture
5. Clean Power

The plan prioritized the sectors which offered the greatest opportunities for achievable emissions reductions which were viable economically and could deliver meaningful benefits to disadvantaged communities, with buildings and transportation (and freight in particular) demonstrating the greatest potential.

The agricultural and industrial sectors were also extensively explored, due to their large presence in Illinois and the potential for identifying replicable measures that can be scaled up and/or adopted more broadly, including outside of the state.

Illinois has extensive programming and policy in place in the power sector, so while that sector is included in the plan, there are very few strategies in that sector that are lacking funding elsewhere. Thus, the PCAP places more emphasis on other measures, in keeping with the CPRG's aim of resourcing emissions reductions opportunities that are otherwise under-resourced.

Clean & Efficient Buildings

CEJA and the IRA support high levels of electric and transportation sector decarbonization, but additional efforts are needed to ensure the equitable achievement of building decarbonization. By 2050, Illinois will need to improve efficiency and install electric appliances in millions of homes and buildings to meet its commitment to the Paris Agreement.

While the state has made some progress and is building upon a strong policy foundation, efforts to make buildings cleaner and more efficient are being hindered by obstacles such as: lack of awareness about opportunities, programs and incentives to make buildings cleaner and more efficient, and difficulty navigating those programs where people are aware of them; a shortage of qualified contractors and customers' difficulty connecting with those contractors, especially in some geographic areas; a lack of resources to support uptake of lower-emitting building codes.

As the state embarks on the energy transition, it is essential to address these obstacles, and especially to identify pathways to support and prioritize vulnerable and low-income people and communities. Through its stakeholder engagement process conducted throughout 2023 and early 2024, the state identified significant gaps, obstacles, and challenges in carbon-free building efforts at the state and federal level that are essential to overcome through new efforts.

Outreach and programmatic support are particularly important to ensure that disadvantaged communities and people with low incomes can enjoy the benefits of energy efficiency and electrification. They stand to disproportionately benefit from the cost savings, given the higher percentage of their income that people with low incomes tend to spend on energy (referred to as "energy burden"). They may also be short on the time and social capital needed to navigate the various

program and incentive processes that would help them qualify for various forms of financial support to complete energy efficiency projects in their homes.

Measures for people with low incomes can be more expensive on a per-megawatt-saved or per-ton-of-CO2-avoided basis, in part due to housing stock that is often older and less well-maintained. However, these measures are often those most contingent upon policy and programmatic support – the projects might not happen *but for* these interventions – and the benefits to LIDACs and people with low incomes are substantial.

In pursuing this measure, the state proposes strategies including, but not limited to:

- **Filling in gaps and leveraging existing funds to ensure identified clean building projects get done.** Filling in gaps in state and federal efficiency and electrification efforts, including by providing strategic and targeted financial support that leverages existing funding and programmatic infrastructure and enables projects that would have failed but for additional support, particularly projects in low-income households which are harmed by high rates of "walk-aways" from projects that residents want.
- **Connecting more customers with clean building opportunities and easing the process of completing them.** Reducing administrative burdens for customers by helping them navigate programs, incentives, and qualified contractors; and increasing awareness about energy efficiency and electrification opportunities and incentives, particularly among vulnerable communities and building classes with high opportunities for decarbonization measures.
- **Preparing more contractors to do clean buildings work, and ensuring customers can find them.** Expanding workforce and contractor training and capacity to implement efficiency and electrification measures and supporting customers in connecting with contractors qualified to perform these measures, which today is difficult and impedes uptake of these measures.
- **Implementing building codes to support efficiency and decarbonization.** Supporting implementation of energy-efficient and low-carbon building codes, which can achieve significant, cost-effective emissions and cost savings but may be impeded in some cases by the difficulty of initial implementation and administration.

Topline Outputs and GHG Emission Reduction Estimates

1. Improve building efficiency, reaching a 33% reduction in energy use in buildings by 2050.
    a. Efficiency is the foundation of emissions reductions in the building sector. It increases the emissions and cost-saving impact of electrification measures, and in many cases is a prerequisite to other building decarbonization measures. In addition to GHG emissions reductions, it can reduce bills for customers, reduce exposure to criteria pollution, and make homes safer and more comfortable.
    b. Achieving this target would reduce GHG emissions 2.9 MMTCO2e by 2030 and 118.7 MMTCO2e by 2050.
    c. The 33% reduction in building energy use is drawn from a building decarbonization scenario in a report by Lawrence Berkeley National Laboratory.

2. Accelerate the use of efficient, all-electric heating and appliances in buildings, significantly increasing their share of new sales to between 50% and 90% by 2050.
    a. In combination with efficiency, deployment of all-electric appliances (for heating, water heating) is an essential tool to reduce emissions in the buildings sector.
    b. The modeled targets for this measure are set as a percentage of new sales for all-electric appliances, and steadily increase over time reaching the following levels: for residential heating, 90% by 2050 and 75% by 2030; for residential appliances and "other," 85% by 2050 and 50% by 2030; for commercial heating, 66% by 2050 and 30% by 2030; and for commercial appliances and "other," 50% by 2050 and 10% by 2030.
    c. Achieving this target would reduce GHG emissions 7.9 MMTCO2e by 2030 and 317.9 MMTCO2e by 2050.
    d. The modeled targets above are drawn from a building decarbonization scenario in a report by Lawrence Berkeley National Laboratory (LBNL). The scenario sets targets for residential and commercial heating and residential and commercial water heating, and the Energy Policy Simulator allows target-setting for residential and commercial heating, residential and commercial appliances, and residential and commercial "other." The LBNL figures for water heating were used for both the appliance and "other" figures for the Energy Policy Simulator model.

Implementing Authority

The Capital Development Board (CDB) has statutory authority to review and recommend periodic revisions to established building and construction codes to promote public safety and energy efficiency. Public Act 103-510 created the framework for the adoption of statewide building codes under CDB, to be implemented by July 1, 2025; units of local government retain authority until that date. CDB is also currently developing the Illinois Stretch Energy Code pursuant to a mandate under CEJA.

The Illinois Department of Commerce and Economic Opportunity operates a robust network of workforce development programs that includes more contemporary programs authorized under CEJA specific to building the clean energy pipeline - namely, the Clean Jobs Workforce Network Program and Clean Energy Contractor Incubator Program.

The Illinois EPA currently operates a growing number of energy efficiency assessment programs for municipal water systems and public housing, including programs implemented via intergovernmental agreement with Illinois public universities. Illinois EPA and other state agencies have existing authority under the Grant Accountability and Transparency Act and complementary rules to uniformly implement competitive grant and incentive programs utilizing state and federal pass-through funds.

The Illinois Power Agency has statutory authority to implement the Solar for All program that provides incentives for low-income distributed generation and community solar projects; this includes the Bright Neighborhoods Pilot program.

The Illinois Climate Bank has broad authority to develop and implement new financial assistance opportunities, including grant and loan programs, to leverage existing funding programs, along with an ability to efficiently obtain necessary board approvals for new initiatives.

Illinois state agencies require annual appropriation authority to spend funds allocated from General Revenue Funds, other state funds, and federal funds.

Implementing Agencies

- Illinois Commerce Commission
- Illinois Department of Commerce and Economic Opportunity
- Illinois Environmental Protection Agency
- Illinois Finance Authority / Illinois Climate Bank
- Illinois Capital Development Board
- Illinois Power Agency

Measure Initiatives

1. Establish a Clean Building Gap Closing and Incentive Stacking Catalyst Fund

Summary

While there are significant new sources of federal funding to support building decarbonization efforts, the state has worked with stakeholders to identify persisting gaps in incentives and structures to enable electrification of all building types on the schedule needed to meet the state's 2050 economy-wide decarbonization goals.

Based on its stakeholder engagement, the state has identified the following gaps that require additional support in order to reach target populations:

- Delivery approaches that braid together available incentives to achieve full decarbonization of residential buildings for low-income and moderate income households, and households in disadvantaged communities.
- Deployment costs related to cold climate heat pumps, heat pump water heaters, and enabling investments for health & safety that prevent program walk-aways.
- Market segments of multi-family residential buildings, moderate income households, and small commercial buildings in low-income and disadvantaged communities where rebates may not make projects viable and a lack of tax liability prevents tax credit benefits.

- The state will coordinate efforts among state agencies and utilities to deploy gap-filling decarbonization investments and low-cost equitable loan and lease offerings, strategically coordinated with complementary program deployment across other programs. This coordinated approach will reduce administrative and participant recruitment costs, and support mutual achievement of program efforts.

Elements

Whole-building electrification incentive. To support and encourage whole-home electrification investments, the state will deploy a whole-home decarbonization incentive of up to $12,000 per household to cover the remaining gaps in decarbonization measures after existing state and federal incentives.

Low-cost equitable financing. The Illinois Climate Bank will launch a low-cost and easy-to access finance offering for residential and small commercial decarbonization investments, intentionally braided and offered at the point of sale of contractor and outreach engagement with households. The loan will partially serve as a bridge loan to cover cash needs of project investments until repaid by rebates and other grants, while also covering any remaining investment costs over a 5-10 year period.

Lease-to-own. Further, the Illinois Climate Bank will develop a lease-to-own offering that allows for projects in low-income households to gain the benefit of no-upfront cost installations, near- and long-term maintenance, federal tax credit monetization, and long-term ownership and wealth-building.

Complementary Funding and Initiatives

The initiative is designed to leverage several distinct state, utility, and federal complementary funding sources and initiatives. This includes initiatives from the Illinois Department of Commerce and Economic Opportunity, which administers the Clean Jobs Workforce Network Program, Illinois Home Weatherization Assistance Program (IHWAPP), State Supplemental Low Income Energy Assistance Fund (LIHEAP), Energy Transition Navigator Program, Contractor efficiency and electrification certification programs; initiatives from the Illinois Environmental Protection Agency, which administers Home Efficiency Rebates, Home Electrification and Appliance Rebates, Energy Code Training and Technical Support, Energy Efficiency Trust Fund Grant Program, Energy Efficiency and Conservation Block Grants, Energy efficiency measures for public water infrastructure; initiatives from the Illinois Climate Bank, which administers the Energy Efficiency Revolving Loan Fund, State Small Business Climate Initiative, Commercial Property Assessed Clean Energy, Various climate finance products, Solar for All Enabling Upgrades Grant Program, Solar for All Energy Storage Grant Program; and federal funding sources such as energy efficiency and energy property tax credits.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA and the Illinois Climate Bank will expand its residential

grant program offerings, which currently include funding for energy efficiency, electrification, enabling upgrades, and energy storage rebates, to include additional program categories.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Rulemaking at Illinois EPA, if necessary, can be completed within 12 months, with program launch within 18 months from the start of the initiative at the earliest.
- Timelines with the Illinois Climate Bank can be even more expeditious, with board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.
- New loan offerings by the Illinois Climate Bank can be established within 6 months of the start of the initiative at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

2. Navigator program providing consumer outreach and clean building project support

Summary

Residential housing accounts for more than 10% of all greenhouse gas emissions in Illinois. Most of those emissions are associated with the burning of fossil gas for space heating, water heating, cooking and other end uses. These emissions can be dramatically reduced through investment in energy efficiency upgrades, electrification, and other clean energy investments that can provide environmental benefits as well as cost savings to families.

There is a wide range of support available that can help people access these investments, including rebates and programs from state, local, utility and federal sources.

Yet for a variety of reasons, many people are unaware of how these measures could benefit them. They may not be aware of the technologies, or the benefits they can provide; they may not know of contractors who are trained to install those technologies. They may not be aware of the programs and incentives to make those technologies more affordable, and if they are, they may not be able to navigate the process around how to apply to one program or incentive, let alone several.

The result of this lack of knowledge is a gap between the potential benefit that clean energy investments and incentives could provide, and the actual realized benefits.

Peer-reviewed research has found that disadvantaged communities face a number of barriers to accessing energy efficiency programs. This suggests that this gap is likely experienced most acutely by disadvantaged communities and people with low incomes, who would benefit most from the cost savings they could provide. This gap also represents unrealized emissions and climate benefits.

The Navigator program is intended to fill this gap, expand the number of people who know about and use clean energy incentives and programs, and deliver more environmental and emissions benefits to more people.

Elements

Navigator Program. The state will support the development of a Navigator program that educates residential customers about efficiency and electrification opportunities for their homes; supports them in identifying projects, contractors, and incentives; and works to coordinate clean energy support services across currently uncoordinated program and incentive streams. The Navigator program would provide support to customers in connecting with programs including:

- Electric and gas utility efficiency programs.
- Electric utility programs that promote rooftop solar, community solar, energy storage, demand response and other distributed energy resources.
- Illinois Power Agency's "Solar for All" program.
- Illinois Climate Bank's enabling upgrades and energy storage grant programs, as well as low-cost loans.
- State and federal low-income weatherization program.
- Federal Inflation Reduction Act rebates for both efficiency and electrification measures.
- Municipal programs, such as the City of Chicago's support for the installation of energy efficient electrification measures and solar panels.

Complementary Funding and Initiatives

This effort will significantly build and expand on the Illinois Power Agency's Bright Neighborhoods Pilot, launched in 2023, which works to provide targeted support to 3 target communities. The Bright Neighborhoods Pilot will provide important lessons learned to support the expansion and roll-out of the effort to all low-income and disadvantaged communities across the state.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA and Illinois Climate Bank will work with Illinois Power Agency to expand its Bright Neighborhoods Pilot, which is currently focused on rooftop solar, to include education, outreach, and coordination for energy efficiency and electrification.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

3. Clean Buildings Access Portal

Summary

Illinois Climate Bank will work with Illinois Department of Commerce and Economic Opportunity, utilities, and the Illinois Power Agency to develop a single portal targeted at supporting low-income and disadvantaged community access to state and federal solar, decarbonization, energy efficiency, energy storage, pre-weatherization, and weatherization assistance programs.

The contractor portal will be designed to share information across agencies (application and credential/accreditation information), track contractor support opportunities at different agencies and direct contractors to them, and manage low-cost and easy to access loans and working capital. The Portal will streamline application processes and reduce administrative burdens in accessing grant and loan offerings.

Elements

Coordinated applications. The carbon-free buildings portal will bring together the rebate and incentive applications from the Illinois EPA State Energy Office, Illinois Power Agency, Department of Commerce and Economic Opportunity, Illinois Climate Bank, and utilities to reduce duplicative

Connect to finance. The portal will coordinate household investments with new finance opportunities being launched by the Illinois Climate Bank on the back end to enable rebate and performance contract programs to achieve zero-upfront cost to the building owner/tenant on the front end. Typical incentive processing takes 30-180 days, leaving a cash gap that has blocked access to incentives for low-income households.

Referrals to approved contractors. The portal will enable first-touch contractors (i.e. the contractors supporting a retrofit or installation of the household's first carbon-free technology type or investment) to provide easy referrals to local approved contractors that can support additional retrofit investments, through the same account in the portal.

Complementary Funding and Initiatives

The initiative is designed to leverage several distinct state, utility, and federal complementary funding sources and initiatives. This includes initiatives from the Illinois Department of Commerce and Economic Opportunity, which administers the Clean Jobs Workforce Network Program, Illinois Home Weatherization Assistance Program (IHWAPP), State Supplemental Low Income Energy Assistance Fund (LIHEAP), Energy Transition Navigator Program, Contractor efficiency and electrification certification programs; initiatives from the Illinois Environmental Protection Agency, which administers Home Efficiency Rebates, Home Electrification and Appliance Rebates, Energy Code Training and Technical Support, Energy Efficiency Trust Fund Grant Program, Energy Efficiency and Conservation Block Grants, Energy efficiency measures for public water infrastructure; initiatives from the Illinois Climate Bank, which administers the Energy Efficiency Revolving Loan Fund, State Small Business Climate Initiative,

Commercial Property Assessed Clean Energy, Various climate finance products, Solar for All Enabling Upgrades Grant Program, Solar for All Energy Storage Grant Program; and federal funding sources such as energy efficiency and energy property tax credits.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, the Illinois Climate Bank will work with the Illinois Department of Commerce and Economic Opportunity, Illinois EPA, and Illinois Power Agency to develop and launch the portal, connecting the agencies' initiatives.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

4. Clean Buildings Contractor Training

Summary

Illinois has existing robust clean workforce and business development programs, including the framework of The Future Energy Jobs Act (FEJA) and CEJA clean energy job workforce training, apprenticeship and job placement programs. With new investment types, however, come additional training needs that are currently being unmet by the state's workforce training and contractor accelerator efforts, which focus largely on solar installations and energy efficiency. Further, the state has identified contractor gaps where disadvantaged communities do not have a robust contractor network able to support the level of investment expected under CEJA and IRA investments.

Elements

Expand Clean Jobs Workforce Network Program. The state will provide additional resources to the Clean Jobs Workforce Network Program to support additional skills needs around ground-source and air-source heat pump installation, heat pump water heat installation, roof replacement and repair, mold and asbestos abatement needs identified and remediation, electrical upgrades, energy storage installation, and more.

Expand Clean Energy Contractor Incubator Program. The state will provide additional resources to the Clean Energy Contractor Incubator program to support new contractor and subcontractor business development in communities not well served by an existing contractor base in ground-source and air-source heat pump installation, heat pump water heat installation, roof replacement and repair, mold

and asbestos abatement needs identified and remediation, electrical upgrades, energy storage installation, and more.

Complementary Funding and Initiatives

Illinois Department of Commerce and Economic Opportunity currently administer the Clean Jobs Workforce Network Program and the Clean Energy Contractor Incubator Program, which will be expanded to include additional skills.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, the Illinois Department of Commerce and Economic Opportunity will expand their Clean Jobs Workforce Network Program and Clean Energy Contractor Incubator Program to focus on specific communities and to include new technology and service areas as described.

Establishment of the programs will require no statutory change, and limited regulatory intervention. The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

5. Large Building Owner Outreach and Clean Buildings Concierge

Summary

Many multi-family and commercial property owners lack the expertise, time, and resources necessary to make strategic clean energy investments in their properties, even when tenants are seeking to lower their bill or pursue decarbonization. This initiative aims to empower large building owners by providing them with the necessary resources and guidance to identify and implement energy efficiency, retrofit, and electrification solutions with a focus on owners that may not have the internal resources to access programs and incentives. Through targeted outreach and personalized concierge services, large building owners will be equipped to navigate the complexities of decarbonization, leading to a measurable reduction in GHG emissions across the sector. By also integrating load shifting opportunities, the initiative seeks to support these buildings in significantly reducing their GHG emissions while capturing financial benefits from enhanced energy management and operational efficiency.

Elements

Contractor Outreach. Establishing networks between building owners and contractors experienced in decarbonization to facilitate successful transitions.

Strategic Planning Assistance. The state will fund experienced third parties to act as a dedicated point of contact for large building operators, offering tailored advice, access to the latest decarbonization technologies, and connections to financing options, ensuring that the companies are well-informed and

able to take full advantage of any and all available resources. This service will streamline the process of transforming large buildings into cleaner, more sustainable assets.

Workforce Training. Creating a feedback loop with established workforce training hubs to identify and address skill gaps, ensuring the workforce is equipped to support decarbonization of large buildings.

Contractor Support. Providing building contractors with tools and resources to better understand the benefits and incentives available to large building owners. This ensures that contractors can effectively support these owners in their transition to cleaner technologies, amplifying the impact of the concierge service.

Building Planning and Stakeholder Engagement. Facilitating communications between large building owners and planning coalitions including state agencies, municipalities, and community organizations to promote comprehensive support and engagement in building decarbonization efforts.

Complementary Funding and Initiatives

The initiative is designed to leverage several distinct state, utility, and federal complementary funding sources and initiatives. This includes initiatives from the Illinois Department of Commerce and Economic Opportunity, which administers the Clean Jobs Workforce Network Program, Energy Transition Navigator Program, Contractor efficiency and electrification certification programs; initiatives from the Illinois Environmental Protection Agency, which administers Energy Code Training and Technical Support; initiatives from the Illinois Climate Bank, which administers the Energy Efficiency Revolving Loan Fund, State Small Business Climate Initiative, Commercial Property Assessed Clean Energy, Various climate finance products; and federal funding sources such as energy efficiency and energy property tax credits.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA and the Illinois Climate Bank will engage with third-party contractors to lead the effort, in coordination with the utilities administering the statewide energy efficiency programs.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Rulemaking at Illinois EPA, if necessary, can be completed within 12 months, with program launch within 18 months from the start of the initiative at the earliest.
- Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

6. Public Building Decarbonization Assessment - Lead by Example

Summary

The objective of this initiative is to conduct comprehensive energy efficiency and electrification assessments for local and state government buildings, public universities, and municipalities, aiming to significantly reduce energy consumption in line with the leading targets for commercial and public buildings. The assessment will require the planning for and anticipated cost-effective retrofit of facilities to reduce energy consumption by 35% by 2035, achieve zero emissions, and support the electrification of transport. The results of the assessments will be made publicly available to share best practices.

By leading through example, these efforts aim to inspire and accelerate similar decarbonization efforts among other large building owners. This proactive approach is expected to catalyze broader GHG reductions, demonstrating the feasibility and benefits of energy efficiency and sustainable practices on a wider scale.

Elements

Assessment of Public Buildings: Perform detailed energy audits to pinpoint efficiency opportunities and electrification potentials across a wide range of public buildings.

Leadership: Shared lessons learned and models for energy-conscious practices and investments in the broader building industry, encouraging similar initiatives statewide.

Financing Connection: Facilitate access to retrofit financing for identified projects through the Illinois Climate Bank, including bridge loans for federal tax credit elective pay opportunities, as well as construction and term loans, ensuring actionable paths towards implementation.

Complementary Funding and Initiatives

This initiative contributes directly to the state's ambitious objectives of achieving zero GHG emissions by 2050 and reducing public building energy consumption by 35% by 2035. Through the demonstration of effective energy assessments and best practices, this initiative serves as a beacon for sustainable development and energy efficiency statewide.

The initiative will provide support to public entities to leverage new federal tax credits under the Inflation Reduction Act, and specifically the elective pay and transferability provisions of applicable clean energy tax credits. Further, the program will align with new Bridge Loan offerings being created by the Illinois Climate Bank in 2024 to support public entities and non-profits with short-term capital needs to access and benefit from such tax credits.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA and the Illinois Climate Bank will engage with third-party

contractors to lead the effort, in coordination with the utilities administering the statewide energy efficiency programs.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Rulemaking at Illinois EPA, if necessary, can be completed within 12 months, with program launch within 18 months from the start of the initiative at the earliest.
- Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

7. Community Geothermal Planning + Pilots

Summary

Shared geothermal and thermal energy networks have been recognized by the Illinois General Assembly as a potential means to affordably decarbonize buildings at both the community-scale and utility-scale, while helping achieve the decarbonization goals of the Climate and Equitable Jobs Act ("CEJA").

Geothermal energy is the thermal energy produced by and stored by the earth. This thermal energy is naturally and continuously occurring worldwide, which makes it an exceptional renewable energy source for heating, building climate control, and electricity generation.

Geothermal heat pump applications rely on the stable, moderate temperature conditions that are found within the subsurface layers of the earth's crust. Once below the frost line, the temperature within the earth maintains an average temperature around 55-65°F. In geothermal heat pump applications, the thermal energy within the ground is transferred to a heat pump by a series of looped piping filled with a fluid energy exchange medium, most often water or a water-based solution. The heat pump converts this energy to provide heating or cooling in a building.

The state will seek to pilot new replicable and scalable models of stand-alone or interconnected community-scale geothermal networks in the public right-of-way that enable residents and businesses to opt-in to connect to a shared geothermal ground loop to heat and cool their buildings. By leveraging the Earth's temperature for energy, these systems can provide heat to buildings 5x more efficiently than gas heat, and help cool those buildings in the summer.

Elements

Competitive Community Geothermal Solicitation. The state will conduct a competitive solicitation for community geothermal projects to cover the additional costs related to new technology deployment and market development.

Leveraging Federal Funds and Loan. The state community geothermal effort will position selected projects and partners to pursue additional federal funding under the IRA's updated Investment Tax Credit, and through the DOE's Loan Programs Office to develop and grow their efforts.

Center Community Engagement. Projects will be required to center community engagement, and develop systems that meet residents and businesses where and when they are at in their decarbonization efforts.

Complementary Funding and Initiatives

The state does not currently have any funding or initiatives to support community geothermal projects. However, the Illinois Commerce Commission is currently considering the role of thermal energy network pilots within their jurisdiction, and the Sustainable Chicago Geothermal pilot project is currently being led in the state with funding from the U.S. Department of Energy.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, the Illinois Climate Bank will conduct a competitive solicitation for Community Geothermal projects to receive grant funding, and will create and develop a loan program offering.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

8. Accelerate stretch building code adoption by local governments

In 2021's CEJA, the Illinois General Assembly directed the state Capital Development Board to work with the Illinois EPA to create and adopt a new Illinois Stretch Energy Code that would achieve greater energy efficiency outcomes than the Illinois Energy Conservation Code. Once finalized, any municipality that is interested in achieving higher performance will be able to opt-in to the Stretch Energy Code without needing to undergo their own extensive code development process.

If Illinois local governments updated to the state's new stretch energy codes over the next decade, the state would be able to see a 75% reduction in site energy index (compared to the Illinois Energy Conservation Code).

To support this adoption, the state will provide implementation grants to local governments to support the transition to a stretch energy code.

Elements

Stretch Energy Code Implementation grants. State Stretch Energy Code implementation grants will support local governments in adopting, implementing, and enforcing the latest state stretch energy codes, zero energy codes, or equivalent codes and standards, improving residential and commercial new construction and retrofits, and transitioning the building stock to more efficient, decarbonized buildings.

Coordination. The state will support coordination among local governments to reduce administrative burdens, share resources, and develop a common platform for sharing public information on code adoption by geographic area.

Complementary Funding and Initiatives

Under its Solar for All proposal to US EPA, Illinois Climate Bank proposed a grant program for local governments to adopt SolarAPP+ to streamlining permitting of solar projects at the local level.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, the Illinois Climate Bank will make available grants to local governments through an open process. This would be made available in a manner similar to the upcoming grant program for local governments to adopt SolarAPP+.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

Geographic Location

Statewide. Some initiatives to meet this measure may be focused in 13 regions designated as hubs by the Illinois Department of Commerce and Economic Opportunity: Chicago (South Side), Chicago (Southwest & West Sides), Waukegan, Rockford, Aurora, Joliet, Peoria, Champaign, Danville, Decatur, Carbondale, East St. Louis, and Alton. Deploying additional resources in these areas provides good geographic coverage as the state as a whole, supports disadvantaged communities, leverages existing programmatic infrastructure, and centers expressed priorities of stakeholders, including those in disadvantaged communities.

Complementary Funding and Initiatives

For the Clean & Efficient Buildings measure, this PCAP identifies methods of complementing, and not replicating, funding from State, utility, and federal funding sources:

- **State Initiatives**
    a. Illinois Department of Commerce and Economic Opportunity. Administers:
        i. Clean Jobs Workforce Network Program
        ii. Illinois Home Weatherization Assistance Program (IHWAPP)
        iii. State Supplemental Low Income Energy Assistance Fund (LIHEAP)
        iv. Energy Transition Navigator Program (for workforce, not associated with the navigator program initiative discussed above)
        v. Contractor efficiency and electrification certification programs
    b. Illinois Environmental Protection Agency. Administers:
        i. Home Efficiency Rebates
        ii. Home Electrification and Appliance Rebates
        iii. Energy Code Training and Technical Support
        iv. Energy Efficiency Trust Fund Grant Program
        v. Energy Efficiency and Conservation Block Grants
        vi. Energy efficiency measures for public water infrastructure.
    c. Illinois Climate Bank. Administers:
        i. Energy Efficiency Revolving Loan Fund
        ii. State Small Business Climate Initiative
        iii. Commercial Property Assessed Clean Energy
        iv. Various climate finance products
        v. Solar for All Enabling Upgrades Grant Program
        vi. Solar for All Energy Storage Grant Program
- **Utility Initiatives**
    a. The two large investor-owned utilities in the state, ComEd and Ameren, operate the following statutorily-mandated programs, overseen by the Illinois Commerce Commission:
        i. Energy Efficiency Programs
        ii. Beneficial Electrification Programs
- **Federal Funding**
    a. Energy Efficient Home Improvement Tax Credit
    b. US EPA Greenhouse Gas Reduction Solar for All Competition
    c. US EPA Greenhouse Gas Reduction National Clean Investment Fund Competition
    d. IRA Investment Tax Credits

Metrics for Tracking Progress

The State of Illinois has identified an initial set of tracking metrics to evaluate progress toward the achievement of its PCAP Clean & Efficient Buildings measure:

CLEAN & EFFICIENT BUILDINGS METRICS

Metric	Description
Buildings-1	Reduction in project abandonment rates for energy efficiency, weatherization, and zero-emissions appliance measures, particularly in low-income households and disadvantaged communities
Buildings-2	Increased participation in energy efficiency and electrification measures among building owners and residents
Buildings-3	Increased awareness, training, capacity, and certification for efficiency and electrification work among HVAC contractors
Buildings-4	Increased deployment of efficiency measures and zero-emissions appliances in homes and buildings, particularly in low-income and disadvantaged communities
Buildings-5	Reduced total GHG and criteria pollutant emissions in homes and buildings
Buildings-6	Increased number of buildings emitting zero greenhouse gases and criteria pollutants
Buildings-7	Increased number of buildings served by networked geothermal heating systems
Buildings-8	Increased adoption of stretch energy codes by municipal governments
Buildings-9	Increased average efficiency of new buildings
Buildings-10	Reduced average emissions in new buildings
Buildings-11	Reduced energy burden in low-income and disadvantaged communities

Clean Transportation and Freight

Transportation is the largest source for GHG emissions in Illinois, in addition to being a major source of criteria pollution that impacts environmental justice communities.

A strong foundation is already in place to reduce transportation in Illinois. Aside from a suite of federal tax credits, there is a state rebate for electric passenger vehicles and a process for utilities to develop and submit beneficial electrification plans, both established in CEJA.

Illinois is a central hub for the United States' logistic network, with between one-quarter and one-third of all U.S. freight originating, terminating, or passing through the region. Chicagoland in particular is a hub for freight: it contains the largest inland port in North America (in Will County), seven interstate highways, six of the seven Class I railroads in North America, O'Hare International Airport, and water terminals serving the Great Lakes and Illinois Waterway.

Recognizing its strategic importance, the shift to drive sustainable transportation and freight solutions is not only a regional priority but also a national imperative. Based on the 2021 GHG inventory, 25% of the state's overall greenhouse gas (GHG) emissions are from the transportation sector. Because of this, there is an urgent need for cleaner, more sustainable transportation methods. Investment in clean fleets and freight, with a focus on sub-sectors that typically are underserved in federal and state programs, directly tackles this challenge.

The integration of small and medium-sized freight operators is essential in achieving widespread GHG reductions across the logistics chain. These operators often face barriers to adopting zero-emission technologies, making targeted support crucial for their successful transition. The comprehensive suite of initiatives, including Local Fleet Charging Infrastructure, Railway Trackside Power Deployment, Medium and Heavy-Duty Vehicle Electrification, Clean Fleet and Freight Concierge, Freight Hub Data Collections and Analysis, Workforce Training Program for Fleet Operators, Specialized Workforce for HDV Charging Infrastructure, Local Planning Partnerships, and Facilitating Statewide and Interagency for Critical Freight Planning, can each play a pivotal role in expediting their conversion.

Additionally, the adoption of zero-emission heavy-duty freight further addresses health concerns in communities disproportionately affected by poor air quality resulting from diesel emissions. This additional measure complements the comprehensive approach, aligning with the initiative's goal of promoting environmental justice and improving public health outcomes in these affected areas.

Topline Outputs and GHG Emission Reduction Estimates

As noted in the introduction, these outputs represent a possible scenario for greenhouse gas reduction. Whether the targets outlined here are achieved will depend on a number of factors. Their inclusion in the PCAP does not constitute an endorsement of a specific policy.

1. Support adoption of zero-emission light commercial, medium- and heavy-duty electric vehicles, reaching 30% of new sales by 2030, 60% by 2035, 65% by 2040, and 80% by 2050. Pursuing this measure could include strategies such as incentives for the purchase of vehicles, programmatic or financial support for charging infrastructure, workforce and operator training and development, outreach and planning efforts, and programs or rates to encourage smart charging, EV-to-grid technologies, or EVs as a distributed energy resource.
    a. Medium and heavy duty vehicles emit a disproportionate amount of greenhouse gas and criteria pollutant emissions, and often travel in close proximity to LIDAC communities. Adopting zero-emission heavy duty vehicles in Illinois' large freight sector could provide both substantial emissions benefits and a laboratory for operational improvements and scalability that could help accelerate adoption elsewhere.
    b. This would reduce GHG emissions 2.1 MMTCO2e by 2030, and 76.4 MMTCO2e by 2050.
    c. This scenario is based on projections of U.S. heavy-duty electric truck sales by McKinsey.
    d. To determine the GHG emission impact of this scenario, the RMI Energy Policy Simulator was used to model emissions impacts of the scenario in the transportation sector. The transportation sector emissions impacts were broken out and discounted by 34% to account for the power sector emissions impact of the electricity used to charge the trucks. This discount was determined using a class 8 truck as a proxy: using data from the US Department of Transportation Vehicle Inventory and Use Survey, the average MPG of these trucks was found to be 7, and diesel fuel emits 22.45 pounds CO2 per gallon when burned per US EIA, providing a CO2 per mile traveled figure of ~3.207. To compare this to an electric heavy-duty truck, the Tesla Semi was used as a proxy. The Tesla Semi has an officially stated fuel efficiency of 2 kWh/mi, and Pepsi, one of the

largest operators of the trucks, says it has achieved an efficiency of 1.7 kWh/mi; an average of these two figures, 1.85 kWh/mi, was used. The electricity used to charge the truck is assumed to have a carbon intensity of ~0.588 lbs CO2 per kWh. This was derived from US EIA data which shows Illinois' average emissions intensity to be 639 lbs CO2 per MWh, which was then discounted an additional 8% to approximate off-peak charging (which operators will be incentivized to do, as nearly all large customers in Illinois are on time-of-use pricing). The 8% reduction is based on PJM's reported differential between the marginal CO2 emissions rates of its on-peak and off-peak power, and when applied results in 587.77 CO2 per MWh, or ~0.588 lbs CO2 per kWh. This level of carbon intensity in a truck with a mileage of 1.85 kWh/mi results in 1.088 lbs CO2 per mile traveled for the electric truck. This is ~2.12 lbs of CO2 per mile less than the diesel truck, almost exactly a 34% reduction in CO2 emissions on a per mile basis. This 34% discount was applied to the annual transportation sector emissions output by the RMI Energy Policy Simulator to account for the offsetting power sector emissions produced by the electric heavy-duty trucks and produce the GHG reduction estimates for this measure.

2. Support adoption of passenger electric vehicles, reaching 55% of new sales by 2030, 90% by 2040, and 95% by 2050. Pursuing this measure could include strategies such as incentives for the purchase of vehicles, shared mobility programs, programmatic or financial support for charging infrastructure, and programs or rates to encourage smart charging, EV-to-grid technologies, or EVs as a distributed energy resource.
    a. This would reduce GHG emissions by 2 MMTCO2e by 2030, and 131.4 MMTCO2e by 2050.
    b. This scenario is loosely based on Illinois' stated policy goal of putting 1 million electric vehicles on the road by 2030. It is further backed by the concept that Illinois could accelerate somewhat ahead of the baseline projection for passenger electric vehicles' overall market share in the US, which RMI projects at roughly 50% in 2030, EY projects at 50% in 2032, and Morningstar projects at 40% by 2030.
3. Expand mobility access, shifting 15% of trips to lower-carbon forms of travel by 2050.
    a. The United Nations Intergovernmental Panel on Climate Change identifies mode shift as a particularly important tool in decarbonizing the transportation sector, and demand for sustainable mobility options and infrastructure has grown in Illinois. Walking and biking have significant health, quality of life, and economic co-benefits beyond their significant emissions reductions.
    b. If achieved, this would reduce emissions by 6.5 MMTCO2e by 2023, and 79.3 MMTCO2e by 2050.
    c. This value was selected as a conservative midpoint within a variable range provided within the RMI Energy Policy Simulator.
4. Strategically support electrification of freight rail and trackside power.
    a. Diesel emissions from idling freight cars and generators on freight yards is similar in climate and environmental justice impact to other heavy-duty vehicles, but is logistically different and involves different stakeholders.
    b. This could reduce GHG emissions 0.25 MMTCO2e by 2030, and 5.7 MMTCO2e by 2050, based on a modeled action of shifting 20% of sales of new rail freight vehicles. This is

only an approximation of the emissions potential for rail electrification, as limited emissions calculation tools are available for more targeted interventions in this area.

Implementing Authority

- **Clean Energy Jobs Act (CEJA):**
  - CEJA has granted significant authority for implementing transportation electrification programs in Illinois.
  - Outlined a statutory intent to increase electric vehicle (EV) adoption to one million by 2030.
- **Illinois Department of Commerce and Economic Opportunity (DCEO):**
  - Operates a robust network of workforce development programs.
  - Expects to use Clean Jobs Workforce Training Hubs under CEJA to build the EV workforce pipeline.
- **Illinois Environmental Protection Agency (EPA):**
  - Has existing authority under the Grant Accountability and Transparency Act and complementary rules to uniformly implement competitive grant and incentive programs utilities state and federal pass-through funds.
  - Operates EV and charging infrastructure grant programs under the umbrella of its Driving a Cleaner Illinois Program, which includes federal Volkswagen Settlement and additional EV rebate and charging programs authorized under CEJA and Rebuild Illinois capital program.
- **Illinois Department of Transportation (IDOT):**
  - Has existing authority under the Grant Accountability and Transparency Act and complementary rules to uniformly implement competitive grant and incentive programs utilities state and federal pass-through funds.
  - Has primary responsibility for implementing the National Electric Vehicle Infrastructure (NEVI) program, public transit, and port electrification programs.
- **Legislative Authority for Idling Law:**
  - Illinois expects to seek legislative authority to strengthen the state's idling law under the Illinois Vehicle Code, which currently applies to areas designated as nonattainment for ozone.
- **Illinois Climate Bank:**
  - Has broad authority to develop and implement new financing options.
  - Can leverage existing funding programs and efficiently obtain necessary board approvals for new initiatives.
  - Does not require annual appropriation authority to spend funds.
- **Annual Appropriation Authority:**
  - Illinois state agencies require annual appropriation authority to spend funds allocated from General Revenue Funds, other state funds, and federal funds.

This information suggests a comprehensive approach in Illinois to promote clean energy, electric vehicle adoption, workforce development, and environmental protection through various legislative and programmatic measures.

Implementing Agencies

- Illinois Department of Commerce and Economic Opportunity
- Illinois Environmental Protection Agency
- Illinois Finance Authority / Illinois Climate Bank
- Illinois Department of Transportation

Measure Initiatives

1. Create a Heavy Duty Vehicle Charging Infrastructure Program for Small and Medium Fleet Operators

Summary

This initiative is designed to spearhead the construction of charging infrastructure tailored for small to midsize fleet and freight operators, with a particular focus on supporting local and regional routes within high-emission urban areas. Recognizing the unique challenges these operators face, such as limited benefit from current highway-centric charging solutions and ineligibility for certain tax incentives due to their operational scale and financial structure, the program aims to provide a more accessible and equitable path towards electrification. A key aspect of this approach is the co-creation of charging projects in direct partnership with the communities they serve, ensuring local benefits and aligning with broader environmental and equity goals.

Elements:

Shared EV Charging Grants. Direct grant incentives will be offered to facilitate the establishment of on-site or shared EV charging infrastructure, catering specifically to the needs of small and medium fleet operators. This effort is coupled with the Clean Freight Concierge Initiative, which provides tailored support and guidance, ensuring that these operators not only gain access to charging solutions but also navigate the transition to electric vehicles with comprehensive support.

Low-Cost Loans. A low-cost loan program will be introduced, emphasizing the deployment of DC fast-charging stations and including bridge loan options. These loans are particularly aimed at supporting small and medium-sized operators, especially those located in disadvantaged communities, enhancing financial accessibility. This element is synergistic with the concierge initiative, offering financial guidance and support.

Workforce to Maintain Charging Infrastructure. Maintenance of the charging infrastructure is crucial, as detailed in the Workforce to Maintain Heavy Duty Charging Infrastructure initiative, ensuring reliability and longevity of the investments.

Freight Outreach. This program will rely on the clean fleet and freight concierge initiative to ensure active participation, financial support, education and accessibility completing the cycle to guarantee the realization of emissions reductions.

Priority for Illinois:

Integrating this initiative with Illinois' broader environmental and economic objectives, including the ambitious targets set by the Climate and Equitable Jobs Act (CEJA), underscores the state's commitment to a sustainable, equitable transition to electrification for all transportation sectors. By specifically addressing the needs of small and medium-sized freight operators, the program not only aims to improve local air quality but also to bolster the economic resilience of these critical businesses within their communities.

Complementary Funding and Initiatives

This initiative enhances and aligns with existing state efforts, including the Illinois Environmental Protection Agency's (IL EPA) Charging Infrastructure Grant Program, the Illinois Department of Transportation's (IDOT) National Electric Vehicle Infrastructure (NEVI) Program, and the IL EPA's Drive a Cleaner Illinois Program. It specifically addresses the unique requirements of small to medium-sized operators, complementing but not replicating existing resources. This initiative focuses on making charging infrastructure more affordable for sectors of the transportation and freight industry that are often overlooked or underserved by programs. Through integration with the Clean Freight Concierge Initiative, it promotes a unified strategy to eliminate barriers to electrification, facilitating a smoother and more inclusive transition for all stakeholders involved.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will leverage its authority under its existing Charging Infrastructure Grant Program to expand a medium- and heavy-duty vehicle charging infrastructure grant program. Illinois Climate Bank is working to establish a low-cost loan program for EV charging infrastructure that can be accessed by fleet and freight operators.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Rulemaking at Illinois EPA, if necessary, can be completed within 12 months, with program launch within 18 months from the start of the initiative at the earliest.
- Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

2. Support Deployment of Trackside Power to Reduce Diesel Engine Idling

Summary

This initiative entails deploying trackside power along railway tracks, eliminating the necessity for diesel generators on trains, as well as offering enhanced idling reduction programs to significantly reduce the use of diesel generators. These strategically positioned hubs can also support the transition to electrified engines in commuter trains to further advance the state's cleaner transportation goals and address environmental justice concerns in communities that are disproportionately affected by diesel emissions. The dual emphasis on infrastructure and idling reduction aligns with Illinois' broader objectives, including saving fuel costs, preventing air pollution, reducing carbon dioxide emissions, fostering economic savings, and providing environmental sustainability.

Elements:

Trackside Power Grants. Grant incentives for equipment retrofits that do not qualify for tax credits, or where projects are not being completed because costs are well in excess of tax credit value. These grants aim to encourage small to medium-sized freight operators to upgrade or retrofit equipment to improve efficiency and reduce environmental impact.

Low-Cost Loans. Provide targeted low-cost loans designed for the freight industry segments traditionally underserved by conventional financing options. These loans will be focused on large capital cost items that accelerate trackside power and idling reduction such as outfitting freight with auxiliary engines.

GHG Emissions Calculation. Utilize the Freight Hub Data Collection and Analysis Program to rigorously measure the initiative's impact on GHG emissions. This should include tracking reductions achieved through the adoption of trackside power and reduced idling, offering transparent and actionable data to guide ongoing improvements.

Freight Outreach. This program will rely on the clean fleet and freight concierge initiative to ensure active participation, financial support, education, and accessibility completing the cycle to guarantee the realization of emissions reductions.

New Policy and Regulation. Collaborate closely with interagency and statewide freight planning initiatives to craft policies and regulations that bolster trackside power use and minimize diesel idling. This effort should review and possibly recommend enhancements to Illinois' idle reduction laws, focusing on reducing emissions in frontline and disadvantaged communities.

Priority for Illinois:

Deploying trackside power and enhancing idling reduction programs are top priorities for Illinois, reflecting the state's dedicated effort to combat diesel emissions and their adverse effects on community health and the environment. The initiative directly aligns with Illinois' priority to safeguard public health, enhance air quality, and advance equitable outcomes across all communities by targeting gaps in support

for specific freight operators, types, and equipment. By significantly reducing diesel emissions, especially in freight hubs that disproportionately impact disadvantaged and low-income communities, Illinois strengthens its commitment to environmental justice and public health, aligning with the Illinois Idle Reduction Laws and Idle Reduction Weight Exemptions.

Complementary Funding and Initiatives

This initiative adeptly fills critical gaps across a spectrum of state and federal environmental and transportation programs, including Driving a Cleaner Illinois, the Diesel Emissions Reduction Act, The Clean Ports Program, and Illinois Department of Transportation (IDOT) NEVI and Rail Freight Programs. Specifically designed to extend the reach of these foundational efforts, it introduces essential support for freight infrastructure, a sector previously underserved by existing policies and incentives. By providing targeted assistance where it's most needed, this initiative ensures that no segment of the freight and transportation sector is left behind in Illinois' transition to clean energy. Additionally, by aligning with and enhancing the Illinois Idle Reduction Laws, this approach not only complies with state regulations but also significantly amplifies their environmental impact. This strategic integration ensures comprehensive and effective emissions reductions across the state's freight transport sector, reinforcing Illinois' commitment to a cleaner, healthier future for all its residents.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will leverage its authority under its existing Charging Infrastructure Grant Program and Rail Freight Programs to issue grants for trackside power for freight operators. Illinois Climate Bank will work to expand its low-cost loan program for EV charging infrastructure to include freight trackside power.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Rulemaking at Illinois EPA, if necessary, can be completed within 12 months, with program launch within 18 months from the start of the initiative at the earliest.
- Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

3. Support Zero-Emissions On-Road and Off-Road Vehicle Deployment for Small and Medium Fleet Operators

Summary

The initiative is dedicated to advancing the electrification of Medium and Heavy-Duty Vehicles (MHDVs), with a particular focus on small and medium fleet operators who face significant challenges due to the

high upfront costs of electric vehicles. By offering targeted rebates and innovative financing solutions, this program specifically addresses the accessibility and affordability barriers these operators encounter. The aim is to significantly boost adoption within this group, directly contributing to Illinois' 2030 EV goals and addressing a pivotal gap in the market. This targeted approach ensures that small and medium fleet operators, often overlooked by broader incentive programs, receive the support necessary for transitioning to zero-emission vehicles.

Elements:

Vehicle purchase rebate. Offers targeted rebates for the acquisition of specific types of MHDVs and particular categories of buyers, especially those traditionally ineligible for existing programs (such as the Illinois Electric Vehicle Rebate Program) or cannot take advantage of tax credits.

Low-Cost Loans. Provides financial support to fleet operators with a carve-out to benefit small and medium-sized fleet operators. Includes provisions for third-party ownership to capitalize on tax incentives, exploring innovative financing arrangements where entities could lease vehicles.

Equipment Retrofits. Grant incentives for equipment retrofits. Help to extend the life of capital assets that already support decarbonization efforts but do not qualify for tax credits.

Fleet Operational and Logistics Training. Training for fleets on how to optimize the life of the vehicles and further described in the initiative, Workforce Training for Fleet Operators.

Freight Outreach. This program will rely on the clean fleet and freight concierge initiative to ensure active participation, financial support, education, and accessibility completing the cycle to guarantee the realization of emissions reductions.

Priority for Illinois:

This initiative is a key part of Illinois' drive to meet its environmental and public health goals under the Clean Energy Jobs Act (CEJA). It focuses on expanding support for zero-emission vehicles, including medium and heavy-duty vehicles (MHDVs), both on-road and off-road, and equipment retrofits. This effort is crucial for reducing statewide greenhouse gas emissions, improving air quality, and advancing towards the CEJA goal of 1 million electric vehicles by 2030, showcasing Illinois' comprehensive strategy for decarbonization.

Complementary Funding and Initiatives

This initiative aligns with and enhances federal incentives such as those under the Inflation Reduction Act (IRA), targeting electrification across Illinois. It specifically addresses the funding gaps left by federal tax credits and existing programs, focusing on medium and heavy-duty vehicle (MHDV) operators, particularly in segments of the transportation sector typically underserved today by programs like the Drive a Cleaner Illinois initiative. By providing targeted support for small and medium fleet operators, including rebates, low-cost loans, and equipment retrofit incentives, this effort ensures a more inclusive transition to zero-emission vehicles.

Driving a Cleaner Illinois is the Illinois EPA's grant program developed to distribute funding for various types of mobile source electrification projects. The Driving a Cleaner Illinois Program implements funding from a variety of sources, including the Climate and Equitable Jobs Act, the Volkswagen Environmental Mitigation Trust, U.S. Environmental Protection Agency's Diesel Emission Reduction Act (DERA) Program, and Federal Highway Administration's Congestion Mitigation and Air Quality Improvement (CMAQ) Program.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will leverage its authority under its existing Driving a Cleaner Illinois, the grant program developed to distribute funding for various types of mobile source electrification projects. Illinois Climate Bank will work to create a low-cost loan program for medium- and heavy-duty fleet vehicles.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Rulemaking at Illinois EPA, if necessary, can be completed within 12 months, with program launch within 18 months from the start of the initiative at the earliest.
- Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

4. Create a Clean Fleet and Freight Concierge

Summary

The initiative to create a Clean Fleet and Freight Concierge focuses on enhancing coordination and support for freight companies, especially those that don't have the internal resources to access programs and incentives. By guiding these companies toward economical, low-carbon technologies and practices, this program aims to significantly reduce greenhouse gas emissions and promote cleaner transportation methods across Illinois.

The Clean Fleet and Freight Concierge is not a standalone initiative but a vital component that complements and enhances a suite of efforts aimed at reducing greenhouse gas emissions within Illinois. It plays a crucial role in ensuring the success of other key initiatives, including the Heavy-Duty Vehicle Charging Infrastructure Program, the deployment of trackside power to reduce diesel engine idling, and the support for zero-emissions vehicle deployments among small fleet operators. By serving as a central hub for information, resources, and support, the concierge fosters a synergistic environment where the success of one initiative amplifies the impact of others.

Moreover, the concierge is integral to facilitating seamless communication and coordination among various related efforts, such as clean freight planning, stakeholder engagement, and workforce training

initiatives. It acts as the linchpin that ensures these diverse programs work in concert, not only to achieve their objectives but also to collectively advance Illinois' overarching environmental and transportation goals.

Elements:

Contractor Education. Establishing networks between freight companies and contractors skilled in low-carbon technologies, ensuring the success of the transition initiatives. Providing contractors with tools and resources to better understand the benefits and incentives available to fleets and freight companies. This ensures that contractors can effectively support these companies in their transition to cleaner technologies, amplifying the impact of the concierge service.

Strategic Planning Assistance. Acting as the main point of contact for freights and fleets, this feature involves entering into a contract with a third-party implementer to disseminate information about various programs, incentives, and opportunities for decarbonization, ensuring that companies are well-informed and able to take full advantage of available resources.

Workforce Training. Creating a feedback loop with workforce training programs to identify and address skill gaps, ensuring the workforce is equipped to support the transition to cleaner freight and fleet operations.

Clean Freight Planning and Stakeholder Engagement. Facilitating communication between freight companies and stakeholders, including communities and partnership organizations, to promote comprehensive support and engagement in decarbonization efforts.

Priority for Illinois

This concierge service is vital for Illinois, given its significant role in the national freight system and the urgent need to reduce transportation sector emissions. By providing targeted support and facilitating the adoption of clean technologies, this initiative directly aligns with Illinois' goals to decrease GHG emissions and enhance air quality, particularly in disadvantaged communities affected by freight-related pollution.

Complementary Funding and Initiatives

By complementing and enhancing the Illinois Department of Transportation's Rail Freight Program and other existing initiatives, the Clean Fleet and Freight Concierge ensures that resources are leveraged effectively, avoiding duplication and maximizing impact. This initiative is a strategic component of Illinois' broader effort to combat climate change, offering a synergistic approach to reducing GHG emissions across the state's transportation sector.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will conduct a solicitation for a third-party implementer to serve as a clean freight concierge.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Rulemaking at Illinois EPA, if necessary, can be completed within 12 months, with program launch within 18 months from the start of the initiative at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

5. Create a Freight Hub Data Collection and Analysis Program Emphasizing Monitoring and Metrics in Local Communities.

Summary

The Freight Hub Data Collections and Analysis initiative for GHG emissions aims to implement comprehensive air pollution monitoring at key distributed freight hubs that may not be served by the US EPA Clean Ports Program. By deploying advanced tracking technologies both at these hubs and in homes located in close proximity, the program seeks to closely monitor, track, and subsequently enhance local health outcomes and air quality associated with the clean freight transition. This targeted approach allows for the quantification of GHG reduction progress over time, setting a critical baseline and tracking metrics specifically designed for this large polluting industry and the disadvantaged communities that are most affected by heavy freight emissions.

Elements

Air Pollution Monitoring. Implementation of state-of-the-art air quality monitoring stations at strategic freight hub locations to gather real-time data on emissions and their impact on local air quality.

Fund Community Trackers. Distribution of indoor air quality monitoring devices to households and local businesses in close vicinity to freight hubs, enabling the collection of data on the ambient air pollution levels they are exposed to.

Data Analysis and Reporting. Utilization of sophisticated data analysis tools and methodologies to process and interpret the collected data, aiming to identify trends, measure the effectiveness of emissions reduction initiatives, and inform future policy and program development.

Community Engagement and Feedback. Establishing mechanisms for community feedback and participation in the monitoring process, ensuring transparency and fostering trust among the most highly affected populations. This includes outreach and education around community trackers.

Priority for Illinois:

This initiative is a top priority for Illinois as it directly addresses the health and environmental disparities faced by disadvantaged communities located near freight hubs. By setting a baseline and tracking improvements in air quality, the state can demonstrate tangible benefits from emissions reduction programs, such as trackside power and idling reduction initiatives. This focus on measurable outcomes

supports Illinois' broader goals for sustainable transportation, environmental justice, and GHG emissions reduction, ensuring that progress is both significant and enduring.

Complementary Funding and Initiatives

This initiative complements existing efforts to reduce GHG emissions and improve air quality around freight hubs while filling the gaps in the Clean Ports Program. It enhances the accountability and efficacy of programs like the Trackside Power and Idling Reduction and the Zero Emissions Vehicle Deployment by providing clear, quantifiable metrics of success. Furthermore, this initiative supports Illinois' commitment to environmental justice by focusing on quantifiable benefits for low-income and disadvantaged communities, ensuring that they are not left behind in the state's transition to a cleaner, healthier future. This program's deployment of new technologies and tracking methods sets a replicable model for other regions and aligns with the Illinois Department of Transportation's goals for innovation in sustainable freight logistics.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will expand its Ambient Air Monitoring Network Plan to include targeted air quality monitoring sites in targeted environmental justice communities.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Rulemaking at Illinois EPA, if necessary, can be completed within 12 months, with program launch within 18 months from the start of the initiative at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

6. Develop Workforce Training for Fleet and Freight Operators

Summary

The Workforce Training Program for Fleet and Freight Operators is an integral component of Illinois' strategic effort to transition towards a more sustainable, efficient, and electrified fleet industry. This initiative is crafted with the understanding that the success and longevity of the fleets acquired through the Zero Emissions Vehicle Initiative critically depend on the operators' proficiency in utilizing these vehicles to their fullest potential. As such, the training program is designed to provide comprehensive instruction to fleet operators, dispatchers, and drivers, focusing on optimizing electric vehicle (EV) use from operational, logistical, and environmental standpoints. The curriculum aims to enhance the skill set of those at the forefront of fleet operations, ensuring that the investment in zero-emission vehicles yields maximum environmental and economic benefits. By integrating the Workforce Training Program closely with the Zero Emissions Vehicle Initiative, Illinois is establishing a holistic approach that marries

vehicle acquisition with operator expertise, setting a standard for a cleaner, more sustainable transportation future.

Elements

Fleet Operator Training. Tailored training on driving strategies to maximize battery life, route optimization, vehicle weight, distance, start-stop frequency, speed, logistics, and topography.

Dispatcher Training. Instructions on planning efficient routes and logistics that align with battery life and charging station availability, essential for minimizing downtime and maximizing vehicle utility.

Driver Training. Guidance on strategic charging — when and where to charge to ensure operational efficiency and vehicle readiness.

Comprehensive Fleet Training. Workshops and/or training on managed charging, utilizing software and tools for ensuring charging availability, and exploring potential revenue streams from smart charging practices.

Coordination with Clean Freight Concierge. This element ensures alignment with broader state initiatives, leveraging insights and support from the Clean Freight Concierge to enhance training relevance and application.

Utilization of Workforce Training Hubs. Capitalizing on established and emerging workforce development centers across Illinois to deliver this training, ensuring statewide accessibility and consistency.

Priority for Illinois

Investing in a workforce capable of navigating the intricacies of electric fleet operations is a priority for Illinois. This training program directly supports the state's ambitious environmental goals by ensuring that fleet operators are equipped with the knowledge and tools necessary to optimize EV use and contribute to the reduction of greenhouse gas emissions. It aligns with Illinois' commitment to transition to a more sustainable transportation sector, bolstering economic growth while safeguarding environmental health.

Existing/Complementary Efforts

This initiative is an essential supporting component to the effective execution of the Zero Emissions Vehicle Initiative and the Clean Freight Concierge program. Workforce development investments that focus on the fleet, dispatcher, and driver training fill in the gaps in the existing state workforce, and certification initiatives focus on infrastructure deployment and construction. The workforce efforts will leverage and expand the capacity of Illinois' developing workforce training hubs, created by CEJA and which will be located in 13 targeted locations across the state. This comprehensive approach ensures that Illinois' workforce is ready to meet the demands of a green transportation future, making the state a leader in sustainable fleet and freight operations.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will work with the Illinois Department of Commerce and Economic Opportunity to leverage and expand the capacity of Illinois' developing Clean Jobs Workforce Network Program to include fleet workforce training.

Establishment of the programs will require no statutory change, and limited regulatory intervention. The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

7. Build a Workforce to Maintain Heavy-Duty Charging Infrastructure

Summary

The initiative is strategically designed to foster the development of a specialized workforce dedicated to maintaining heavy-duty electric charging infrastructure with a dual focus on ensuring operational reliability and supporting economic growth within local communities. This program targets the critical need for specialized maintenance to keep heavy-duty EV charging stations functional and reliable, particularly vital for commercial transportation and logistics sectors that depend heavily on these facilities. It aligns with the broader Heavy Duty Vehicle Charging Initiative, addressing the reliability and accessibility challenges of HDV charging infrastructure. Importantly, the initiative is committed to creating local prevailing wage jobs in the communities where this infrastructure is deployed, prioritizing disadvantaged or low-income areas. This approach not only addresses a significant gap in the EV infrastructure ecosystem but also contributes to economic empowerment and resilience in communities that stand to benefit the most from localized job creation and skill development.

Elements

Vocational Training Programs. Extend the work of Clean Jobs Workforce Hubs to create specialized vocational training and certification programs tailored for the maintenance of HDV and charging infrastructure. These initiatives aim to equip participants with essential technical skills, ensuring proficient maintenance and reliable operations in the field.

Local Training and Job Creation. Focused on leveraging the deployment of charging stations as a catalyst for local job creation and training, particularly in disadvantaged or low-income communities. This initiative ensures a skilled maintenance workforce is developed directly within the communities hosting these chargers, promoting job growth and economic stability.

Standardized Training Curriculum. Develop an inclusive, standardized training curriculum designed specifically for the maintenance of EV charging infrastructure, with a focus on heavy-duty chargers. This initiative aims to utilize established educational materials from industry-leading programs, adapting them to align with Illinois-specific codes, standards, and operational contexts

Collaboration with Workforce Hubs. These collaborations aim to leverage the robust support created by CEJA and already available through the Clean Jobs Workforce Hubs. By working closely with these established hubs, the program ensures that the workforce is not only equipped with cutting-edge knowledge and techniques but also benefits from a localized training approach. This localized approach facilitates access to training and employment opportunities, particularly for residents of disadvantaged or low-income communities, thereby fostering a skilled workforce that is well-distributed across the state. Through these partnerships, the initiative will ensure that the curriculum and training opportunities are widely accessible, meet the highest industry standards, and are tailored to address the specific needs of Illinois' EV charging infrastructure.t

Support for NEVI, Charging and Fueling Infrastructure, and Other Charging Initiatives. This workforce training effort will also support the maintenance of chargers deployed under the NEVI program and other initiatives, ensuring the long-term reliability of the state's EV infrastructure and ongoing prevailing wage job opportunities.

Priority for Illinois

Elevating the development of a skilled workforce for maintaining heavy-duty vehicles and heavy-duty EV charging infrastructure is a strategic priority for Illinois, directly supporting the state's environmental and economic goals. This initiative not only aims to enhance the reliability of critical charging infrastructure but also emphasizes the creation of local, prevailing wage jobs in disadvantaged or low-income communities. By doing so, Illinois addresses a key component of sustainable transportation infrastructure while fostering economic development and social equity, ensuring that the benefits of the state's transition to electrified transportation are shared widely.

Existing/Complementary Efforts

This workforce development program complements existing initiatives by filling a critical need for skilled maintenance personnel, ensuring the longevity and reliability of Illinois' growing EV charging infrastructure while leveraging the knowledge and resources of the Clean Jobs Workforce Hubs. It leverages and expands upon the foundation laid by the Heavy Duty Vehicle Charging Initiative and aligns with federal efforts under the NEVI program. This holistic approach ensures that as Illinois advances its electric mobility infrastructure, it also cultivates a local workforce capable of sustaining this growth, bringing jobs to the communities that are most impacted by enhancing the effectiveness of both state and federal investments in clean transportation.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will work with the Illinois Department of Commerce and Economic Opportunity to leverage and expand the capacity of Illinois' developing Clean Jobs Workforce Network Program to include fleet workforce training.

Establishment of the programs will require no statutory change, and limited regulatory intervention. The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

8. Facilitate Statewide and Interagency Coordination Around Critical Freight Planning and Engagement

Summary

This initiative aims to establish a comprehensive planning and engagement framework for critical freight projects across the state and will act as a central architecture that will inform and support the other initiatives within the clean freight area. By fostering collaboration among state agencies, local communities, and the private sector, this initiative aims to prioritize freight projects that significantly contribute to GHG reductions. This strategic planning process is essential for identifying projects that not only support decarbonization efforts but also ensure the effective utilization of state and federal funding, including CPRG funds focused on clean freight.

Elements

Strategic Planning Process. Development of a strategic planning process to identify high-priority clean freight projects. This process will include various stakeholders and incorporate engagement to foster input and feedback. This planning process will focus on creating a governance structure for inland ports, a strategic plan for the allocation of state and federal funding, including CPRG funds to maximize GHG reductions, and create a framework to work through challenges that can limit the GHG reductions in other initiatives.

Coalition Building. Formation of a coalition comprising state agencies, communities of high impact, community based organizations, environmental justice groups, industry, education, and others that will inform the strategic planning process.

Community Based Organization (CBO's) Compensation. CBO's, and environmental justice communities will be compensated for their participation in the planning process, ensuring that these critical voices are represented and included throughout the process. There will also be compensation for certain outreach and engagement efforts that may be created out of this initiative.

Overcoming Known Barriers. Facilitate forums to address and strategize on overcoming supply chain barriers, ensuring the success of other clean freight initiatives that depend on infrastructure and supplies. Work collaboratively to find solutions to building codes and streamlining the building code . Collaborate with local communities on land use planning and engage with the appropriate stakeholder around standardization of interconnection to ensure the success of other clean freight initiatives.

Priority for Illinois

This initiative is crucial for Illinois, aligning with the state's commitment to sustainable transportation and decarbonization. By facilitating statewide and interagency coordination, Illinois sets a foundation for strategic freight planning, ensuring the success and maximization of GHG reductions from clean freight investments.

Existing/Complementary Efforts

It is anticipated that this effort will be able to coordinate investments and strategies with any successful applications under the US EPA Clean Ports Program.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will establish an interagency working group for coordination and begin to work with community-based organizations to address known barriers.

Establishment of the programs will require no statutory change, and limited regulatory intervention. The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

Geographic Location

Statewide, with an emphasis on freight in the Chicagoland region, as its highly concentrated freight operations in close proximity to vulnerable communities presents one of the most compelling opportunities in the nation for deploying clean freight measures that yield a combination of climate and community benefits.

Complementary Funding and Initiatives

For the Clean Transportation and Freight measure, this PCAP identifies methods of complementing, and not replicating, funding from State, utility, and federal funding sources:

- **State Initiatives**
    a. Illinois Department of Commerce and Economic Opportunity. Administers:
        i. Clean Jobs Workforce Network Program
        ii. Energy Transition Navigator Program (for workforce)
        iii. Contractor efficiency and electrification certification programs
    b. Illinois Environmental Protection Agency. Administers:
        i. Charging Infrastructure Grant Program
        ii. Drive Cleaner Illinois Program
        iii. Volkswagen Environmental Mitigation Trust
    c. Illinois Department of Transportation
        i. National Electric Vehicle Infrastructure (NEVI) Program
        ii. Rail Freight Program
        iii. Idle Reduction Weight Exemption
    d. Illinois Climate Bank. Administers:

i. Various climate finance products

- **Utility Initiatives**
  a. The two large investor-owned utilities in the state, ComEd and Ameren, operate the following statutorily-mandated programs, overseen by the Illinois Commerce Commission:
     i. Beneficial Electrification Programs
- **Federal Funding**
  a. US Treasury Commercial Clean Vehicle Credit
  b. US EPA Clean Ports Program
  c. US EPA Diesel Emission Reduction Act (DERA) Program
  d. US EPA Greenhouse Gas Reduction National Clean Investment Fund Competition
  e. US FHWA Congestion Mitigation and Air Quality Improvement (CMAQ) Program
  f. US FHWA Charging and Fueling Infrastructure Program

Metrics for Tracking Progress

CLEAN TRANSPORTATION & FREIGHT

Metric	Description
Transportation-1	Total medium- and heavy-duty electric vehicles registered in Illinois, including in geographies near freight facilities and disadvantaged communities
Transportation-2	Share of medium- and heavy-duty electric vehicles registered in Illinois, including in geographies near freight facilities and disadvantaged communities
Transportation-3	Total medium- and heavy-duty internal combustion vehicles registered in Illinois, including in geographies near freight facilities and disadvantaged communities
Transportation-4	Share of medium- and heavy-duty electric vehicles registered in Illinois, including in geographies near freight facilities and disadvantaged communities
Transportation-5	Air quality near freight facilities, including near rail facilities where trackside power measures have been implemented

Clean Industry

Manufacturers in Illinois account for 12.83% of the total output in the state, employing 9.44% of Illinois workforce. Industry is responsible for about 18% of Illinois GHG emissions, or roughly 45 MMTCO2e a year including both industrial energy and process emissions. Industrial GHG emissions declined by less than 10 MMTCO2e between 1990 and 2021.

While CEJA and the IRA support high levels of electric and transportation sector decarbonization that will help reduce GHG emissions in the industrial sector, new policies are needed to address industry decarbonization, particularly with respect to replacing high global warming potential substances with the low-carbon alternatives, electrifying industrial thermal processes and using clean hydrogen in the hard to electrify industries.

Electrifying industrial processes, particularly industrial thermal processes, offers a significant opportunity to decarbonize Illinois' industrial sector. Industrial thermal energy needs, and heat in particular, represent about ⅔ of the industrial sector's energy demand, while only about 10% of such demand is fulfilled with renewable energy nationwide. Process heating, reactions, evaporation, concentration, and drying are responsible for about 52% of the US industrial direct GHG emissions.

Due to their highest global warming potential (GWPs) and longest atmospheric lifetime among other GHGs emitted by human activities, replacement of fluorinated gases (also known as F- gases), such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF6), and nitrogen trifluoride (NF3), with low carbon alternatives creates a high GHG reduction potential for Illinois industry. About 92% of F-gas emissions come from substitutes of ozone-depleting substances, particularly HFCs used as refrigerants in building and vehicle air conditioning, with the remaining 8% coming from a variety of industrial processes such as aluminum and semiconductor manufacturing, according to the US EPA. F-gases, particularly HFCs, are released into the atmosphere during manufacturing processes, and leaks,

servicing, and disposal of equipment in which they are used. Industrial emissions of fluorinated gases can be reduced through F-gas capture and destruction processes, optimizing production to minimize emissions, and replacing these gases with alternatives.

For the sectors that are hard to electrify, the state is investigating efficient production and use of clean hydrogen as part of a regional effort. Illinois participates in the Midwest Alliance for Clean Hydrogen (MachH2), a multi-state, multi-sector network that includes Illinois, Indiana, and Michigan, that will focus on hydrogen created through electrolysis, a process which will use carbon-free electricity to separate water molecules into hydrogen and oxygen to produce carbon-free hydrogen. In October 2023, the U.S. Department of Energy (DOE) awarded Midwest Alliance $1 billion in federal funding under the Regional Clean Hydrogen Hubs Program funded through the Bipartisan Infrastructure Law, to promote decarbonization through hydrogen use in steel and glass production, power generation, refining, heavy-duty transportation, and sustainable aviation fuel.

Topline Outputs and Greenhouse Gas Emission Reductions

1. Improve industrial efficiency 5% by 2030 and 25% by 2050, and support implementation of process improvements.
    a. Industrial efficiency is the most cost-effective and readily available measure to reduce emissions from the industrial sector. By building upon existing state and federal programs, and leveraging existing relationships with industrial operations, Illinois could accelerate the pace of industrial efficiency improvements that are already occurring.
    b. Achieving this would reduce GHG emissions by 27.2 MMTCO2e by 2030, and 151 MMTCO2e by 2050.
    c. This goal is based on an analysis by the U.S. Department of Energy which estimated that an additional 1.2% efficiency per year in the industrial sector was feasible in most sectors. The 2030 and 2050 goals both assume achievement just shy of that goal, as well as process and system design improvements that would progressively reduce fuel consumption by 1.8% by 2050.
2. Electrify 10% of low-temperature industrial heat by 2030 and 95% by 2050.
    a. Low-temperature industrial heating end uses are among the most readily available opportunities for GHG emissions reductions in the industrial sector, outside of efficiency. All-electric technologies such as industrial heat pumps are technically capable, today, of filling this role in nearly all cases. Federal tax credits, combined with state programs to support uptake by businesses, could bring these technologies into cost parity or cost advantage compared to comparable gas-fired industrial equipment.
    b. Achieving these targets would reduce GHG emissions by 7.427 MMTCO2e by 2030, and 201.3 MMTCO2e by 2050.
    c. This scenario is based on one modeled by the National Renewable Energy Laboratory (NREL), which shifted several varieties of low-temperature industrial heat to 100% by 2050 as part of an overall decarbonization scenario.
3. Convert 30% of medium- and high-temperature industrial heat in targeted sectors to electricity or hydrogen by 2050.

a. While technologies for high-temperature industrial heating are still nascent, several low-carbon steel plants are moving forward worldwide, and there is growing interest from US Steel (which has committed to net zero emissions by 2050) and Midwest-based Cleveland Cliffs. As part of the MachH2 Hydrogen Hub, Illinois is well-positioned to be a leader in this area, and it presents a significant emissions reduction opportunity.
b. Achieving this goal would reduce GHG emissions by 0.25 MMTCO2e by 2030, and 15.6 MMTCO2e by 2050.
c. This scenario assumes that Pulp Paper and Printing, Chemicals, Glass and Glass Products, Cement and Other Nonmetallic Minerals, Iron and Steel, and Other Metals shift to 15% electricity and 15% hydrogen for high-heat operations by 2050. Since the technology is still relatively new, the penetration assumed for this measure is moderate and unavoidably somewhat speculative.
d. While the immediate emissions reductions are not as large as some other measures, developing markets, programs, know-how, and economies of scale for high-heat industrial processes will be essential for reducing Illinois' emissions to the levels needed for the state and the US to meet their respective commitments to the Paris Climate Agreement. Given its relatively low-cost and low-carbon electricity, the presence of a DOE hydrogen hub, and its industrial base, Illinois is a strong place to pioneer measures that can be scaled and replicated elsewhere.

4. Reduce emissions of hyper-potent fluorinated gases by 20% by 2030 and 67% by 2050, primarily through substation of lower-warming-potential alternatives, and supported by improved disposal, equipment and maintenance.
    a. There are readily available lower-potency gases that can replace the functions fluorinated gases (or "f-gases") serve in many instances, and their incredible potency makes their replacement relatively logistically simple compared to some other forms of GHG reduction, and allows for rapid near-term reductions, which is a priority of the CPR program as articulated.
    b. Achieving this goal would reduce GHG emissions by 2.46 MMTCO2e by 2030, and 45 MMTCO2e by 2050.
    c. As a freight and warehousing hub, Chicagoland has among the largest footprints of cold-storage space in the country, with large new facilities under construction in Lake County and elsewhere. Refrigeration is one major source of f-gases. The large cold storage sector in Illinois presents a large opportunity for immediate impact, and the presence of cold storage operators who do business nationally could help best practices developed here spread more readily elsewhere.

Implementing Authority

The State of Illinois's participation in MachH2 is bolstered by the Hydrogen Economy Task Force created under the Department of Commerce and Economic Opportunity via Public Act 102-1086. The Task Force was charged with creating a plan to facilitate the deployment of hydrogen in the state's economy.

DCEO already operates a robust network of workforce development programs - the Department expects to leverage these existing programs to support industry transition to cleaner manufacturing processes and practices.

Illinois EPA and other state agencies have existing authority under the Grant Accountability and Transparency Act and complementary rules to uniformly implement competitive grant and incentive programs utilizing state and federal pass-through funds.

Legislative authority may be needed to either pilot or mandate state or local government utilization of low-carbon commodities. Authorizing statutory authority or memoranda of agreement may also be required for participation in a multi-state industrial decarbonization effort.

The Illinois Climate Bank has broad authority to develop and implement new financial assistance opportunities, including grant and loan programs, to leverage existing funding programs, along with an ability to efficiently obtain necessary board approvals for new initiatives.

Illinois state agencies require annual appropriation authority to spend funds allocated from General Revenue Funds, other state funds, and federal funds.

Implementing Agencies

- Illinois Department of Commerce and Economic Opportunity
- Illinois Environmental Protection Agency
- Illinois Finance Authority / Illinois Climate Bank
- Illinois Department of Transportation

Measure Initiatives

1. Clean Industry Concierge.

Summary

With the acceleration of funding opportunities on the state and federal level, industrial customers miss opportunities, remain unaware of the full range of decarbonization programs they may be eligible for, and lack internal resources to access these opportunities. The Clean Industry Concierge initiative will help Illinois industrial facilities to navigate, coordinate and access funding opportunities, get support in designing and implementing decarbonization measures, and provide strong guidance on industry best practices in efficient and cost-effective low-carbon technologies and processes. A special focus will be placed on small- and medium-sized industrial facilities and operators that often fall through the cracks. The Clean Industry Concierge will coordinate with the other decarbonization efforts within Illinois, including building and transportation decarbonization, equity and workforce development, to reduce

costs, increase synergies and increase community benefits, as well as fill the gaps and avoid duplication. It plays a crucial role in ensuring the success of other key initiatives, and will serve as a central hub for information, resources, and support, to foster a synergistic environment where the success of one initiative amplifies the impact of others.

Elements

Contractor and Supply Chain Connections and Education. Establishing networks between manufacturers and contractors skilled in low-carbon technologies, as well as suppliers of lower-carbon materials and products, to ensure the success of the transition initiatives.Providing contractors and suppliers with tools and resources to better understand the benefits and incentives available to manufacturers in Illinois. This ensures that contractors and suppliers can effectively support these companies in their transition to cleaner technologies, amplifying the impact of the concierge services.

Strategic Planning Support. Acting as the main point of contact for manufacturers, this feature involves disseminating information about various programs, incentives, and opportunities for decarbonization, ensuring that companies are well-informed and able to take full advantage of available resources.

Workforce Training Liaison. Creating a feedback loop with workforce training programs to identify and address skill gaps, ensuring the workforce is equipped to support the transition to cleaner manufacturing processes and practices.

Clean Industry Planning and Stakeholder Engagement. Facilitating communication between manufacturers and stakeholders, including communities and partnership organizations, to promote comprehensive support and engagement in decarbonization efforts.

Complementary Funding and Initiatives

By complementing and enhancing the Illinois DCEO Workforce Development Program and other existing initiatives, the Clean Industry Concierge ensures that resources are leveraged effectively, avoiding duplication and maximizing impact. This initiative is a strategic component of Illinois' broader effort to combat climate change, offering a synergistic approach to reducing the state's industrial GHG emissions.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will conduct a solicitation for a third-party implementer to serve as a clean freight concierge.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Rulemaking at Illinois EPA, if necessary, can be completed within 12 months, with program launch within 18 months from the start of the initiative at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

2. Buy Clean Planning and Pilot.

Summary

The "Buy Clean and Pilot" initiative supports low-carbon commodities through state and local government planning, testing, and piloting. It targets commodities with low embodied carbon or captured carbon, and projects that improve energy and operational efficiency, and leverage federal incentives.

Elements

Planning, Testing and Demonstrations. State and local agencies and governments will plan, test, and pilot low-or no-carbon commodities, products, services, and processes , including commodities produced with embedded captured carbon, and identify opportunities and challenges for their use in Illinois. The focus will be on the commodities, products, services, and processes that are used in Illinois with at least 40% GHG reduction potential, coordination regionally and leveraging other resources available on the federal and state level.

Pilot Grants. Allocate gap funding for testing, demonstration and evaluating high-potential GHG emissions reduction projects in the industrial sector, prioritizing those lacking funding from other sources.

Complementary Funding and Initiatives

Currently, there are no direct state federal funding resources to launch a Buy Clean initiative. However, potential synergies exist with the Illinois Department of Transportation's Material Labs program, which ensures that quality materials are used in highway projects.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, the Illinois Department of Transportation will coordinate its Material Labs to test, sample, document, and report on new low-carbon materials for use in highway projects.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

3. Fluorinated Gas Reduction Program.

Summary

The Fluorinated Gas Reduction Program, which has high GHG reduction potential for Illinois industry, aims to mitigate the impact of fluorinated gases, which have high global warming potential and long atmospheric lifetimes. The state will work with stakeholders to develop and implement an incentive program encouraging the adoption of lower carbon alternatives and enhancing industrial processes and logistics to reduce emissions from leaks, servicing and disposal of equipment utilizing fluorinated gases. The state will engage in the stakeholder outreach, planning, and project identification and will establish a program that will provide technical support and financial incentives to phase out super-emitting fluorinated gases.

Elements

Technical Support. Technical assistance to industrial and manufacturing facilities in the form of facility assessments to help the facility identify cost-effective and innovative approaches, funding opportunities and needed support to execute a project.

Incentive Program. The state will establish a Fluorinated Gas Reduction Incentive Program to support:

- replacement of fluorinated gases with cost-effective low global warming potential technologies, primarily in commercial and industrial refrigeration;
- optimization of manufacturing processes and logistics to minimize emissions from leaks, servicing and disposal of equipment that uses F- gases.

Complementary Funding and Initiatives

There are no existing funding sources related to the substitution of fluorinated gases.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will develop an incentive program to support substitution of F- gases with lower carbon alternatives.

Establishment of the programs will require no statutory change, and limited regulatory intervention. The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

4. Regional Industrial Decarbonization.

Summary

The state will work in tandem with regional coalitions and partnerships to implement a competitive grant program supporting investments in innovation at industrial and manufacturing facilities that also reduce air pollution. Projects eligible for this program will demonstrate implementation readiness, innovation, direct air pollutant reductions, co-benefits, benefits to low-income and disadvantaged communities, with an ability for projects to be completed within five years. Incentives to cover the costs of installation or upgrades to enhance industrial efficiency and reduce air pollution will be provided in the form of reimbursements to qualified and selected applicants. Such support is contingent on securing funding for specific measures by respective coalitions. The state will select projects on a competitive basis, contingent upon an applicant satisfying the criteria set by the coalition. This measure could be utilized by eligible manufacturing, mining/quarrying and energy production or extraction companies, carbon management project developers, local and tribal governments, and other qualifying public/private partnerships within the state.

Elements

The state will leverage funding available through the regional industrial decarbonization efforts and coalitions it joins to provide:

Technical Assistance. Technical assistance to industrial and manufacturing facilities in the form of facility assessments to help the facility identify:

- cost-saving and innovative measures,
- funding opportunities to implement those measures, and
- gaps in funding needed to execute a project.

Implementation Grants. Grants to qualifying industrial and manufacturing facilities in coalition states to address gaps in funding to realize cost savings and reduce onsite emissions through electrification, fuel switching and lower-heat alternatives, including green hydrogen utilization for process heat, electrification, enhanced process and energy efficiency, catalyst for emission reduction from N2O, or carbon capture and storage.

Complementary Funding and Initiatives

This measure intends to fill gaps in funding left after implementation of the federal 48C Clean Manufacturing Tax Credit. That program is currently funded at a $4 billion level, and applications were due in December 2023. The winners of 48C credits have not been announced. The 48C program is expected to leave an abundance of unfunded projects to spur innovation and reduce emissions. This coalition grant program will build on the 48C grants and focus on projects that do not get 48C funding.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA, Illinois Climate Bank, and Illinois Department of Commerce and Economic Opportunity will work together, to provide technical assistance to interested industrial facilities, and to support the creation of a competitive grant program for the distribution of implementation grants.

Establishment of the programs will require no statutory change, and limited regulatory intervention. The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

Geography

Statewide, finding opportunities where possible for industrial GHG reductions that occur near disadvantaged communities and can provide air quality co-benefits. The state may also collaborate with regional partners.

Complementary Funding and Initiatives

For the Clean Industry measure, this PCAP identifies methods of complementing, and not replicating, funding from State, utility, and federal funding sources:

- **State Initiatives**
  a) Illinois Department of Commerce and Economic Opportunity. Administers:
    i) Workforce Development Program
    ii) Clean Jobs Workforce Network Program
    iii) Energy Transition Navigator Program (for workforce)
    iv) Contractor efficiency and electrification certification programs
  b) Illinois Climate Bank. Administers:
    i) Various climate finance products
- **Utility Initiatives**
  a. The two large investor-owned utilities in the state, ComEd and Ameren, operate the following statutorily-mandated programs, overseen by the Illinois Commerce Commission:
    i. Beneficial Electrification Programs
- **Federal Funding**
  a. US Treasury 48C Clean Manufacturing Tax Credit
  b. US EPA Greenhouse Gas Reduction National Clean Investment Fund Competition
  c. US DOE Regional Clean Hydrogen Hubs Program
  d. US DOE Advanced Energy Manufacturing and Recycling Grant Program
  e. US DOE Industrial Demonstrations Program

Measurement and Metrics

CLEAN INDUSTRY

Metric	Description
Industry-1	Number of qualified facilities/organizations applying for the funding.
Industry-2	Number of qualified facilities/organizations successfully implementing projects within the given timeline.
Industry-3	Number of tested and demonstrated low-carbon and no-carbon commodities, products, services, and processes that achieve at least 40% GHG reduction vs business as usual for a targeted industry.
Industry-4	Number of fluorinated gases replaced and number of technologies and processes changed that lead to reduction/avoidance of GHG emissions vs business as usual for a targeted industry.
Industry-5	Amount of CO2 and other co-pollutants reduced at each participating site, both on an annual basis and over the duration of the program.
Industry-6	Amount of CO2 and other co-pollutants reduced in a targeted industry, both on an annual basis and over the duration of the program.
Industry-7	Amount of CO2 and other co-pollutants reduced in Illinois, both on an annual basis and over the duration of the program.
Industry-8	Percentage of manufacturing processes, including low and medium heat processes, electrified by switching from fossil fuels to clean energy resources.
Industry-9	Percentage of improved industrial efficiency and process improvements.
Industry-10	Number of people and percentage of Illinois population living in environmental justice and disadvantaged communities benefiting from lower emissions from neighboring manufacturing facilities.
Industry-11	Number of jobs created and number of people trained in clean manufacturing practices.

Clean Agriculture

Reducing Emissions from Agriculture, Land Use, and Methane

Illinois is actively addressing the imperative of reducing greenhouse gas (GHG) emissions in its large agricultural sector, which currently accounts for 12% of the state's total emissions. Building on existing federal and state initiatives, Illinois is implementing key initiatives to maximize GHG emissions reduction from agriculture, land use, and methane in those and other sectors.

The largest source of emissions within the agriculture sector, by far, is soil management, and reducing these emissions is a focus of the state's climate strategy. The state has already made efforts to support and expand programs to support low-till and no-till agriculture and cover crop planting, but opportunity in this area vastly outstrips available resources.

Other opportunities and areas of focus include creating innovative approaches for natural carbon storage to mitigate climate change, accelerating the adoption of zero-emissions commercial landscaping and agricultural equipment through the small clean equipment and machinery program, and mitigating or capturing and utilizing methane emissions in the agricultural sector and elsewhere, such as wastewater and landfill facilities.

In addition to their climate benefits, these efforts produce significant supplemental benefits including improved soil health, reduced erosion, and improved air quality.

By leveraging successful programs and established networks, Illinois is taking decisive steps to implement practical solutions, demonstrating a commitment to sustainable practices, environmental stewardship, and contributing to broader efforts to combat climate change within the crucial agricultural industry.

Topline Outputs and Greenhouse Gas Emission Reductions

1. Reduce agricultural process and land-use emissions 2% by 2030 and 10% by 2050, using approaches such as no-till and low-till agriculture, cover crops, natural carbon sequestration, and other measures.
    a. This would reduce GHG emissions 0.95 MMTCO2e by 2030. If continued in perpetuity, they would yield 4.75 MMTCO2e by 2050, but that continuation would be contingent upon funding, programmatic capacity, and other factors.
    b. These projections were estimated based on the following assumptions:
        i. Conversion of 100,000 acres of conventional tilled farmland to a no-till practice, reducing 0.5 MTCO2e per acre, for a total of 50,000 MTCO2e annually.
        ii. Incentivizing current no-till acres not accounted for under any current carbon market program to participate in one, continuing to sequester carbon that would have otherwise been released. This could be done on 112,000 acres annually, reducing GHG emissions by 0.57 MTCO2e per acre, totaling 63,840 MTCO2e.
        iii. Addition of 112,000 acres of cover crops to land currently planted into a no-till system, achieving a per-acre reduction of 0.68 MTCO2e, totaling 76,160 MTCO2e.
        iv. Combined, these reductions total 190,000 MTCO2e annually. Depending on timing for grant issuance and deployment may be by 2030. Their continuation beyond this period would be contingent upon additional funding, programmatic capacity, and other factors.
    c. This methodology is based on estimates by the Illinois Department of Agriculture of what is possible based on a placeholder program budget. There is likely considerable additional opportunity for emissions reductions in this area depending on the scale of resources the program receives.
2. Reduce total combined emissions from wastewater, landfills, and livestock by 10% by 2050, through approaches such as methane capture and utilization, anaerobic digestion, and others, focusing on approaches which are most cost-effective and offer the most added benefits.
    a. This would reduce GHG emissions by an estimated 0.8 MMTCO2e by 2030, and 16.9 MMTCO2e by 2050. This estimate was developed by summing the 2016-2020 average of Illinois' methane emissions across agriculture, waste, and wastewater in the state GHG inventory – 13 MMTCO2e – and progressively reducing that figure by 0.4% annually beginning in 2026. The five-year average was used instead of a single year in order to account for year-to-year statistical "noise," and control somewhat for 2020 emissions that may have been skewed by the COVID pandemic.
3. Reduce GHG emissions from lawn equipment and other small engines by accelerating the shift from gas-powered to electric-powered lawn equipment and other small engines, with a focus on heavily-used tools in professional landscaping, shifting 40% of new sales to all-electric equipment by 2030 and 99% of new sales to all-electric equipment by 2035.
    a. This could reduce GHG emissions by an estimated 2.63 MTCO2e by 2030, and 84.46 MMTCO2e by 2050.

b. This estimate was reached by starting with a total of average annual emissions between 2016 and 2020 of CO2, CH4, and N2O expressed as MTCO2e in the Mobile Source Emissions>Non-Highway>Other section of the state GHG inventory, which is 6.47 MMTCO2e. The estimate assumes 10% turnover per year (as expressed as a percentage of emissions), and a growing percentage of new sales being electric equipment, and a growing percentage of those new sales being electric, beginning with a baseline of 45% in 2026 (approximated using recent reports from Grand View Data and Fact.MR on electric mower market penetration and growth rate) and increasing linearly to 70% in 2030 and 99% in 2035, then remaining at 99% thereafter to conservatively assume that some small portion of the market may be very slow to adopt electric equipment. The emissions from the portion of the market that turns over to electric equipment is assumed to reduce its emissions by 92.3%, using a modified emissions calculator from Mow Electric that estimates the per-acre emissions differential between gas and electric mowers, and considers the carbon intensity of the Illinois power grid (assumed to be 0.5287 lbs CO2 per kWh). The year-over-year annual reduction tapers off over time, as the 10% turnover comes from an increasingly electrified sector where there is presumably less gas equipment to replace each year. The annual emissions produced by this scenario are then subtracted from the BAU level of emissions, and summed to reach the 2030 and 2050 reduction numbers. More sophisticated tools to calculate these emissions do not appear to be readily available off the shelf, and the emissions reductions calculation approach here is oversimplified; it uses mowers as a proxy for other non-mower small engines (string trimmers, chainsaws, etc.), market penetration may slow for various reasons, the market share of electric lawn equipment and other small engines is growing organically such that some level of emission reduction is likely to occur organically (though this is true of most clean energy technologies). In any case, there are clear GHG emissions reduction gains to be made from accelerating the transition towards electric small engines and lawn equipment.

Implementing Authority

Illinois EPA, Department of Agriculture (DOA), and Department of Natural Resources (DNR) have existing authority under the Grant Accountability and Transparency Act and complementary rules to uniformly implement competitive grant and incentive programs utilizing state and federal pass-through funds.

DOA intends to leverage its existing "Fall Covers for Spring Savings" program to expand the incentives available for cover crop integration, no-till farming practices, and sustainable agriculture enhancement. DOA also implements programs under the authority of the Illinois Forestry Development Act.

The State of Illinois expects to pass legislation to strengthen the regulatory structure under Illinois EPA and DNR to advance carbon sequestration efforts.

The Illinois Climate Bank has broad authority to develop and implement new financial assistance opportunities, including grant and loan programs, to leverage existing funding programs, along with an ability to efficiently obtain necessary board approvals for new initiatives.

Illinois state agencies require annual appropriation authority to spend funds allocated from General Revenue Funds, other state funds, and federal funds.

Implementing Agencies

- Illinois Department of Agriculture
- Illinois Environmental Protection Agency
- Illinois Finance Authority / Illinois Climate Bank
- Illinois Department of Natural Resources

Measure Initiatives

1. Expanding Deployment and Improving Efficiency of Low-Till, No-Till, and Cover Crop Practices

Summary

This initiative aims to expand the adoption of cover crops and increase the efficiency of no-till practices among Illinois farmers through advanced technology deployment and financial incentives. By building on the solid foundation of the "Fall Covers for Spring Savings" initiative, led by the Illinois Department of Agriculture (DOA), this program introduces advanced technological solutions and financial incentives that are expected to decrease greenhouse gas (GHG) emissions, and the systems to report and track these emissions reductions. Furthermore, the initiative emphasizes leveraging trusted partners and networks to disseminate knowledge about this initiative's benefits.

The current IDOA program covers a total of 140,000 acres, providing a premium discount of up to $5 per acre on the following year's crop insurance for every covered crop acre enrolled and verified in the program. In 2023, the acreage allotment was met in under 24 hours, with a total of 182,688 acres requested in that application period. IDOA launched "Fall Covers for Spring Savings" to promote additional acres of cover crops that are not covered by other state or federal incentives.

Elements

Illinois Cover Crop Program Expansion. Significantly raise the acreage cap to accommodate the growing interest and demand from farmers wishing to participate in the cover crop program. This expansion will ensure that more farmers can benefit from the initiative. Layer in additional incentives based on new technology deployment. Cover crop participants receive a $5/acre financial incentive per acre of cover crop enrolled in the program. The state will expand the program as described in the GHG emissions reduction estimate above in this section, evaluate the introduction of tiered incentives based on the percentage of crop cover within a field, and begin offering multi-year program enrollment instead of annual allotments to encourage ongoing participation. These contracts will not only provide a stable financial incentive for farmers to continue their sustainable practices but also contribute to the program's overall goals of improving soil health and increasing carbon sequestration over time.

Enhanced Support and Communication. Leverage and expand already existing networks and resources such as the Illinois Sustainable Agriculture Partnership, ReGenerate Illinois, Saving Tomorrow's Agriculture Resources (STAR), and others to provide support to farmers participating in the initiatives, including technical assistance, education on best practices for cover crop and no-till management, and financial incentives that make it more attractive for farmers to adopt these sustainable practices.

Low-Cost Loans for New Technologies. The Illinois Climate Bank will establish a new low-cost loan program specifically designed to support farmers in acquiring new technologies that optimize practices that reduce GHG emissions and increase soil health. This element aims to reduce the financial barriers to adopting innovative solutions like robotic cover crop planters and advanced soil health monitoring tools. By making these technologies more accessible, the program seeks to enhance the efficiency and effectiveness of cover crop practices, leading to broader adoption and greater environmental benefits across the state.

Comprehensive Tracking and Reporting. The state will develop a robust system for tracking cover crop acreage and soil health improvements, leveraging the latest in remote sensing and data analytics. This system will ensure precise measurement of the program's impact on soil conservation and carbon sequestration efforts across Illinois.

Carbon Credit Facilitation. The state will explore an innovative and scalable initiative aimed at streamlining the process for farmers, landowners, and operators to generate and verify carbon credits, aligning with both voluntary and compliance carbon market demands. This program will integrate with a range of clean agriculture initiatives, addressing the traditionally complex and inefficient process of carbon credit generation. By streamlining this procedure, the initiative ensures that farmers and operators can capitalize on previously untapped revenue streams, effectively turning sustainable practices into financial benefits.

Advanced Technology Integration. The Illinois Climate Bank provides grant and loan funding to pilot the deployment of innovative technologies for the planting and verification of cover crops and soil carbon levels. The use of robotic planting technology will streamline the seeding process, making it more efficient and less labor-intensive. Meanwhile, soil carbon verification technology will provide accurate

data on the environmental benefits of cover crop practices, supporting better tracking and accountability.

Complementary Funding and Initiatives

This initiative builds upon and complements key agricultural programs in Illinois. It works alongside the Illinois Department of Agriculture "Fall Covers for Spring Savings" program, aimed at cover crop promotion, by offering additional incentives for cover crop integration. It also provides stackable financial benefits with the Conservation Stewardship Program, which incentivizes no-till farming practices. Supported by the Saving Tomorrow's Agriculture Resources (STAR) framework, the initiative promotes standardized, scalable conservation practices, effectively enhancing sustainable agriculture across the state.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, the Illinois Department of Agriculture will expand its "Fall Covers for Spring Savings" program to meet demand.

Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

Establishment of the programs will require no statutory change, and limited regulatory intervention. The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

2. Biomethane Emissions Reduction, Capture, and Utilization in High-Value End Uses

Summary

The initiative prioritizes the development of localized, distributed biomethane utilization systems, aiming to significantly reduce local greenhouse gas emissions and develop regional supply chains specifically for its deployment in high-value end uses, such as industrial heat, sustainable aviation fuel, and maritime transport. By concentrating on the practical aspects of methane capture, storage, and utilization from local sources in the agriculture, wastewater, and waste sectors, Illinois seeks to make a substantial contribution to its environmental goals. This strategy underlines the importance of leveraging local manure as a valuable resource, thereby enhancing methane management on a regional scale and supporting these sectors' integration into Illinois' broader environmental objectives.

Elements

Enhanced Support and Communication. The overarching goal is to leverage existing networks and trusted partners to provide owners of wastewater, waste, and livestock facilities with crucial information, empowering them to meet state regulations, access financial incentives, and benefit from educational support, thereby promoting environmentally responsible manure management practices.

Connecting Distributed Biomethane Collection to High-Value End Use Supply Chains. Ensure seamless integration of distributed methane capture systems with regional biomethane supply chains, creating an economic and efficient flow of captured methane to utilization in high-value end uses where limited options for decarbonization exist.

Seed Grants. Tailor financial incentives to seed sound biomethane practices such as manure source, collection, handling, and storage; methane capture at waste and waste facilities; processing of food waste into biomethane; and other approaches that reduce emissions at the local level and integrate into regional biomethane supply chains. Considerations will be made to avoid "split incentives" for operators.

Revenue Stacking and Contract Facilitation. Focuses on assisting operators of facilities producing biomethane in maximizing financial benefits through strategic contract facilitation. This involves supporting operators in securing contracts for the end-use of resources, including agreements for purchase of by-products and participation in carbon credit and offset programs. The initiative aims to optimize revenue streams for operators by leveraging multiple income sources and facilitating agreements that enhance the economic viability of sustainable practices.

Carbon Credit Facilitation. The state will explore an innovative and scalable initiative aimed at streamlining the process for farmers, landowners, and operators to generate and verify carbon credits, aligning with both voluntary and compliance carbon market demands. This program will integrate with a range of clean agriculture initiatives, addressing the traditionally complex and inefficient process of carbon credit generation. By streamlining this procedure, the initiative ensures that farmers and operators can capitalize on previously untapped revenue streams, effectively turning sustainable practices into financial benefits.

Complementary Funding and Initiatives

The initiative is designed to complement existing efforts, notably the EPA and DOE Methane Emissions Reduction program, which has provided the Illinois Department of Natural Resources with $17.4 million. While this federal funding addresses certain methane emission reduction projects, this initiative specifically targets the underrepresented area of local manure production from farming and agriculture. This targeted approach ensures that the initiative fills a critical gap by addressing segments not covered by existing funding, thus providing a comprehensive and inclusive strategy for methane management and utilization in the state.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, the Illinois Climate Bank will develop a competitive grant program,

paired with low-cost loan programs, to community-based projects to coordinate distributed biomethane utilization systems.

Establishment of the programs will require no statutory change, and limited regulatory intervention.

- Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

3. Supporting Natural Carbon Storage

Summary

The Natural Carbon Storage Initiative strategically aims to enhance Illinois' approach to climate change mitigation by restoring forests, grasslands, and other natural areas, emphasizing not only carbon sequestration but also the improvement of climate resilience, quality of life, and access to natural spaces for its residents. This initiative recognizes natural carbon storage as a cornerstone in the state's broader strategy to significantly reduce greenhouse gas emissions, improve water quality, and increase biodiversity by addressing critical gaps in existing programs like the USDA Agriculture Conservation Easement Program (ACEP) and the USDA Conservation Stewardship Program (CSP) and building upon the Illinois Department of Natural Resources Forest Assistance Program.

By integrating the restoration of natural landscapes with community access and recreational opportunities and climate resilience benefits, Illinois commits to a holistic environmental strategy that benefits both the planet and its people, ensuring that the initiative contributes to the state's overarching goals of enhancing biodiversity, public health, and climate resilience.

Elements

Partnerships and Outreach. Utilize current resources and develop trusted partnerships to engage private landowners, leveraging enhanced outreach efforts to communicate the benefits of participating in the initiative.

Conservation Easements. Offer competitive easement payments to incentivize the preservation of lands, with a focus on placing long-term conservation easements of no less than 40 years. This initiative will enroll parcels to protect prime, unique, or other productive soils, ensuring their contribution to carbon sequestration.

5-Year Incentive Contracts for Prime Lands. Implement 5-year incentive contracts based on competitive bids to identify and secure prime lands capable of achieving higher-than-average carbon storage. This element aims to prioritize the conservation and restoration of lands with significant carbon sequestration potential, offering financial incentives to landowners who commit to carbon storage practices that exceed standard benchmarks.

Conservation Planning Support. Provide support for local jurisdictions in conservation planning and restoration efforts, aimed at improving quality of life and reducing GHG emissions through enhanced natural carbon storage.

Resource Monitoring. Develop efficient tools for resource monitoring to track the impact of conserved lands on carbon sequestration and ecosystem health.

Carbon Credit Facilitation. The state will explore an innovative and scalable initiative aimed at streamlining the process for farmers, landowners, and operators to generate and verify carbon credits, aligning with both voluntary and compliance carbon market demands. This program will integrate with a range of clean agriculture initiatives, addressing the traditionally complex and inefficient process of carbon credit generation. By streamlining this procedure, the initiative ensures that farmers and operators can capitalize on previously untapped revenue streams, effectively turning sustainable practices into financial benefits.

Complementary Funding and Initiatives

While building on the foundation provided by federal conservation programs and the Illinois Department of Natural Resources' efforts, this initiative seeks to expand the scope of natural carbon storage practices. By focusing on areas not adequately covered by existing USDA programs such as the USDA Agriculture Conservation Easement Program (ACEP) and USDA Conservation Stewardship Program (CSP), this initiative specifically targets private and urban landowners for forestry management assistance and facilitates local planning and local conservation. By doing this, the initiative creates a more inclusive and effective approach to enhancing Illinois' natural carbon sinks. This collaborative and integrative strategy enhances the state's capacity to combat climate change, promote biodiversity, and provide public recreational opportunities.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, the Illinois Department of Natural Resources will build upon its Forest Assistance Program to implement the effort.

Establishment of the programs will require no statutory change, and limited regulatory intervention. The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

4. Accelerating Clean Landscaping and Small Engine Equipment

Summary

The Clean Landscaping and Small Engine Program would support Illinois' efforts to promote sustainable professional landscaping and agriculture through the adoption of all-electric equipment. While federal tax credits appear to allow for rebates of very large, commercial-scale landscaping equipment, there are

virtually no incentives available for small engines and landscaping equipment below this size. This initiative seeks to fill this gap and support a broader variety of lawn and small motor equipment. In addition to the emissions reductions opportunities in this area, this program would mitigate air and noise pollution, reduce workers' exposure to harmful pollutants, and aligns with Illinois' environmental goals by offering grants, rebates, and low-cost loans to overcome financial barriers to electric transition. This strategic investment in efficient technologies addresses both environmental impacts and economic benefits, such as reduced maintenance costs and longer equipment lifespans.

Elements

Equipment Grants or Rebates. The program will provide grants or rebates for the purchase of all-electric commercial landscaping equipment, such as blowers, trimmers, and mowers. This initiative aims to make cleaner, quieter, and more efficient equipment accessible to professionals in the field.

Complementary Funding and Initiatives

This initiative complements existing federal and state incentives, such as the IRA tax credit for the largest commercial electric lawn mowers and the Illinois sales tax exemption for on-farm equipment, by filling critical gaps. While these programs have laid the groundwork for a transition to cleaner equipment, the Accelerating Clean Landscaping and Small Engine Equipment Program specifically addresses the broader range of equipment needs, focusing on professional landscaping. By offering support beyond mowers to include a wide array of professional-grade electric equipment, this initiative significantly lowers the cost barrier, facilitating a more comprehensive and accelerated shift towards electrification.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will develop a grant program for the purchase of all-electric equipment.

Establishment of the programs will require no statutory change, and limited regulatory intervention. The state expects it could launch the program by 2026, with measurable metrics reporting and GHG emissions reductions able to be reported for the subsequent period.

Geography

Statewide, finding opportunities where possible for industrial GHG reductions that occur near disadvantaged communities and can provide air quality co-benefits. Agricultural investments will be concentrated in more rural areas of the state, while biomethane investments will drive investment toward small towns and other accessible transportation hubs near rural areas. The small engine equipment program will drive investments statewide.

Complementary Funding and Initiatives

For the Clean Agriculture measure, this PCAP identifies methods of complementing, and not replicating, funding from State, utility, and federal funding sources:

- **State Initiatives**
    a. Illinois Department of Agriculture. Administers:
        i. Fall Covers for Spring Savings Program
    b. Illinois Climate Bank. Administers:
        i. Various climate finance products
    c. Illinois Department of Revenue
        i. Sale tax exemption for on-farm equipment
- **Federal Funding**
    a. US DOE Methane Emissions Reduction Program
    b. USDA Agriculture Conservation Easement Program
    c. USDA Conservation Stewardship Program
    d. US EPA Greenhouse Gas Reduction National Clean Investment Fund Competition
    e. US Treasury Tax Credit - commercial grade electric lawn mowers

Measurement and Metrics

CLEAN AGRICULTURE

Metric	Description
Agriculture-1	Acres of land where low-till, no-till, and cover crop practices are utilized
Agriculture-2	Amount of fertilizer runoff detected in waterways
Agriculture-3	Acres lost due to erosion of agricultural land
Agriculture-4	Acreage of natural land
Agriculture-5	Total methane emissions from the agriculture, wastewater, and waste sectors
Agriculture-6	Metric tons of Biomethane collected
Agriculture-7	Metric tons of Biomethane put to high-value end uses
Agriculture-8	Dollars spent on purchase of all-electric landscaping equipment

Clean Power

Illinois has embarked on an effort to rapidly decrease carbon emissions from the power sector thanks to the Climate and Equitable Jobs Act (CEJA), passed in 2021. CEJA sets ambitious goals for the state to achieve a growing percentage of its power from carbon-free sources: 40% clean energy by 2030, 50% by 2040, and 100% by 2050, with interim targets. The state has also established a detailed power sector decarbonization schedule that prioritizes emissions reductions from the dirtiest power plants, and those impacting environmental justice communities, with interim targets from 2030 - 2045.

This commitment to reducing greenhouse gas emissions requires a strategic shift from reliance on fossil fuels to the adoption of renewable energy sources. Rapidly and affordably scaling clean generation to the levels needed to achieve the state's climate goals will require changes to the operation and infrastructure of the grid, and the deployment of a suite of other technologies: energy storage, transmission, demand response, and more. Minimizing emissions while maintaining affordability and reliability will require strategic deployment of specific resources in specific proportions, and every utility, grid, and state will have unique solutions. While market signals are important and useful drivers of clean energy deployment, they have limitations, and more detailed information about the challenges and opportunities of the clean energy transition is important to both clean energy companies and policymakers.

Comprehensive energy modeling will enable the state to identify pressing needs during its transition to 100% clean energy, considering economic, environmental, and social factors. The modeling effort will help the state identify future state policy intervention, including strategies for cost-effectively building out its electric grid to accommodate electrification and the transition to decentralized, renewable energy resources. State regulators recently began more rigorous grid planning processes, but these are primarily concerned with the distribution system, and modeling and planning which assessed the state's generation system would be a valuable complement to this. Regional transmission operators (RTOs)

conduct some modeling of, e.g., expected plant retirements in their territory, but that modeling does not occur until shortly before a plant is expected to retire, so that modeling would not allow adequate time to undertake any needed efforts to deploy new resources, nor would it consider cases where fossil plants reduce their generation but do not close.

Further, more support is necessary to accelerate transition to renewable energy at the municipal and co-op utilities in Illinois. Many smaller utilities are currently under long-term contracts for supply from fossil-fuel generation, and have insufficient internal capacity and investment scale to manage the transition, including to study, analyze, and enter into new agreements for the long-term supply of renewable energy as a successor to current long-term contracts.

Topline Outputs and Greenhouse Gas Emission Reductions

1. Generate 40% clean energy by 2030, 50% by 2040, and 100% by 2050, using tools including but not limited to: deployment of clean and zero-carbon energy (such as wind, solar, geothermal, or other zero-emission sources, both utility-scale and distributed), deployment of energy storage (including lithium-ion and other storage media, both utility-scale and distributed), expansion of demand response (including virtual power plants, distributed demand response, and smart electric vehicles and appliances), improved energy efficiency, increasing transmission capacity (including new transmission lines and the use of grid-enhancing technologies). This would result in an estimated 29.7 MMTCO2e in emissions reductions by 2030 and 416.9 MMTCO2e in emissions reductions by 2050.

Implementing Authority

The Illinois Power Agency has broad authority to efficiently procure technical resources needed to further support and expand planning capacity under the existing Long-Term Renewable Resources Procurement Plan process. The Illinois Commerce Commission has similar broad authority to procure technical resources needed for grid planning activities.

Illinois EPA has existing authority under the Grant Accountability and Transparency Act and complementary rules to uniformly implement competitive grant and incentive programs utilizing state and federal pass-through funds.

The Illinois Climate Bank has broad authority to develop and implement new financial assistance opportunities, including grant and loan programs, to leverage existing funding programs, along with an ability to efficiently obtain necessary board approvals for new initiatives.

Illinois state agencies require annual appropriation authority to spend funds allocated from General Revenue Funds, other state funds, and federal funds.

Implementing Agencies

- Illinois Commerce Commission
- Illinois Environmental Protection Agency
- Illinois Department of Commerce and Economic Opportunity
- Illinois Power Agency

Measure Initiatives

1. Statewide Clean Energy Modeling

Summary

The state will support comprehensive statewide energy modeling and planning that will inform decision-making and strategic planning of the Illinois Power Agency (IPA)'s Long-Term Renewable Resources Procurement Plan process. Due to long delays in RPS implementation and, more recently, interconnection backlogs, Illinois is behind the Renewable Portfolio Standard schedule and is lagging in new renewable energy deployment. State statute directs the state to consider multiple options in the event that a grid reliability is at risk, including the expansion of renewable energy, demand response, and energy efficiency programs, the implementation of DER initiatives, and temporary extensions of pollution deadlines. Energy modeling will help ensure that Illinois has clean energy resources to backfill retiring fossil fuel plants and stay the course for CEJA's decarbonization timeline

Elements

Modeling Support. In 2025, the Illinois EPA will undertake a modeling exercise in conjunction with the IPA to determine what if any resources would be needed to maintain reliability while fossil fuel plant closure schedules in CEJA. IEPA will engage energy modeling consultants to develop and implement state-of-the-art energy models, incorporating the latest technologies and market trends.

Integrating Modeling into Renewable Energy Procurement Plans. IPA staff will manage the project, collaborate with consultants, and integrate modeling results into the procurement planning process of the biennial Long-Term Renewable ResourcesProcurement Plans.

Complementary Funding and Initiatives

The Illinois Power Agency (IPA) has expertise in forecasting and planning incentives for renewable resources in Illinois through its biennial Long-Term Renewable Resources Procurement Plan process. However, additional resources are needed to allow the IPA engage comprehensive, statewide energy modeling in its biennial plan development process.

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois EPA will work with Illinois Power Agency to conduct a modeling exercise. Illinois Power Agency will incorporate the output of the modeling work into its existing biennial Long-Term Renewable Resources Procurement Plans.

Establishment of the programs will require no statutory change. The state will undertake the modeling exercise in 2025, with results potentially included in subsequent Long-Term Renewable Resources Procurement Plans after its completion.

2. Small Utility Clean Energy Planning Support

Summary

Many smaller utilities are currently under long-term contracts for supply from fossil-fuel generation, and have insufficient internal capacity and investment scale to manage the transition, including to study, analyze, and enter into new agreements for the long-term supply of renewable energy as a successor to current long-term contracts. The state will work with municipal and co-op utilities in Illinois to help them identify a path to transition the state's power sector to carbon-free by 2045. The state will provide technical and financial support in assessing needs and identifying ways to replace fossil fuel resources with renewable energy.

Elements

Technical Assistance. The state will provide technical assistance to municipal and co-op utilities in Illinois in assessing their energy supply needs and identifying potential clean energy supply sources to fill that need and replace fossil fuel generation.

Strategic Planning Grants. The state will issue grants to municipal and co-op utilities in Illinois to help them negotiate and secure power system and generation plans, renewable energy power purchase agreements that comply with CEJA goals of a 100% carbon-free power sector by 2045.

Complementary Funding and Initiatives

The state is in the process of applying for a US DOE Grid Resilience and Innovative Partnerships (GRIP) funding to deploy a comprehensive initiative to help the state prepare its distribution grid infrastructure in rural areas for the transition to a zero carbon economy in order to reduce peak loads, better integrate renewable energy, support Illinois' decarbonization goals, improve distribution grid reliability and resiliency, and lower the cost of the energy transition and energy system upgrades. The Initiative is aimed to create a model for coordinating, aggregating and optimizing distributed energy resources (DER) and flexible customer load, focusing on energy storage, optimized electric vehicle (EV) charging, vehicle-to-grid (V2G) capabilities, load management, and virtual power plants (VPPs) across the state,

with a special focus on disparate, small, under-resourced utilities within two different Regional Transmission Organizations that Illinois is part of (MISO/PJM).

Implementation Schedule and Milestones

This initiative will build on existing infrastructure within the state to implement and execute in an expedited manner. For this initiative, Illinois Climate Bank will develop a technical assistance resource, and make available strategic planning grants, to eligible municipal and co-op utilities.

Establishment of the programs will require no statutory change, and limited regulatory intervention. Illinois Climate Bank would be able to obtain board approval for new initiatives within 60 to 90 days of the start of the initiative, with program launch within 9 months at the earliest.

The state expects it could launch the program by 2026, though measurable metrics reporting and GHG emissions reductions will not occur until 2030 and later.

Geography

Statewide, and in areas served by municipal and rural cooperative utilities.

Complementary Funding and Initiatives

For the Clean Power measure, this PCAP identifies methods of complementing, and not replicating, funding from State, utility, and federal funding sources:

- **State Initiatives**
    a. Illinois Power Agency. Administers:
        i. Illinois Renewable Portfolio Standard
        ii. Illinois Solar for All Program
- **Federal Funding**
    a. USDA Empowering Rural America New ERA Program
    b. Rural Energy for America Program (REAP)
    c. US DOE Grid Resilience and Innovative Partnerships Program
    d. US EPA Greenhouse Gas Reduction Solar for All Competition
    e. US EPA Greenhouse Gas Reduction National Clean Investment Fund Competition
    f. IRA Investment Tax Credits

Measurement and Metrics

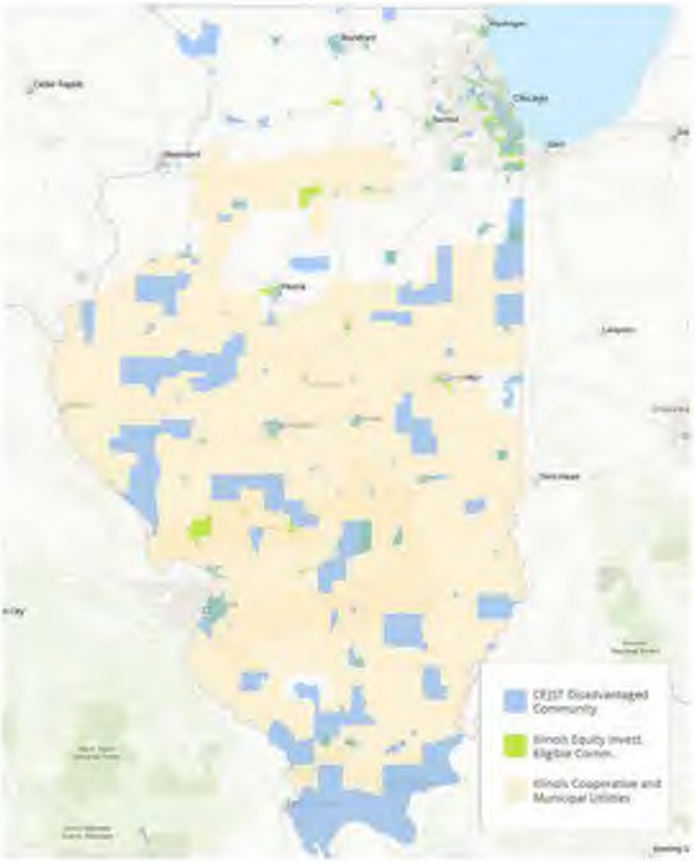
CLEAN POWER

Metric	Description
Power-1	MWh of clean energy generated in Illinois
Power-2	MWh of fossil energy generated in Illinois
Power-3	Share of generation from clean and carbon-free sources in Illinois
Power-4	Share of generation from clean and carbon-free sources in Illinois
Power-5	CO2 emissions from electricity generation
Power-6	Criteria pollutant emissions from electricity generation

Low Income Disadvantaged Communities Benefits Analysis

Low-Income and Disadvantaged Community Identification

In the Climate and Equitable Jobs Act, passed in 2021, The State of Illinois created a new designation of Equity Investment Eligible Communities that often suffer the most from poor air quality and economic inequality, and may otherwise be left behind in the shift to a clean energy economy.



Under CEJA, the state targets consideration and explicit benefits to these newly-defined Equity Eligible Persons and Equity Investment Eligible Communities which are, among other criteria, residents of Environmental Justice or R3 areas.

Environmental Justice Communities: Environmental Justice Communities are communities that have been identified through a calculation utilizing the U.S. EPA tool EJ Screen and a demonstrated higher risk of exposure to pollution based on environmental and socioeconomic factors. Importantly, the statute further creates a formal self-designation process at the state level for communities that believe the data methodology unjustly excludes them.

Restore. Reinvest. Renew. (R3) Areas: R3 areas are communities that have been harmed by violence, excessive incarceration, and economic disinvestment, as originally defined for eligibility for R3 grants under Illinois' cannabis law.

The two community designations were thoughtfully considered to ensure that the state's energy policy and investments both targeted communities experiencing burdens due to pollution, but also those that have faced socioeconomic harm and historic disinvestment. A census tract with either designation qualifies as an Equity Investment Eligible Community under Illinois law, which creates opportunities for residents and businesses to see benefits from solar energy and energy efficiency programs, workforce development and contractor accelerator programs, electric vehicle deployment, and utility infrastructure planning.

Illinois intends for at least 40% of benefits of this effort to support communities that have been classified as either disadvantaged communities, under federal guidance, or equity investment eligible communities, under the new state designation, growing to 60%. These efforts will drive new capital investment in Illinois' Equity Investment Eligible Communities and create wealth-building opportunities for Equity Eligible Contractors.

An initial examination has determined that there are 1,452 census tracts in Illinois that are either classified as an Equity Investment Eligible Community by The State of Illinois or as a Disadvantaged Community by the White House CEQ' Climate and Environmental Justice Screening Tool ("CEJST"). There are 860 census tracts that overlap, meaning they are both Equity Investment Eligible Communities per Illinois and Disadvantaged Communities per CEJST. There are 201 census tracts that have been designated by CEJST but are not Equity Investment Eligible Communities. And there are 391 census tracts that are Equity Investment Eligible Communities and not Disadvantaged Communities per CEJST.

History of Engagement

Development of the plan also included consultation on the CPRG with multiple stakeholders, including: community organizations, including organizations representing disadvantaged communities; non-governmental organizations with expertise in climate mitigation; private businesses; higher education institutions; and trade associations.

To identify market barriers to the equitable GHG emission reductions in Illinois, the Illinois Climate Bank, in partnership with other state agencies, held a series of stakeholder meetings, small group meetings and workshops, and virtual presentations, throughout 2023 and early 2024 with more than 150 different entities to get a broad perspective on market gaps.

In 2023, the state collected stakeholder inputs through Climate and Equity Surveys to gain additional perspectives on program design under CPRG, GGRF, and complementary federal funding opportunities.

The stakeholder engagement produced valuable data on continued barriers to low-income and disadvantaged community participation in and benefit from climate and clean energy strategies that could be addressed through additional funding and thoughtfully-designed programs. Key market gaps identified included:

- the high number of walk-aways from low-income single-family and multi-family households due to the need for health & safety upgrades, such as roof repair, mold and asbestos abatement, or electrical upgrades;
- the lack of low-cost, easy-to-access finance for low-income households and the desire to create long-term wealth-building opportunities through solar;
- reliability and resiliency risks for the most vulnerable during extreme weather/outages;
- the high demand for low-income community solar projects that reach program capacity;
- challenges for community-driven community solar projects to compete with national developers;
- difficulty by developers in braiding and coordinating different funding streams;
- difficulty by small, DBEs to access capital and expand beyond a cash businesses; and
- a lack of trust in the marketplace driven by more than a decade of bad actors in the retail electric supply market.

In late 2023, Illinois EPA created an area on its website for individuals and stakeholders to share information and solicit feedback about the PCAP and CPRG, through which staff received and responded to many additional public comments.

In early 2024, Illinois EPA held two online public listening sessions to solicit feedback on the draft plan. One was held during the work day and another was held in the evening to facilitate attendance by community leaders and people with work obligations. More than 130 people participated in the two public listening sessions on the draft plan.

Future Engagement

As part of its implementation of CPRG initiatives, the Illinois EPA and other state partners will engage stakeholders and community-based organizations in an initial planning phase that will provide essential input on the design of program elements.

The planning phase will begin as soon as Q4 2024 with public processes that are accessible to community representations. The planning process will focus on the following Program elements:

- Meaningful Benefits Plan
    - Information gathering on real-world costs of gap-filling
    - Identifying communities most in need and implementation ready
    - Identifying community resilience benefits as part of implementation
- Financial Assistance
    - Conducting analysis to establish incentive levels for grant and incentive programs
    - Developing simplified application requirements/processes
- Finance Offerings:
    - Ensuring equitable lending processes
    - Deesign financial products that promote long-term ownership and wealth-building in low-income and disadvantaged communities.
- Outreach strategy
    - Developing scope of work for Community-Based Outreach partners

  - Continued evaluation of opportunities and processes for braiding initiatives with other incentives and initiatives
  - Designing strategies for cross-entity customer referrals
- Equitable Access and Meaningful Involvement
  - Continuously improving access opportunities to decision-making processes that impact low-income and disadvantaged communities
- Workforce Training:
  - Assessment of skills needed to be incorporated into pre-apprenticeship pipelines and project requirements.

Estimating Potential Benefits of GHG Emission Reduction Measures to LIDACs

The measures being proposed under this PCAP will be prioritized based on their impact on low-income and disadvantaged communities, but not in any specific disadvantaged communities at this time. The statewide nature of this deployment will impact disadvantaged communities and equity investment eligible communities across the state.

The PCAP's Fleet and Freight initiatives will directly support community public health, environmental, and economic needs. The Illinois Climate Bank has identified significant benefits accruing to Illinois' disadvantaged communities from fleet and freight electrification.

	Societal value of reduced pollution ($/vehicle/yr)		
Vehicle Type	**CO2**	**NOx**	**PM**
Passenger	$281	$11	$2
School Bus	$1,520	$886	$136
Transit Bus	$8,674	$4,559	$85
Delivery Vehicle	$1,595	$876	$31
Class 8 Truck	$7,721	$3,108	$222

Data source: Argonne National Laboratory AFLEET tool

Criteria Pollutant Reduction Benefits to LIDACs

It is difficult to assess the exact impact of pollution reduction on specific geographic areas without fairly detailed knowledge of the specific projects that are being supported. However, peer-reviewed research suggests that people with lower incomes and lower socioeconomic status experience worse impacts from air pollution. and some of Illniois' worst air quality is located in densely populated urban areas where there are vulnerable communities. The opportunities to deliver benefits are here, and have been described in many of the measures, including and especially around clean freight and fleets.

Illinois already has a well-established suite of policies to ensure that vulnerable communities are prioritized for pollution reduction, including emissions reductions timelines in CEJA that prioritize reductions at plants located near equity investment eligible communities (as defined above) and at plants with higher levels of criteria pollutant emissions. Measures in this plan will build upon this model, leveraging stakeholder feedback, institutional knowledge, processes, and relationships to ensure policy implementation and program design that continues to prioritize LIDAC communities.

Climate Risks Impacting LIDACs

The 2023 National Climate Assessment and many other studies have concluded that a warming climate is already increasing a variety of dangerous extreme events in Illinois and across the Midwest, including flooding and extreme heat. LIDACs already face many of the worst impacts of these events, and their residents are among the least-equipped to deal with them.

Climate mitigation such as the GHG reduction measures described in this plan are necessary but not sufficient to address these vulnerable people and communities exposed to flooding risk.

An array of adaptation, resilience, investment, and programmatic measures is necessary to support these people and communities, even in a best-case climate scenario. But a failure to mitigate climate change will mean even worse outcomes for these already-vulnerable communities.

Flooding

A study by the Center for Neighborhood Technology found that nearly three-quarters of flood damage claims in Chicago in recent years have occurred in 13 zip codes where 62% of households have an income of less than $50,000, and over a quarter are below the poverty line, compared to a median household income of over $71,000 and 16.9% of people in poverty in Chicago as a whole. Similarly, in southern Illinois' Metro East region, East St. Louis and Cahokia Heights "experience significant flooding and sewage backups following heavy rain events," per US EPA. The poverty rate in this area is more than three times the state average.

Extreme heat

A 2023 analysis found that Chicago had the seventh-highest average heat index, weighted for its area, in the United States, and another 2023 analysis by the Chicago Tribune mapped heat in Chicago – it found that more than 300,000 people live in areas that are hotter than 90% of the rest of the city, predominately on the southwest side, one of the city's poorest areas. This is consistent with peer-reviewed research which found that people with lower incomes have higher exposure to extreme heat.

Prioritizing Job Benefits to LIDACs

While a quantitative assessment of the job benefits to LIDACs would be difficult at this stage, Illinois has proactively sought input from people in LIDACs in its stakeholder process and will continue to do so in stakeholder engagement going forward.

Just as Illinois is building upon an existing record of concrete policy measures that prioritize LIDACs to benefit from pollution reductions in the power sector, it is building upon policies and programs designed to include and prioritize LIDACs to receive job and economic benefits from the energy transition.

The Department of Commerce and Economic Opportunity already administers a host of programs that support people from LIDACs to participate in the clean energy economy, such as: the Clean Jobs Workforce Network Program, Climate Works Pre-apprenticeship Program, Energy Transition Navigator Program, Returning Resident Clean Jobs Program, Solar Training Pipeline Program, Multi-cultural Jobs Program, and Craft Apprenticeship Program.

Illinois has been among the proactive states in the country in this regard. Those efforts will continue and grow under this plan.

Review of Authority to Implement

Illinois EPA has reviewed the statutory and regulatory authority necessary to implement the priority GHG reduction measures identified in the Illinois PCAP.

The Grant Accountability and Transparency Act (GATA) and complementary regulations provide the uniform structure for state agencies to implement effective oversight of the competitive selection and monitoring of grant recipients. GATA adopts the federal "Uniform Guidance" and allows state agencies to distribute state, federal, and General funds via customizable Notices of Funding Opportunity (NOFO). The numerous incentive programs identified under Illinois's PCAP priority measures would primarily be effectuated under the established GATA process.

Most Illinois state agencies require annual appropriation or re-appropriation authority to spend funds allocated from General Revenue Funds, other state funds, and federal funds. State agencies have worked closely with the Governor's Office of Management and Budget and legislative appropriation staff to ensure necessary budget and budget implementation language is included in agency budgets to implement the abundance of new grant programs under the Inflation Reduction Act and Infrastructure Investment and Jobs Act.

CEJA designated the Illinois Finance Authority as the Illinois Climate Bank, with its purpose to distribute the benefits of clean energy in an equitable manner, make clean energy accessible to all, and accelerate the investment of private capital into clean energy projects in a manner reflective of the geographic, racial, ethnic, gender, and income-level diversity of the state. The Illinois Climate Bank has broad authority to develop and implement new financial assistance efforts, including grant and loan programs, to leverage existing funding programs, along with an ability to efficiently obtain necessary board approvals for new initiatives. Much of the financing options outlined under the priority measures would utilize the lending capacity of the Climate Bank. Public Act 103-187, which became effective January 1, 2024, better enables municipalities to borrow directly from the Climate Bank.

The Illinois Environmental Protection Act, among its express purposes, states the obligation of the state to encourage and assist local governments to adopt and implement environmental protection programs consistent with the Act, promote the development of technology for environmental protection and conservation of natural resources, and in appropriate cases to afford financial assistance in preventing environmental damage. Illinois EPA is the primary implementing agency for programs and requirements under the Illinois Environmental Protection Act.

CEJA authorized significant new authority for implementation of transportation electrification programs and outlined a statutory intent to increase the adoption of electric vehicles in Illinois to one million by

2030. Illinois EPA distributes EV adoption incentives under the umbrella of its Driving a Cleaner Illinois Program, which includes the federal Volkswagen Settlement and consumer EV rebate and EV charging infrastructure grants authorized under CEJA and the Rebuild Illinois capital program. These existing programs, along with IDOT's NEVI program implementation, will be coordinated with efforts under the Clean Transportation and Freight measures to support adoption of medium and heavy-duty EVs fleet vehicles. To reinforce this high-priority measure, Illinois expects to seek legislative authority to strengthen the state's idling law under the Illinois Vehicle Code, which currently applies to areas designated as nonattainment for ozone.

The Illinois Department of Commerce and Economic Opportunity has existing statutory and regulatory authority to operate workforce development programs on behalf of the state. CEJA provided additional authorization for seven new programs to build or strengthen the clean energy pipeline and help grow the electric vehicle, renewable energy, and clean manufacturing sectors:

- Clean Jobs Workforce Network Program
- Climate Works Pre-Apprenticeship Program
- Energy Transition Navigator Program
- Returning Resident Clean Jobs Program
- Solar Training Pipeline Program
- Multicultural Jobs Program
- Craft Apprenticeship Program

Additionally, CEJA created the Clean Energy Contractor Incubator Program and Clean Energy Primes Contractor Accelerator Program to support contractors training and business development needs.

For building efficiency measures, the Capital Development Board (CDB) has statutory authority to review and recommend periodic revisions to established building and construction codes to promote public safety and energy efficiency. Public Act 103-510 created the framework for the adoption of statewide building codes under CDB, to be implemented by July 1, 2025; units of local government retain authority until that date. CDB is also currently developing the Illinois Stretch Energy Code pursuant to a mandate under CEJA.

To bolster measures to expand renewable energy access, the Illinois Power Agency (IPA) has statutory authority to implement the Solar for All program that provides incentives for low-income distributed generation and community solar projects; this includes the Bright Neighborhoods Pilot program, which is testing a model to provide solar installations to income-eligible residents with no upfront costs and guaranteed electric bill savings. The IPA also has broad authority to efficiently procure the technical resources needed to further support and expand planning capacity under the existing Long-Term Renewable Resources Procurement Plan process.

The Illinois Commerce Commission has similar broad authority to procure technical resources needed for grid planning activities.

To implement Clean Agriculture measures, the Illinois Department of Agriculture intends to leverage its existing "Fall Covers for Spring Savings" program to expand the incentives available for cover crop

integration, no-till farming practices, and sustainable agriculture enhancement. DOA also implements programs under the authority of the Illinois Forestry Development Act.

The State of Illinois expects to pass legislation to strengthen the regulatory structure under Illinois EPA and the Department of Natural Resources to advance carbon storage efforts.

Regional industrial decarbonization is a key measure under the Clean Industry priority. Illinois expects to work with a regional coalition to implement a competitive grant program to support innovative investments at industrial and manufacturing facilities. Authorizing statutory authority or memoranda of agreement may also be required for participation in the multi-state effort.

Intersection with Other Funding Availability

This PCAP includes measures directly targeted at filling in the gaps of funding, and leveraging other funding, to address the challenges and opportunities in equitable clean energy adoption. The impact of a Priority Climate Action Plan can only be realized by approaching the challenges holistically, across the economy.

The identification of the intersection with other funding availability is included in the description of each measure, identified down to each initiative within the measures. A summary of the major intersections identified is included below:

For the **Clean & Efficient Buildings** measure, this PCAP identifies methods of complementing, and not replicating, funding from State, utility, and federal funding sources:

- **State Initiatives**
    a. Illinois Department of Commerce and Economic Opportunity. Administers:
        i. Clean Jobs Workforce Network Program
        ii. Illinois Home Weatherization Assistance Program (IHWAPP)
        iii. State Supplemental Low Income Energy Assistance Fund (LIHEAP)
        iv. Energy Transition Navigator Program (for workforce, not associated with the navigator program initiative discussed above)
        v. Contractor efficiency and electrification certification programs
    b. Illinois Environmental Protection Agency. Administers:
        i. Home Efficiency Rebates
        ii. Home Electrification and Appliance Rebates
        iii. Energy Code Training and Technical Support
        iv. Energy Efficiency Trust Fund Grant Program
        v. Energy Efficiency and Conservation Block Grants
        vi. Energy efficiency measures for public water infrastructure.
    c. Illinois Climate Bank. Administers:
        i. Energy Efficiency Revolving Loan Fund
        ii. State Small Business Climate Initiative
        iii. Commercial Property Assessed Clean Energy
        iv. Various climate finance products
        v. Solar for All Enabling Upgrades Grant Program
        vi. Solar for All Energy Storage Grant Program
- **Utility Initiatives**

    a. The two large investor-owned utilities in the state, ComEd and Ameren, operate the following statutorily-mandated programs, overseen by the Illinois Commerce Commission:
        i. Energy Efficiency Programs
        ii. Beneficial Electrification Programs
- **Federal Funding**
    a. Energy Efficient Home Improvement Tax Credit
    b. US EPA Greenhouse Gas Reduction Solar for All Competition
    c. US EPA Greenhouse Gas Reduction National Clean Investment Fund Competition
    d. IRA Investment Tax Credits

For the **Clean Transportation and Freight** measure, this PCAP identifies methods of complementing, and not replicating, funding from State, utility, and federal funding sources:

- **State Initiatives**
    a. Illinois Department of Commerce and Economic Opportunity. Administers:
        i. Clean Jobs Workforce Network Program
        ii. Energy Transition Navigator Program (for workforce)
        iii. Contractor efficiency and electrification certification programs
    b. Illinois Environmental Protection Agency. Administers:
        i. Charging Infrastructure Grant Program
        ii. Drive Cleaner Illinois Program
        iii. Volkswagen Environmental Mitigation Trust
    c. Illinois Department of Transportation
        i. National Electric Vehicle Infrastructure (NEVI) Program
    d. Illinois Climate Bank. Administers:
        i. Various climate finance products
- **Utility Initiatives**
    a. The two large investor-owned utilities in the state, ComEd and Ameren, operate the following statutorily-mandated programs, overseen by the Illinois Commerce Commission:
        i. Beneficial Electrification Programs
- **Federal Funding**
    a. US Treasury Commercial Clean Vehicle Credit
    b. US EPA Clean Ports Program
    c. US EPA Diesel Emission Reduction Act (DERA) Program
    d. US EPA Greenhouse Gas Reduction National Clean Investment Fund Competition
    e. US FHWA Congestion Mitigation and Air Quality Improvement (CMAQ) Program
    f. US FHWA Charging and Fueling Infrastructure Program

For the **Clean Industry** measure, this PCAP identifies methods of complementing, and not replicating, funding from State, utility, and federal funding sources:

- **State Initiatives**

    a. Illinois Department of Commerce and Economic Opportunity. Administers:
        i. Workforce Development Program
        ii. Clean Jobs Workforce Network Program
        iii. Energy Transition Navigator Program (for workforce)
        iv. Contractor efficiency and electrification certification programs
    b. Illinois Climate Bank. Administers:
        i. Various climate finance products
- **Utility Initiatives**
    a. The two large investor-owned utilities in the state, ComEd and Ameren, operate the following statutorily-mandated programs, overseen by the Illinois Commerce Commission:
        i. Beneficial Electrification Programs
- **Federal Funding**
    a. US Treasury 48C Clean Manufacturing Tax Credit
    b. US EPA Greenhouse Gas Reduction National Clean Investment Fund Competition
    c. US DOE Regional Clean Hydrogen Hubs Program
    d. US DOE Advanced Energy Manufacturing and Recycling Grant Program
    e. US DOE Industrial Demonstrations Program

For the **Clean Agriculture** measure, this PCAP identifies methods of complementing, and not replicating, funding from State, utility, and federal funding sources:

- **State Initiatives**
    a. Illinois Department of Agriculture. Administers:
        i. Fall Covers for Spring Savings Program
    b. Illinois Climate Bank. Administers:
        i. Various climate finance products
    c. Illinois Department of Revenue
        i. Sale tax exemption for on-farm equipment
- **Federal Funding**
    a. US DOE Methane Emissions Reduction Program
    b. USDA Agriculture Conservation Easement Program
    c. USDA Conservation Stewardship Program
    d. US EPA Greenhouse Gas Reduction National Clean Investment Fund Competition
    e. US Treasury Tax Credit - commercial grade electric lawn mowers

For the **Clean Power** measure, this PCAP identifies methods of complementing, and not replicating, funding from State, utility, and federal funding sources:

- **State Initiatives**
    a. Illinois Power Agency. Administers:
        i. Illinois Renewable Portfolio Standard
        ii. Illinois Solar for All Program
- **Federal Funding**

a. USDA Empowering Rural America New ERA Program
b. Rural Energy for America Program (REAP)
c. US DOE Grid Resilience and Innovative Partnerships Program
d. US EPA Greenhouse Gas Reduction Solar for All Competition
e. US EPA Greenhouse Gas Reduction National Clean Investment Fund Competition
f. IRA Investment Tax Credits

Workforce Planning Analysis

This PCAP includes measures directly targeted at addressing challenges and opportunities in the clean energy workforce, because the success of any GHG measure is contingent upon having a workforce that is able to implement it. This analysis is spread throughout the sectors and measures included in the PCAP, and summarized below.

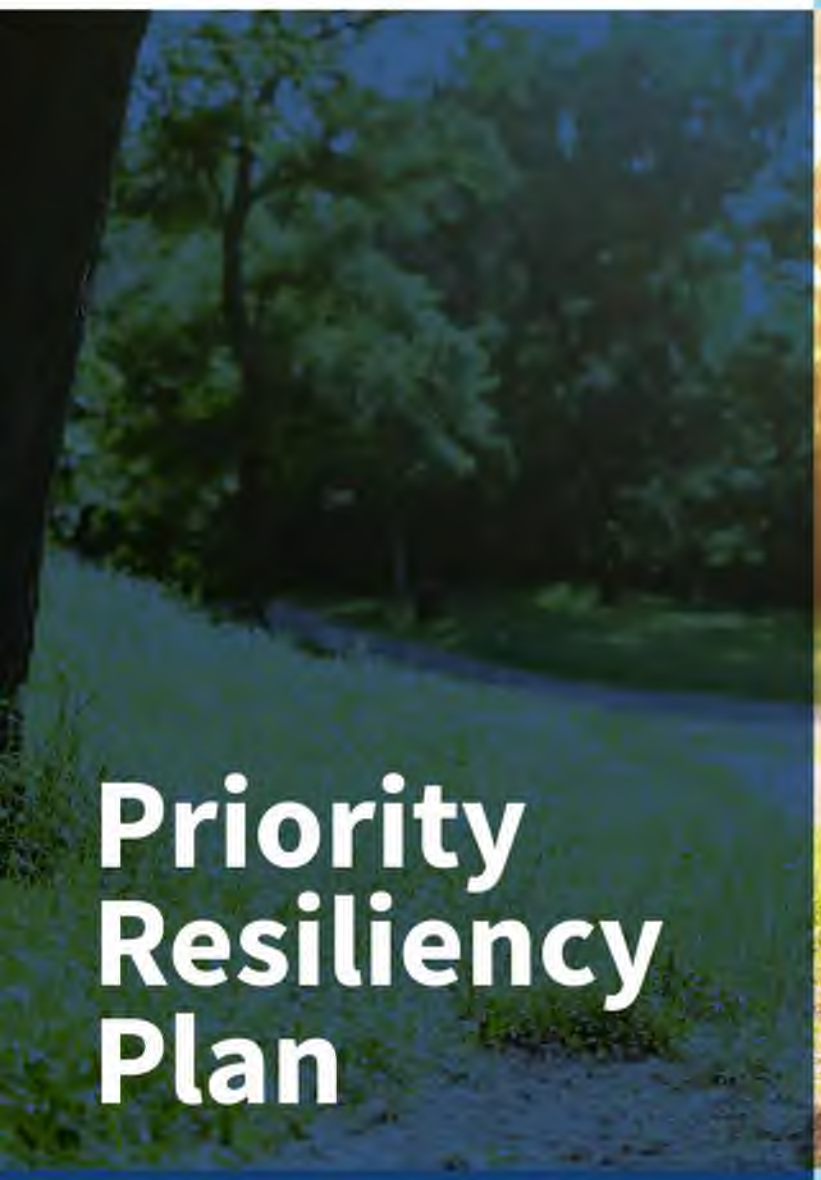
In the area of **clean buildings**, the plan emphasizes preparing more contractors to do clean buildings work, and ensuring customers can find them. It targets expanding workforce and contractor training and capacity to implement efficiency and electrification measures and supporting customers in connecting with contractors qualified to perform these measures, which today is difficult and impedes uptake of these measures. It proposes to **expand the existing Clean Jobs Workforce Network Program** to support additional skills needs around ground-source and air-source heat pump installation, heat pump water heat installation, roof replacement and repair, mold and asbestos abatement needs identified and remediation, electrical upgrades, energy storage installation, and more. It also proposes to **expand the Clean Energy Contractor Incubator Program** to support new contractor and subcontractor business development in communities not well served by an existing contractor base in ground-source and air-source heat pump installation, heat pump water heat installation, roof replacement and repair, mold and asbestos abatement needs and remediation, electrical upgrades, energy storage installation, and more.

In the area of **clean freight and fleets**, the plan outlines how the Workforce Training Program for Fleet and Freight Operators is an integral component of Illinois' strategic effort to transition towards a more sustainable, efficient, and electrified fleet industry. It prioritizes this based on the assessment that the success and longevity of the fleets acquired through the Zero Emissions Vehicle Initiative critically depend on the operators' ability to use these vehicles to their fullest potential. This training program is designed to provide comprehensive instruction to fleet operators, dispatchers, and drivers, focusing on optimizing electric vehicle (EV) use from operational, logistical, and environmental standpoints. The curriculum aims to enhance the skill set of those at the forefront of fleet operations, ensuring that the investment in zero-emission vehicles yields maximum environmental and economic benefits. By integrating the Workforce Training Program closely with the Zero Emissions Vehicle Initiative, Illinois is establishing a holistic approach that marries vehicle acquisition with operator expertise, setting a standard for a cleaner, more sustainable transportation future. This initiative would include:

- Fleet Operator Training on driving strategies to maximize battery life, route optimization, vehicle weight, distance, start-stop frequency, speed, logistics, and topography.
- Dispatcher Training. Instructions on planning efficient routes and logistics that align with battery life and charging station availability, essential for minimizing downtime and maximizing vehicle utility.

- Driver Training. Guidance on strategic charging — when and where to charge to ensure operational efficiency and vehicle readiness.
- Comprehensive Fleet Training. Workshops and/or training on managed charging, utilizing software and tools for ensuring charging availability, and exploring potential revenue streams from smart charging practices.

Finally, all this builds on Illinois' existing policy measures and programs to address workforce development in the **power sector,** including: the Clean Jobs Workforce Network Program, Climate Works Pre-apprenticeship Program, Energy Transition Navigator Program, Returning Resident Clean Jobs Program, Solar Training Pipeline Program, Multi-cultural Jobs Program, and Craft Apprenticeship Program. These programs are also cited in the LIDAC section of this plan, because the state has prioritized knitting workforce development initiatives together with benefits to LIDACs.



Priority Resiliency Plan

U.S. EPA Climate Pollution Reduction Grant Program

March 2024

Ohio Environmental Protection Agency

Executive Summary

The Climate Pollution Reduction Grant (CPRG) is a program administered by the United States Environmental Protection Agency (U.S. EPA) and authorized by the Inflation Reduction Act (IRA). The CPRG, a two-phase program, provides up to $5 billion in grants to states, local governments, tribes, and territories to develop and implement plans to reduce greenhouse gas (GHG) and other air emissions.

GHGs are gases that trap heat in the atmosphere and contribute to a long-term shift and change in temperatures and weather patterns.[1] Measuring and reducing GHG emissions is crucial to creating a more resilient future. Reducing emissions can also lead to other benefits, such as healthier Ohioans, especially those in high-risk groups like children and the elderly. This can also lead to new economic development created to support emerging technologies in the energy sector.

On behalf of the state, the Ohio Environmental Protection Agency (Ohio EPA), received planning grant funding from the CPRG and prepared this Priority Resiliency Plan (the Plan) in the first phase of planning for the broader GHG reduction goals for Ohio. We will develop a Comprehensive Resiliency Plan (CRP) in 2025, which will provide greater detail and analysis of the state's GHG reduction measures and implementation plans.

A key component of Plan development was our engagement with Ohioans, including leaders across the state representing different regions, communities, and areas of expertise. Outreach efforts and community engagement included one-on-one and small group interviews, a focus group with rural municipalities, two public webinars, a web-based survey, and by attending recurring meetings with target stakeholder groups. Through each conversation, we received feedback and recommendations for additional engagement and continuous process improvement. For this reason, the engagement approach resulted in a comprehensive, representative Plan.

This Plan summarizes:

- A statewide GHG inventory detailing the major sources of emissions in Ohio
- The primary emission reduction measures that the state will focus on to reduce emissions in the priority sectors in the near-term
- Our stakeholder engagement plan and efforts to date
- A preliminary analysis of the impact of the reduction measures on low-income and disadvantaged communities (LIDACs) in Ohio

This Plan focuses on near-term reduction measures that address GHG emissions by 2030 and can be implemented given current technological, programmatic, and regulatory capabilities.

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[1] https://www.epa.gov/ghgemissions/overview-greenhouse-gases

In Ohio, the largest sources of GHG emissions come from electric power production, energy used by residential, commercial, public, and industrial buildings, and energy used for transportation. Additional emissions come from sources such as waste, agricultural processes, industrial processes, and others, as detailed in the GHG Emissions Inventory section of this report. Emission-generating activities occur across the state but are generally concentrated in cities, where large volumes of energy consumption occur. Four of Ohio's largest metropolitan statistical areas (MSAs) have also received funding from the CPRG to develop their own emission reduction plans:

- Cincinnati, OH-KY-IN Metro area;
- Cleveland-Elyria, OH Metro area;
- Columbus, OH Metro area; and
- Dayton-Kettering, OH Metro area.

Ohio EPA is working with these regions to coordinate planning and considering reduction measures that will benefit regions of the state that did not receive funding from the CRPG.

The priority reduction measures identified in this Plan focus on GHG emissions from the largest sources in Ohio: electric power production, buildings, and transportation. Specific regions in Ohio identified waste as a priority sector; for that reason, we have included select measures to reduce emissions from waste. Additional non-priority measures are documented based on stakeholder feedback related to other sources of emissions.

Eight priority reduction measures are identified in this Plan for near-term implementation:

	PRIORITY REDUCTION MEASURE	DESCRIPTION
1.	**Light-duty Zero Emission Vehicles (ZEV) and modernization**	Increase the use of light-duty ZEVs, associated charging infrastructure, and other modernization technologies
2.	**Medium- and heavy-duty (MDHD) ZEVs and modernization**	Increase the use of MDHD ZEVs and associated charging infrastructure, and other modernization technologies
3.	**Transportation efficiencies**	Expand strategies that can affect changes in infrastructure, assets, and behavioral changes to create a more time-efficient, environmentally friendly, and sustainable transportation system
4.	**Renewable electricity generation**	Increase the use of renewable energy, such as solar and wind, to produce electricity in Ohio
5.	**Building energy efficiency**	Increase the energy efficiency of residential, commercial, public, and industrial buildings, by designing new buildings and retrofitting existing buildings with technologies to minimize energy consumption, reduce GHG emissions, and promote sustainability
6.	**Clean heating**	Reduce fossil fuel usage for building heating, through measures such as electrifying heating systems
7.	**Composting**	Promote the expansion of composting to reduce organic waste sent to landfill
8.	**Clean Waste-to-Energy (WtE)**	Promote the expansion of clean, organic WtE as a solution to transform organic waste materials into various forms of energy such as electricity, heat, or fuel

Ohio EPA expects implementation of this Plan to provide benefits to LIDACs. Through review of LIDACs across Ohio, and with input from stakeholders on challenges faced in these communities, we address the potential benefits and impacts for each of the proposed priority GHG reduction measures in these areas. We performed a high-level quantification of the potential impact of light-duty ZEVs on LIDACs in Franklin County as an illustrative example. We found that a 10% reduction of internal combustion engine (ICE) vehicle miles traveled (VMT) would have a potential annual benefit of $16.1 million to $18.0 million from the reduction in mortality and morbidity in Franklin County alone over the course of a single year (2030). These costs affect both individual residents and the community through loss of productivity, additional medications, treatment, hospital visits, and even death. A county-level analysis does not allow us to explicitly assign these costs to particular LIDACs. However, the location of LIDACs in Franklin County are mainly along the highway network making it apparent that a large share of benefits from this reduction in emissions would directly benefit LIDACs.

We summarize the key potential benefits and impacts for LIDACs for specific emissions reduction measures in the table below:

	PRIORITY REDUCTION MEASURE	POTENTIAL BENEFITS	POTENTIAL IMPACTS
1.	**Light-duty ZEVs and modernization**	• Reduction in co-pollutants[2] • Improved health outcomes • Employment opportunities for manufacturing, installation, and maintenance of charging stations and infrastructure	• Employment implications for fossil fuel-based transportation (e.g., mechanics, gas stations) • Affordability
2.	**MDHD ZEVs and modernization**	• Reduction in co-pollutants • Improved health outcomes • Employment opportunities for manufacturing, installation, and maintenance of charging stations and infrastructure	• Employment implications for fossil fuel-based transportation (e.g., mechanics, gas stations) • Affordability
3.	**Transportation efficiencies**	• Reduction in co-pollutants • Improved health outcomes • Reduction in commuting costs • Employment opportunities in transit	• Employment implications for taxi, rideshare, and private transportation • Less impactful in rural areas
4.	**Renewable electricity generation**	• Reduction in co-pollutants • Improved health outcomes • Reduction in energy costs and therefore energy burden • Employment opportunities for the construction, installation, and maintenance of renewable energy installations	• Employment implications in fossil fuel extraction and fossil fuel based electrical power generation • Current lack of skilled workforce • Land use conflict

[2] For this document, co-pollutants refer to other pollutants released along with GHGs, which have negative health impacts

5.	**Building energy efficiency**	• Reduction in co-pollutants • Improved health outcomes • Reduction in energy costs and therefore energy burden • Employment implications in particular industries	• Increase to land value and rent, impacting affordability for current residents
6.	**Clean heating**	• Reduction in co-pollutants • Improved health outcomes • Reduction in energy costs and therefore energy burden • Employment implications in particular industries	• Increase to land value and rent, impacting affordability for current residents • High costs of capital required for clean heating retrofits
7.	**Composting**	• Waste reduction leading to less garbage processing like landfilling, and environmental and direct costs • Supports local fresh food production	• Additional space/land requirements
8.	**Clean Waste-to-Energy (WtE)**	• Waste reduction • Reduction in co-pollutants by offsetting fuel combustion when clean WtE is used as vehicle fuel, heating fuel, or to generate electricity • Improved health outcomes • Reduction in energy costs and burden for those installing WtE at their facility	• Additional space/land requirements

This Plan lays the foundation for the next steps of Ohio's CPRG program. It is the first step in creating Ohio's Comprehensive Resiliency Plan (CRP), a more detailed plan addressing GHG reduction measures from all major and minor sources of emissions in Ohio. The CRP will be published in 2025.

Table of Contents

Introduction

The Ohio Environmental Protection Agency (Ohio EPA) produced this Priority Resiliency Plan (the Plan) to support investment in policies, practices, and technologies that reduce GHG emissions across the state. The Plan is designed to identify GHG reduction measures that reflect the priorities and concerns of different Ohio communities, while achieving a broader goal to reduce aggregate emissions produced in the state. Reducing GHG emissions through these measures will also have additional benefits, such as improving public health, creating high-quality jobs, spurring economic growth, and enhancing the quality of life for all Ohioans. This project was funded wholly or in part by the U.S. EPA under assistance agreement 00E03464 of $3 million to Ohio EPA. The contents of this document do not necessarily reflect the views and policies of the U.S EPA, nor does the U.S. EPA endorse trade names or recommend the use of commercial products mentioned in this document.

The measures contained herein should be construed as broadly available to any entity in the state eligible for receiving funding under the U.S. EPA's Climate Pollution Reduction Implementation Grant (CPRG) and other funding streams, as applicable.

The subsequent sections of the Plan will cover the following topic areas:

SECTION	DESCRIPTION
Greenhouse Gas Emissions Inventory	An overview of Ohio's GHG emissions footprint, identifying major priority and minor sectors contributing to Ohio's overall emissions.
Market Landscape	Current conditions of Ohio's electrical grid, building footprint, and transportation system, as it relates to the priority GHG emission sectors in Ohio.
Priority GHG Reduction Measures	Near-term GHG reduction measures related to the priority GHG emission sectors that Ohio will seek to implement as part of the CPRG program. Also provides an overview of potential additional measures that may be considered in the long-term by the State or near-term by other state constituents.
LIDAC Benefits Analysis	Results of the qualitative analysis over benefits and impacts of the GHG reduction measures outlined in this Plan.
Coordination and Outreach	An overview of Ohio EPA's stakeholder engagement efforts to date and plans for future outreach.
Comprehensive Resiliency Plan	An overview of the next steps of this program, including drafting a Comprehensive Resiliency Plan.

Greenhouse Gas Emissions Inventory

INVENTORY OVERVIEW

Ohio EPA developed a statewide inventory of major sources of GHG emissions in Ohio.[3] We prepared an estimate of emissions from each major source using the following data resources:

- State-level GHG inventories prepared by the U.S. EPA;[4]
- U.S. EPA's State Inventory Tool (SIT);[5]
- 2019 listing of registered motor vehicles and total vehicle miles traveled (VMT), obtained from Ohio Bureau of Motor Vehicles (BMV)
- U.S. Energy Information Administration's (EIA) 2019 Form EIA-923 (electric power generation data)[6]

The following GHGs are included in this inventory:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- fluorinated gases (F-gases) including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3)

Unless otherwise noted, the GHG inventory prepared for this Plan calculates GHG emissions in million metric tons (MMT) of carbon dioxide equivalent (CO_2e) for all economic sectors including, where available, emissions per fossil fuel type.[7,8] The calculated emissions for each included GHG are converted to CO_2e using global warming potentials (GWPs). This converts a unit of gas to the equivalent number of units of CO_2 required to create the same warming effect.[9] The Ohio GHG inventory includes emissions from the sectors defined in Table 1. Priority sectors have been identified as those that represent a significant portion of Ohio's emissions and are a focus of this Plan. Minor sectors will be further explored in the Comprehensive Resiliency Plan (CRP).

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[3] Ohio EPA prepared a Quality Assurance Project Plan (QAPP) that includes a detailed methodology for the GHG inventory. The QAPP was submitted to and approved by the U.S. EPA in October 2023

[4] https://www.epa.gov/ghgemissions/state-ghg-emissions-and-removals

[5] https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool

[6] Form EIA-923 detailed data with previous form data (EIA-906/920) - U.S. Energy Information Administration (EIA)

[7] Global warming potentials (GWPs) in SIT convert all GHG gas types listed into CO_2e

[8] See Appendix II for fossil fuel types included in SIT calculations by sector

[9] https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

Table 1. Sectors Included in Ohio's GHG Inventory

	SECTOR	DEFINITION[10]
PRIORITY	**Electric Power Generation**	Emissions from fossil fuel combustion at power plants for the purpose of generating electricity at power plants.
PRIORITY	**Buildings**	Emissions from fossil fuel combustion that occurs at residential, commercial, public, and industrial buildings.[11] Buildings also have indirect electricity emissions from electric power consumption.
PRIORITY	**Transportation**	Emissions from fossil fuel consumption in transportation, including on-road vehicles, aviation, boats and vessels, locomotives, other non-road vehicle sources, and alternative fuel vehicles. Transportation also has indirect electricity emissions from electric power consumption.[12]
MINOR	**Other Energy**	Emissions from international bunker fuels used in marine and aviation transport originating in the United States with international destinations, coal mining, abandoned coal mines, and natural gas and oil systems, including production, transmission, distribution, and venting and flaring of natural gas, and petroleum systems.
MINOR	**Industrial Processes and Materials**	Emissions from industrial processes, including, but not limited to, cement production, iron and steel production, ammonia manufacturing, and other material production and manufacturing activities.
MINOR	**Waste**	Emissions from municipal solid waste management, including landfilled waste.
	Agriculture	Emissions from agricultural processes, including enteric fermentation, manure management, soils, rice cultivation, liming of soils, urea fertilization, and agricultural residue burning.
	Land Use, Land-use Change, and Forestry (LULUCF)	Emissions and carbon sequestration (the absorption of carbon from the atmosphere) resulting from land-use change and forest management activities.

[10] Sector definitions are aligned to the definition provided by the U.S. EPA in the SIT

[11] For buildings, emissions capture major fuel types used in buildings including natural gas, propane, and coal. Minor fuel types and fugitive emissions from building HVAC systems are not captured currently due to lack of data. See Appendix for a complete list of fuel types considered for electric power, building, and other energy sectors.

[12] Electric and other zero emission vehicles like hydrogen or fuel-cell were not accounted for in the SIT as Ohio BMV VMT data utilized does not distinguish vehicles by fuel types; these can be integrated into the GHG Inventory for the CRP

OHIO STATEWIDE GHG EMISSIONS BY SECTOR

As shown in Figure 1, total gross emissions within Ohio are 245 $MMTCO_2e$. The three most significant sectors in Ohio are electric power generation, buildings, and transportation, which account for most of Ohio's emissions (79% of gross emissions):

- Electric power: 28%
- Buildings: 25%
  - Direct fossil fuel combustion at buildings is 25% of gross emissions. However, indirect electric power consumption from buildings is 28% of gross emissions. This results in 53% of gross emissions being attributable to buildings.
- Transportation: 26%[13]

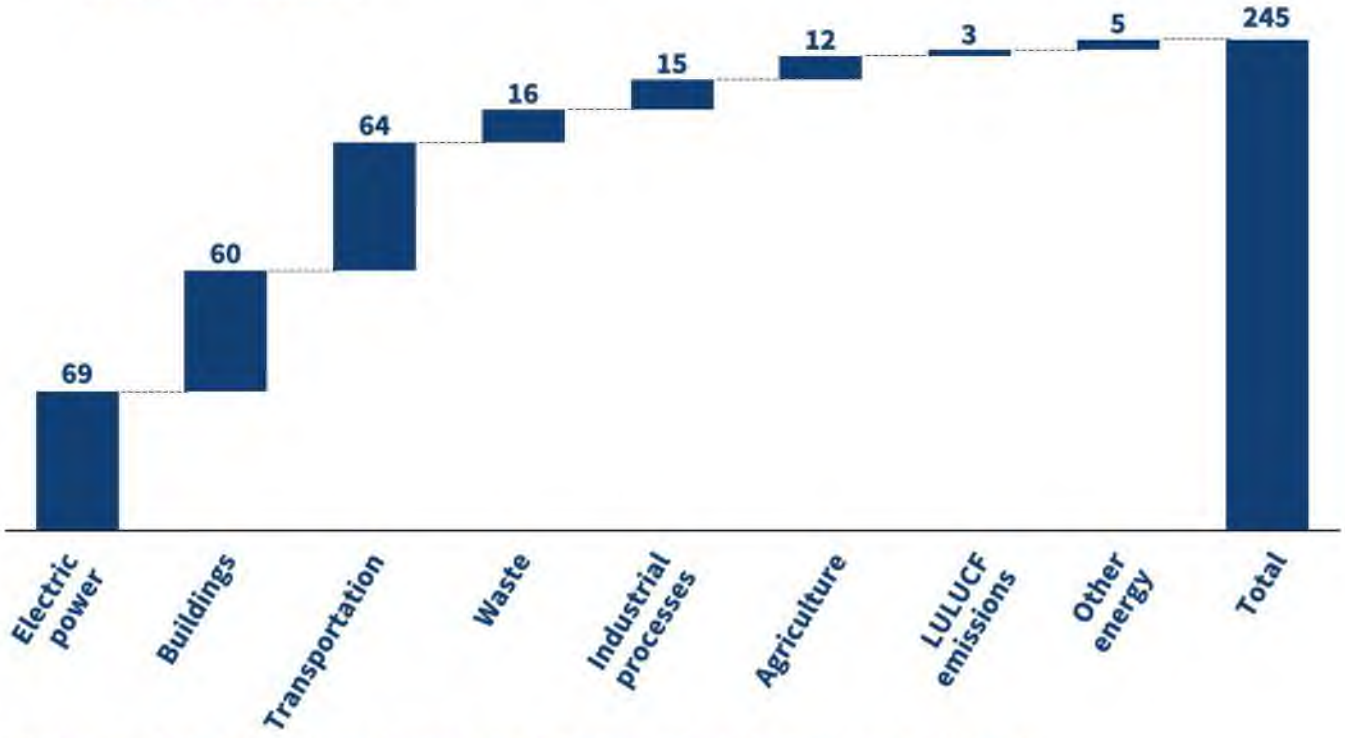

Figure 1. Ohio Statewide Gross GHG Emissions by Sector ($MMTCO_2e$)[14]

As shown in Figure 1, there are additional sectors aside from electric power, buildings, and transportation that are minor contributors to the statewide gross emissions total:

- Waste: 7%
- Industrial processes: 6%
- Agriculture: 5%
- LULUCF: 1%
- Other Energy: 2%

[13] Indirect electricity emissions are less than 1% for transportation. Electric and other zero emission vehicles like hydrogen or fuel-cell were not accounted for in the SIT as Ohio BMV VMT data utilized does not distinguish vehicles by fuel types; these can be integrated into the GHG Inventory for the CRP

[14] "Other Energy" includes fossil fuels combusted in international bunker fuels (shipping and airfare fuels), coal mining, and natural gas and oil systems

Figure 2 shows net emissions within Ohio by reflecting emissions sinks and avoided emissions (negative values) in the waste and LULUCF sectors.

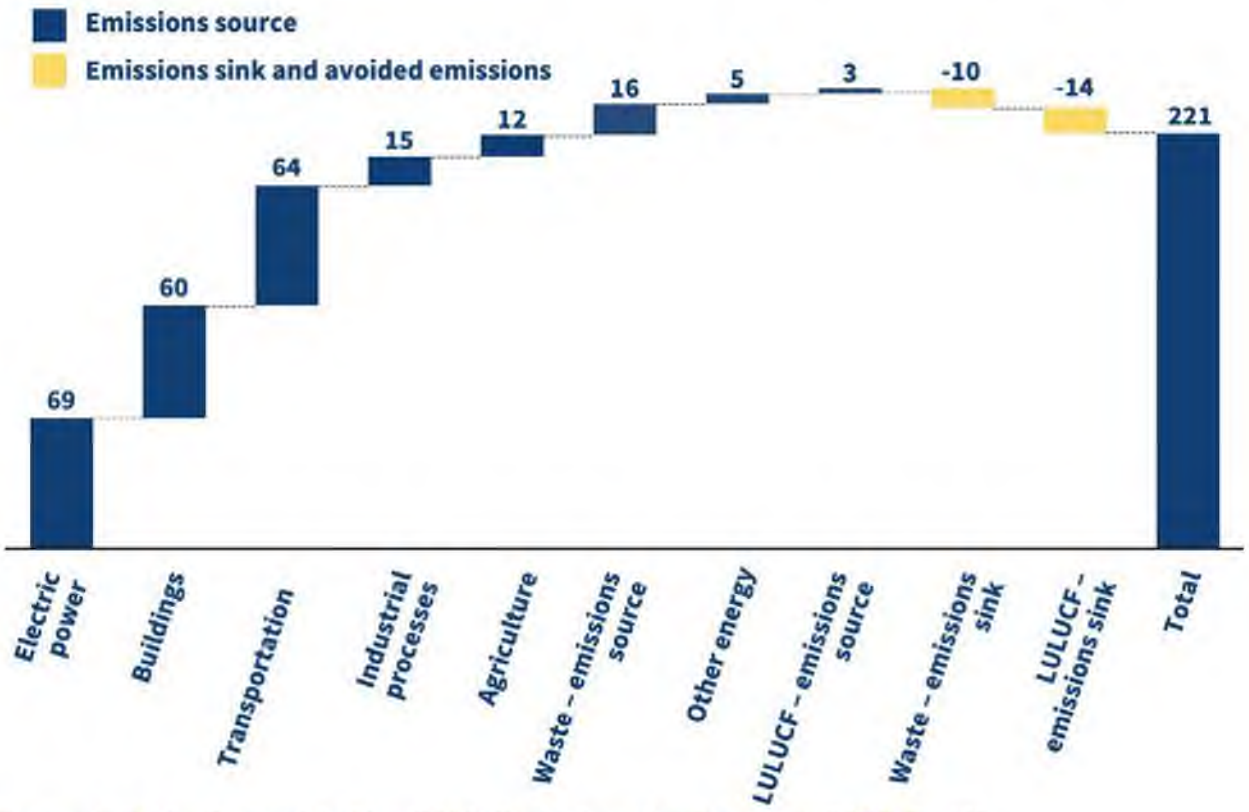

Figure 2. Ohio Statewide Net GHG Emissions by Sector ($MMTCO_2e$)[15]

Considering both gross and net emissions, the three sectors contributing the most to GHG emissions in Ohio are electric power, buildings, and transportation.

[15] "Other Energy" includes fossil fuels combusted in international bunker fuels (shipping and airfare fuels), coal mining, and natural gas and oil systems. "LULUCF – Emissions Source" includes emissions from conversion of forest land to land and N_2O emissions from settlement soils. "LULUCF – Emissions Sink" includes carbon sequestration or from forests; converting land to forest land; urban trees; landfilled yard trimmings and food scraps; and agricultural soil carbon flux. Emissions from Waste include CH_4 production from municipal solid waste generation and industrial generation, while emissions sinks, and avoided emissions include avoided CH_4 emissions from flaring and landfill gas-to-energy and oxidation at landfills

ELECTRIC POWER AND BUILDINGS

Fossil fuel combustion to generate electricity – referred to as "electric power" – results in 28% of total statewide gross emissions, as shown in Figure 1.

Electric power generation is the largest sector contributor to GHG emissions. Energy use in buildings (including residential, commercial, and industrial) consumes the vast majority of this produced electricity (99%), and transportation consumes the remainder (1%).[16] Energy use in buildings drives demand for electric power in Ohio and impacts the total emissions generated from this sector.

As shown in Figure 3, when considering both electricity consumed by buildings and fossil fuel combustion onsite, buildings are responsible for 129 $MMTCO_2e$, or 58% of total net emissions in Ohio.

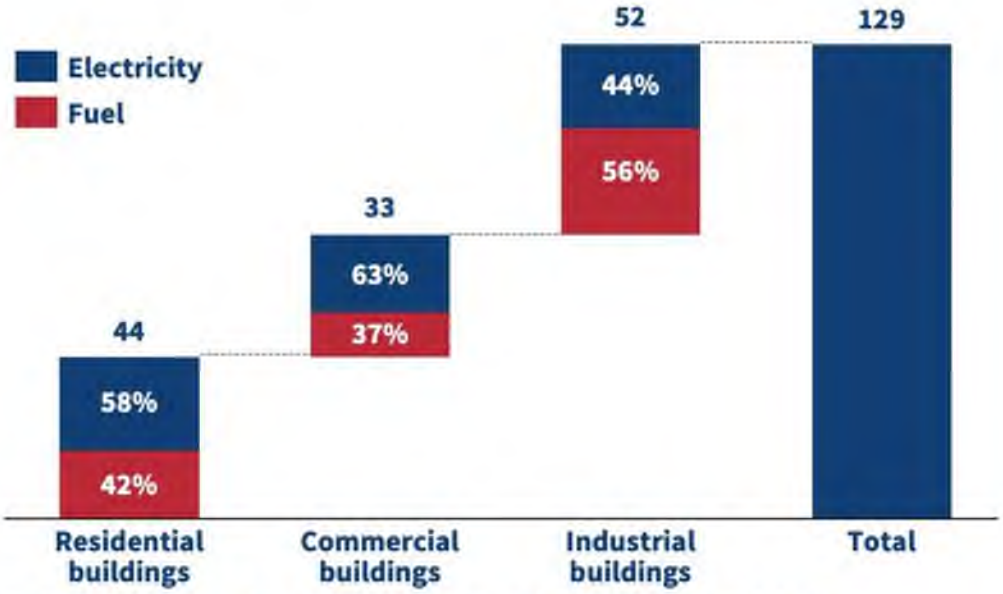

Figure 3. Building Emissions from Consumption of Energy ($MMTCO_2e$) [17]

Electricity is a larger source of residential and commercial building emissions than fuel, which means that more emissions are generated offsite at power plants as opposed to onsite combustion of fossil fuels at the buildings.[18]

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[16] Electric and other zero emission vehicles like hydrogen or fuel-cell were not accounted for in the SIT as Ohio BMV VMT data utilized does not distinguish vehicles by fuel types; these can be integrated into the GHG Inventory for the CRP

[17] See Appendix II for fossil fuel types included in SIT calculations by sector

[18] Emission from public buildings were not calculated separately in this Plan, but will be analyzed in the CRP

In industrial buildings, fuel emissions are higher than electricity emissions, meaning more emissions are generated from onsite combustion of fossil fuels as opposed to emissions generated offsite at power plants.

Among building types in Ohio, there are different sources of electricity consumption. While there are average trends for residential and commercial building types, the age, size, geography, climate, heating system, and other characteristics, dictate how this energy is consumed in the building and the resulting production of emissions from fuel and electricity use.[19] For example, older buildings may be more inefficient or rely on more carbon-intensive fuels for heating, while newer buildings are more likely to be electrified and efficient. Geography may also influence the emissions profile of a building. For example, buildings in colder areas may require more fuel for heating than buildings in warmer climates, thus leading to more emissions from the use of fuels.

It is notable that electricity use represents a greater share of the carbon footprint for residential and commercial buildings, whereas fuel use is a greater share of the carbon footprint for industrial buildings. This is driven by a combination of greater usage of onsite fuel compared to electricity in some cases as well as the carbon intensity of the onsite fuel type versus electricity. Because fuel usage is a significant portion of industrial building carbon footprints, there is an opportunity to look at specific decarbonization measures that target fuel use in industrial buildings to reduce the overall contribution of these buildings to Ohio's GHG emissions.

ELECTRICITY EMISSIONS FROM BUILDINGS

Figure 4 shows an assessment of electricity use in residential, commercial, and industrial buildings broken out by these building types. The breakout of electricity uses by building type allows for the assessment of how residential, commercial, and industrial buildings use electricity.

- For the average Ohio residential building, the largest proportion of electricity use emissions stem from lighting and appliances (54%).
- Lighting (18%), computers (9%), and other appliances (27%) are also the predominant sources (54%) of electricity use emissions for commercial buildings.
- In industrial buildings, manufacturing process equipment result in the most emissions (69%), with lighting (12%) and other appliances (4%) being relatively smaller sources of electricity use emissions.

[19] Space heating emissions only capture emissions from space heating via electricity from electric resistance and/or electric heat pumps. It does not include space heating emissions from fossil fuel combustion

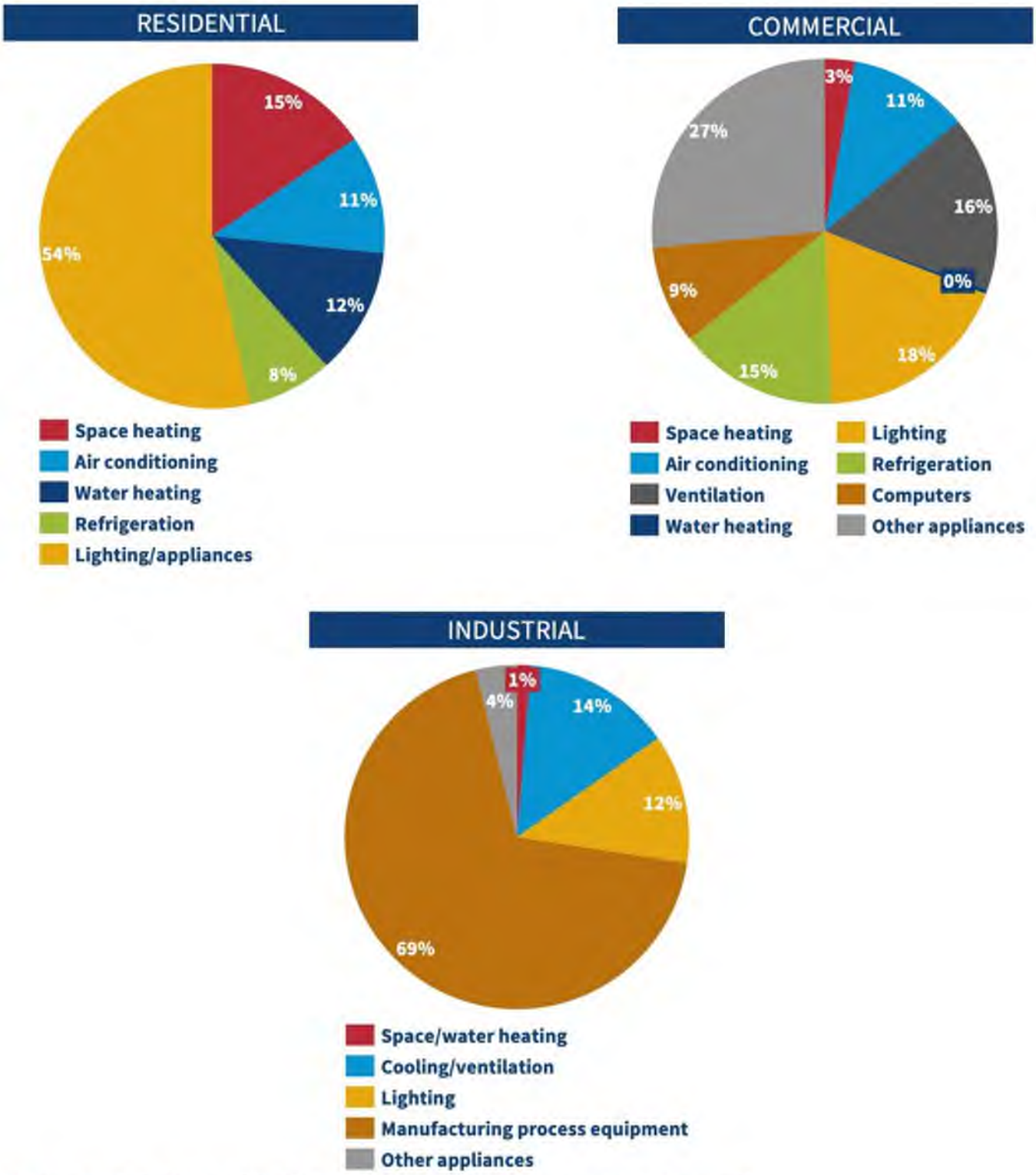

Figure 4. Ohio Statewide Buildings Electricity Emissions by Source [20]

[20] Electricity emission sources reported in SIT vary by residential, commercial, and industrial building types

FOSSIL FUEL COMBUSTION

The primary fuel types included in this inventory for electric power and buildings are coal, petroleum, and natural gas. Electric power generation burns fuel at power plants to produce electricity, whereas buildings commonly burn fossil fuels onsite for the following reasons:

- Space (air) and water heating
- Cogeneration (e.g., combined heat and power for routine onsite electricity generation)
- Backup power generation (e.g., generators used during power outages)

As shown in Figure 5, emissions from natural gas are the majority of overall emissions from the electric power and buildings sectors (38%). Natural gas use causes nearly one-third (30%) of electricity generation emissions and nearly three-quarters (73%) of building fuel emissions.

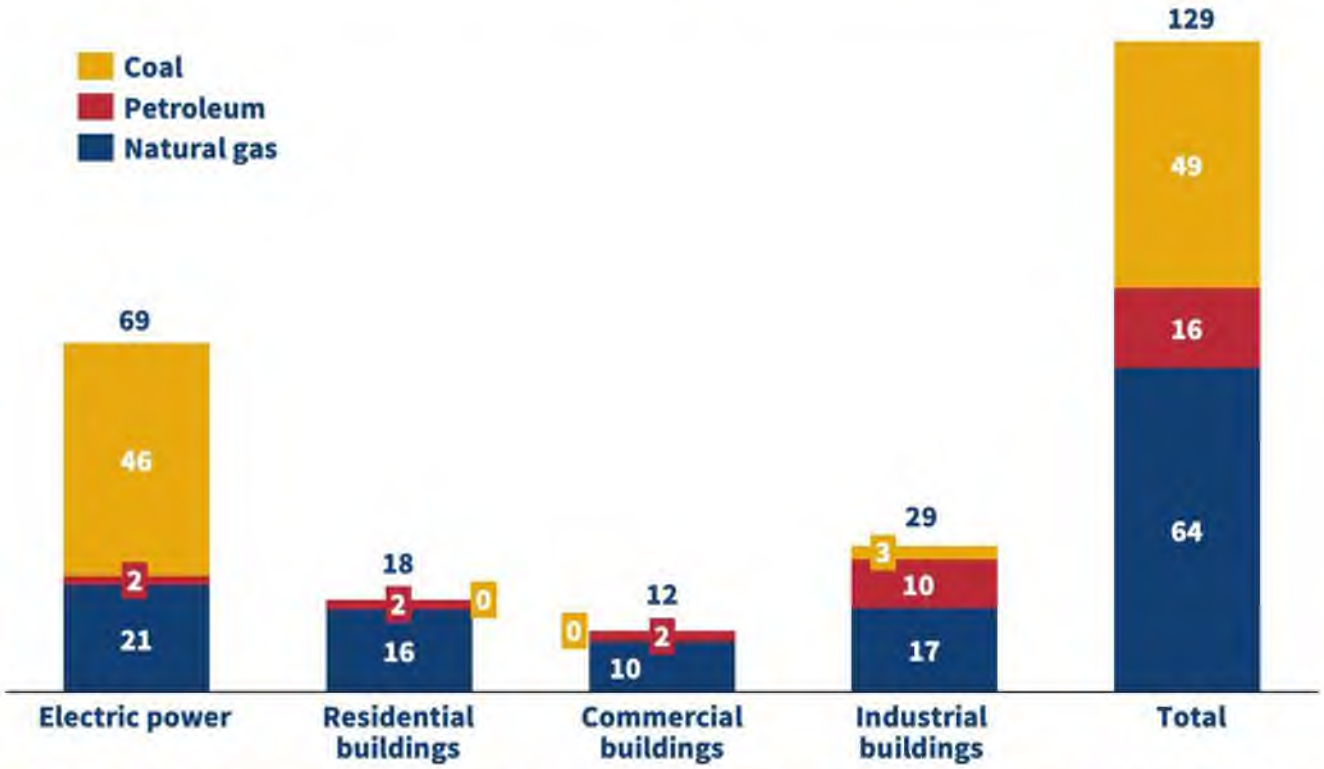

Figure 5. Ohio Emissions from Electric Power and Building Sectors, by Fuel Type ($MMTCO_2e$)[21]

Residential and commercial buildings predominately burn natural gas for heating, cogeneration, and/or back up power generation (approximately 87% of residential and commercial fuel emissions are from natural gas).

[21] See Appendix II for fossil fuel types included in SIT calculations by sector

Industrial buildings burn proportionally less natural gas (59%) than residential and commercial buildings, with greater consumption of petroleum (34%).

For electric power generation specifically, coal use is the cause of two thirds of emissions (67% of total electric power emissions). Coal is more emissions intensive than natural gas, meaning for one unit of energy, coal produces more emissions than natural gas. The use of coal in Ohio's electricity production contributes to higher overall emissions from Ohio's electric power generation when compared to other possible fuel mixes.

TRANSPORTATION

Transportation is the second largest individual contributor to statewide emissions (26% of gross emissions). Emissions from transportation come from the combustion of fossil fuels in vehicles, which releases GHG emissions into the atmosphere. In Ohio, these emissions predominantly come from on-road vehicles, such as passenger cars and trucks. Transportation also captures emissions from aviation, boats, and rail transport. Transportation is responsible for a small share of electricity consumption emissions, including use of electricity by electric rail.[22] Figure 6 shows the proportion of total transportation emissions that come from each type of vehicle.

On-road vehicles account for 84% of total transportation emissions in Ohio, including:

- Passenger cars
- Light-duty trucks
- Heavy-duty vehicles
- Heavy-duty buses
- Motorcycles

[22] Electric and other zero emission vehicles like hydrogen or fuel-cell were not accounted for in the SIT as Ohio BMV VMT data utilized does not distinguish vehicles by fuel types; these can be integrated into the GHG Inventory for the CRP

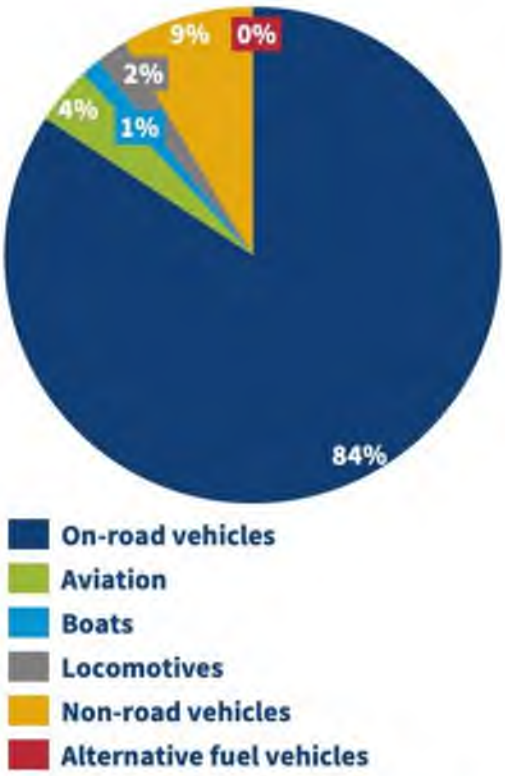

Figure 6. Ohio Statewide Transportation Emissions by Vehicle Type[23]

As seen in Figure 7, the vehicle types that contribute to most on-road vehicle emissions are passenger cars, light-duty trucks, and heavy-duty vehicles:

- Light-duty vehicles, including passenger cars and light-duty trucks, are the largest contributors representing 44% of total transportation emissions
- Heavy-duty vehicles, including large freight trucks (excluding transit and school buses) represent 24% of total transportation emissions
- Light-duty trucks represent 16% of total transportation emissions

[23] "Non-road vehicles" includes other miscellaneous mobile equipment, such as farm equipment, construction equipment, snowmobiles, small gasoline powered utility equipment, heavy-duty gasoline powered utility equipment, and heavy-duty diesel-powered utility equipment

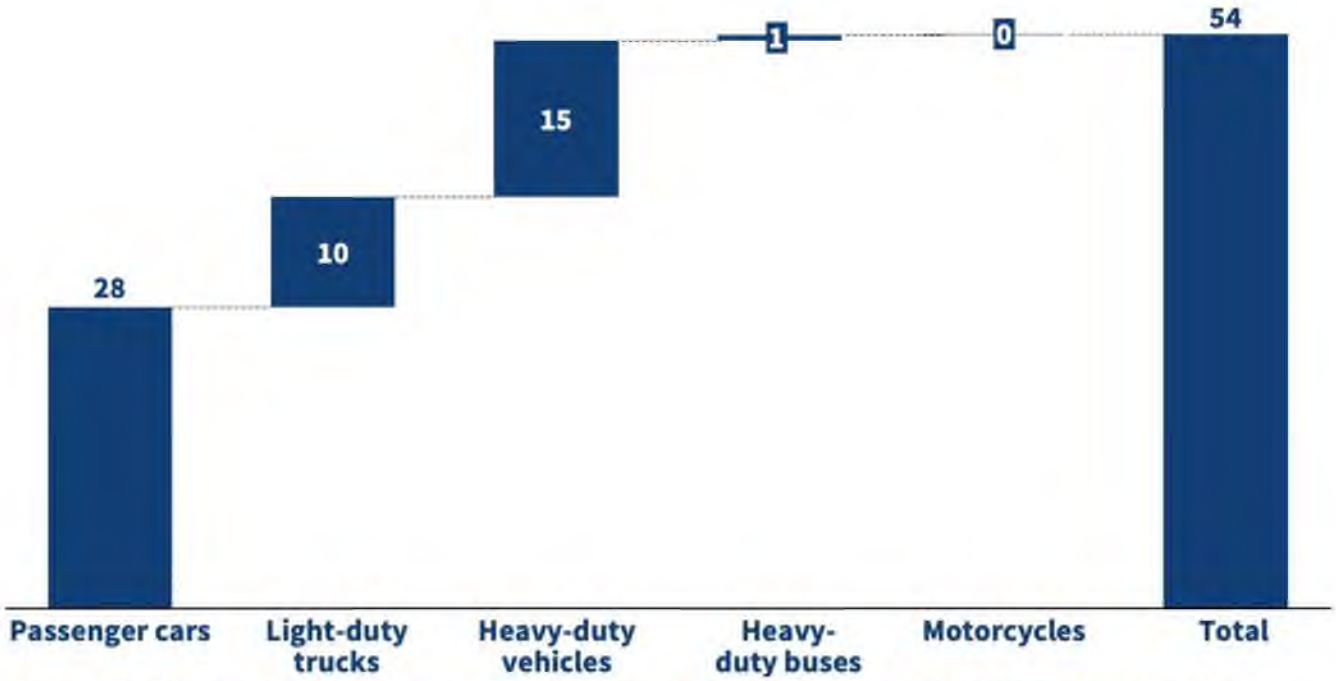

Figure 7. Ohio Statewide Transportation Emissions from On-road Vehicles ($MMTCO_2e$)

OHIO STATEWIDE EMISSIONS BY GHG TYPE

There are several types of greenhouses gases emitted from different types of sources that are included in Ohio's GHG inventory. While CO_2 is the primary GHG of focus, CH_4, N_2O, and fluorinated gases including HFCs, PFCs, SF_6, and NF_3, all have higher global warming potentials (GWP) than CO_2.[24] GWP is a metric developed to allow different types of GHGs to be compared based on their warming impact. It measures how much energy 1 metric ton of gas will absorb over time. The U.S. EPA SIT uses a period of 100 years for calculations. CO_2 is the reference gas for global warming potential and has a GWP of 1. The following are the GWPs of the GHGs included in Ohio's GHG inventory:

- CO2 = 1
- CH4 = 28
- N2O = 273
- Fluorinated gases = range from nearly thousands to tens of thousands

Figure 8 shows that CO_2 accounts for 86% of total statewide net emissions, even when accounting for the GWPs of the other GHGs.

The largest sources of CO_2 are electric power, buildings, and transportation. Meanwhile the largest sources of CH_4, N_2O, and fluorinated gases, respectively, are waste, agriculture, and industrial processes and materials manufacturing.

[24] Understanding Global Warming Potentials | US EPA

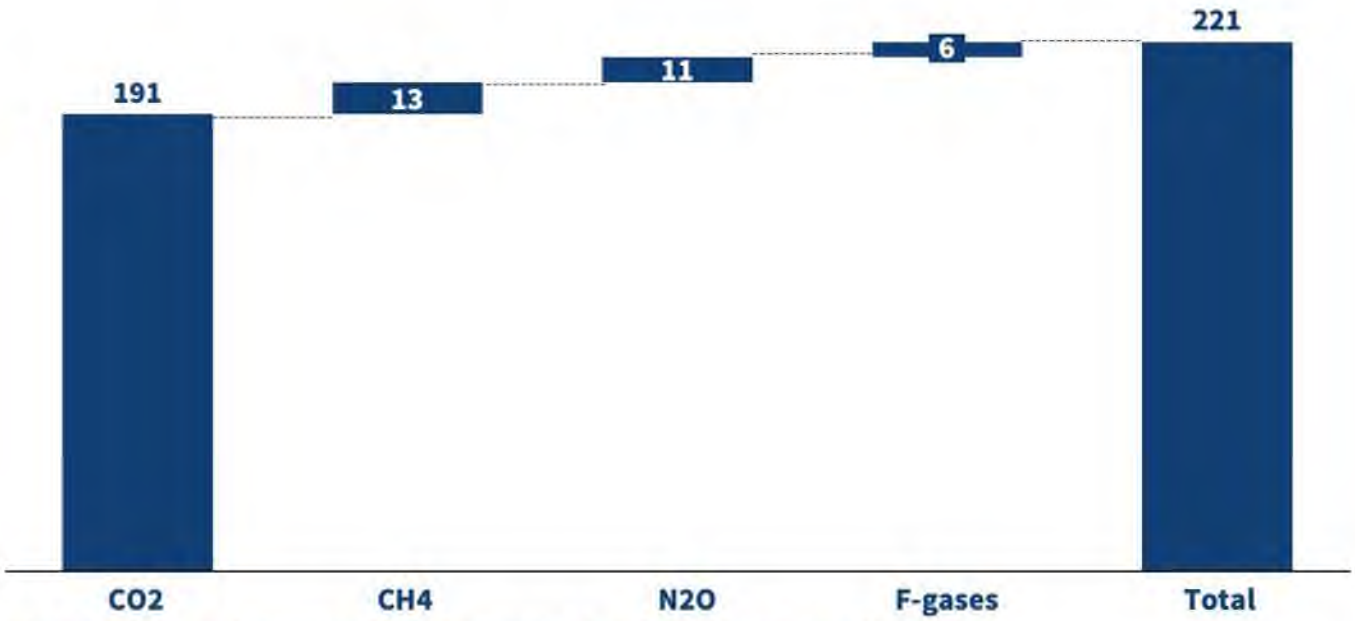

Figure 8. Total Statewide Net Emissions by GHG Type ($MMTCO_2e$)

Market Landscape

An analysis of key trends that affect GHG emission patterns was conducted for the three most emission-intensive sectors: 1) electricity generation; 2) buildings; and 3) transportation.

ELECTRICITY GENERATION

In Ohio, electricity generation is fueled primarily by the combustion of fossil fuels at power plants to create energy. There are a total of 31 investor-owned utilities (IOUs) and cooperative electric utilities (co-ops) in Ohio, plus municipal owned utilities, which are primarily responsible for the transmission and distribution of electricity in the state.[25] Currently, Ohio imports 20-25% of its electricity from regions outside the state, including Canada and neighboring states.[26,27]

Figure 9 shows the annual generation mix, or the mix of fuels and energy sources that are used to generate utility-scale electricity for Ohio in 2022. Eighty-four percent (84%) of Ohio's total electricity generation comes from fossil fuels, indicating a significant opportunity to increase the share of clean energy for electricity production to reduce Ohio's impact from this high-emitting sector. Ohio's emissions per megawatt-hour (MWh) of electricity production is 1,162 pounds (lbs) CO2e/MWh, which is higher emitting than the U.S. average (828 lbs CO2e/MWh).[28] As of 2022, in terms of electricity generation, Ohio is the 12th highest carbon dioxide-emitting state in the U.S.[29]

Natural gas is the most utilized energy source to generate electricity at 51% of total MWh, followed by coal at 32%. Petroleum represents a minor share of electricity generation (1%), while other energy sources represent less than 1%.

Clean energy, including renewables, currently represent a small percentage of Ohio's total electricity generation (16%), indicating there is significant opportunity for Ohio to maximize the use of clean energy to decarbonize its power generation. Clean energy, including renewables, currently represent a small percentage of Ohio's total electricity generation (16%), indicating there is significant opportunity for Ohio to maximize the use of clean energy to decarbonize its power generation.

Figure 10 shows the breakdown of electricity generation sources from clean energy in Ohio in 2022. Nuclear represents the largest share of total electricity generation from clean energy (76%), followed by wind (14%) and utility-scale solar (4%).

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[25] Ohio EV Charger Planning Map for Public (arcgis.com)

[26] U.S. Energy Information Administration – EIA – Independent Statistics and Analysis

[27] Imported electricity emissions are not included in Ohio's statewide GHG inventory boundary.

[28] US EPA eGrid 2022

[29] EIA Rankings: Total Carbon Dioxide Emissions (2021)

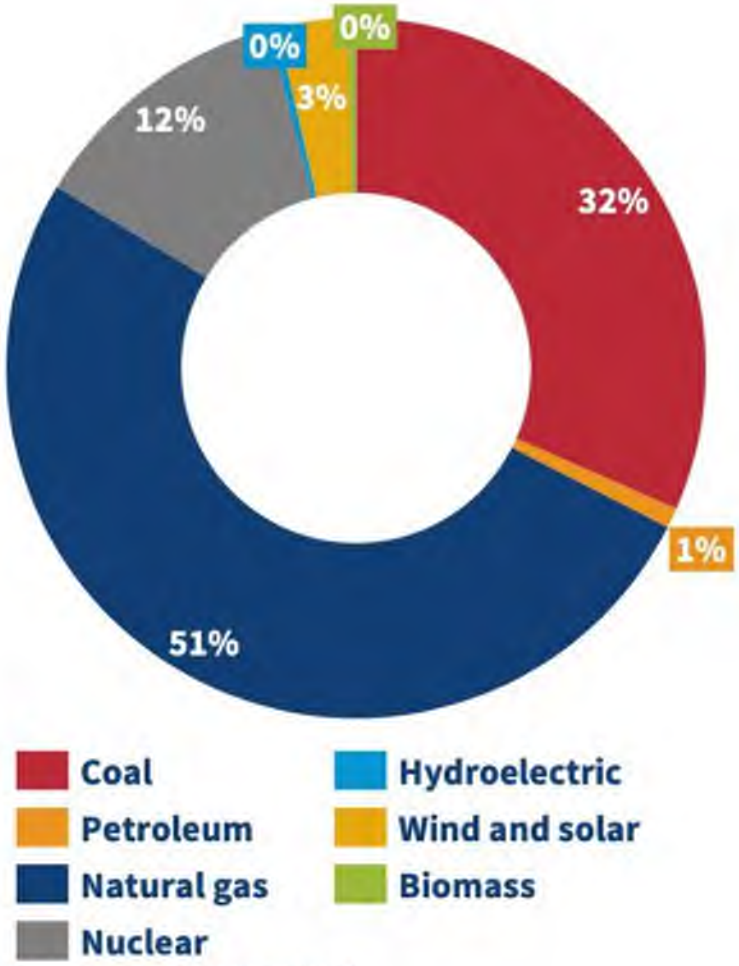


Figure 9. Ohio Annual Generation Mix (MWh) [30]

[30] Last year reported (2022) U.S. Energy Information Agency (EIA) data for Ohio's electricity generation. Natural gas includes contribution from other gases including blast furnace gas, natural gas, and other gas (undefined by EIA). More information can be found in the Technical Notes to this data

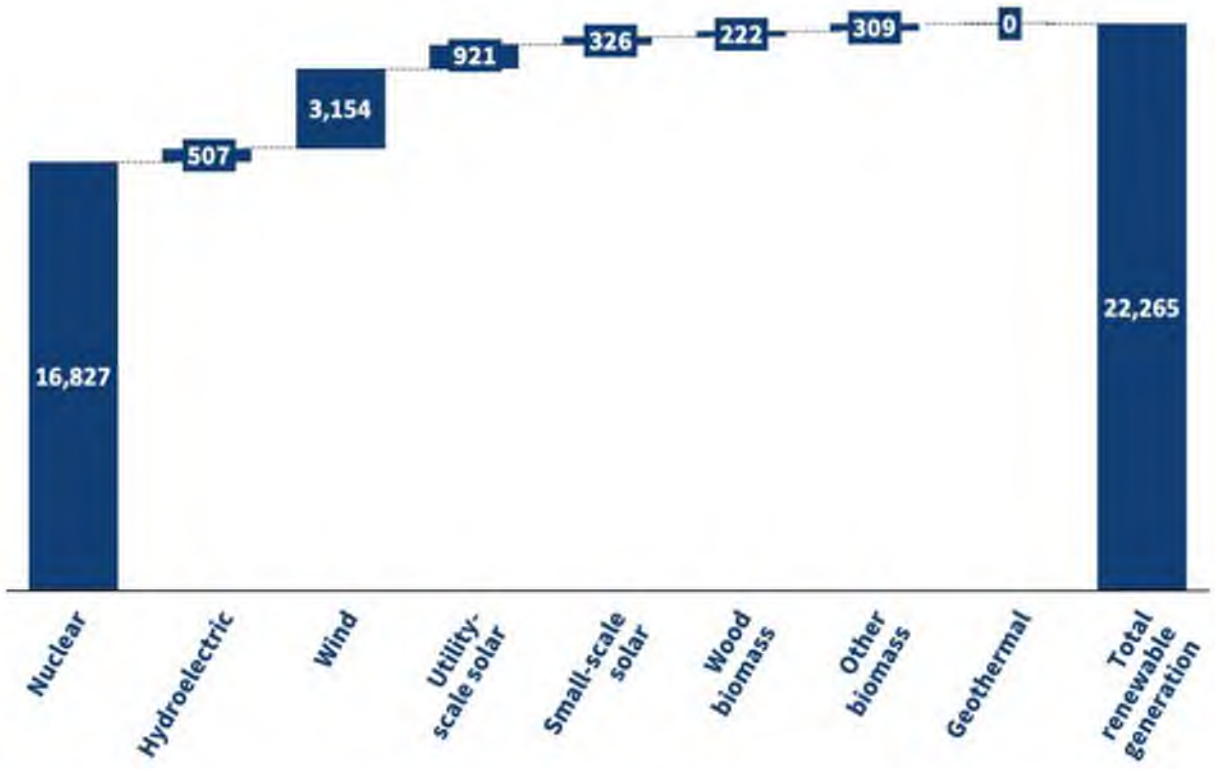


Figure 10. Ohio Annual Clean Energy Generation (MWh)[31]

BUILDINGS

The National Renewable Energy Laboratory (NREL)'s ResStock tool assesses the energy efficiency and electrification of residential homes in each state. Figure 11 shows the breakdown of homes in Ohio based on their year of construction. Older homes are typically less energy efficient due to poor insulation and outdated HVAC systems.[32] The majority of homes in Ohio were built between 1940 and 2000 (68%).[33]

Furthermore, most residential buildings in Ohio currently rely on fossil fuels or inefficient electric technologies for heating (Figure 12). Heating via a boiler or furnace burns fossil fuels to produce heat. Baseboard heating, while electric, is a dated and inefficient heating technology. Air source heat pumps are the most efficient way to heat a building using electric power, but currently there is limited use in Ohio, as seen in Figure 12. Therefore, there are significant opportunities for

[31] Latest year reported (2022) U.S. Energy Information Agency (EIA) data for Ohio's electricity generation. This data only represents utility-scale electricity generation along with small-scale solar

[32] LEAD Tool | Department of Energy

[33] NREL ResStock Analysis

increased adoption of efficient heating electrification technologies to reduce emissions produced by Ohio homes.

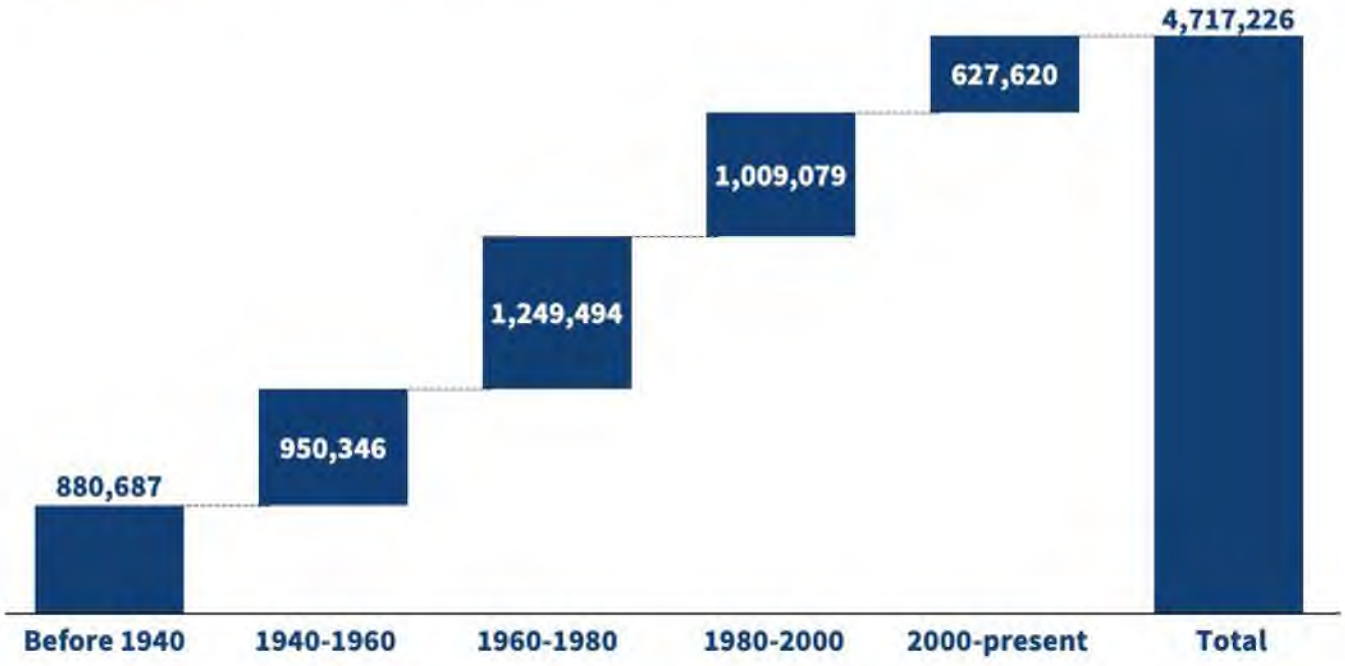
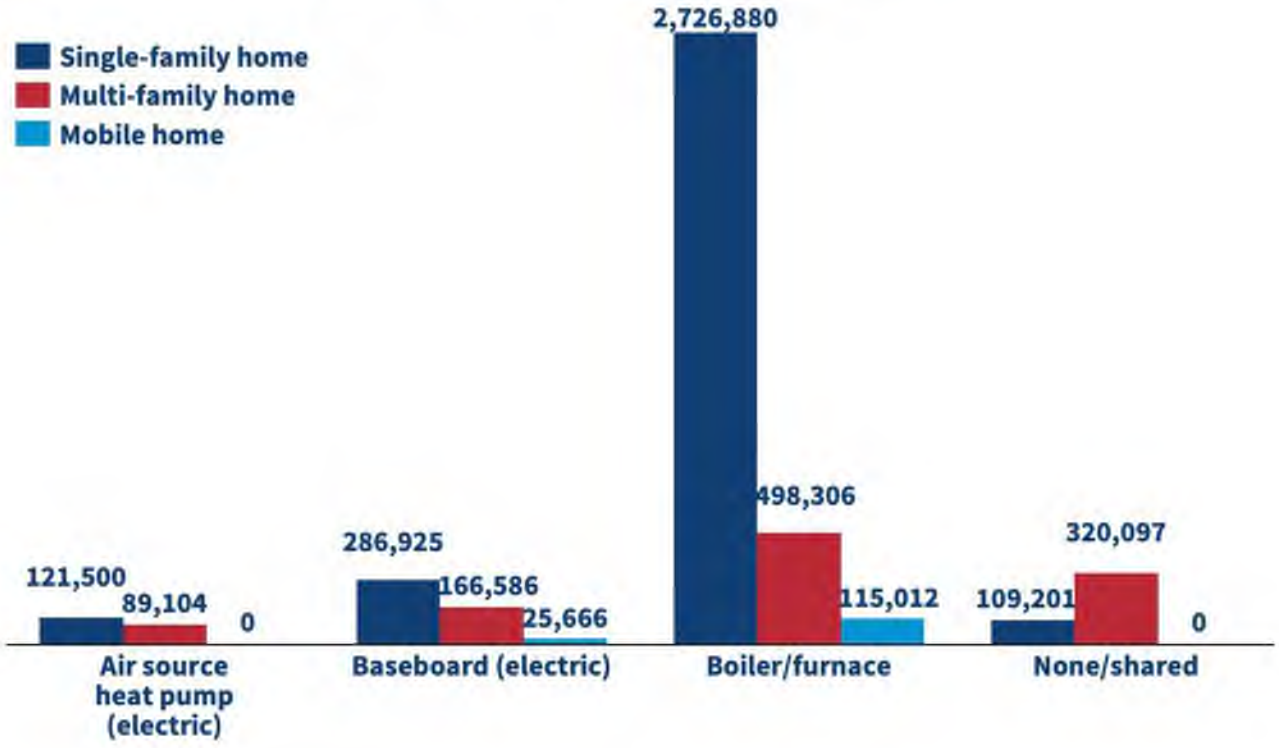


Figure 11. Residential Buildings in Ohio Based on Year Built (2023) [34]



[34] NREL ResStock Analysis

Figure 12. Heating System Types in Ohio Residential Buildings, by Type of Home (2023) [35]

Insulation of homes can also be an indicator of potential energy inefficiencies. U.S. EPA and the Department of Energy (DOE) recommend an insulation level of R10 or above for Ohio's climate zone.[36] As shown in Figure 13, over half of Ohio homes are uninsulated, and an additional 15% have insufficient insulation per the recommendation of U.S. EPA.

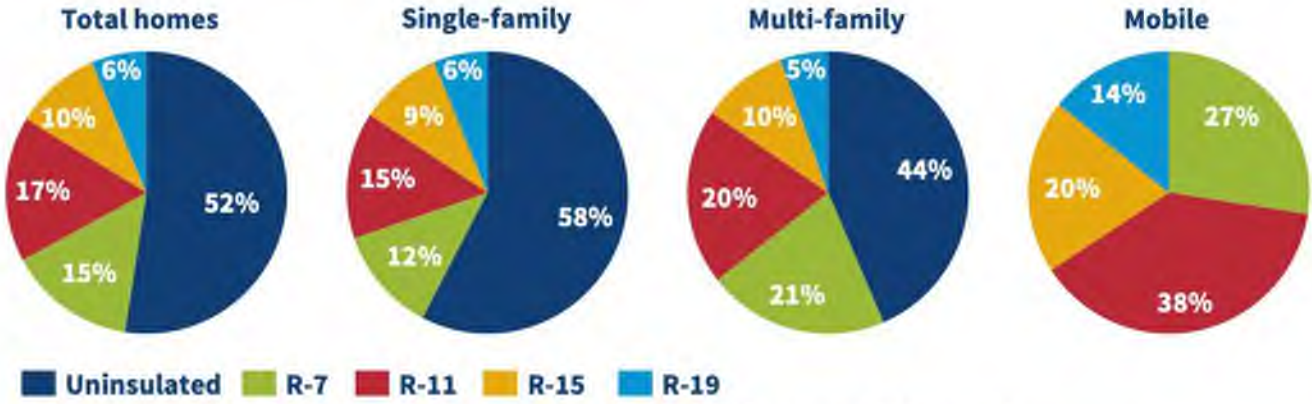


Figure 13. Insulation in Ohio Residential Buildings, By Type of Home [37]

The same principles apply to commercial and industrial buildings, where older buildings will likely require efficiency upgrades to save on energy and reduce GHG emissions.

TRANSPORTATION

The types of transport in Ohio that generate emissions includes passenger cars, light- and heavy-duty trucks, rail, boats, and aircraft. The most significant of these sources in terms of fuel combustion is transport by passenger cars and light- and heavy-duty trucks.

ON-ROAD VEHICLES

Light-duty cars – otherwise known as passenger cars – comprise most vehicle miles traveled (VMT) in Ohio (53% of total annual VMT). These passenger cars primarily burn gasoline, although this category can also include ZEVs or alternative fuel vehicles. Figure 14 shows annual VMT for GHG emitting on-road vehicles (not including ZEVs).[38] Meanwhile, buses, including public transit and school buses, represent less than 1% of total annual VMT.[39]

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[35] NREL ResStock Analysis, Heating System

[36] Recommended Home Insulation R–Values | ENERGY STAR

[37] NREL ResStock Analysis, Wall Insulation

[38] Electric and other zero emission vehicles like hydrogen or fuel-cell were not accounted for in the SIT as Ohio BMV VMT data utilized does not distinguish vehicles by fuel types; these can be integrated into the GHG Inventory for the CRP

[39] Other public transit, such as rail VMT data, was not available for this analysis.

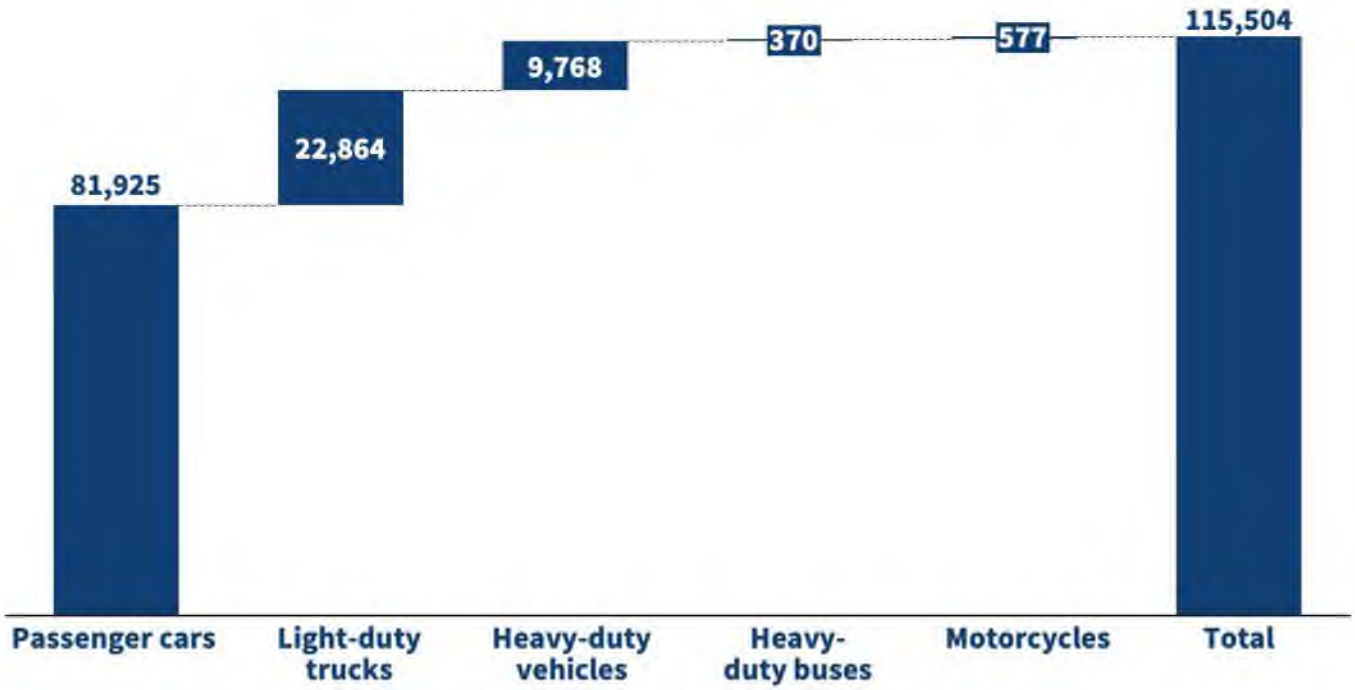

Figure 14. Annual VMT in Ohio for Emitting On-road Vehicles (Million Miles)

UPTAKE OF ELECTRIC VEHICLES IN OHIO

In 2022, the total number of fully electric vehicle registrations in Ohio was 34,100, representing less than 0.01% of total light-duty vehicle registrations in Ohio.[40] Ohio ranked 17th in the country for number of electric vehicle registrations, with California having the most at approximately 903,600 and North Dakota having the least at 600.[41] Total electric vehicle registrations in Ohio, including plug-in hybrids and hybrid electric, totaled 217,600. This number has been rising steadily since 2016.

Ohio has already begun to expand electric vehicle charging infrastructure to accommodate increasing demand. The Ohio Department of Transportation (ODOT) has a public map of all current Level 2 electric vehicle chargers (in green) shown in Figure 16, as well as planned future chargers (in blue) from the National Electric Vehicle Investment (NEVI) federal award funding Round I.

[40] US Department of Energy Alternative Fuels Data Center, Vehicle Registration Counts by State

[41] US Department of Energy Alternative Fuels Data Center, Vehicle Registration Counts by State

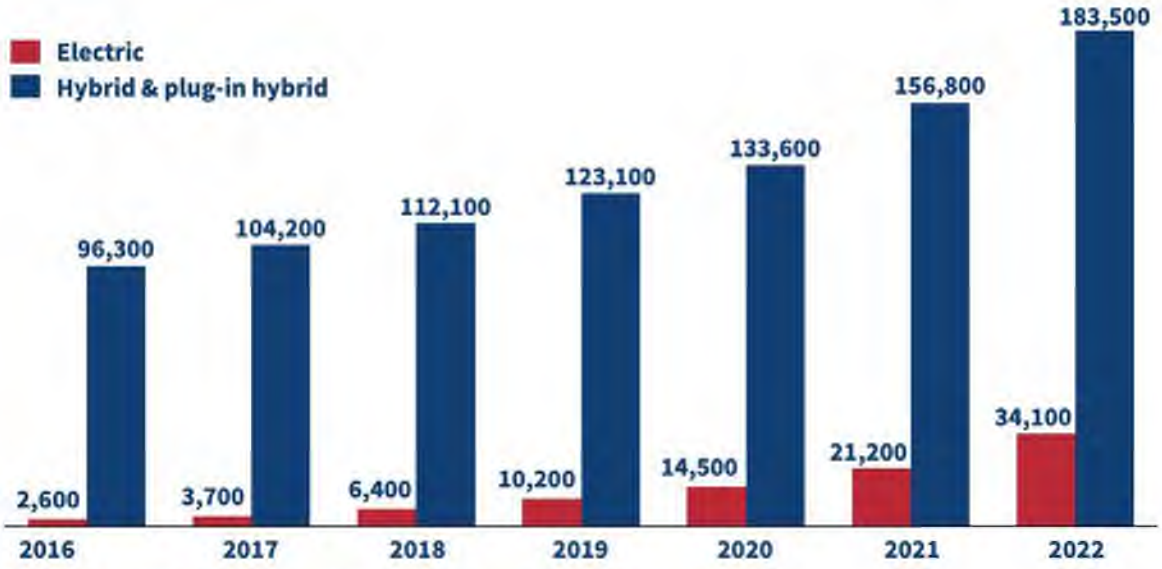

Figure 15. Electric Vehicle Registrations in Ohio 2016-2022[42]

[42] US Department of Energy Alternative Fuels Data Center, Vehicle Registration Counts by State

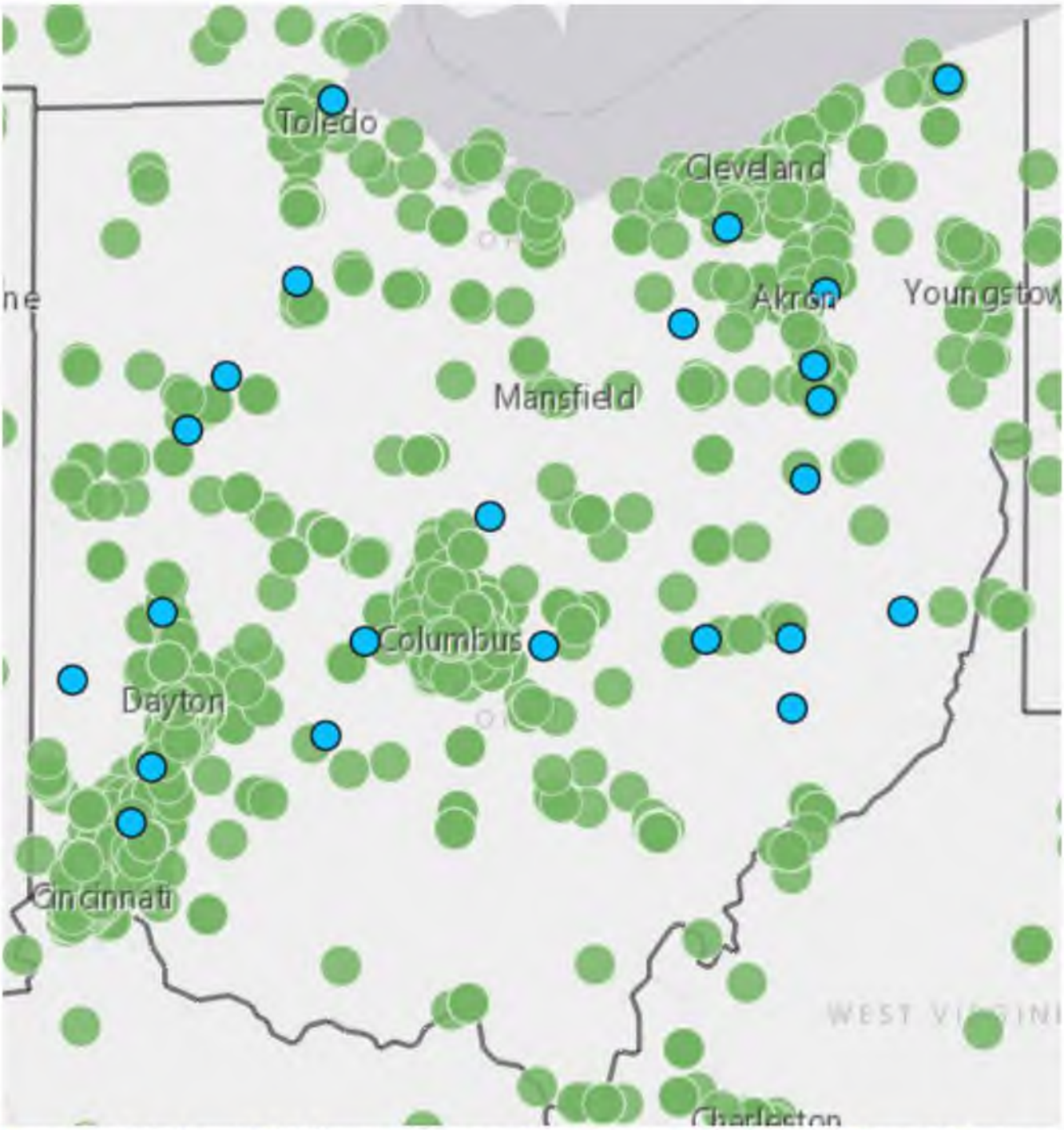

Figure 16. Ohio Level 2 EV Charging Stations (As of October 27th, 2023, and Round I Contingent NEVI Awards) [43]

[43] Ohio EV Charger Planning Map for Public (arcgis.com)

WALKING AND BICYCLING MODES OF TRANSPORT

Only 2.5% of Ohioans report walking (2.2%) or biking (0.3%) to work, according to the American Community Survey, and Ohio is ranked 28th in the country for combined walking and bicycling commute rates.[44] The state with the highest combined mode share for commuting to work is Alaska, with 8.78% of Alaskans commuting to work via bike or walking. Increasing the percentage of Ohioans who walk or bike would not only reduce GHG emissions, but also save people money and contribute to improved air quality.

Figure 17 depicts the current bike and shared lane infrastructure (both state and U.S. Bike Route System) in Ohio; it is important to acknowledge that this graphic may not be complete, as further analysis is required to understand the full system.

- Currently, the state and U.S. Bike Routes comprise more than 3,000 miles of network in more than 76 counties
- Segments of five U.S. Bike Routes are present in Ohio
- Each ODOT district has at least 150 miles of identified state or U.S. Bike Routes within their jurisdiction
- The majority of bicycle route segments are shared lanes; shared use paths are those that are separated from the roadway

[44] WBO_ExistingConditionsSummary_Final.pdf (ohio.gov)

Figure 17. Current bike and shared lane infrastructure in Ohio[45]

[45] WBO ExistingConditionsSummary_Final.pdf (ohio.gov)

Priority GHG Reduction Measures

IDENTIFICATION AND PRIORITIZATION APPROACH

The GHG reduction measures in this section are identified as "priority measures." These priority measures align with the state's need to consider the most beneficial near-term opportunities to reduce emissions, including pursuing funding through CPRG implementation grants. This list of measures is not exhaustive of all of Ohio's priorities.

To identify the reduction measures for inclusion in this Plan, Ohio EPA compiled a list of potential measures pertaining to different sectors and sources of emissions. Major sectors with the highest emissions identified in the statewide GHG inventory – electric power, buildings, and transportation – were of particular focus for Plan priority measures. However, the State recognizes minor sectors, such as agriculture and waste, may be the largest sources of emissions in some communities. Therefore, minor sector potential reduction measures were also accounted for, especially those that were heard as priorities during the State's stakeholder engagement for the Plan.

Ohio EPA then conducted a screening process to identify a set of near-term, high impact priority measures. The screening framework for prioritization of reduction measures included evaluation of the following:

- **GHG emissions impact**: assessing the size of the source of emissions the measure impacted relative to the state's total emissions.
- **Emissions reduction potential:** the potential of the measure to create emissions reductions within the specific emissions source it impacted.
- **Air emissions impact:** [e.g., criteria air pollutants (CAP) and hazardous air pollutants (HAP)], both the size of the air emissions source and the air emissions reduction potential of the measure.
- **Implementation feasibility:** the measures are readily deployable in the near term as defined by this Plan given current technical, regulatory, contractual, or other stakeholder coordination efforts.
- **Scalability:** the potential of a measure to be replicable across different geographic and demographic regions in Ohio.
- **Potential for co-benefits for other State priorities**: health impacts, economic impacts, or other environmental and social benefits beyond GHG emissions reductions especially benefiting LIDACs.

- **Intersection with other existing funding sources:** the availability of other federal, state, or municipal funding to implement the measure.

From this exercise, a reduced list of measures was identified for inclusion in the Plan. This list was then consolidated into three categories, with varying levels of analysis provided in this Plan for each measure:

1. **Priority Measures for State Implementation:** These measures were identified as those most suitable for near-term implementation by the State. This Plan includes a description of the measure and mechanisms for implementation, as well as estimates of the cumulative GHG emission reductions from 2025 through 2030 and 2050, cost estimates, impacts on LIDACs, authority to implement, and additional details, such as intersection with existing federal funding and workforce needs.[46]

2. **Priority Measures for the State of Ohio and Constituents:** These measures were identified as those most suitable for near-term implementation by other Ohio constituents, potentially in partnership with the State. Similar information to the Priority Measures for State Implementation is provided for these measures, except for long-term GHG reduction, cost estimate, intersection with existing federal funding, and workforce needs analyses.

3. **Other Measures the State of Ohio and Constituents Would Consider:** These measures were identified to be considered for near- to long-term implementation by the State and were relevant and potentially significant to Ohio constituents and other stakeholders within the state. A brief description of each of these measures is provided.

GHG REDUCTION CALCULATIONS

For each priority measure, estimated cumulative 2025 – 2030 GHG reductions were calculated based on a GHG reduction scenario. For priority measures for State Implementation, 2030 – 2050 estimated cumulative emission reductions were also calculated. Emission reduction scenarios included a combination of forecasts for future adoption based on market growth anticipated, additional growth from Plan-related activities associated with each measure, and lastly potential impact of implementation grant funding. Each priority measure aligns to a discrete sector or source of emissions for which percent reductions compare to baseline emissions.[47]

[46] Additional details can be found in Appendix IV

[47] See Appendix III for Methodology

AUTHORITY TO IMPLEMENT

Ohio EPA has reviewed existing statutory and regulatory authority to implement each priority measure contained in this Plan and has not found any State statute or regulation that would preclude these measures from being implemented in Ohio.

1. LIGHT-DUTY ZERO EMISSION VEHICLES (ZEVS) AND MODERNIZATION

What is a zero emission vehicle? [48]

Zero Emission Vehicle (ZEV): An on-road passenger car or light-duty vehicle, light-duty truck, medium-duty vehicle, or heavy-duty vehicle that produces zero exhaust emissions of all of the following pollutants: non-methane organic gases, carbon monoxide, particulate matter, formaldehyde, oxides of nitrogen, or greenhouse gas emissions including carbon dioxide, methane, and nitrous oxide, including, but not limited to, battery electric vehicles ("BEV") and fuel cell vehicles ("FCEV").

Plug-in Hybrid Electric Vehicle (PHEV): An on-road passenger car, light duty truck, medium duty vehicle, or heavy-duty vehicle that has both a battery / electric motor and an internal combustion engine (ICE) and gasoline tank. PHEVs do produce exhaust emissions when relying on the internal combustion motor but produce none when relying on electric.

Battery Electric Vehicle (BEV): All electric vehicle with electric motor. Uses battery pack to store electricity that powers the motor. BEVs do not emit any harmful tailpipe emissions.

Fuel Cell Vehicle (FCEV): FCEVs are ZEVs powered by hydrogen, which is used to generate electric power onboard. FCEVs do not emit any harmful tailpipe emissions.

DESCRIPTION

Expanding light-duty ZEVs and modernization in Ohio aims to promote environmentally friendly and efficient transportation options like BEVs and other alternative fuel vehicles to reduce GHG emissions and improve air quality.[49] Achieving this goal requires the development and expansion of robust charging infrastructure, including residential, commercial, and public charging stations.

MEASURE TYPE

Priority measure for State implementation

APPLICABLE SECTOR

Transportation

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[48] Frequently Asked Questions on the Zero Emission Vehicle Investment | US EPA

[49] Defined by the Federal Highway Administration as Class 1 (<6,000lbs) or Class 2 (6,001-10,000lbs) vehicles

RELATED GHG EMISSIONS

Light-duty passenger cars and trucks represent:

- 16% of total gross emissions
- 44% of total transportation emissions

RELATED PROGRAMS AND POLICIES

The State of Ohio is engaged in/supported by numerous federal grants and programs that will facilitate the transition to light-duty ZEV, including:

- NEVI funding through the Bipartisan Infrastructure Law (BIL); Ohio has been awarded $140 million to deploy over five years, including approximately $20.7 million in funding in FY22 and is predicted to total $140 million through 2026. Ohio's NEVI Plan documents the State's approach to deploy public charging infrastructure across Federal Highway Administration (FHWA) Designated EV Alternative Fuel Corridors (AFCs).
- Federally allocated financial incentives under the Inflation Reduction Act (IRA) to encourage consumers and companies to purchase EVs / FCEVs.
  - The IRA continues the Qualified Plug-in Electric Drive Motor Vehicle Credit, also known as the Clean Vehicle Credit, which provides up to $7,500 per qualified plug-in electric vehicle or fuel cell vehicle.
  - The IRA provides a Used Clean Vehicle Credit for qualified used electric vehicle or fuel cell vehicles from licensed dealers for $25,000 or less. The credit equals 30% of the sale price up to $4,000.
  - Business and tax-exempt organizations can access the Commercial Clean Vehicle Credit. The credit provides a maximum of $7,500 for qualified vehicles with gross vehicle weight ratings of under 14,000 pounds.
- Federally allocated financial incentives under the IRA to encourage the purchase of ZEV charging infrastructure, such as Alternative Fuel Vehicle Refueling Property Credit. The credit is available for qualified fueling property (including clean burning fuel or electric) installed on qualified locations and can be leveraged by individual households and commercial entities.
  - Businesses are eligible for up to $100,000 per item
  - Consumers are eligible to receive a tax credit up to 30% of the cost, up to $1,000

The State of Ohio also facilitates or supports the following programs:

- Vehicles powered by electricity are exempt from state motor vehicle emissions inspections after a one-time verification inspection. Vehicles operating on alternative fuels require one-time visual verifications by the Ohio EPA Mobile Sources Section.

Utilities and local cities are also involved with the transition to light-duty ZEVs, and have taken the following actions:

- Cincinnati has announced plans to buy electric vehicles and eventually transition to all electric vehicle fleets.

- Cleveland is developing new charging stations within city limits.
- Utilities, including rural ones, such as the Firelands Electric Cooperative, offer rebates to support the installation of EV chargers.

ACTIVITIES

There are several potential activities the State can use to support the transition to light-duty ZEVs and modernization. Ohio stakeholders are focusing attention on expanding electric vehicles rather than the broader group of ZEVs. Sources that supported the development of this list include the ODOT study on freight electrification, stakeholder interviews, and additional research into other state incentives and programs:

- **Expanding financial incentives**: Provide incentives such as direct rebates, tax credits, and grants for ZEV purchases or leases for the public and larger organizations, with targeted support for low/middle-income households and private charging/alternative fuel equipment purchases. This also applies to modernization technologies, such as anti-idling systems.
- **Investing in alternative fueling infrastructure**: Increase the number of alternative fueling stations (e.g., charging stations) and promote their operational maintenance through financial incentives and/or regulatory changes to reduce wait times to improve the overall ZEV driving experience.
- **Investing in public fleets:** Provide financial incentives to encourage public entities to modernize fleets, including purchasing ZEVs and other alternative fuel vehicles, adopting emissions reduction technologies, such as anti-idling technology, and performing operational maintenance to reduce inefficiencies.
- **Driving perks for electric vehicle users:** Encourage ZEV adoption by offering benefits like access to high-occupancy vehicle (HOV) lanes and toll discounts.
- **Updating building codes and zoning standards:** Promote preparation for the widespread adoption of EVs by considering updating regulations to accommodate future EV charging equipment installation.
- **Studies on electrification and pollution:** Support research on various topics, including strategies for improving low-income ZEV adoption and addressing the disproportionate impact of pollution on vulnerable communities across Ohio.
- **Financing and taxation solutions:** Leverage Ohio Air Quality Development Authority (OAQDA)'s Clean Air Improvement Program for funding clean vehicles and infrastructure, explore new financing options, and study gas tax alternatives as ZEV adoption becomes more widespread.
- **Collaboration with other states and federal systems:** Work closely with other states and federal systems to formulate cohesive resolutions for ZEV adoption and related issues.

Additional opportunities exist at the municipal and utility levels to expand ZEV adoption, including:

- Set local fleet electrification goals
- Asses public charging needs
- Support matchmaking of stakeholders involved in charging infrastructure
- Educate members, officials, and staff on fleet electrification

- Adopt ordinances and regulations for ZEV-friendly infrastructure and parking
- Review of ZEV feasibility in government fleets
- Consider innovative financing for ZEV adoption
- Collaborate with utilities to optimize ZEV integration
- Conduct demonstrations and gather regional ZEV data
- Share lessons learned from ZEV implementation projects
- Ensure ZEV rollouts generate enthusiasm and user satisfaction
- Develop programs that support / subsidize ZEV ownership in rural areas

ESTIMATE OF CUMULATIVE GHG EMISSION REDUCTIONS[50]

2025 – 2030: 3.9 up to 6.4 $MMTCO_2e$

- 6 – 7% reduction in tailpipe light-duty vehicle GHG emissions.
- 3 – 5% reduction in electricity generation GHG emissions (assuming increased renewables to accommodate charging demand).
- 2 – 3% reduction in total net GHG emissions.

2030 – 2050: 15.7 up to 25.7 MMTCO2e

- 25 – 29% reduction in tailpipe transportation GHG emissions.
- 10 – 20% reduction in electricity generation GHG emissions (assuming increased renewables to accommodate charging demand).
- 7 – 12% reduction in total net GHG emissions.

ESTIMATE OF CO-POLLUTANT REDUCTIONS

Co-pollutants – other air emissions – are also reduced alongside GHG emissions. The table below summarizes the annual co-pollutant reductions under the same parameters as the GHG reductions.

CO-POLLUTANT	POUNDS REDUCED ANNUALLY 2025 – 2030
Sulfur Dioxide, SO_2	503,060 to 535,200
Nitrous Oxides, NO_x	459,920 to 720,780

[50] Expanding electric vehicle adoption was the ZEV focus for GHG reduction calculations for the Plan; however, this can be expanded to cover other ZEV for the CRP. To do so, U.S. Department of Energy (DOE) Alternative Fuels Data Center (AFDC) Ohio electric vehicle registration data and 2016 – 2022 trends were analyzed to forecast market adoption emissions reductions and additional reductions with an implementation grant scenario. The U.S. EPA's Avoided Emissions and Generation Tool (AVERT) was used to calculate tailpipe emission reductions and emission impacts of increased electricity generation based on the average 2025 – 2030 annual growth projections of EVs. Energy Information Agency (EIA) Wind and Solar Energy Industries Association (SEIA) wind and solar trends and projections were considered. For 2030 – 2050, the 2025 – 2030 five-year growth in vehicles and associated emission reductions was assumed to be the same for the remaining four, five-year periods 2030 – 2050. See Appendix III for sources and additional details

Particulate Matter 2.5, $PM_{2.5}$	39,110 to 44,350
Volatile Organic Compounds (VOCs)	180,500 to 546,970
Ammonia (NH_3)	44,190 to 105,720

Co-pollutants – other air emissions – are also reduced alongside GHG emissions. The table below summarizes the annual co-pollutant reductions under the same parameters as the GHG reductions.

Note: Range based on market adoption and additional estimates.[51] Reductions are less than 1% of total Ohio co-pollutants; however, certain regions may see more significant benefits with uptake.[52]

ESTIMATE OF COSTS[53]

- Average cost of a passenger EV is nearly $34,000[54]
- Average cost of a Level 2 charger and installation is $1,990[55]
- Estimated operating savings of $579[56] pays back the costs of charging within four years, assuming average mileage
- Additional State ZEV incentives could offer an average of $2,500 per vehicle[57]

INTERSECTION WITH FEDERAL FUNDING

Please see Appendix IV for a description of the intersection with federal funding for this measure.

[51] Outputs from U.S. EPA AVERT

[52] Based on average pounds reduced annually from 2020 National Emissions Inventory (NEI) data including CAP, HAP, PFAS (Per- and Polyfluoroalkyl Substances), and other co-pollutants not defined as GHGs

[53] For Ohio's CRP, the total cost of ownership of an internal combustion engine (ICE) fossil fuel vehicle versus ZEVs across types including upfront costs of the vehicles, operations (fuel and electricity costs), maintenance differences, and other key capital and operating variables will be assessed

[54] Average of Tesla, Chevrolet, and other brands least expensive cars and budget SUV upfront costs

[55] Alternative Fuels Data Center: Charging Infrastructure Procurement and Installation (energy.gov)

[56] Estimated based on annual average residential charging demand (kWh) from Energy Sage and EIA residential electricity prices for Ohio as of November, 2023 compared to average gallons of fuel consumed per FHWA and EIA Midwest gasoline prices as of January 2024

[57] See Appendix III for Methodology

2. MEDIUM- AND HEAVY-DUTY (MDHD) ZERO EMISSION VEHICLES (ZEV) AND MODERNIZATION

DESCRIPTION

Expanding MDHD ZEVs and modernization in Ohio aims to promote environmentally friendly and efficient transportation options such as battery electric vehicles (BEV), hydrogen fuel cell, and other alternative vehicles to reduce GHG emissions and improve air quality.[58] Broad medium- and heavy-duty vehicle electrification refers to the transition from internal combustion engines (ICE) to electric or fuel cell commercial trucks, buses, and specialized larger port and agricultural vehicles. Successful implementation relies on innovation in batteries, especially for long distance freight trucks, sophisticated charging infrastructure, improvements to hydrogen and alternative fuel technologies, and supportive policies for a cleaner, more sustainable future.

MEASURE TYPE

Priority Measures for the State of Ohio and Constituents

APPLICABLE SECTOR

Transportation

RELATED GHG EMISSIONS

MDHD trucks and buses represent:

- 7% of total gross emissions
- 25% of total transportation emissions

RELATED PROGRAMS AND POLICIES

The State of Ohio is engaged in numerous federal grants and programs that support the transition for MDHD ZEVs, including:

- NEVI funding through the BIL: Ohio has been awarded $140 million to deploy over five years, which includes approximately $20.7 million in funding in FY22 and is predicted to total $140 million through 2026. Ohio's NEVI Plan documents the State's approach to deploy public charging infrastructure across FHWA Designated EV AFCs.
- The Regional Clean Hydrogen Hubs program includes up to $7 billion to establish hydrogen hubs as part of a larger $8 billion effort funded through the BIL. The program aims to scale up hydrogen production, processing, delivery, storage, and end-use of clean hydrogen. Ohio will receive funding through the Appalachian Hydrogen Hub.
- Ohio school districts benefit from the U.S. EPA's Clean School Bus Program, which, through the BIL, provides $5 billion between 2022-2026 to replace existing school buses

[58] Medium and Heavy-Duty vehicles are defined by the FHFA as vehicles greater than 10,000 lbs

with zero- and low-emission models. The program awarded 39 Clean School Bus Awards in the state of Ohio in 2022.
- The IRA allocates approximately $1 billion in funding for clean heavy-duty vehicles between now and 2031. The funding can be used to replace heavy-duty vehicles, ZEV infrastructure, workforce development and training, and planning and technical activities.
- The U.S. is signatory to the Global Memorandum of Understanding on Zero Emission Medium and Heavy Duty Vehicles, which hopes to enable 100% zero-emission new truck and bus sales by 2040.
- Diesel Emissions Reduction Grants are funded through federal Congestion Mitigation and Air Quality (CMAQ) dollars awarded by the Federal Highway Administration to the ODOT. CMAQ provides roughly $2.6 billion each through 2026 after being reauthorized and extended under the IRA.

The State of Ohio also facilities or supports the following programs:

- Ohio EPA offers grants for the replacement or repower of eligible on- and off-road vehicles and equipment, including Class 4-8 trucks, school, shuttles, public transit buses, freight-switcher locomotives, etc. The funding for these grants is sourced from Ohio's share of an Environmental Mitigation Trust Fund. The fund was developed as part of Volkswagen's settlement with U.S. EPA following allegations that they violated the Clean Air Act.
- Vehicles powered by electricity are exempt from state motor vehicle emissions inspections after a one-time verification inspection.

Additionally, ODOT implemented the DriveOhio initiative in 2018, which aims to connect all the organizations supporting Ohio's smart mobility efforts. As part of this initiative, DriveOhio produced a freight electrification report, released in 2021, detailing steps Ohio can take to support MDHD vehicle electrification.

ACTIVITIES

The State of Ohio has several potential activities through which it can support the transition from ICE MDHD vehicles to ZEVs. The ODOT study on freight electrification detailed the following areas where the state or relevant agencies can take steps to prepare for freight electrification:

- **Codes and Standards:** Promote updating building codes and zoning standards to prepare for future installation of ZEV fueling equipment (e.g., chargers, hydrogen fueling station).
- **Market Research:** Support additional studies into topics relevant to the ZEV effort, including potential strategies to address the disproportionate impact of pollution from freight / logistics operations.
- **Vehicle Incentives:** Reform and streamline Diesel Emission Reduction Grant (DERG) program, adopt voucher, and rebate best practices, and align new state initiatives with federal programs.
- **Infrastructure Incentives**: Consider state incentives for ZEV fueling infrastructure including freight electrification and combine administration with new federal sources (for applications not eligible under NEVI).
- **Education and Financing**: Utilize OAQDA financing/forgiveness tools through the Clean Air Improvement Program (CAIP) for clean vehicles and infrastructure and explore

additional financing programs. Expand education programs related to Federal and State incentives / programs.
- **Taxation**: Study solutions for gas tax replacement with ZEV adoption, collaborate with other states and federal systems for common resolutions.

Additional opportunities exist at the municipal and utility levels, including:

- Set local fleet electrification goals
- Analyze opportunities to add ZEVs to various fleets
- Conduct assessments of public charging needs
- Support matchmaking of stakeholders involved in charging infrastructure
- Educate members, officials, and staff on fleet electrification and ZEV infrastructure
- Promote adoption of ordinances and regulations for ZEV-friendly infrastructure and parking
- Promote thorough review of ZEV feasibility in government fleets
- Consider innovative financing for ZEV adoption
- Collaborate with utilities to optimize ZEV integration
- Conduct demonstrations and gather information on regional ZEV data
- Share lessons learned from ZEV implementation projects
- Ensure ZEV rollouts generate enthusiasm and user satisfaction
- Lower charging costs through battery storage technology

ESTIMATE OF CUMULATIVE GHG EMISSION REDUCTIONS[59]

2025 – 2030: 309,910 $MTCO_2e$

- 2% reduction in bus tailpipe GHG emissions
- <1% reduction in total net GHG emissions (since buses only comprise a small proportion); however, reduces numerous other co-pollutants

ESTIMATE OF CO-POLLUTANT EMISSION REDUCTIONS[60]

Co-pollutants – other air emissions – are also reduced alongside GHG emissions. The table below summarizes the annual co-pollutant reductions under the same parameters as the GHG reductions. While reductions are less than 1% of total Ohio co-pollutants, certain regions may see more significant benefits with uptake.

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[59] Buses were selected as the MDHD asset of focus for GHG reduction scenario for the Plan aligned with the U.S. EPA AVERT tool's capabilities to accommodate this MDHD asset class; however, this can be expanded for the CRP to cover other MDHD asset classes. Ohio BMV Vehicle Registration data for 2022 was utilized as a proxy for 2024 to determine the total number of buses in the state. AVERT was then used to calculate tailpipe emission reductions and emission impacts of increased electricity generation based on the average 2025 – 2030 annual growth projections of electric transit and school buses. Energy Information Agency (EIA) Wind and Solar Energy Industries Association (SEIA) wind and solar trends and projections were considered. Notably, only one year's worth of emission reductions is accounted for assuming vehicles are operational by 2030; however, emissions would be even greater if vehicles were converted prior to 2030. See Appendix III for sources and additional details

[60] Outputs from U.S. EPA AVERT

CO-POLLUTANT	POUNDS REDUCED ANNUALLY 2025 – 2030
Sulfur Dioxide, SO_2	547,810
Nitrous Oxides, NO_x	374,200
Particulate Matter 2.5, $PM_{2.5}$	37,480
Volatile Organic Compounds (VOCs)	12,150
Ammonia (NH_3)	16,020

INTERSECTION WITH FEDERAL FUNDING

- Low or No Emission Grant Program: Ohio awarded $29.3 million for Zero Emission Ready Ohio
- Appalachian Hydrogen Hub: Up to $925 million awarded in 2023 the Regional Clean Hydrogen Hubs program. The DOE awarded funding for the Appalachia region, including Ohio, to support the development of low-cost clean hydrogen.

3. TRANSPORTATION EFFICIENCIES

DESCRIPTION

Expanding various strategies that can effectively implement infrastructural, asset, and behavioral changes to create a more time-efficient, environmentally friendly, and sustainable transportation system. The primary objective is to reduce travel times, lengths, and the overall carbon intensity of trips, thereby reducing emissions and enhancing mobility and connectivity in urban and suburban areas.

MEASURE TYPE

Priority Measures for the State of Ohio and Constituents

APPLICABLE SECTOR

Transportation

RELATED GHG EMISSIONS

Currently transportation fossil fuel emissions represent:

- 26% of total gross emissions

RELATED PROGRAMS AND POLICIES

The State of Ohio maintains numerous programs that are dedicated to supporting changes to modal share, including:

- Ohio's Transportation Alternatives Program (TAP) offers financial support for a variety of transportation-related projects, encompassing both on- and off-road facilities for pedestrians and cyclists, infrastructure improvements aimed at facilitating non-driver access to public transportation, as well as promoting enhanced mobility. Additionally, the program covers community development initiatives, environmental mitigation efforts, recreational trail developments, and projects focused on ensuring safe routes to educational institutions.
- Ohio's Urban Transit Program supports efficient and effective use of State funds in the provision of transportation services.
- ODOT maintains a Statewide Bike and Pedestrian Plan. Called Walk.Bike.Ohio, the plan provides a roadmap for overcoming challenges related to increasing pedestrian and bike trips.
- Ohio plans to establish a network of state and U.S. bicycle routes to provide cyclists with connections between different destinations in the state.
- The Safe Routes to School program provides resources, technical assistance and project funding to encourage and enable students in K-12 to walk or ride their bike to school.
- The Ohio Active Transportation Academy provides training, workshops, and implementation programs to communities throughout Ohio.

Cities and municipalities also operate several programs that are focused on this area, including:

- Akron's Tree Canopy Program has planted thousands of trees to increase tree coverage throughout the city, which improves the pedestrian experience and reduces pollutants.
- Columbus established an E-Bike incentive pilot program which discounts E-Bikes for qualifying Columbus residents.
- Cleveland continues to invest in the development of urban bikeways.

ACTIVITIES

The State of Ohio and local municipalities have several potential activities through which both can support the broader goal of shifting modal share away from vehicles towards walking and biking. These activities include:

- **Investments in the public realm:** non-car transportation infrastructure, including bike lanes, bike and e-bike share programs, public transit, and pedestrian pathways to improve regional interconnectivity.
- **Trip subsidies:** subsidizing transit ridership (e.g., transit cards for students, low-income riders).
- **Transit prioritization:** implementing transit prioritization projects, such as transit signal priority and dedicated bus lanes.
- **Zoning:** Promoting updates to building/zoning codes to permit private developments that encourage alternative transportation methods (e.g., allowing new multifamily buildings near public transportation).
- **Incentivize alternative trips:** Public enablers to encourage transit use and decrease VMT, such as reduced street parking and demand-based metered parking.
- **Transportation investments:** Financial support for implementation of transportation infrastructure efficiencies that reduce idling and/or VMT pollutant emissions, including

roundabouts, traffic signal optimization, ramp metering, and traffic incident management, etc.

- **Intelligent traffic systems:** Financial support/regulatory streamlining for intelligent traffic system implementation.
- **Education:** Providing education programs that support alternative transportation methods (e.g., bike education programs, smart driving training, etc.).

ESTIMATE OF CUMULATIVE GHG EMISSION REDUCTIONS[61]

2025 – 2030: 1,511,556 $MTCO_2e$

- 2.6% reduction in non-public transit motor vehicle transportation emissions.
- <1% reduction in total net emissions with conservative assumption for public transportation, bike, and walking mode share adoption.

INTERSECTION WITH FEDERAL FUNDING

- U.S. DOT RAISE Program: $52.9 million provided under the BIL in 2022 to support projects that projects that modernize roads, bridges, transit, rail, ports, and intermodal transportation in Ohio.

4. RENEWABLE ELECTRICITY GENERATION

DEFINITIONS

Renewable Energy: Energy sourced from fuel sources that restore themselves over short periods of time and do not diminish. Examples include: the sun, wind, moving water, geothermal, etc.

Net Metering: Identified in Ohio Revised Code Section 4928.01 "as measuring the difference in an applicable billing period between the electricity supplied by an electric service provider and the electricity generated by a customer-generator that is fed back to the electric service provider."

DESCRIPTION

Solar-focused distributed energy and utility-scale solar are complementary approaches to harnessing solar power for electricity generation. Distributed solar energy involves installing small-scale photovoltaic (PV) systems, typically on rooftops or ground-mounted systems, for individual homes, businesses, or communities, leading to decentralized energy production and

[61] Expanding public transportation, biking, and walking focuses for GHG reduction calculations for the Plan; however, this can be expanded to cover other types of transportation efficiencies for the CRP. To do so, ODOT analyses of the current proportion of VMT and commuting modes that are traveled by public transportation, biking, and walking was assessed, including growth projections and emission reduction estimates. Additional emission reductions for additional zero emission biking and walking modal share increases were also considered based on replacing 4% of annual passenger car commuting miles that are reported to be less than one mile by the FHWA with biking. See Appendix III for sources and additional details

increased grid stability. Utility-scale solar, on the other hand, refers to large-scale solar power plants that produce electricity for distribution through the grid, employing either PV panels or concentrated solar power (CSP) technology. Utility-scale wind is also prominent. These large-scale projects provide substantial amounts of clean energy while benefiting from economies of scale. Hydrogen can also be considered a renewable energy resource when it is generated from renewable sources. Combining these approaches maximizes renewable energy benefits, contributing to a more sustainable and environmentally friendly energy landscape.

MEASURE TYPE

Priority Measures for the State of Ohio and Constituents

APPLICABLE SECTOR

Electric power

RELATED GHG EMISSIONS

Electric power from electricity generation represent:

- 28% of total gross emissions

RELATED PROGRAMS AND POLICIES

The federal government and relevant agencies provide funding and programs to support the development of renewable power generation, including the following programs:

- Tax credits funded by the IRA, such as the federal residential solar energy tax credit, the Business Energy Investment Tax Credit, or the federal solar tax credits for businesses, that financially support residents, commercial and industrial entities interested in purchasing their own solar arrays.
- Advantageous lending programs, such as the U.S. DOE's Section 1703 program, which has been expanded to provide loans to innovative clean energy technologies. The IRA provides an additional $40 billion of loan authority for projects through 2026 under the program.
- The Regional Clean Hydrogen Hubs program includes up to $7 billion to establish hydrogen hubs as part of a larger $8 billion effort funded through the BIL. The program aims to scale up hydrogen production, processing, delivery, storage, and end-use of clean hydrogen. Ohio benefits from this program as it will receive funding through the Appalachian Hydrogen Hub.

The State of Ohio itself administers several programs, regulations, and funding to support the deployment of renewable energy technology:

- The Ohio Net Metering program allows for billing arrangements whereby customers who produce their own electricity can receive electric utility bill credits for extra electricity products, up to 120% of the energy produced. The current program requires all electric utilities to offer a standard net metering tariff to customers providing electricity through renewable/alternative means.

- Solar Sales Tax Exemption, which exempts some properties used for solar energy projects from Ohio sales taxes.
- The Qualified Energy Project Tax Exemption exempts some properties used for solar energy projects from public utility tangible personal property tax.
- Ohio Property Assessed Cleaning Energy (PACE) Financing program which connects property owners with capital providers and contractors and offers fixed-rate PACE loans. PACE financing relies on special assessments to repay and secure upfront funding for energy efficiency or creation improvements, and can result in improved financing terms (e.g., lower interest rates).
- ECO-Link, which is designed to provide reduce rate financing for homeowners interested in weatherization and energy efficiency improvements. ECO-Link can be used on solar arrays as well.
- Ohio's Renewable Energy Portfolio Standard (RPS) mandates that 8.5% of electricity sold by Ohio's electric utilities or service companies must be generated from renewable energy sources by 2026.

Cities are actively involved in the development of renewable energy solutions:

- Cities, such as Cleveland and Cincinnati, also offer several tax exemptions and abatement programs that support the development and installation of solar panels.
- Sustainable Columbus is a program approved by voters whereby the city is allowed to aggregate the retail electric for residents and small businesses to support local clean energy generation.

ACTIVITIES

The State of Ohio and local municipalities have several potential activities through which both can support the broader goal of increasing the share of energy from renewable sources (in particular, solar). These activities include the following:

- **Financial Incentives:** Incentivize renewable energy generation on residential, industrial, public, and commercial properties (e.g., rebates, tax credits, net metering, affordable financing). Encourage developers to integrate renewable energy technologies, such as solar arrays, into new residential, industrial, commercial, and public developments through financial incentives. Incentives may also cover structural or other upgrades and remediation necessary to prepare land or buildings for renewable energy technology installation.
- **Permitting:** Provide technical and financial assistance to local governments to streamline permitting for renewable energy technology construction across all sectors.
- **Support for large projects:** Support the development of utility-scale renewable energy projects or improve grid interconnection to allow for renewable projects to come online.
- **Regulation:** Promote improvement and streamlining of permitting processes for developing transmission systems connecting renewable generation to the electrical grid.
- **Education:** Develop an education program to inform residents and municipalities how Ohio's net metering programs work, how renewable energy technologies can be financed, etc.
- **Virtual Power Plants:** Encourage cities to work with third party aggregators to design and construct renewable energy assets in their respective regions, then leverage virtual power

plant agreements to source renewable power. This activity can be expanded to the private sector, which includes commercial power purchase agreements that expand utility-scale renewable energy.

ESTIMATE OF CUMULATIVE GHG EMISSION REDUCTIONS[62]

2025 – 2030: 1,811,940 $MTCO_2e$ up to 2,307,000 $MTCO_2e$

- 3% reduction in electric power electricity generation GHG emissions.
- 1% reduction in total net GHG emissions.

INTERSECTION WITH FEDERAL FUNDING

Ohio applied for Solar for All, the $7 billion program which will provide grants to expand the number of LIDACs primed for residential solar investment. Ohio's application targets delivering a total of 310 additional MW of solar capacity.

5. BUILDING ENERGY EFFICIENCY

DEFINITION

Energy efficiency refers to the practice of using less energy to perform tasks or produce results in various settings such as homes, buildings, and manufacturing facilities. This is typically accomplished by implementing measures like weatherization, insulation, air sealing, and efficient heat pumps that reduce energy consumption and emissions.

DESCRIPTION

Efficient buildings encompass residential, industrial, and commercial structures that integrate advanced design approaches, materials, and technologies to minimize energy consumption, reduce greenhouse gas emissions, and promote sustainability. These buildings prioritize features such as high-performance insulation, energy-efficient windows, efficient HVAC systems, and smart thermostats, while often incorporating technologies such as solar panels and geothermal heating systems.

MEASURE TYPE

Priority Measures for the State of Ohio and Constituents

APPLICABLE SECTOR

Buildings

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[62] Expanding wind, utility-scale solar, and small-scale distributed solar were the renewable energy focuses for GHG reduction calculations for the Plan; however, this can be expanded to cover other types of renewable energy for the CRP. To do so, Energy Information Agency (EIA) Wind and Solar Energy Industries Association (SEIA) wind and solar trends and projections were considered, and U.S. EPA's AVERT was used to calculate associated emission reductions. See Appendix III for sources and additional details

RELATED GHG EMISSIONS

Buildings fuel and electricity usage (electric power consumption) comprises:

- 53% of total gross emissions

RELATED PROGRAMS AND POLICIES

The federal government and relevant agencies provide funding and programs to support the expansion of building efficiency measures, including the following programs:

- Tax credits, such as the Federal Residential Energy Efficiency Tax Credit, the Energy Efficiency New Homes Tax Credit for Home Builders, or the energy efficient commercial buildings deduction that financially support residents, commercial and industrial entities interested in upgrading their building efficiencies.
- Grant programs to support energy efficiency improvements and other activities, such as the U.S. DOE's Energy Efficiency and Conservation Block Grant Program.
- Advantageous lending programs, such as the FHA's Energy Efficient Mortgage program, which allows additional mortgage funds to finance energy efficient upgrades for homes.
- Training and research programs, such as DOE's Building America Program, which researches the best ways to advance energy efficiency in homes, or the State and Local Energy Efficiency Action Network, which provides resources for the design and implementation of policies and programs that can drive investment in energy efficiency.
- Assistance programs, such as the DOE Weatherization Program, which works with local community agencies and governments to conduct energy assessments and improve energy efficiency for low-income households.

Ohio administers several programs, regulations, and funding to support the development of energy efficient buildings, including:

- The Ohio Community Reinvestment Area program, which provides property tax exemptions for property owners who renovate existing or construct new buildings.
- The Ohio Energy Efficiency program helps businesses, manufacturers, nonprofits and local governments identify energy use and costs and develop energy plans.
- The Ohio Building Code has provisions that support energy efficiency within new construction and for rehab of older buildings.
- ECO-Link, which is designed to provide reduce rate financing for homeowners interested in weatherization and energy efficiency improvements.
- The Ohio Housing Finance Agency Design and Architectural Standards requires that multifamily developments obtain energy efficiency and/or green building certifications.

Municipalities and other local cities, such as Cleveland and Cincinnati, also offer tax exemptions and abatement programs that support the development of energy efficient buildings.

In addition, many local utilities offer incentives such as rebates or home energy audits to support the installation of energy efficient devices and improved energy efficiency practices. For

example, CenterPoint Energy offers rebates for replacing gas furnaces, insulation and home sealing, and smart thermostats.

ACTIVITIES

The State of Ohio and local municipalities have several activities through which both can support the implementation of energy efficient devices and practices in buildings across the state. These activities include:

- **Financial incentives for products:** Offer targeted financial incentives (e.g., rebates, low-interest loans) for improved efficiency measures (e.g., LED lighting, occupancy sensors, high-efficiency appliances, cooling paint) or structural and operational upgrades/remediation in old/new residential, industrial, commercial, and public construction.
- **Financial incentives for construction:** Develop financial incentives that promote the use of low carbon construction materials (e.g., cross-laminated timber, recycled steel, low-embodied-energy concrete) in new residential commercial, and public construction and rehabilitations.
- **Zoning and building codes:** Encourage changes to state/municipal zoning/building codes including energy code, reviewing, and updating them to support compact, mixed-use, transit-oriented development and require higher energy efficiency standards in new construction projects.
- **Regulatory changes:** Provide financial incentives and promote regulatory streamlining (e.g., grants, tax credits, simplified permitting processes) for adaptive reuse of industrial and commercial buildings; encourage energy benchmarking programs to measure performance of buildings and/or building performance standards.
- **Education:** Develop education programs to support individuals/organizations interested in learning more about energy efficiency measures and programs.

ESTIMATE OF CUMULATIVE GHG EMISSION REDUCTIONS[63]

2025 – 2030:

- Residential: 9,158 MTCO2e
- Commercial and Industrial: 447,286 MTCO2e
- Less than 1% reduction in total net building emissions given conservative (low-end) estimate considering high costs of capital required for deep energy efficiency retrofits.

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[63] Retrofitting existing Ohio buildings was the focus for GHG reduction calculations for the Plan; however, this can be expanded to cover new builds for the CRP. NREL's ResStock was used to calculate Ohio average residential energy efficiency emission reductions. Costs of energy efficiency retrofits to assess reasonable adoption and scale of reductions was then sourced from the American Council for an Energy-Efficient Economy. For commercial and industrial buildings, emission reduction potentials for a variety of measures such as occupancy sensors and smart programmable thermostats was sourced from the Department of Energy. Notably, only one year's worth of emission reductions are accounted for assuming buildings are retrofitted by 2030; however, emissions would be even greater if buildings were retrofitted prior to 2030. See Appendix III for sources and additional details

INTERSECTION WITH FEDERAL FUNDING

- Home Energy/Weatherization Assistance Program (HEAP and HWAP) are federally funded and provide home energy bill and energy efficiency assistance.

6. CLEAN HEATING

DESCRIPTION

This priority measure emphasizes expanding clean heating solutions to replace energy-intensive systems within buildings including residential, commercial, industrial, and public buildings. Essential strategies for clean heating include implementing high-efficiency electric heat pumps (that increase emission reductions further when paired with renewable electricity), geothermal heat pumps, deploying bioenergy-based heating systems, utilizing solar thermal collectors, and incorporating district heating powered by renewable energy sources.

MEASURE TYPE

Priority Measures for the State of Ohio and Constituents

APPLICABLE SECTOR

Buildings

RELATED GHG EMISSIONS

Buildings fuel usage, including for heating applications, comprises:

- 25% of total gross emissions

RELATED PROGRAMS AND POLICIES

The federal government and relevant agencies provide funding and programs to support the installation of electric heating and cooling systems, including the following programs:

- Rebate programs, including the Home Electrification and Appliance rebate program and Home Efficiency rebates, which will come into effect this year and provide rebates on certain home energy projects.
- Tax credits, including Clean Energy Tax Credits for Consumers that cover products such as heat pumps and efficient air conditioners.
- Assistance programs, such as the DOE Weatherization Program, which works with local community agencies and governments to conduct energy assessments and improve energy efficiency for low-income households.

The State of Ohio itself administers several programs, regulations, and funding to support the development of energy efficient buildings, including:

- The Ohio Community Reinvestment Area program, which provides property tax exemptions for property owners who renovate existing or construct new buildings.
- The Ohio Energy Efficiency program helps businesses, manufacturers, nonprofits, and local governments identify energy use and costs and develop energy plans.

Ohio cities are also highly involved with the development of clean heating policies, programs, and solutions, including:

- Akron maintains a district energy system that supplies energy, heating, and cooling to buildings in downtown Akron.
- Cleveland's District Energy System, which provides steam and chilled water from a central plant eliminating the need for building owners to install and maintain expensive onsite HVAC equipment.

ACTIVITIES

The State of Ohio and local municipalities have several potential activities through which both can support electrification and heating goals. These activities include the following:

- **Financial Incentives:** Offer financial incentives and low-interest loans to make electrification more affordable by providing financial support such as tax rebates, grants, or low-interest loans.
- **Building codes:** Promote updating building codes and streamline zoning and permitting to encourage electrification adoption through building regulations that favor electric systems and simplifying zoning and permitting processes.
- **Education:** Promote education, outreach, and technical assistance for property owners and professionals by raising awareness about the benefits of electrification.
- **Certifications:** Create green certifications and collaborate with utilities to provide additional incentives by developing green building certifications to recognize and reward properties that incorporate electrification measures.
- **Partnerships:** Partnering with utilities for additional incentives and rebates.
  Procurement: Implement bulk procurement programs to lower the cost of electrification equipment.

ESTIMATE OF CUMULATIVE GHG EMISSION REDUCTIONS[64]

2025 – 2030:

- Residential: 130,962 $MTCO_2e$
- Commercial and Industrial: 2,028,952 $MTCO_2e$
- 3% reduction in total building emissions
- Less than 1% reduction in total net emissions given conservative (low-end) estimate considering high costs of capital required for clean heating retrofits

INTERSECTION WITH FEDERAL FUNDING

- No other federal funding has been awarded to Ohio for clean heating initiatives.

7. COMPOSTING

DESCRIPTION

This Plan aims to promote composting as an emissions mitigation strategy and sustainable waste management practice. Composting is the controlled, aerobic (oxygen-required) biological decomposition of organic materials by microorganisms. Organic (carbon-based) materials include grass clippings, leaves, yard and tree trimmings, food scraps, crop residues, animal manure and biosolids.

MEASURE TYPE

Priority Measures for the State of Ohio and Constituents

APPLICABLE SECTOR

Waste

RELATED GHG EMISSIONS

Municipal solid waste (MSW) in landfills comprises:

- 2% of total gross emissions (5.3 net out of 245 $MMTCO_2e$)
- 64% of gross landfill methane emissions is already diverted from Ohio's total emissions.

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[64] Retrofitting existing Ohio buildings was focus for GHG reduction calculations for the Plan; however, this can be expanded to cover new builds for the CRP. NREL's ResStock was used to calculate Ohio's average residential electrification emission reductions. Costs of electrification were then sourced to assess reasonable adoption and scale of reductions. Likewise, emission reduction potentials and costs were sourced for commercial and industrial buildings. Notably, only one year's worth of emission reductions is accounted for assuming buildings are retrofitted by 2030; however, emissions would be even greater if buildings were retrofitted prior to 2030. See Appendix III for sources and additional details

- Out of total diverted emissions, 6% is already oxidized in composting, 27% is flared whereby CH_4 is burned to release CO2 into the atmosphere that is already biogenic – or part of the atmospheric carbon cycle[65], and 67% is converted from waste methane to energy.

RELATED PROGRAMS AND POLICIES

The federal government and relevant agencies provide funding and programs to support the composting programs, including:

- USDA Composting and Food Waste Reduction Cooperative Agreements support waste management plans to reduce food waste and diverse waste from landfills.
- Programs/toolkits to support composting across different communities, including U.S. EPA's Sustainable and Healthy Communities Research Program and the North American Initiative on Organic Waste Diversion and Processes.

The State of Ohio has several licensed and registered facilities that facilitate composting and provides guidance to households interested in composting.

Local municipalities and nonprofits are also highly involved with the development of composting programs and solutions. Some example programs include the following:

- Rust Belt Riders is a worker-owned cooperative that provides composting services across Northeast Ohio.
- Cuyahoga County Solid Waste District provides guidance on sites that support composting across the county.

ACTIVITIES

The State of Ohio and local municipalities have several potential activities through which both can support the broader goal of increasing composting. Key measures can include public education campaigns, offering incentives for adopting composting practices, and supporting community composting sites to reduce waste, lower emissions, and benefit local agriculture and the environment. These activities include:

- **Community goals:** Set waste reduction goal for community; create and implement a plan to achieve it.
- **Community engagement:** Support home composting by reviewing ordinances and hosting a composting workshop.
- **Develop programs:** Establish a community-wide composting program to manage food and organic waste.
- **Partnerships:** Partner with private sector composting companies at the regional level.
- **Zoning:** Promote use of Ohio EPA's model zoning code to encourage organic waste composting and urban agriculture.

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[65] DOE Flaring and Venting R&D: Reducing Emissions and Developing Valuable Low-Carbon Products | Department of Energy

- **Financial incentives:** Facilitate composting grants at local levels.
- **Education:** Join and support efforts to establish food waste composting on a regional scale via education programs.

ESTIMATE OF CUMULATIVE GHG EMISSION REDUCTIONS[66]

2025 – 2030: 1,669,197 $MTCO_2e$

- 26% reduction in net waste emissions
- 1% reduction in total net emissions

INTERSECTION WITH FEDERAL FUNDING

USDA Composting and Food Waste Reduction (CFWR) cooperative agreements provide funding to expand composting locations, increase waste diverse, and subsidize composting subscriptions to low-income households. In Ohio, Cleveland will access some of this funding to expand drop-off residential composting locations.

8. CLEAN WASTE-TO-ENERGY

DESCRIPTION

Waste-to-energy (WtE) is a solution that transforms waste materials, typically non-recyclable municipal solid waste (MSW) or agricultural waste, into various forms of energy such as electricity, heat, or fuel. The primary WtE technologies considered in the Plan include clean, organic gasification, anaerobic digestion, and landfill methane capture. Anaerobic digestion involves a process where bacteria decompose organic materials (e.g., animal waste, wastewater biosolids, and food waste) without the presence of oxygen. Landfill gas – a mixture of methane, carbon dioxide, and trace organic compounds – is the natural byproduct of decomposing organic material in landfills. Both produce valuable outputs that can be used to produce energy or replace products for other applications.

MEASURE TYPE

Priority Measures for the State of Ohio and Constituents

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[66] To estimate the potential for composting, the total tons of organic waste disposed in the state of Ohio annually was sourced from Ohio EPA. Based on the total avoided emissions, the current volume of organic waste remaining in landfills was calculated. Then the cost of a commercial composting operation processing 1,000 ton of organic waste annually was determined to assess reasonable adoption rates. Emission reductions were calculated based on estimated additional tonnage of organic waste diverted from landfills for composting. Notably, only one year's worth of emission reductions is accounted for assuming facilities are operational by 2030; however, emissions would be even greater if facilities are operational prior to 2030. See Appendix III for sources and additional details

APPLICABLE SECTOR

Waste and agriculture

RELATED GHG EMISSIONS

Municipal solid waste (MSW) in landfills comprises:

- 2% of total gross emissions (5.3 net out of 245 MMTCO2e)
- 64% of gross landfill methane emissions is already diverted from Ohio's total emissions.
- Out of total diverted emissions, 6% is already oxidized in composting, 27% is flared whereby CH4 is burned to release CO2 into the atmosphere that is already biogenic – or part of the atmospheric carbon cycle[67], and 67% is converted from waste methane to energy.

Agriculture comprises:

- 5% of total gross emissions
- 81% (9.4 out of the 11.5 $MMTCO_2e$) of agriculture emissions stem from methane from livestock manure management. Livestock manure is a feedstock for anaerobic digestion.

RELATED PROGRAMS AND POLICIES

The federal government and relevant agencies provide funding and programs to support WtE, including:

- WTE Technical Assistance for Local Governments, which supports local communities to efficiently recover energy and resources from municipal organic waste.

Several organizations provide WtE services in Ohio:

- Ohio is home to multiple gas-to-energy facilities, which burn landfill gas, providing energy to local communities and fuel for vehicles.

ACTIVITIES

The State of Ohio and local municipalities have a number of potential activities through which both can support the broader goal of increasing composting. These activities include:

- **Incentivize WtE:** Increase the costs associated with landfill dumping to incentivize WtE facilities.
- **Financial Incentives:** Offer subsidies and other financial incentives to encourage the development of WtE facilities.
- **Education:** Establish stronger outreach and education programs to encourage organizations and utilities to explore WtE opportunities.

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[67] DOE Flaring and Venting R&D: Reducing Emissions and Developing Valuable Low-Carbon Products | Department of Energy

ESTIMATE OF CUMULATIVE GHG EMISSION REDUCTIONS[68]

2025 – 2030: 4,704,986MTCO$_2$e

- 50% reduction in net waste emissions (3,221,115 MTCO$_2$e)
- 13% reduction in agriculture emissions (1,483,871 MTCO$_2$e)
- 2% reduction in total net emissions

INTERSECTION WITH FEDERAL FUNDING

No other federal funding has been awarded to Ohio for clean WtE initiatives.

OTHER POTENTIAL MEASURES

The Plan captures near-term emission reduction measures for priority sectors; however, there are additional measures that may be considered by the State or other constituents in Ohio for implementation in either the near-term or long-term.

MEASURE	SECTORS APPLICABLE	DESCRIPTION
Transportation Demand Management	Transportation	Strategies for management transportation demands, such as strategic land use planning and transit signal priority.
Sustainable Construction Vehicles	Transportation	Use of ZEVs in the construction process. Can include vehicles used in construction, agriculture, etc., such as retail forklifts, propane mowers, and alternative fuel specialty vehicles.

[68] Landfill WtE as well as anaerobic digestion of agricultural livestock manure was considered for GHG reduction calculations for the Plan; however, this can be expanded to cover other types of waste to energy for the CRP. To estimate the potential for landfill WtE, the total tons of organic waste disposed in the state of Ohio annually was sourced from Ohio EPA. Based on the total avoided emissions, the current volume of organic waste remaining in landfills was calculated. Then the cost of a landfill waste to energy operation was determined to assess reasonable adoption rates. Emission reductions were calculated based on estimated additional tonnage of organic waste diverted from landfills for waste to energy. Electricity generation emissions assuming landfill waste to energy provided electricity were also calculated based on estimated kilowatt hours production – these emission reductions were < 1% of total electric power emissions and considered negligible. The Environmental and Energy Study Institute estimates 70% of landfill waste to energy provides electricity versus biogas for fuel. Then to estimate the potential for anaerobic digestion from agriculture operations, the average volume of manure required per anaerobic digestor operation was sourced alongside costs. The proportion of Ohio's total livestock targeted for anerobic digestion then served as an estimate for the emission reduction potential. Electricity generation or heating emissions from anaerobic digestion were also assumed to be negligible. Notably, only one year's worth of emission reductions is accounted for assuming facilities are operational by 2030; however, emissions would be even greater if facilities are operational prior to 2030. See Appendix III for sources and additional details

Carbon Reduction Planning and Management for Transportation Infrastructure	Transportation	Regular maintenance of and sustainable design for transportation infrastructure.
Driver Education Programs	Transportation	Develop education programs on operational fuel-saving driving techniques.
Improve Alternative Transportation Infrastructure	Transportation	Expansion and development of rail to encourage travel by less carbon-intensive modes of transport. Encourage zero- or low-emission rail development projects, including the replacement of old, inefficient motors with new, more fuel-efficient motors. Can include development of, upgrades to, and research and development for low- to zero-emission fuels and maintenance of rail and other non-motor vehicle transit, such as marine travel, aviation, etc.
Port, Freight, Rail, and Airport Emission Standards	Transportation	Developing financial incentives for alignment with external emission standards, including federal standards. Potentially include a reduction in carbon emissions as part of the review of applications for Diesel Emission Reduction Grant funding.
Industrial Efficiency Upgrades	Electric Power; Buildings; Industrial Processes	Implement measures to reduce emissions from industrial buildings and processes, including but not limited to deploying carbon capture and storage technologies, increasing industrial building energy efficiency, and upgrading industrial equipment and systems.
Carbon Capture, Utilization, and Storage (CCUS)[69]	Electric Power; Buildings; Industrial Processes	Carbon dioxide is captured from industrial processes and/or fossil fuel combustion (e.g., power plant operations) instead of being released to the atmosphere. ODNR entered the Midwest Region Carbon Initiative (MRCI) in 2020 with the goal to accelerate CCUS)
Energy Storage	Electric Power; Buildings	Energy storage infrastructure such as hydroelectric storage or battery storage that allows renewable energy to be stored for use when renewable energy is not available.
Demand Response	Electric Power; Buildings	Electricity power load management and aggregation practices and programs to ensure demand for electricity aligns with availability of lower-carbon intensive and/or renewable energy.

[69] Carbon Capture, Utilization, & Storage | Ohio Department of Natural Resources (ohiodnr.gov)

Fuel Switching and/or Upgrades for Efficiencies	Buildings (including Industrial)	Switching to fuels and technologies that are more efficient and less emissions intensive, such as switching from furnace and boilers to gas heat pumps for residential building heating, or use of waste fuels in manufacturing; could also upgrade technologies to consume the same fuels in a more efficient system (e.g., a cogeneration system burning natural gas instead of a traditional natural gas boiler).
Pre-development	Buildings; Industrial Processes	Addressing structural deficiencies, hazards, or other construction necessities required prior to any weatherization, energy efficiency retrofits, or renewable energy installations.
Sustainable Construction in Materials	Industrial Processes	Use of low-carbon, recycled or reclaimed construction or maintenance materials. Can include activities associated with maintenance, such as use of low-carbon fuels for road maintenance equipment. In doing so, the embodied carbon of the asset built with these materials is lowered and/or GHG emissions associated with fuel consumption decrease.
Methane Leak Detection and Repair	Natural Gas and Oil Systems	Reducing fugitive emissions from methane leaks in natural gas pipelines, and abandoned gas and oil wells, through use of advanced leak detection technologies and repairs.
Sustainable Power for Wastewater Treatment	Electric Power; Waste	Evaluate localized zero emission energy sources for wastewater treatment plants.
Zero Waste / Waste Reduction	Waste	Reducing municipal solid and industrial waste through education and reuse programs (e.g., reducing food waste through local food banks, food waste diversion, and education on practices to reduce food waste).
Recycling	Waste	Increasing the recycling rate of materials such as plastics, metals, and paper, reducing the new for production of new materials.
Carbon Sequestration	Agriculture, LULUCF	Sequestering carbon through community land trusts, increasing tree canopy cover, increasing urban greenspace, sustainable forestry management, and undertaking sustainability agriculture practices such as soil health improvements, increasing urban agriculture, or other methods.
Feasibility Studies	All	Addressing knowledge gaps to understand the viability of reduction measure implementation (e.g., transmission planning for electric power).

Low-Income and Disadvantaged Community Analysis

The implementation of the measures included in this Plan are anticipated to provide benefits to LIDACs. These communities are identified as LIDACs based on the definitions, thresholds and methodology employed in the Climate and Economic Justice Screening Tool (CEJST). A census tract is identified as a LIDAC if it above the threshold of one or more environmental, climate, or other burdens, as well as also being above the threshold for an associate socioeconomic burden. In addition, a census tract that is surrounded by other disadvantaged communities that meet the burden threshold and is at or above the 50th percentile for low income, is also considered disadvantaged. The indicators of these burdens are outlined by Executive Order 14008,[70] and are further defined by the Office of Management and Budget (OMB).[71] This section identifies each LIDAC within the jurisdiction covered by this Plan, how Ohio EPA meaningfully engaged with LIDACs in the development of this Plan, and how Ohio EPA will continue to engage into the future.

Ohio's LIDACs have historically borne a disproportionate burden of environmental impacts, including poor air quality, extreme weather conditions, and natural disasters. Cities like Cleveland and Toledo were instrumental in the industrialization of the Midwest during the late 19th and 20th centuries. Changing macroeconomic conditions lead to a reduction of manufacturing jobs, resulting in economic hardship in the urban centers of several Ohio cities. For example, in Cleveland there are only four census tracts in the downtown area that are not considered low income and disadvantaged.[72] Columbus had a rise in manufacturing in the south side of the city.[73] The effects of this industrialization can be seen today throughout the whole city, which is almost completely made up of LIDAC census tracts, the majority being south of Broad Street, which runs east to west through the center of the city.[74] The industrialization resulted in higher levels of environmental air pollutants which have resulted in long-term health issues, such as asthma, for the LIDAC residents.

Ohio has also suffered from several environmental disasters expressly caused by industrialization. Perhaps the most infamous example was Cleveland's Cuyahoga River experienced a horrific fire in the late 1960s.[75] Many of the communities impacted by this environmental disaster remain LIDACs to this day. The vulnerability of these communities is exacerbated by socioeconomic factors such as poverty, lack of access to healthcare, and

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[70] Section 219, Executive Order 14008, Tackling the Climate Crisis at Home and Abroad (January 27, 2001)

[71] OMB Memorandum M-21-28, Interim Implementation Guidance for the Justice40 Initiative (July 20, 2021)

[72] Explore the map - Climate & Economic Justice Screening Tool (geoplatform.gov)

[73] Industrialization - Columbus Neighborhoods

[74] Explore the map - Climate & Economic Justice Screening Tool (geoplatform.gov)

[75] Marking 50 years since the Cuyahoga River fire, which sparked US environmental action (acs.org)

inadequate housing, which limit the ability to adapt to and recover from these environmental impacts.

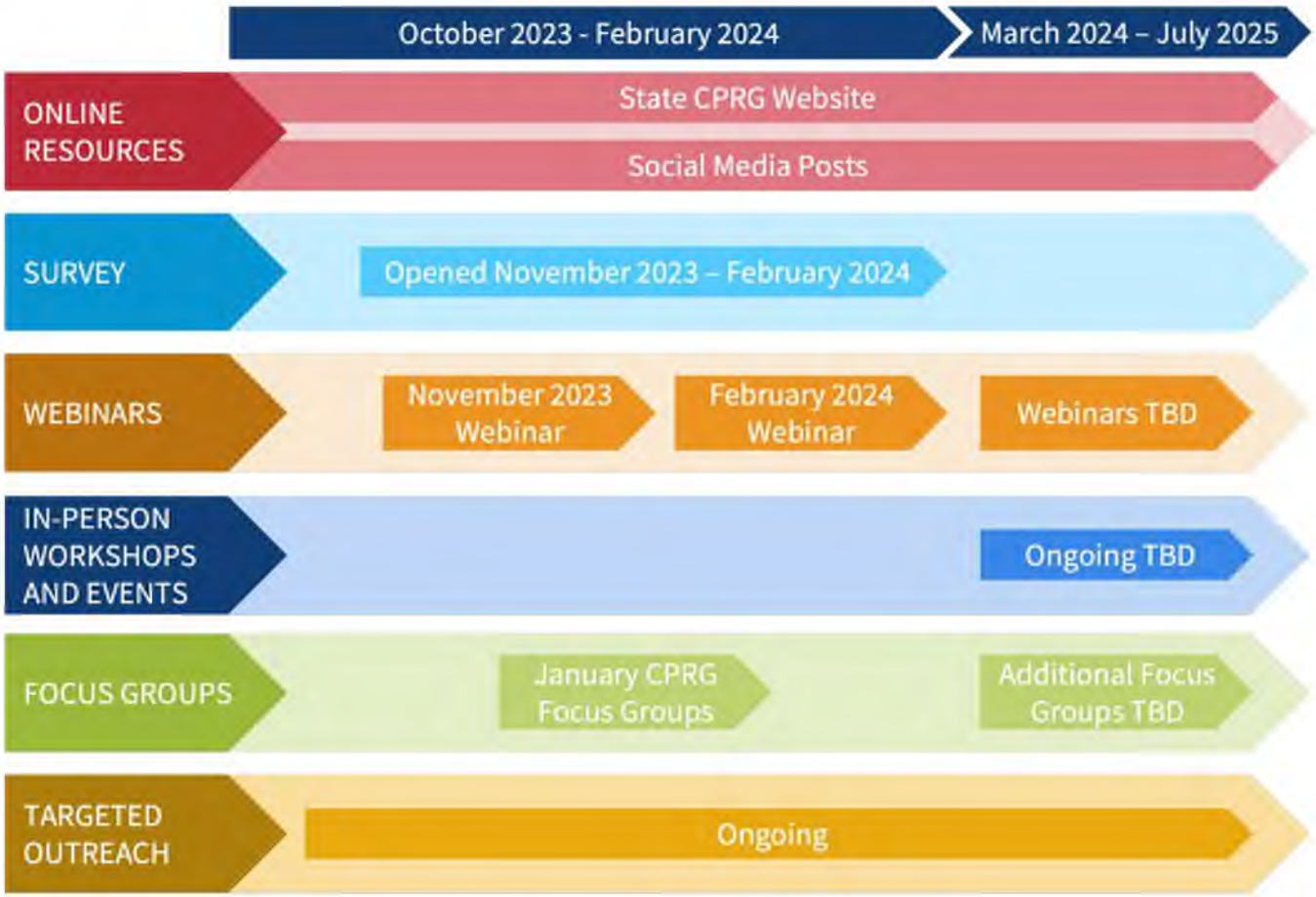
ENGAGEMENT WITH LIDACS

Ohio EPA created an engagement plan for seeking feedback on community priorities during development of this Plan. Receiving community inputs are invaluable to the success of this Plan as they provide insights on learnings from past successes and current initiatives, as well as strategies to overcome barriers and provide meaningful benefits. These inputs have been considered for the GHG reduction measures and LIDAC considerations in this Plan and will continue to be a key strategic component for the CRP. See Appendix I: Coordination and Outreach Log. Strategies for engagement with LIDACs are summarized below:

- Online resources:
  - State CPRG webpage;
  - Social media;
  - Community survey;
- Community meetings with stakeholders across the state with options for virtual participation and playback videos following the session can be found on Ohio EPA's CPRG webpage;
- Targeted outreach to known community-based organizations; and
- Attendance at known community events to disseminate information about how to provide input.

During the focus group, participants had the opportunity to share their perspectives on LIDAC impact, specifically what measures are being implemented today, what existing initiatives target LIDACs, how LIDACs are involved in decision making for reduction measures, how the financial cost of reduction measures are being distributed across LIDACs, and general challenges that have been identified in implementing reduction measures in LIDACs. Participants highlighted examples of successful reduction measure implementation in their communities such as weatherization, programs they would like to see such as general GHG reduction measure education opportunities, and funding being a primary barrier to implementation.

This focus group allowed community members an active role in shaping Ohio's statewide Plan, and their insights and concerns have been considered to create a more effective, inclusive, and responsive plan that supports LIDACs. A key output of this session was a list of additional organizations to engage for the LIDAC perspective. As Ohio EPA develops a stakeholder outreach plan for the CRP efforts, the recommendations shared will guide the way LIDAC groups are engaged in future.



OVERVIEW OF DISADVANTAGED COMMUNITIES

This section identifies the LIDACs across the state of Ohio. For the purposes of this analysis, we utilize the definitions and data from CEJST.

In Ohio there are 2,952 total census tracts, 1,088 of which are considered LIDACs, comprising almost 37% of the census tracts in the state. A total of 3.3 million people live in these LIDACs, with approximately 442,000 children under the age of 10 and 474,000 over the age of 64. Twenty-nine percent (29%) of the total population of the state reside in these LIDACs. A summary of the most relevant demographic characteristics is presented in Table 2 below, and the five regions of Ohio will be discussed in the subsequent section:

Table 2. LIDAC Demographic Information

	TOTAL POPULATION	POPULATION UNDER 10	POPULATION 10 TO 64	POPULATION OVER 64	BLACK	HISPANIC	WHITE
Percent Residing in LIDACs	29%	33%	29%	25%	64%	47%	22%
Central Ohio LIDAC Census Tracts	14%	15%	72%	11%	34%	6%	51%
Northeast Ohio LIDAC Census Tracts	35%	13%	71%	15%	35%	7%	51%
Northwest Ohio LIDAC Census Tracts	14%	13%	72%	13%	20%	7%	67%
Southeast Ohio LIDAC Census Tracts	15%	11%	70%	17%	3%	1%	92%
Southwest Ohio LIDAC Census Tracts	22%	14%	71%	14%	31%	4%	58%

Black and Hispanic people, as well as children under the age of 10 are disproportionally present in LIDACs and may be at particular risk to the various environmental challenges these communities face outlined in the following sections. To identify the specific challenges facing a LIDAC, a host of environmental and socioeconomic indicators are considered. A summary and set of definitions for the most relevant indicators to the priority reduction measures presented in this Plan are noted in Table 3 below: [76]

[76] The Climate and Economic Justice Screening Tool Technical Support Document

Table 3. Key LIDAC Indicators

Category	Type of Burden	Description
Energy	Energy Burden	Average household annual energy cost in dollars divided by the average household income.
Air Quality	Diesel Particulate Matter	Mixture of particles in diesel exhaust in the air, measured as micrograms per cubic meter.
	$PM_{2.5}$ in the Air	Fine inhalable particles with diameters that are generally 2.5 micrometers and smaller, compiled from the Office of Air and Radiation (OAR) fusion of model and monitor data from 2017 as compiled by U.S. EPA's EJScreen, sourced from NATA and DOT traffic data. Common sources of $PM_{2.5}$ emissions include power plants and industrial facilities.
Transportation	Traffic Proximity and Volume	Daily average of vehicles at major roads within 500 meters, divided by distance in meters. This is compiled from U.S. DOT traffic data from 2017.
Water and Wastewater	Underground Storage Tanks and Releases	Weighted formula of the density of leaking underground storage tanks and the number of all active underground storage tanks within 1,500 feet of the census tract boundaries.
	Wastewater Discharge	Modeled toxic concentrations at stream segments within 600 meters, divided by distance in kilometers. This is compiled from the Risk-Screening Environmental Indicators (RSEI) model from 2020.
Legacy Pollution	Proximity to Hazardous Waste Facilities	Count of hazardous waste facilities (Treatment, Storage, and Disposal facilities, and Large Quantity Generators) within 5 kilometers (or nearest one beyond 5 kilometers), divided by distance in kilometers, compiled from Treatment, Storage, and Disposal Facilities (TSDF) data calculated from U.S. EPA's Resource Conservation and Recovery Act (RCRA) Info Database from 2020.

Geographical Distribution of LIDACs

LIDACs can be found across the state of Ohio in various concentrations, often exhibiting different demographic characteristics and facing varied challenges from each other. To consider the state as a whole, we will look at each region, as defined by Ohio EPA in Figure 18, separately. In the following sections, CEJST images are presented for each area, where the shaded census tracts are identified as LIDACs.

Figure 18. Regions of Ohio[77]

[77] District Offices | Ohio Environmental Protection Agency

CENTRAL OHIO

Central Ohio is comprised of Franklin County and nine other counties that directly border it. The city of Columbus, the state capital, is home to five Fortune 500 companies and The Ohio State University, which has a student population of approximately 61,000.

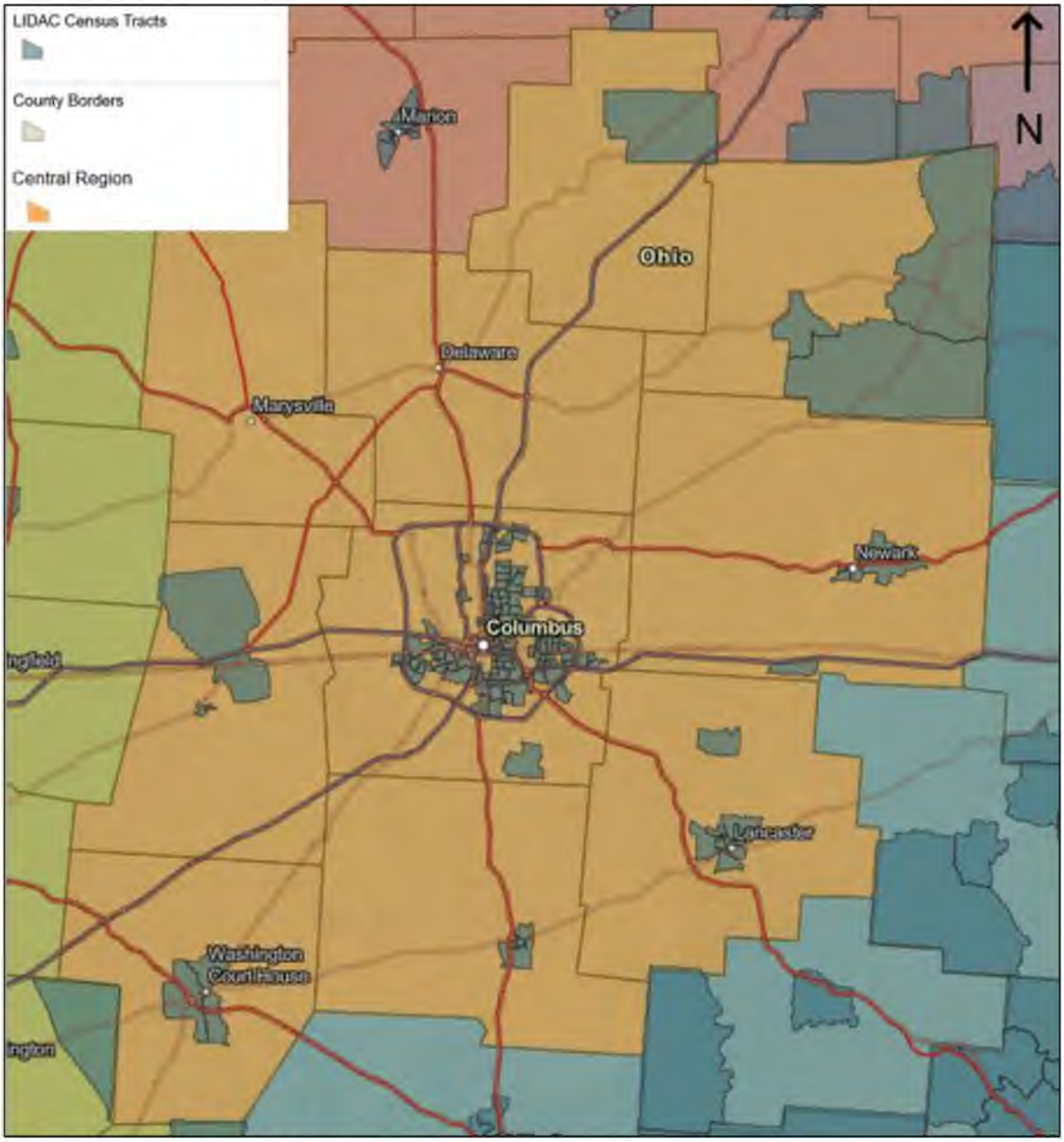


Figure 19. Central Ohio LIDAC Census Tracts

Figure 19 highlights the LIDAC census tracts in Central Ohio. While there are several in rural areas, the majority are in and around Columbus, located along the major highways that run through the city and within the Interstate 270 Beltway. As shown in Figure 19, Central Ohio LIDAC Census Tracts, the LIDACs in this area compared to the entire state have

disproportionate exposure to six of the seven main environmental pollutants, with diesel particulate matter exposure being particularly prevalent. This heightened exposure, commonly found in urban areas, correlated with the higher average percentile of traffic proximity in these communities.

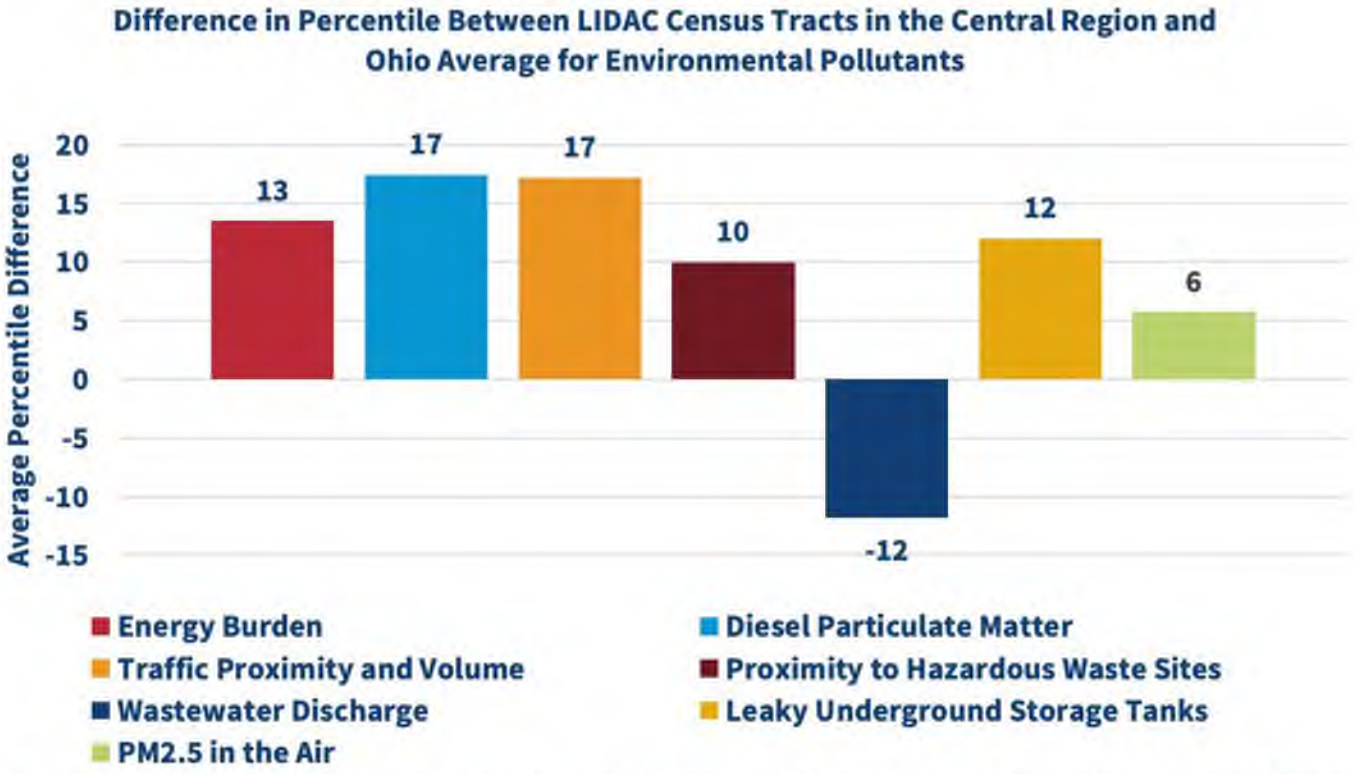


Figure 20. Environmental Pollutant Average Percentile Between the Central Region of Ohio's LIDAC Census Tracts vs. Ohio Census Tracts

Figure 20 displays the environmental pollutant average percentiles of the LIDAC census tracts in the central region of Ohio versus all the census tracts in the state. The chart shows that six out of seven environmental pollutant variables in Central Ohio are greater than the state average, the largest gaps being energy burden, diesel particulate matter, and traffic proximity and volume.

NORTHWEST OHIO

Northwest Ohio is a mix of urban and rural, with Toledo and Lima combined with rural areas and the coast of Lake Erie.

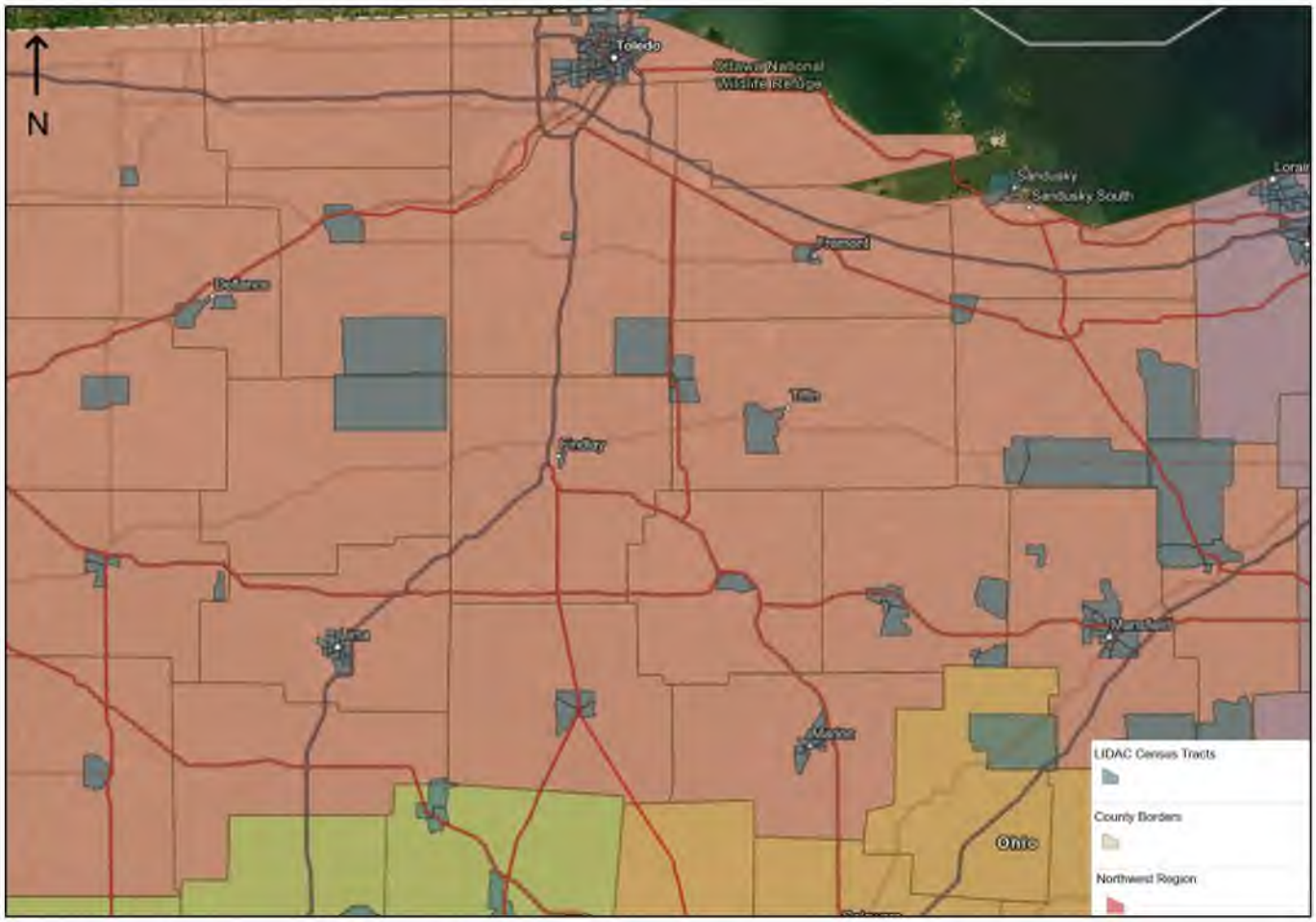


Figure 21. Northwest Ohio LIDAC Census Tracts

Figure 21 shows the LIDAC census tracts in the Northwest Ohio. There are a few scattered throughout the area, but they mainly cluster around the city of Toledo, located in Lucas County. Energy burden appears to be the biggest factor affecting the LIDACs in this area, with the average percentile being 26 points over that of the state's average (Figure 22). An important observation is that 55% of the census tracts in Lucas County have a low-income population, which exceeds the state average by 16%.

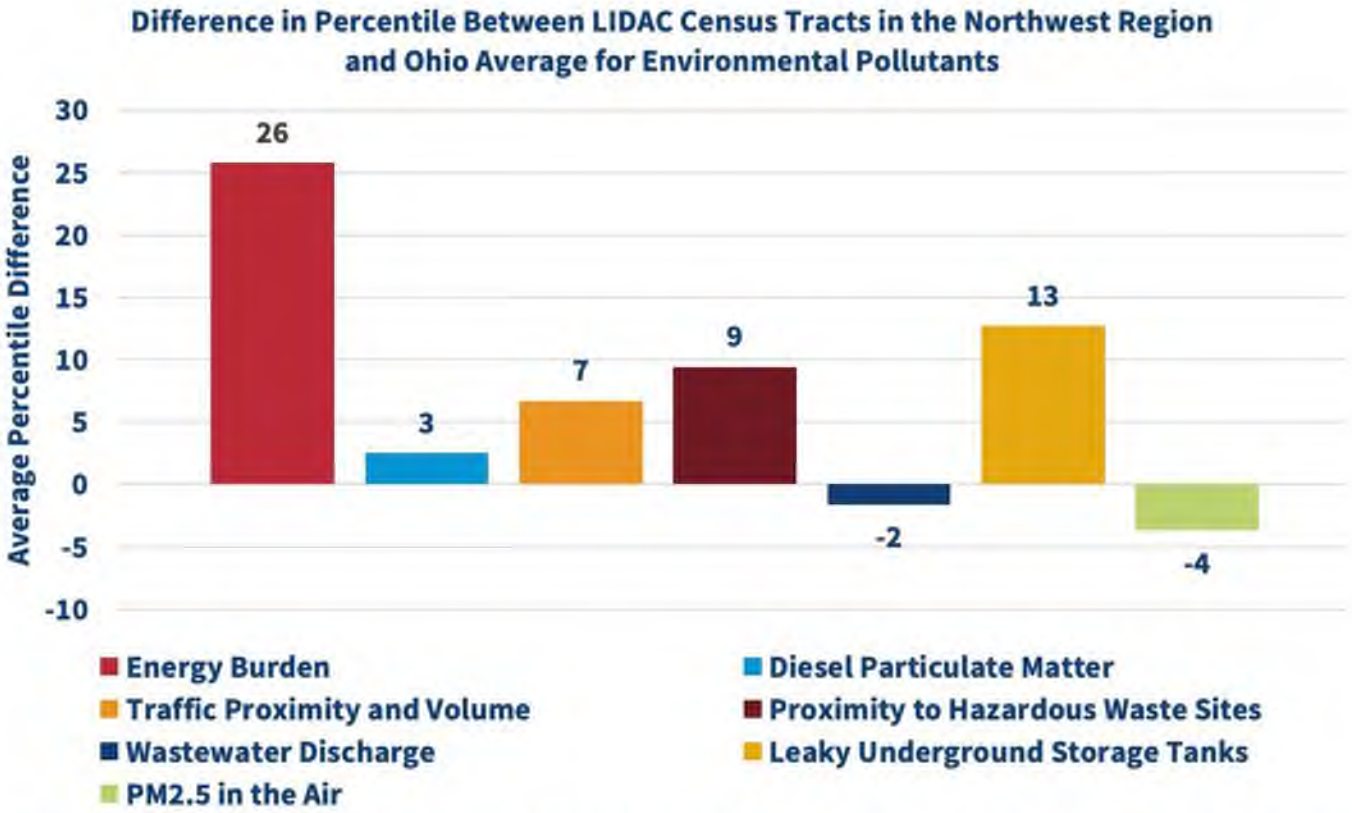


Figure 22. Environmental Pollutant Average Percentile Difference Between the Northwest Region of Ohio's LIDAC Census Tracts vs. Ohio Census Tracts

Figure 22 displays the environmental pollutant average percentiles of the LIDAC census tracts in Northwest Ohio versus all the census tracts across the state. The chart shows five of the seven environmental pollutants in the northwest region being higher than the state's averages; energy burden has the largest gap of 26 points while the rest of the variables are within 15 points of the state average.

NORTHEAST OHIO

Figure 23 depicts the LIDAC census tracts in the Northeast Ohio. This area features more clusters of disadvantaged tracts than the other regions, excluding Southeast Ohio, due to it having multiple cities, which have larger populations but don't have the economy to sustain a living wage for many of the residents.

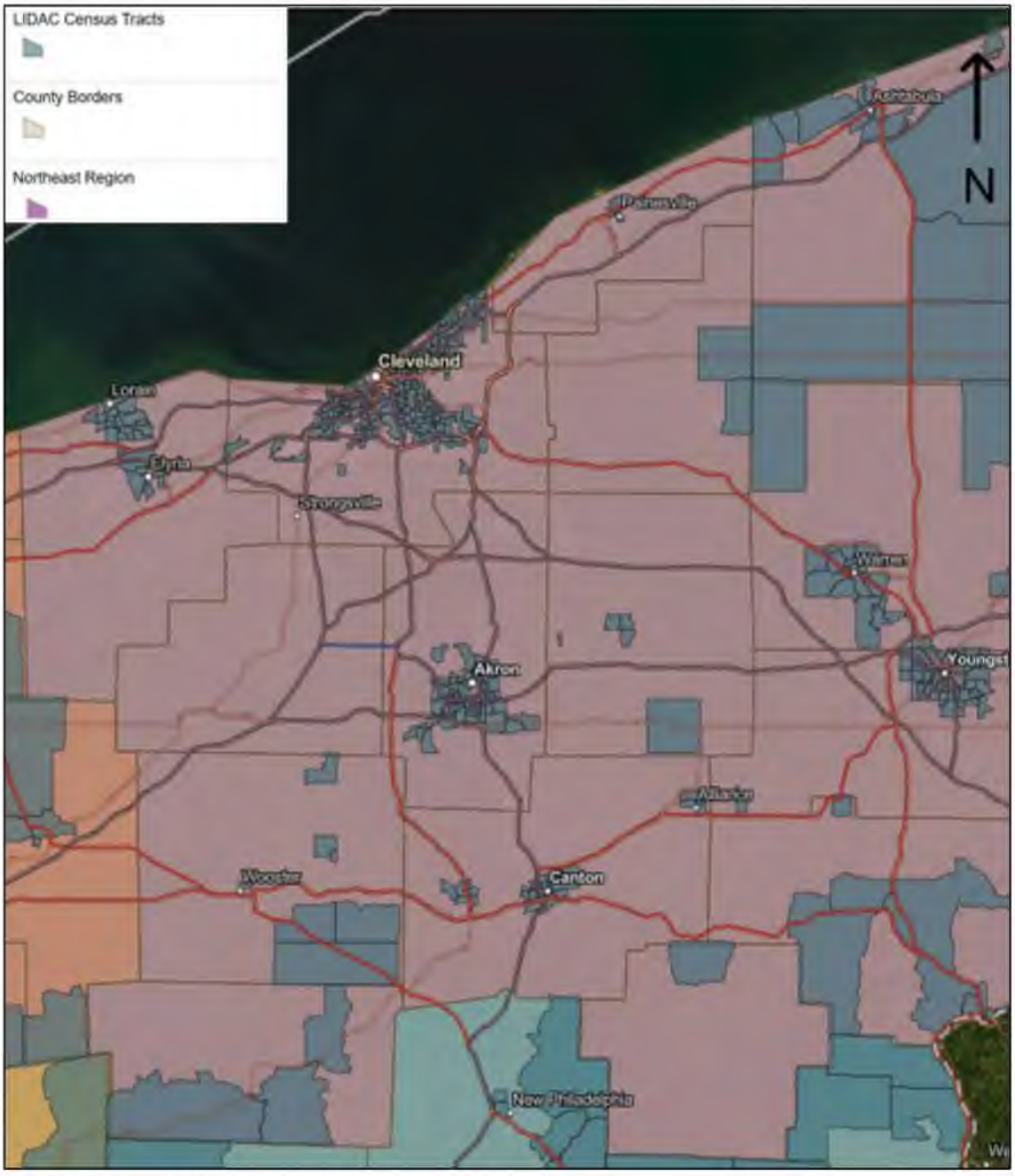


Figure 23. Northeast Ohio LIDAC Census Tracts

Cleveland in Cuyahoga County, Akron in Summit County, Youngstown in Mahoning County, and Canton in Stark County all have clusters of LIDAC census tracts surrounding them and have environmental pollutants, on average, higher than the state's averages. Youngstown is in a partially rural county[78] and has the highest energy burden among the four largest cities in the region, 29 points higher than the state average.

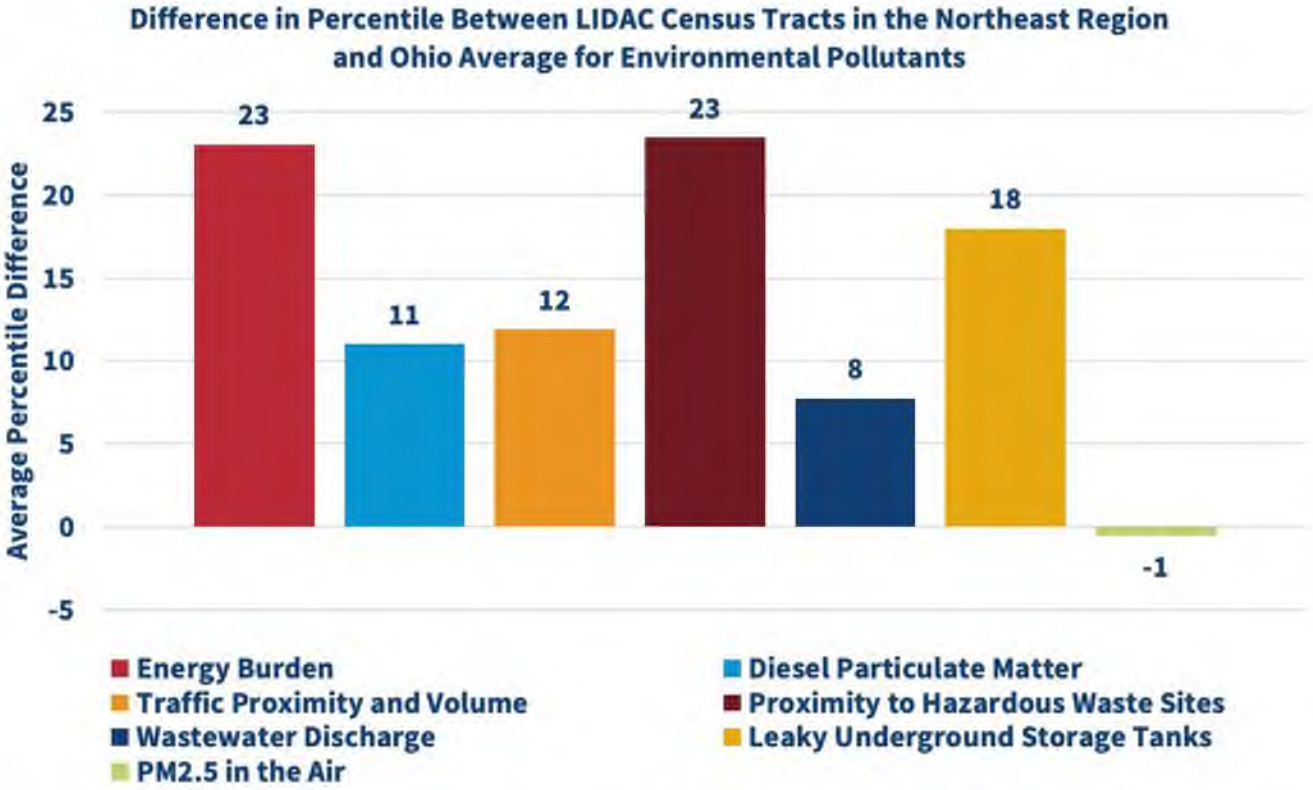


Figure 24. Environmental Pollutant Average Percentile Difference Between the Northeast Region of Ohio's LIDAC Census Tracts vs. Ohio Census Tracts

Figure 24 features the gaps between the average percentiles of environmental pollutants, the largest being energy burden and proximity to hazardous waste sites, of the LIDAC census tracts in Northeast Ohio versus the rest of the state. We choose to highlight the different counties of the region because we observe significant differences in the environmental pollutants and issues that the LIDACs in Northeast Ohio face.

[78] Urban and Rural counties are defined using the Ohio Department of Health's 2020 classifications. 2020_rural_and_urban_counties.pdf (ohioruralhealth.org)

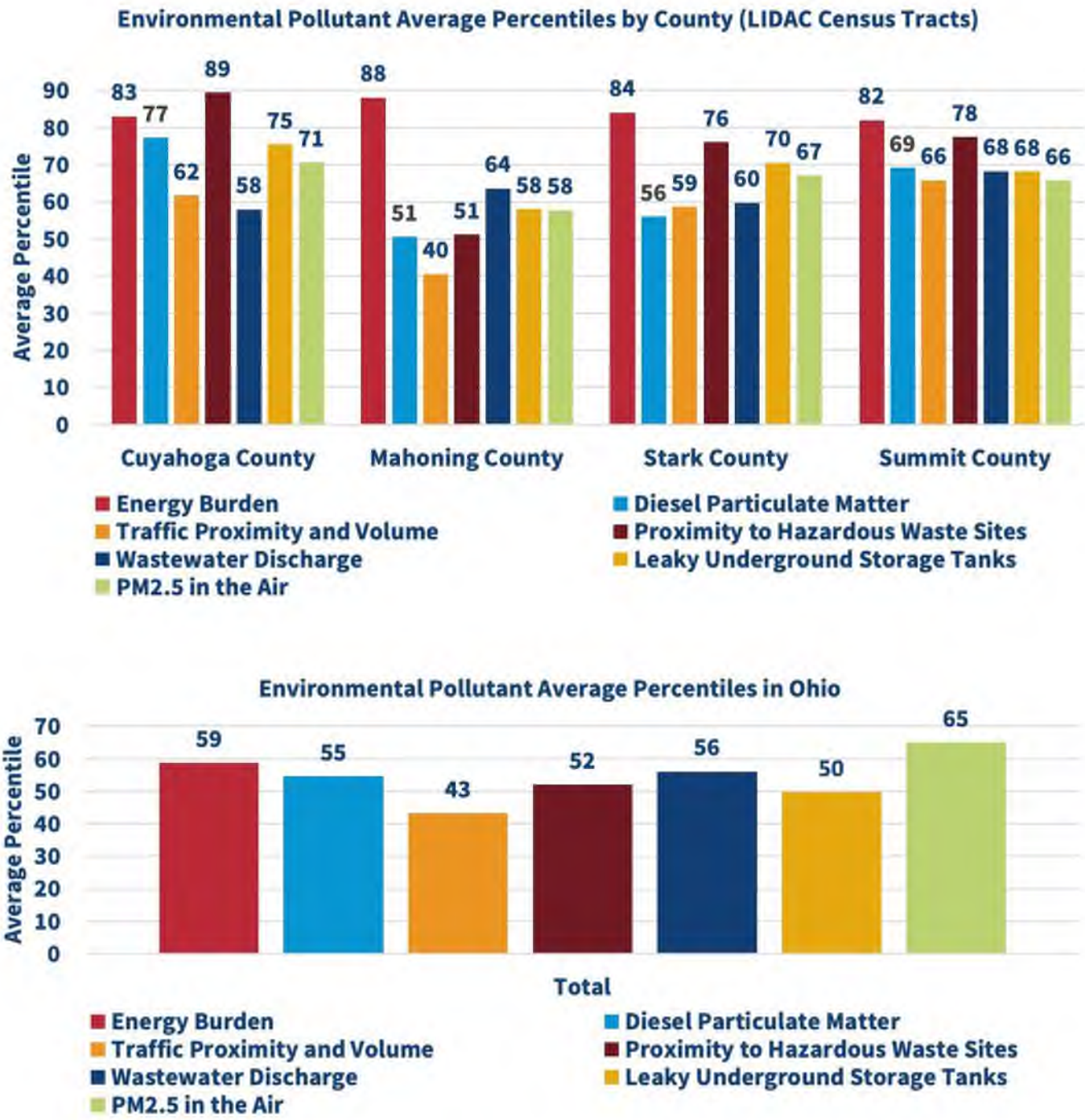


Figure 25. Environmental Pollutant Average Percentiles by County in Northeast Ohio vs. all of Ohio

Figure 25 displays the environmental pollutant average percentiles for the LIDAC census tracts in the counties that have the four largest cities in the northeast region of Ohio, compared to the average percentiles in the state. Proximity to hazardous waste sites is a concern for three of the

four counties, which ranges from 24 to 37 points higher than the state's average. Energy burden is also a concern across the counties, between 23 and 29 points higher than the state.

SOUTHWEST OHIO

Figure 26 shows Southwest Ohio's LIDAC census tracts. There are many LIDAC communities in partially and fully rural counties, such as Brown County where Georgetown is located. The largest clusters can be seen around the metropolitan cities of Cincinnati, Dayton, and Springfield.

Figure 26. Southwest Ohio LIDAC Census Tracts

Cincinnati is Ohio's largest metropolitan area, with an estimated population of 2.1 million people.[79] The Cincinnati Metro Area includes five counties: Brown, Butler, Clermont, Hamilton, and Warren. The average percentile of $PM_{2.5}$ in the air for these counties' LIDAC census tracts is 85, which is 20 points higher than the state's average. Brown County experiences a significantly higher energy burden compared to the state (Figure 27), which has been common throughout many of the rural and partially rural counties. Hamilton County, home to downtown Cincinnati, features high levels of $PM_{2.5}$ in the air as well as diesel particulate matter, 23 and 29 points higher than those of Ohio, respectively (Figure 27).

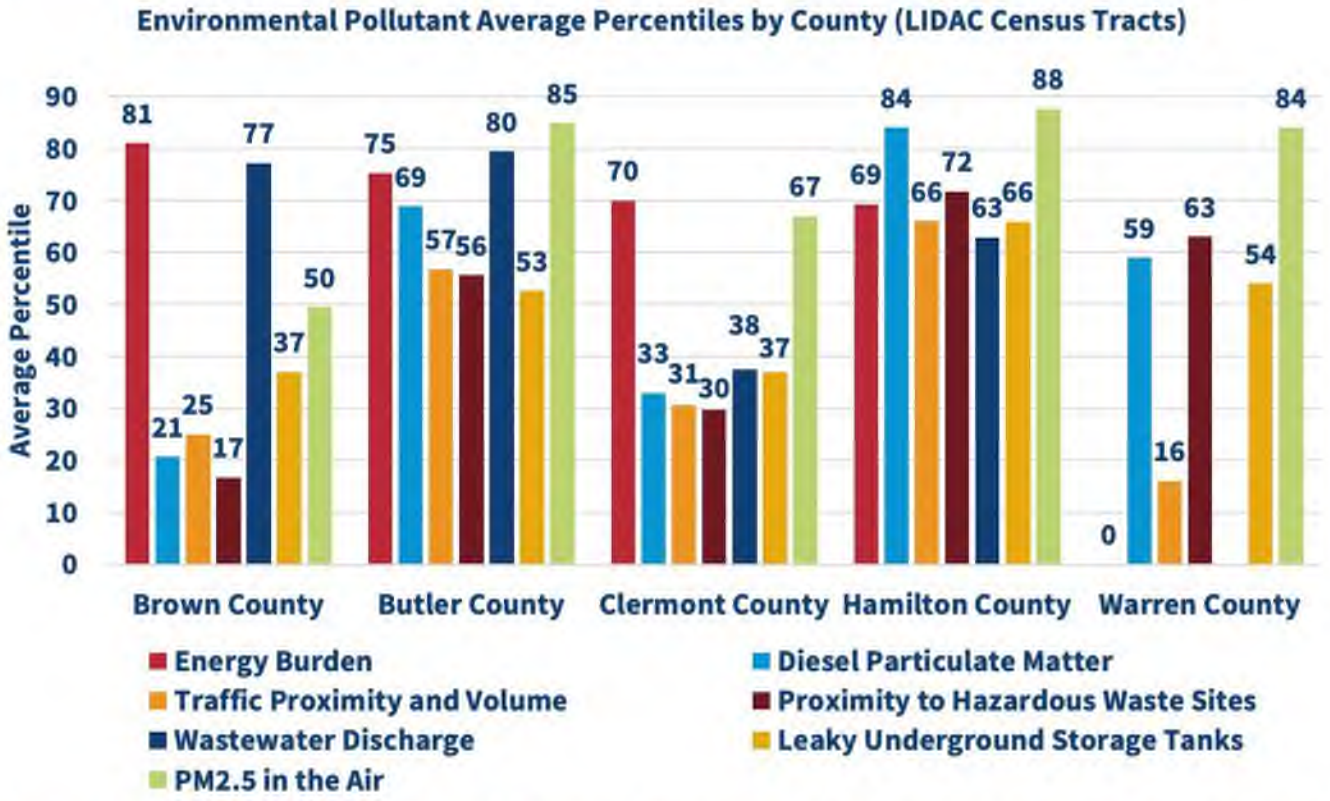


Figure 27. Environmental Pollutant Average Percentile in the Cincinnati Metro Area County's LIDAC Census Tracts

Figure 27 shows the environmental pollutant average percentiles in the Cincinnati Metropolitan Area's counties' LIDAC census tracts. All the counties, except for Brown, have a higher than state average percentile of $PM_{2.5}$ in the air. Hamilton County also features a higher than state average percentile for diesel particulate matter, traffic proximity, and volume.

[79] The Demographic Statistical Atlas of the United States – Statistical Atlas

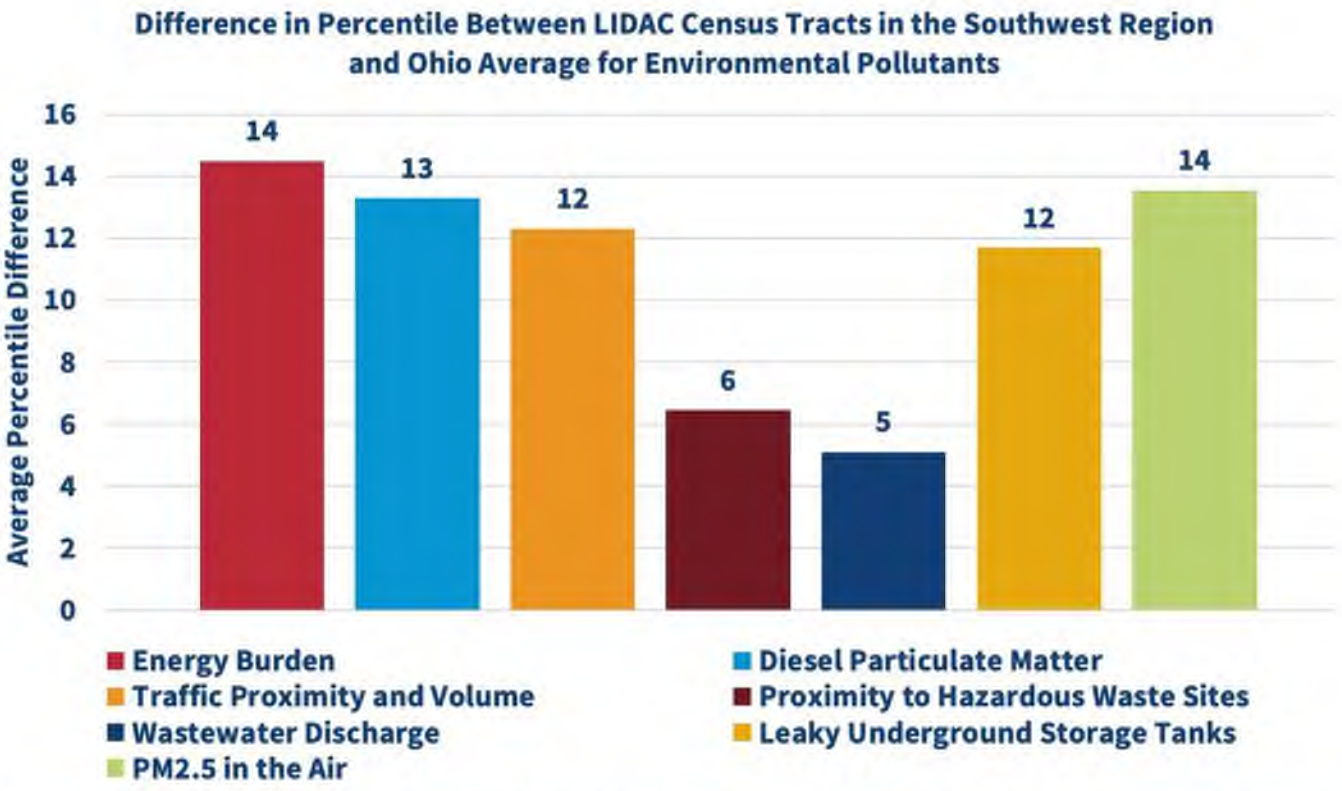


Figure 28. Environmental Pollutant Average Percentile Difference Between the Southwest Region of Ohio's LIDAC Census Tracts vs. Ohio Census Tracts

Figure 28 highlights the difference between Southwest Ohio's LIDAC census tract average environmental pollutants and Ohio's. The seven environmental pollutants are, on average, between 5 and 14 points higher than the state. Energy burden, diesel particulate matter, traffic proximity and volume, and $PM_{2.5}$ show the largest differences, signaling that the LIDACs are most affected by their proximity to roads and highways.

SOUTHEAST OHIO

Figure 29 shows the northern half of Southeast Ohio, and Figure 30 shows the southern half of the region. The map is split due to the large area of this region.

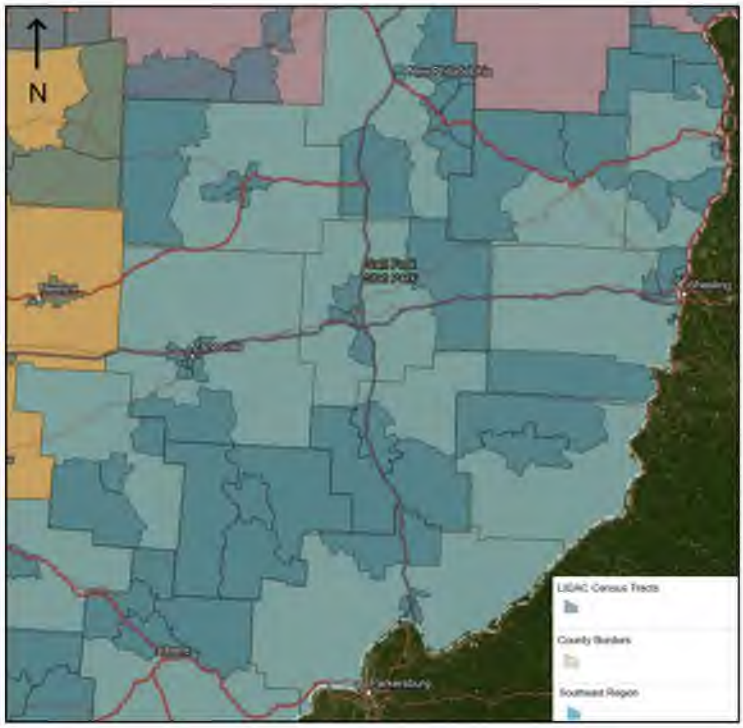


Figure 29. Northern half of Southeast Ohio LIDAC Census Tracts

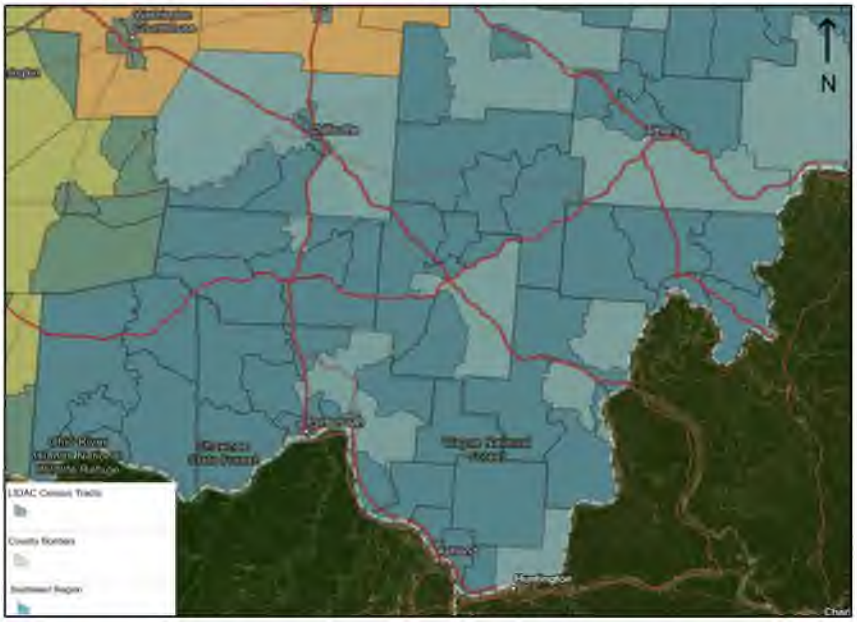


Figure 30. Southern half of Southeast Ohio LIDAC Census Tracts

This area has the relatively largest concentration of rural counties,[80] with the region's biggest challenge being low-income. This is consistent with energy burden having an average percentile 28 points higher than that of the state (Figure 31).

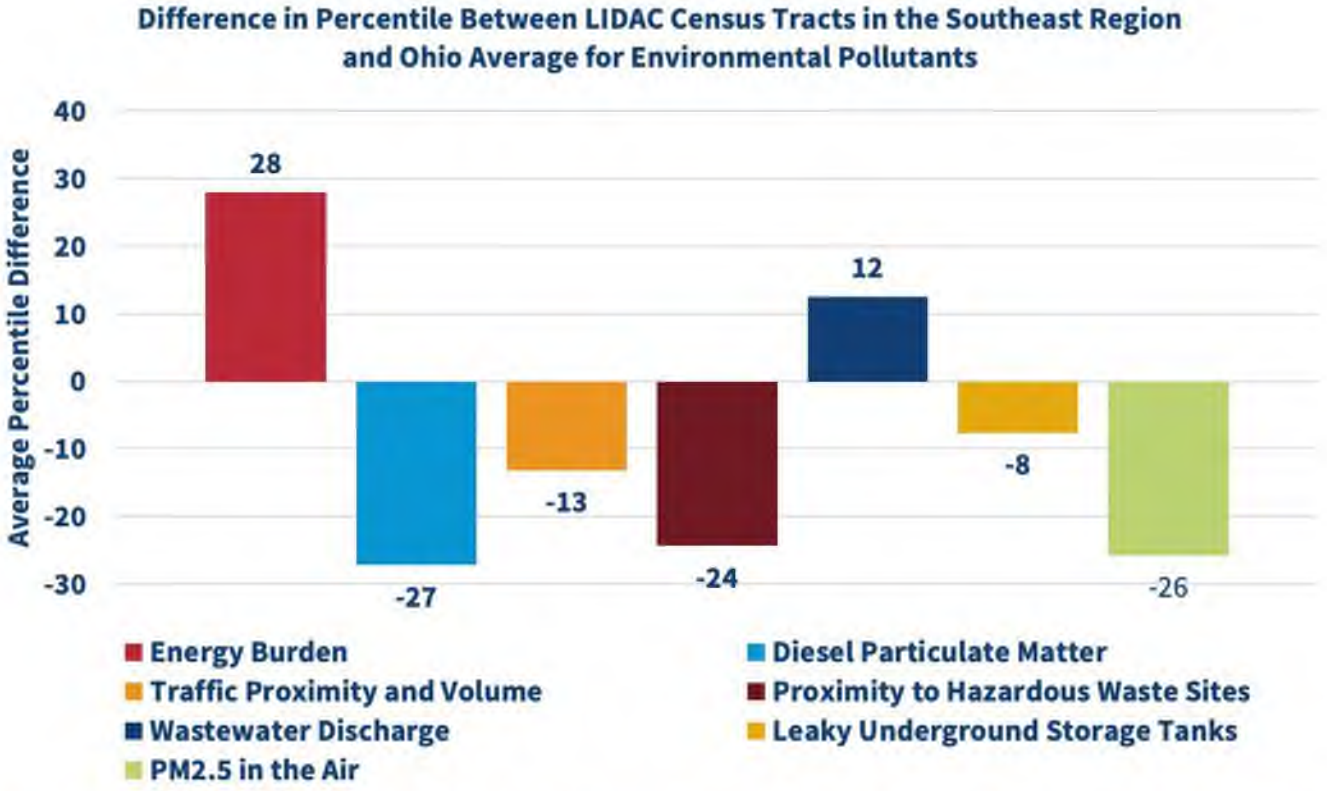


Figure 31. Environmental Pollutant Average Percentile Difference Between the Southeast Region of Ohio LIDAC Census Tracts vs. Ohio Census Tracts

Figure 31 shows the environmental pollutant average percentiles for Southeast Ohio's LIDAC census tracts compared to Ohio's census tracts. Energy burden and wastewater discharge are 28 and 12 points higher than Ohio's averages, respectfully.

OVERVIEW OF CO-POLLUTANTS

In addition to the direct benefits of GHG reduction measures, there are also often additional harmful co-pollutants that can also be mitigated that have damaging health effects. While many factors play a role in health outcomes, LIDAC census tracts in Ohio exhibit markedly worse health outcomes for several key metrics often associated with various co-pollutants.

Table 4. Average Percentiles of Health Variables in LIDAC census tracts vs. all census tracts in Ohio

[80] Urban and Rural counties are defined using the Ohio Department of Health's 2020 classifications. Available at: 2020_rural_and_urban_counties.pdf (ohioruralhealth.org)

Average Percentile

	ADULTS WITH ASTHMA	ADULTS WITH CORONARY HEART DISEASE	ADULTS WITH DIAGNOSED DIABETES	AVERAGE LIFE EXPECTANCY (YEARS)
Disadvantaged Census Tracts in Ohio	90	82	83	73
All Census Tracts in Ohio	69	66	62	77

Below is a brief description of each of the co-pollutant's sources and the side effects of being exposed to them.

SULFUR DIOXIDE (SO2)

The present of SO_2 in the atmosphere primarily stems from the combustion of fossil fuels in power plants, petroleum refining, and steel making operations.

Short-term exposures to SO_2 can significantly harm the human respiratory system, causing breathing difficulties, particularly for individuals with asthma, especially children. Emissions of SO_2, resulting in elevated concentrations of this compound in the air, often prompt the formation of additional sulfur oxides (SO_X). These SO_X can undergo reactions with other compounds in the atmosphere, forming fine particles that contribute to particulate matter (PM) pollution. In significant quantities, these particles are capable of deeply penetrating the lungs and contributing to health problems.[81]

NITROGEN OXIDES (NOX)

NO_x refers to both nitric oxide (NO) and nitrogen dioxide (NO_2). Under ambient conditions, NO is rapidly oxidized to form NO_2; hence, NO_2 is usually considered a primary pollutant. The reaction of NO_2 with water produces nitrous acid (HONO), a strong oxidant and common indoor pollutant. Indoor levels of NO_2 are a function of both outdoor and indoor sources; therefore, indoor levels can be influenced by high outdoor levels originating from combustion or local traffic. It was reported that the distance between buildings and roadways has a significant influence on indoor NO_2 levels.[82] Additionally, major indoor sources include smoking and wood-, gas-, oil-,

[81] https://www.epa.gov/so2-pollution/sulfur-dioxide-basics

[82] Kodama Y., Arashidani K., Tokui N., Kawamoto T., Matsuno K., Kunugita N., Minakawa N. *Environmental NO2 concentration and exposure in daily life along main roads in tokyo.* Environ. Res. 2002;89:236–244.

coal-, and kerosene-burning appliances, such as stoves, space, ovens, and water heaters and fireplaces.[83]

Breathing air with a high concentration of NO_2 can irritate airways in the human respiratory system. Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms (such as coughing, wheezing or difficulty breathing), hospital admissions and visits to emergency rooms. Longer exposures to elevated concentrations of NO_2 may contribute to the development of asthma and potentially increase susceptibility to respiratory infections. People with asthma, as well as children and the elderly, are generally at greater risk for the health effects of NO_2.[84]

PARTICULATE MATTER (PM2.5)

Some $PM_{2.5}$ particles are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks, or fires. Most particles form in the atmosphere because of complex reactions of chemicals such as sulfur dioxide and nitrogen oxides, which are pollutants emitted from power plants, industries, and automobiles.

Particulate matter may contain microscopic solids or liquid droplets that are so small that they can be inhaled and cause serious health problems. Some particles less than 10 micrometers in diameter can get deep into your lungs and some may even get into your bloodstream. Of these, particles less than 2.5 micrometers in diameter, also known as fine particles or $PM_{2.5}$, pose the greatest risk to health. Fine particles are also the main cause of reduced visibility (haze) in parts of the United States.[85]

VOLATILE ORGANIC COMPOUNDS (VOCS)

Organic chemical compounds are in both indoor and outdoor environments because they have become essential ingredients in many products and materials. Outdoors, VOCs are released into the air mostly during manufacturing activities or use of everyday products and materials. Indoors, VOCs are mostly released into the air from the use of products and materials containing VOCs, such as paints, pesticides, building materials, household cleaners, carpeting, and automotive products.

The ability of organic chemicals to cause health effects varies greatly. As with other pollutants, the extent and nature of the health effect will depend on many factors including level of exposure and length of time exposed. Some of the mild effects are eye, nose and throat irritation, headaches, loss of coordination and nausea. The more serious effects can be damage to liver, kidney, and central nervous system, along with cancer in some animals and humans.[86]

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[83] Indoor Air Pollution, Related Human Diseases, and Recent Trends in the Control and Improvement of Indoor Air Quality – PMC (nih.gov)

[84] Basic Information about NO2 | US EPA

[85] Particulate Matter (PM) Basics | US EPA

[86] Volatile Organic Compounds' Impact on Indoor Air Quality | US EPA

AMMONIA (NH3)

NH_3 is found throughout the environment in the air, soil, and water, and in plants and animals, including humans. Ammonia is also found in many household and industrial cleaners.

High levels of ammonia can irritate and burn the skin, mouth, throat, lungs, and eyes. Very high levels of NH_3 can damage the lungs or cause death. The level of exposure depends upon dose, duration, and work being done.[87]

ANTICIPATED BENEFITS AND IMPACTS OF PRIORITY MEASURES

This section discusses the potential benefits and impacts of the priority measures outlined in this Plan to the various LIDACs across the state. A more in-depth case study is performed for the first priority measure in Franklin County as an illustrative example.

1. LIGHT-DUTY ZERO EMISSION VEHICLES (ZEV)

FRANKLIN COUNTY – ILLUSTRATIVE EXAMPLE

Given the typically higher levels of pollutants in LIDACs, it is expected that reducing emissions could have the greatest benefit in these areas. To illustrate this, we conducted a high-level analysis of the county. Franklin County has a population of approximately 1.3 million people, making it the most populous county in the state. The county is characterized by its monocentric layout, with the capital of the state, Columbus, at its center. The county has a population density of 2,186 people per square mile, while Columbus' population density is 4,295 people per square mile. Columbus' downtown area features a mix of high-rise office buildings, apartment complexes, and retail outlets, while its suburbs are more residential. The infrastructure of the county features an extensive network of highways, railroads, and airports, including the John Glenn Columbus International Airport. However, Franklin County's extensive road network, while largely beneficial, also presents certain challenges. The county's heavy reliance on road transportation has led to a rapid increase of roads, highways, and freeways. The infrastructure, while necessary for the county's transportation needs, has also contributed to issues such as urban sprawl, traffic congestion, and environmental pollution. The city is surrounded by the Interstate 270 beltway, intersected by Interstate 70, 71, innerbelt Interstate 670, and significant State Roads 315, 161, 62, and 40, among others.

Despite its urban character, Franklin County also contains several more suburban and rural areas, particularly in its outer regions. These areas are characterized by their lower population densities and more agricultural landscapes.

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[87] Ammonia | NIOSH | CDC

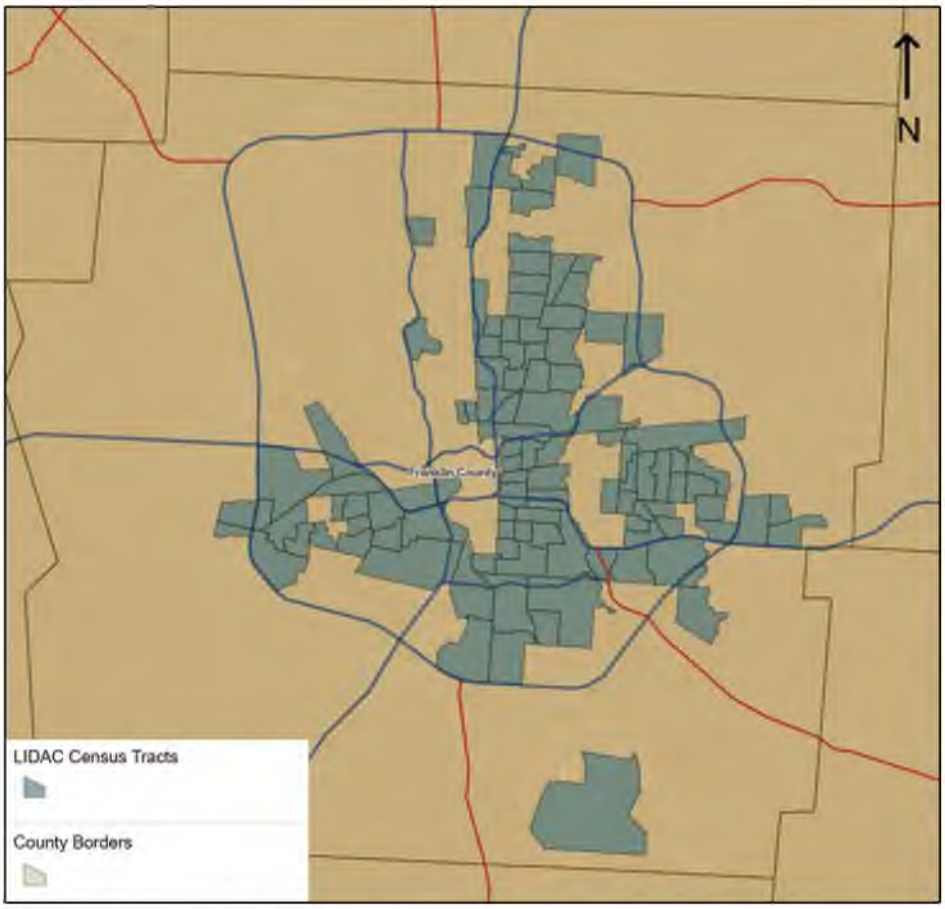
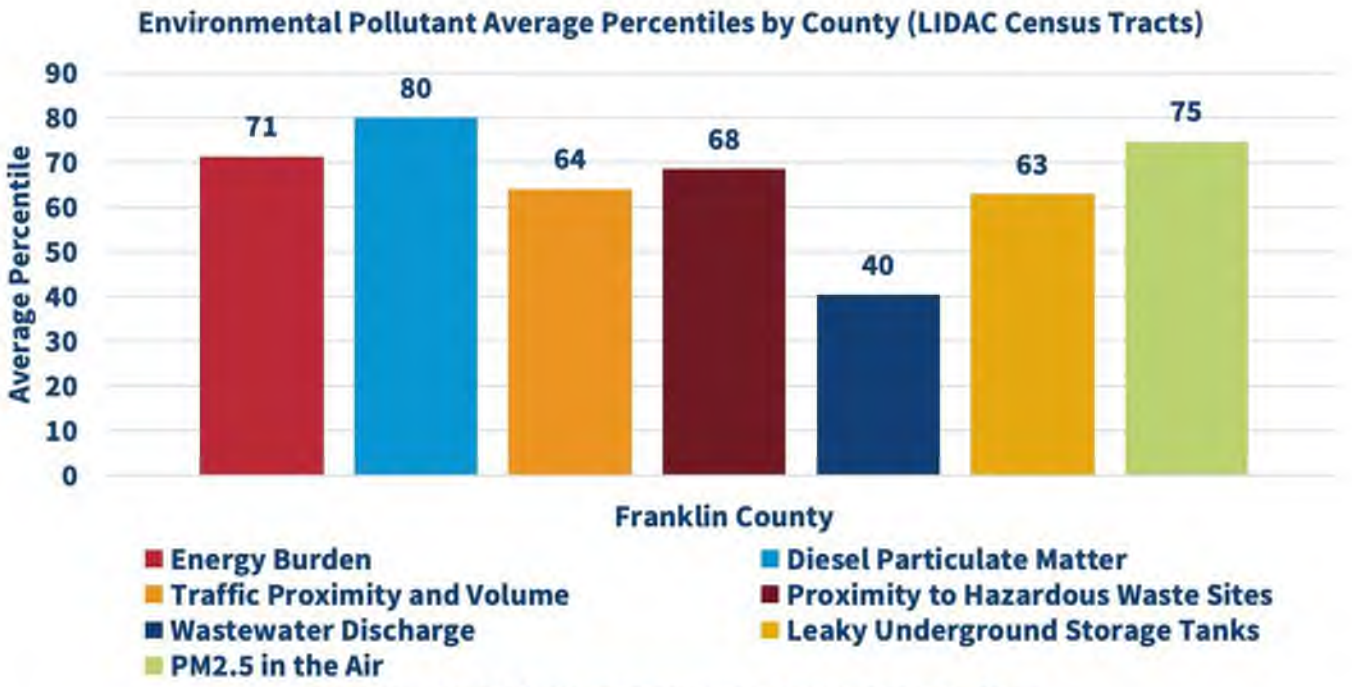
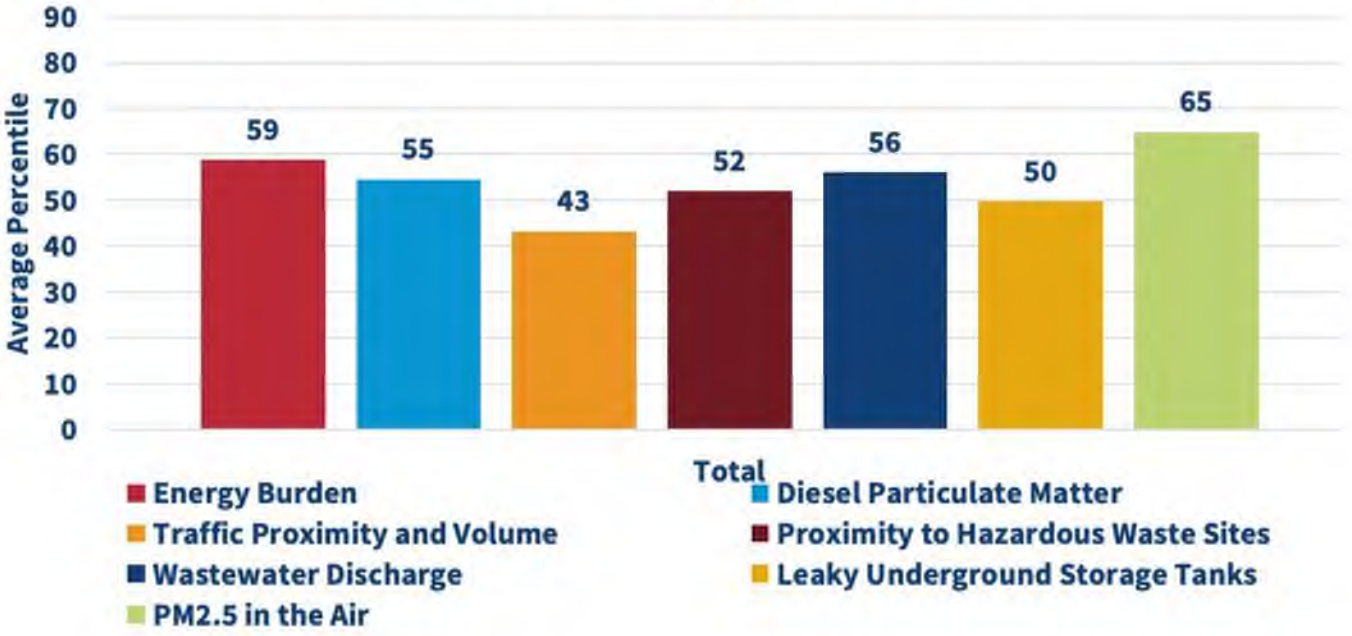


Figure 32. Franklin County LIDAC Census Tracts

One immediate observation of the distribution of LIDAC communities in Franklin County is that nearly every LIDAC community is neighboring a major highway or thoroughfare (Figure 32). In fact, the traffic proximity and volume for Franklin County's LIDACs is 987 (64th percentile), significantly larger than the statewide overall average of 436 (43rd percentile) and state LIDAC average of 638 (52nd percentile, Figure 33).


Environmental Pollutant Average Percentiles by County (LIDAC Census Tracts)
Average Percentile
90
80
70
60
50
40
30
20
10
0
71
80
64
68
40
63
75
Franklin County
Energy Burden
Diesel Particulate Matter
Traffic Proximity and Volume
Proximity to Hazardous Waste Sites
Wastewater Discharge
Leaky Underground Storage Tanks
PM2.5 in the Air


Environmental Pollutant Average Percentiles in Ohio
Average Percentile
90
80
70
60
50
40
30
20
10
0
59
55
43
52
56
50
65
Total
Energy Burden
Diesel Particulate Matter
Traffic Proximity and Volume
Proximity to Hazardous Waste Sites
Wastewater Discharge
Leaky Underground Storage Tanks
PM2.5 in the Air

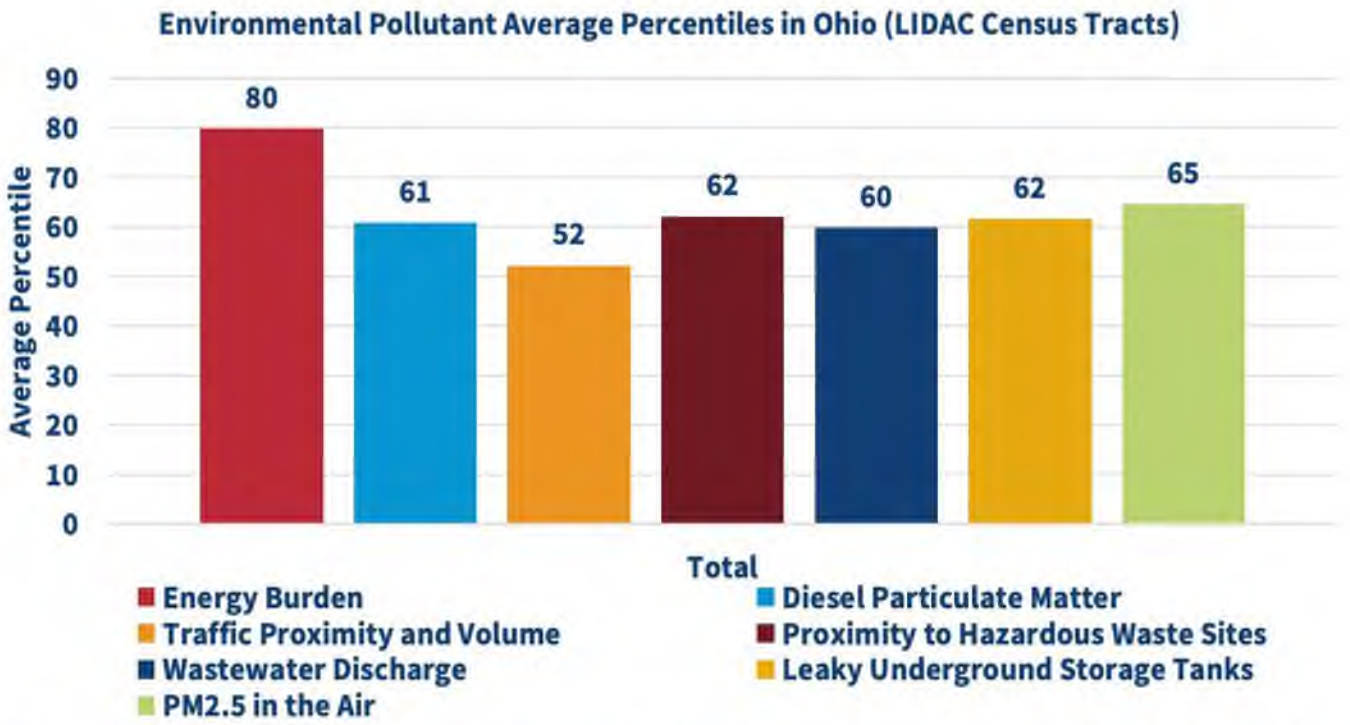


Figure 33. LIDAC Environmental Pollutant Average Percentiles Franklin County vs. all of Ohio vs Ohio LIDAC Census Tracts

Figure 33 features three charts comparing the environmental pollutant averages: the top is Franklin County LIDAC census tracts, the middle chart is all census tracts in Ohio, and the bottom chart is LIDAC census tracts in Ohio. Franklin County features average percentiles higher than both latter charts in diesel particulate matter, traffic proximity and volume, proximity to hazardous waste sites, leaky underground storage tanks, and $PM_{2.5}$ in the air.

Figure 34 shows the average traffic proximity and volume in Franklin County census tracts (left), Ohio census tracts (middle), and Ohio's LIDAC census tracts (right). Franklin County's average traffic proximity and volume is 226% more than that of all census tracts in Ohio, and 154% more than the LIDAC census tracts in Ohio.

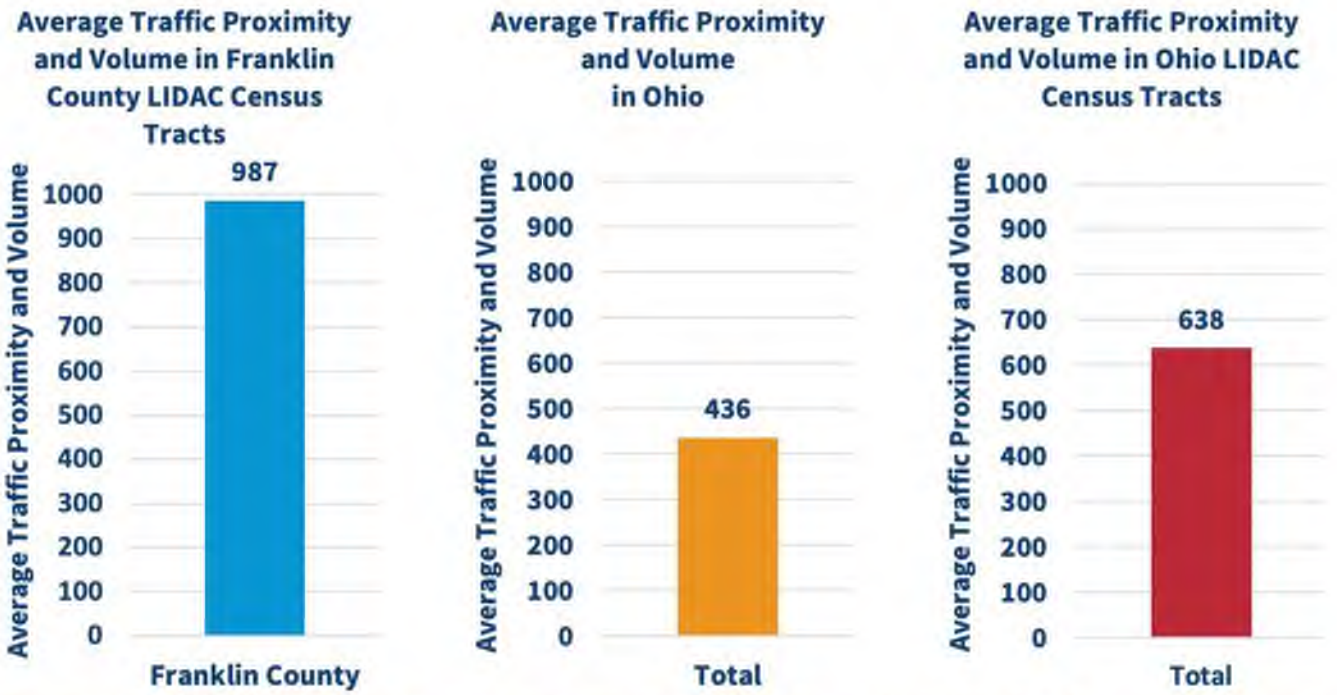


Figure 34. Average Traffic Proximity and Volume in Franklin County LIDAC Census Tracts vs. all of Ohio vs. Ohio LIDAC Census Tracts

Driving is extremely prevalent in Franklin County, with a total daily VMT of 30.6 million miles. The breakdown of these VMT by road type as provided by the ODOT are in Table 5 below.[88]

Table 5. Adjusted Franklin County Daily VMT (In Thousands) 2019

	INTER – STATE	PRINCIPAL ARTERIAL – OTHER FREEWAYS/ EXPRESS-WAYS	PRINCIPAL ARTERIAL – OTHER	MINOR ARTERIAL	MAJOR COLLECTOR	MINOR COLLECTOR	LOCAL	TOTAL
Rural	154.92	0.00	18.47	16.11	83.58	4.50	27.99	305.57
Urban	12,747.98	2,679.07	4,881.59	5,139.5	2,378.51	495.27	1,994.6	30,316.60

Of all daily VMT, 99% are urban and 42% are interstate urban. As previously indicated, the arterial highways in Franklin County run through almost every community and are adjacent to nearly every LIDAC census tract.

[88] Archived DVMT Reports by Year. Available at: 2019 Kdvmt.xlsx (state.oh.us)

PRELIMINARY LIGHT-DUTY ZERO EMISSION VEHICLES (ZEV) ANALYSIS

Employing U.S. EPA's Motor Vehicle Emission Simulator Version 4, in 2019 the total harmful pollutants in Franklin County from passenger vehicles is presented in the table below (in tons).

Table 6. Harmful Annual Emissions due to Passenger Vehicles in Franklin County in 2019 (in tons)

PM2.5	SO2	NOX	NH3	VOC
24	17	1,386	286	1,628

For this preliminary analysis, we employ 2019 VMT and emissions assuming all else equal. Including projected changes in VMT as well as existing organic adoption of alternative fuel and zero-emission vehicles is beyond the scope of this exercise but will be considered in the subsequent CRP.

In order to provide a high-level estimate for the potential quantitative benefits of emissions reductions from further adoption of light-duty zero emissions vehicles, we employ estimates of the total dollar value (mortality and morbidity) per ton of directly emitted $PM_{2.5}$ and $PM_{2.5}$ precursor reduced associated with Internal Combustion Engines in the table below:[89] These health impacts and the economic value of these impacts were derived by U.S. EPA using the Environmental Benefits Mapping and Analysis Program-Community Edition (BenMAP-CE v1.5).[90]

Table 7. Summary of the total dollar value (mortality and morbidity) per ton of directly emitted $PM_{2.5}$ and $PM_{2.5}$ precursor reduced with Internal Combustion Engines 2030 (in 2019 dollars)

	DIRECT				OZONE	
Discount Rate	$PM_{2.5}$	SO_2	NO_X	NH_3	NO_X	VOC
3%	$179,000	$41,600	$11,400	$81,500	$64,400	$10,000
7%	$160,000	$37,300	$10,200	$73,200	$57,700	$8,990

These costs are borne both by individual residents as well as the community, from loss of productivity, additional medications, treatment, hospital visits, and even death.

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[89] U.S. Environmental Protection Agency. *Estimating the Benefit per Ton of Reducing Directly-Emitted $PM_{2.5}$, $PM_{2.5}$ Precursors and Ozone Precursors from 21 Sectors.* September 2023. Available at: source-apportionment-tsd-oct-2021_0.pdf (epa.gov)

[90] Sacks, J. D.; Lloyd, J. M.; Zhu, Y.; Anderton, J.; Jang, C. J.; Hubbell, B.; Fann, N. *The Environmental Benefits Mapping and Analysis Program – Community Edition (BenMAP–CE): A Tool to Estimate the Health and Economic Benefits of Reducing Air Pollution.* Environmental Modelling and Software 2018, 104. https://doi.org/10.1016/j.envsoft.2018.02.009.

To calculate the total costs associated with these emissions for the year 2030 in 2019 dollars, we multiply the quantities of each of the harmful emissions by their corresponding price.

While it is difficult to know the exact impact of electric vehicle incentives on adoption in a specific region, we can consider the hypothetical impact of electrifying a percentage of existing VMT that are currently internal combustion. This reduction in combustion VMT may be achieved by the adoption of zero electric vehicles, plug-in hybrids, or a combination of the two. To illustrate the potential benefits, we project a range for a given percentage of combustion VMT reduced for 2030 in 2019 dollars, summarized in Table 7.

Table 8. Potential Annual (2030) Financial Impact of Vehicle Electrification in Franklin County December 2023 dollars)

	PERCENTAGE OF 2019 VMT REMOVED VIA ELECTRIFICATION		
Discount Rate	5%	7%	10%
3%	$8,979,060	$12,570,684	$17,958,120
7%	$8,049,265	$11,268,971	$16,098,530

These benefits due to reductions in mortality and morbidity equate to between $6.24 cents to $13.92 per resident of Franklin County, per year.

While this analysis has been conducted at the county level, given the makeup and distribution of LIDAC census tracts within Franklin County, it is evident that a large share of these annual benefits would accrue to LIDACs.

It should be noted that the estimates above represent the potential benefits for a single county for a single year. Of course, considering the potential impact over a longer time (and discounting to derive the net present value) would result in significantly larger benefits. Expanding this analysis to the state level would generate correspondingly higher benefits than reported in this illustrative exercise. However, such a quantification is beyond the intention of this illustrative exercise discussing potential benefits to LIDACs.

While these annual potential benefits are significant, we also should note that ZEVs generally require less maintenance and so mechanics and other internal combustion related jobs, such as gas stations, may see reduced employment. Additionally, it is likely that LIDACs will adopt ZEV at lower rates than more wealthy communities, so additional outreach or economic incentives may be required. However, even if LIDACs themselves adopt EVs at a lower rate than non-LIDACs, the benefits from overall VMT, given commuting patterns, may still benefit LIDACs even if they are not themselves driving the ZEVs. For example, Yu et al (2023) found that in California, despite disadvantaged communities adopting zero emission vehicles at a rate 3.8 times less than non-disadvantaged communities, disadvantaged communities receive 40% more benefits

from emissions reductions than non-disadvantaged communities given the location of VMT relative to the placement of disadvantaged communities.[91]

The benefits to such an emissions reduction measure are likely most impactful where traffic proximity and airborne co-pollutants are at the highest concentration. Thus, the potential benefits are likely higher in urban areas and less beneficial in rural areas.

2. MEDIUM- AND HEAVY-DUTY ZERO EMISSION VEHICLES (ZEV)

Expanding medium- and heavy-duty ZEVs would have similar benefits and co-benefits to the LIDAC residents of Ohio, including local reductions in $PM_{2.5}$ resulting from combustion in trucks, reduced exposure to diesel particulate emissions, ozone, and noise.[92]

The introduction of additional Medium- and Heavy-Duty Zero Emission Vehicles ZEV's, just like for Light-Duty ZEVs, also leads to capacity building in terms of ZEV maintenance personnel and facilities. Infrastructure construction for EV charging stations will create new or improved local jobs and build capacity through training; new jobs will be created in ZEV manufacturing and other technology sectors.[93]

However, ZEVs generally require less maintenance, so mechanics and other truck maintenance jobs may be negatively impacted.

The benefits to such an emissions reduction measure are likely most impactful where traffic proximity and airborne co-pollutants are at the highest concentration. Thus, the potential benefits are likely higher in urban areas and less beneficial in rural areas.

3. TRANSPORTATION EFFICIENCIES

Expanding transportation efficiency would reduce time spent in transit, reduction in vehicles with combustion engines, reduced air pollution emissions (specifically $PM_{2.5}$) and other electrification co-benefits such as reduction of noise in streets previously from car engines. The expansion of public transit routes will reduce barriers to travel for low-income households that depend on public transit and improve connectivity to the rest of the city including access to services,

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[91] Yu, Q., He, B. Y., Ma, J., & Zhu, Y. (2023). California's zero-emission vehicle adoption brings air quality benefits yet equity gaps persist. Nature communications, 14(1), 7798. https://doi.org/10.1038/s41467-023-43309-9

[92]Congressional Research Service (2023). Heavy-Duty Vehicles, Air Pollution, and Climate Change. https://crsreports.congress.gov/product/pdf/IF/IF12043

[93] Building Charging for Electric Vehicles Can Create Good Jobs (nrdc.org)

education, jobs, parks, and green spaces. In addition, improvements in access to public transit may reduce poverty burdens due to reduced transportation costs.[94]

Increasing service times, routes, and transit vehicle trip frequencies will result in the creation of new jobs, (e.g., transit drivers and maintenance operators), however, there would be declines in some other jobs such as taxis and private sharing vehicles.[95]

The benefits to such an emissions reduction measure are likely most impactful where traffic proximity and airborne co-pollutants are at the highest concentration. Thus, the potential benefits are likely higher in urban areas and less beneficial in rural areas.

4. RENEWABLE ELECTRICITY GENERATION

Renewable electricity generation can provide household energy savings that reduce high energy burdens[96] and provide other meaningful co-benefits such as pollution abatement (both GHG and air pollutants), improved grid reliability through energy storage, improved economic outcomes for LIDAC households, investment in local businesses and an increase in high-quality local workforce development opportunities.

Expanding renewable electricity generation will lead to several tangible benefits to LIDACs, potentially reducing the electricity costs, and thus energy burdens when LIDACs utility costs are directly reduced. There also may be improvements in air quality depending on the location of existing fossil-fuel based power generation. The manufacture, installation, and maintenance of renewable energy generation could also translate the creation of new jobs. However, this could potentially lead to a decline in jobs such as mining and extraction.[97] It could also contribute to land use conflict for residents and farmers concerned about land value, land available for cultivation, and other ecological concerns. Multiple solar projects in the state of Ohio have received such pushback.[98]

The benefits to such an emissions reduction measure are likely most impactful where energy burden is a prevalent factor. From the prior overview of LIDACs in Ohio, this occurs across the state in both urban and rural communities, in particular Northeast and Southwest Ohio.

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[94] Public Transportation | MIT Climate Portal

[95] How can investing in public transport benefit our cities? | World Economic Forum (weforum.org)

[96] Energy Justice and the Energy Transition (ncsl.org)

[97] Ohio U.S. Energy and Employment Report – 2023 USEER23-OH-v2.pdf (energy.gov)

[98] Farmers concerned over potential solar farm in Greene County (daytondailynews.com)

5. BUILDING ENERGY EFFICIENCY

Expanding building energy efficiency can significantly reduce energy costs for households. By using less power for heating, cooling, and lighting families will have more available money for food, healthcare, and other necessities. Additionally, energy-efficient buildings often provide healthier and more comfortable living environments because they are designed to ensure good air quality, healthy temperatures, and humidity levels to prevent mold, and reduce noise levels, improving overall health. [99] Enacting energy efficiency measures can create local jobs and stimulate economic growth because they often involve retrofitting existing buildings or constructing new, energy-efficient ones.[100]

However, the upfront costs of implementing energy efficiency measures can be high, which may be prohibitive for low-income households and communities and older properties. While these costs can often be recouped over time through energy savings, the initial investment may still be out of reach for many. Additionally, as buildings become more energy-efficient and desirable, property values may rise, potentially pushing out existing residents who can no longer afford to live there.

The benefits to such an emissions reduction measure are likely most Impactful where energy burden is a prevalent factor. From the prior overview of LIDACs in Ohio, this occurs across the state in both urban and rural communities, in particular Northeast and Southwest Ohio.

6. CLEAN HEATING

Expanding clean heating can significantly decrease the cost of heating, which is often a substantial portion of a household's energy bill. High-efficiency electric heat pumps are more energy-efficient than traditional heating systems, cutting electricity use by 50% when compared with electric resistance heating, leading to lower energy consumption and cost savings according to the DOE.[101] Energy burden is a significant issue in many LIDACs in Ohio, so any efforts to reduce the cost of energy can greatly ameliorate this challenge. Clean heating systems can improve indoor air quality by reducing the emissions of $PM_{2.5}$.[102] These pollutants are often produced by traditional heating systems and can cause or exacerbate health problems like asthma, heart disease, and other respiratory conditions. This is particularly important in low-income communities, which often bear a disproportionate burden of air pollution.[103] Additionally,

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[99] Health and Safety Benefits of Clean Energy | Department of Energy

[100] Here's how clean energy will change the global jobs market | World Economic Forum (weforum.org)

[101] Electric Resistance Heating | Department of Energy

[102] Significant but Inequitable Cost-Effective Benefits of a Clean Heating Campaign in Northern China | Environmental Science & Technology (acs.org)

[103] Currit, Elisabeth. "Disproportionate Exposure to Air Pollution for Low-Income Communities in the United States." Ballard Brief. May 2022. www.ballardbrief.byu.edu.

the installation and maintenance of clean heating systems can create local jobs and stimulate economic development, providing a much-needed boost to these communities.

However, there are also potential impacts to consider. The initial cost of installing clean heating systems can be high, which may be a significant barrier for low-income households. While these costs can often be offset over time through energy savings, the upfront investment may still be unaffordable for many, and may require direct assistance, subsidies, or tax incentives. The transition to clean heating may require significant changes to existing infrastructure, which can be disruptive and costly. Like clean heating, the desirability of an energy-efficient area could lead to gentrification and the displacement of the current residents.

The benefits to such an emissions reduction measure are likely most impactful where energy burden is a prevalent factor. From the prior overview of LIDACs in Ohio, this occurs across the state in both urban and rural communities, in particular Northeast and Southwest Ohio.

7. COMPOSTING

Expanding composting in low-income and disadvantaged communities can bring several benefits. Composting can help reduce the amount of municipal waste that households produce, therefore lowering total waste needing to be collected by municipalities and lowering costs. Additionally, composting provides a way to recycle organic waste into nutrient-rich compost, which can be used to improve soil health in community gardens or urban and rural farms, potentially increasing access to fresh produce. Composting can also have environmental benefits by reducing the amount of organic waste that ends up in landfills, where it can produce methane, a potent greenhouse gas.

While composting can reduce waste disposal costs, the initial costs of setting up a composting system or program may be prohibitive for some low-income households or communities. Composting also requires space, which is limited in densely populated urban areas where many low-income and disadvantaged communities are located.

8. CLEAN WASTE-TO-ENERGY

Expanding clean waste-to-energy (WtE) initiatives in low-income and disadvantaged communities can offer several benefits by providing a sustainable solution for waste management. WtE facilities reduce the amount of waste that ends up in landfills or reduces agricultural waste emissions by converting it to energy, and therefore reduces the need for fossil fuel energy. Therefore, there will be fewer greenhouse gas emissions and co-pollutants in the air.[104] WtE also has the potential to reduce energy costs, leading to lower energy burdens for many households in LIDACs where WtE is installed. WtE facilities additionally create jobs

[104] Trash to treasure: The benefits of waste-to-energy technologies | Argonne National Laboratory (anl.gov)

through the construction and operation phases, but they can be expensive to operate and could potentially discourage waste reduction and recycling efforts.

The benefits to such an emissions reduction measure are likely most impactful where energy burden is a prevalent factor. From the prior overview of LIDACs in Ohio, this occurs across the state in both urban and rural communities, in particular Northeast and Southwest Ohio.

Coordination and Outreach

Public outreach and participation are essential to this Plan, and Ohio EPA is committed to centering equity and respect for all community members. Throughout the development of this Plan, we conducted extensive intergovernmental coordination and outreach alongside community outreach. This section describes the framework used to support robust and meaningful engagement, ensuring comprehensive stakeholder representation and overcoming obstacles to engagement, including linguistic, cultural, institutional, geographic, and other barriers.

When developing a stakeholder outreach plan, we took a mindful approach to formulate a strategy, all while actively capturing lessons learned and opportunities for future engagement. Our strategy focuses on learning about communities' priorities and values, building capacity and interest in sustainable development, and increasing the community buy-in and awareness of Ohio EPA's vision. As we learned of highly interested stakeholders or additional groups to engage, these insights were taken into consideration for future engagement opportunities relating to either this Plan or CRP discussions.

IDENTIFICATION OF STAKEHOLDERS

Ohio EPA identified stakeholder representatives who may be impacted by implementation of this Plan. Stakeholders included, without limitation:

INTERAGENCY GROUPS	PRIVATE ORGANIZATIONS	LOCAL ORGANIZATIONS	COMMUNITY-BASED ORGANIZATIONS AND NON-PROFITS
• Transportation Agencies • Energy Agencies • Agricultural agencies • Housing Authorities • Air Quality Authorities	• Ohio Businesses and Corporations • Agricultural Organizations • Utilities	• Metropolitan Planning Organizations • Local elected officials • Community Action Organization	• Faith-based Organizations • Labor Organizations • Underserved and Disadvantaged Community Representatives

To identify stakeholders, Ohio EPA contacted municipalities, interagency organizations, community organizations, regional planning groups, and advocacy organizations known to be interested in climate resiliency and environmental planning. The list of identified stakeholders as of the publication of this Plan is included in Appendix I: Coordination and Outreach Log. The selected group of stakeholders engaged were chosen based on the key knowledge and perspective they hold and the values in which they uphold for their communities and neighboring communities. This was essential criteria for our initial outreach plan to help ensure we were effective in our planning efforts and prioritization.

In addition to our tailored engagement approach, Ohio EPA also provided public events and engagement opportunities which encouraged Ohioans to increase their awareness of our CPRG program and contribute to our planning efforts with their perspectives.

INTERAGENCY AND INTERGOVERNMENTAL COORDINATION

Ohio EPA took a strategic and intentional approach to interagency and intergovernmental coordination. The approach was rooted in both awareness of the planning efforts and the need for collaboration and data sharing.

To begin, we assessed how much state agencies knew about the CPRG program and Plan initiatives being carried out based on previous discussions and informative sessions. We wanted to ensure that every interaction with these groups supported the understanding of this project and the goals of our Plan. In addition, Ohio EPA used this opportunity to inform groups that were not directly related to the Plan's emission sectors about the CPRG program and how they could remain involved during Plan development. For groups that could support the Plan by providing emissions data and collaborating on reduction measures (such as the ODOT and OHFA), the Ohio EPA saw engagement as a collaborative effort to share sector-specific data and examine the feasibility of proposed reduction measures.

A critical driver of our interagency engagement was the idea of creating a strong foundational knowledge regarding the CPRG program. This alignment is what allowed Ohio EPA to establish partnerships with other state agencies that will prove beneficial as we continue to collaborate across the state for CRP planning efforts.

OUTREACH APPROACH AND PLAN

Ohio EPA's outreach plan was grouped into three main categorizations of stakeholder groups and outreach objectives:

Taking a segmented approach allowed Ohio EPA to formulate an engagement strategy to connect with audiences around their priorities and concerns, contributing to an inclusive and representative Plan. Many of our initial conversations were geared towards awareness of the CPRG program – introducing the funding award and the first deliverable, that being the Plan. We leveraged the initial discussions as a way solicit input as to what other communities and organizations to engage for individual discussions. As Ohio EPA began documenting our GHG inventory and potential GHG emissions reduction measures, we capitalized on these small group meetings to gather initial feedback of our findings to date. Being able to review these findings throughout our stakeholder engagement process allows our team to continually fine tune our Plan strategy to better fit the broader goals of the state and its key counterparts.

Ohio EPA acknowledges that individuals and organizations will vary in their understanding and perception of climate resiliency actions and their level of involvement. Consequently, public engagement events and tools were designed to target key stakeholders. To reach a broad stakeholder base of interested organizations wanting to partake in Plan related discussions, Ohio EPA conducted large-style virtual forums to encourage public participation:

VIRTUAL PUBLIC WEBINAR

Ohio EPA hosted a virtual public webinar which was open to all organizations and individuals across the state of Ohio. The webinar, attended by over 100 individuals and over 20 Ohio organizations, provided attendees with a detailed overview of Ohio EPA's CPRG program, details of the objectives and requirements of the Plan, and a forum to ask questions and submit

feedback for consideration as Ohio EPA develops their Plan. All materials from the webinar, including a recording, were made public on Ohio EPA's website to drive awareness and education for those who were unable to attend the session live.

To further promote transparency, Ohio EPA hosted an additional virtual public webinar to report on the findings of this Plan. This forum served to inform stakeholders about the findings in the Plan – specifically the proposed GHG emissions reduction measures. Stakeholders were given the opportunity to ask questions and offer their insights to inform Ohio's ongoing climate resiliency planning.

CPRG SURVEY INPUT AND OUTREACH DOCUMENTATION

To gather input from a wide range of stakeholders, Ohio EPA made an online survey available where respondents could submit feedback, considerations, and opportunities for coordination as the Plan was developed. Our survey received 96 responses including, but not limited to, Ohio local governments, grassroot organizations, and local planning councils. This survey allowed stakeholders to indicate what type of support – financial, technical, or legislative – they would require to further sustainability goals. Questions included:

- Does your organization currently have a program(s) or project(s) in place that drives GHG emissions reductions?
- What Ohio organization(s) do you recommend be engaged to provide insights and considerations as Ohio EPA continues to develop their Resiliency Plans? Organizations may include those who already are progressing (or planning) GHG reduction measures, or community-based organizations active in community programs and outreach.
- Do you have any suggestions for priority GHG reduction measures?
- Would your organization like to participate in additional engagement opportunities with Ohio EPA's CPRG Program to support the Comprehensive Resiliency Plan that will be completed mid-2025?

Not only did the responses allow for direct considerations for this Plan, but also allowed for stakeholders to raise their hand to be involved in future engagement opportunities. This provides Ohio EPA with further detail to build out our engagement strategies for the CRP development. Figure 35 provides an illustrative example of what types of Ohio organizations responded to this survey:

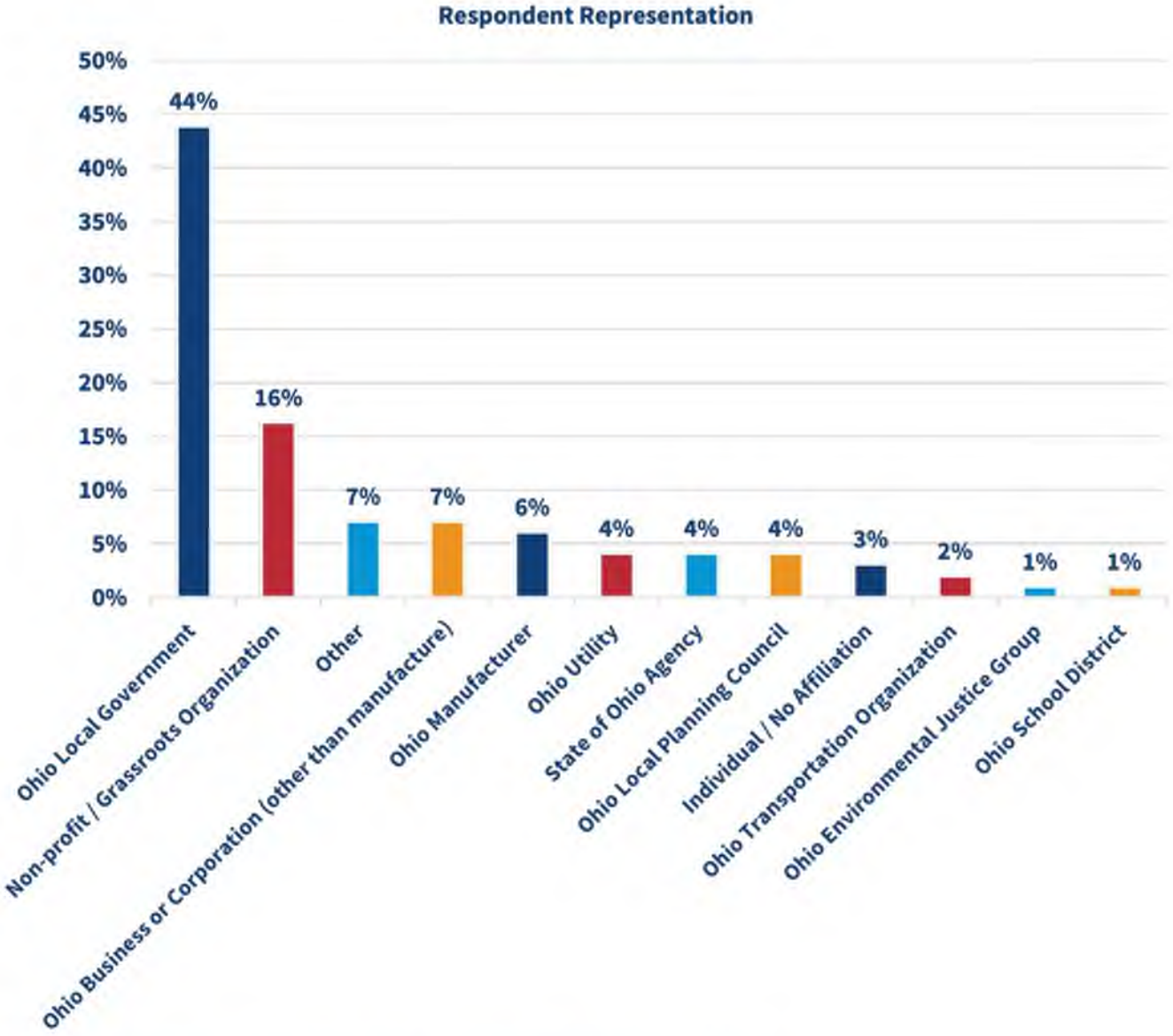

Figure 35. Survey Respondents Organization Representation

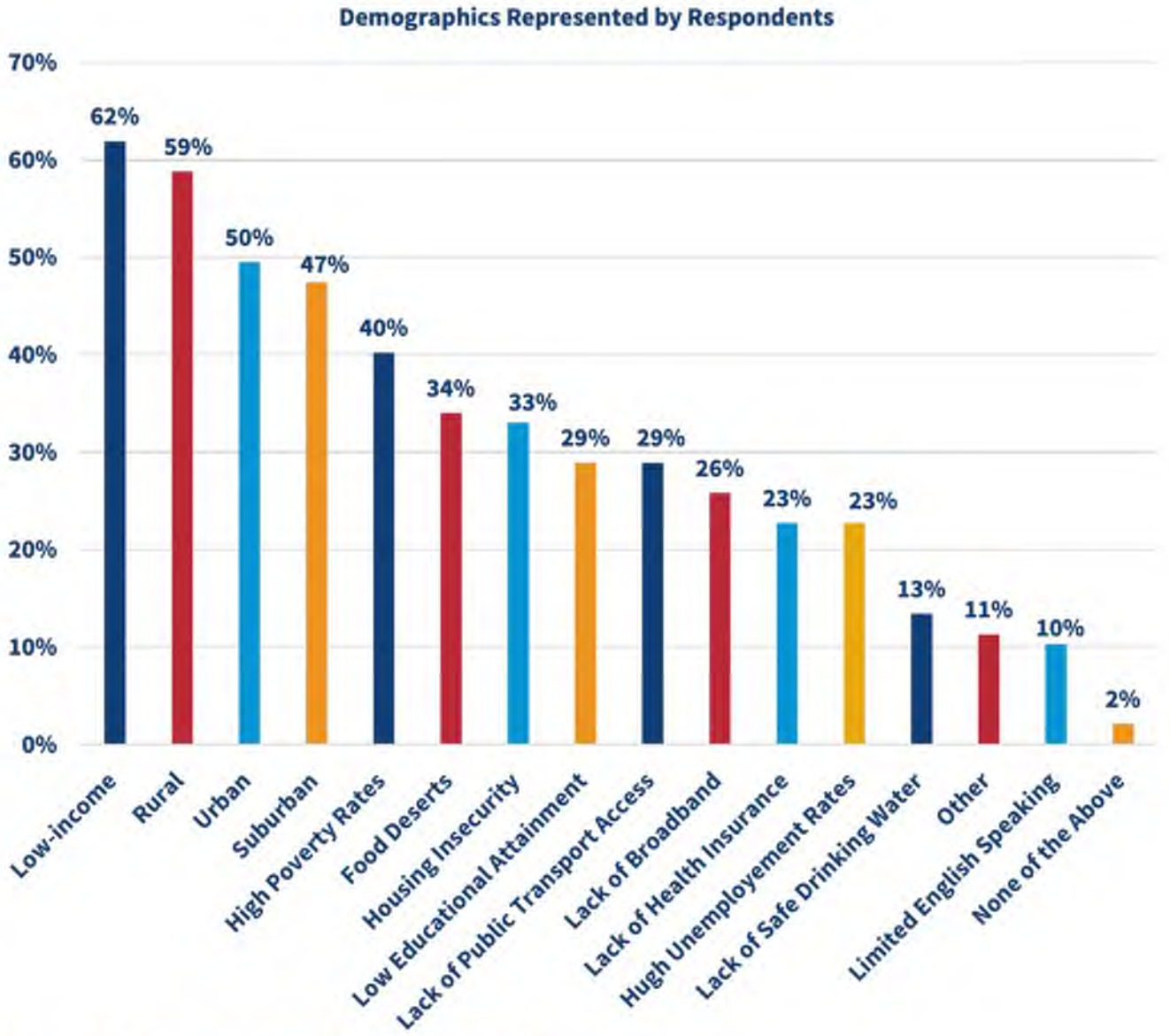

Figure 36. Demographics Represented by Respondents

Nearly two-thirds of respondents identify as low-income and there was nearly even representation of rural, urban, and suburban respondents. The representation of low-income and rural communities helps to validate that the needs and values of those often-underrepresented communities are considered as part of Ohio's Plan.

Respondents that selected "other" indicated they serve communities categorized by the following demographics:

- Amish communities
- Communities facing financial stressors
- Industrial areas

- Communities facing a lack of direct access to resources
- Communities with sewer / water infrastructure challenges

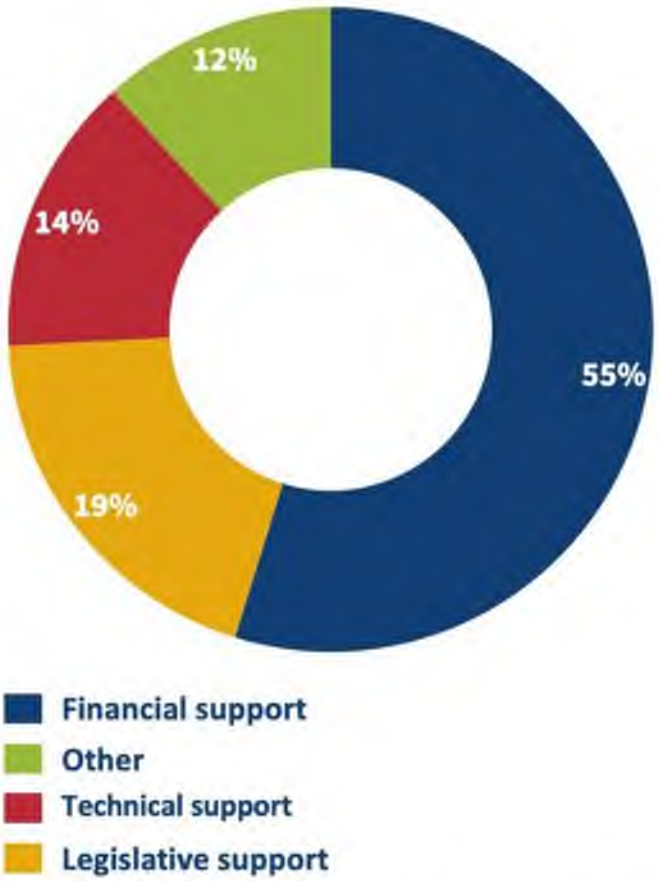

Figure 37. Support Needed to Implement GHG Reduction Measures

Financial support was requested most (55%), followed by legislative support (19%), then technical support (14%), and other (12%). Seeing that financial support is the most common request amongst respondents reinforces the need for Ohio EPA to remain collaborative when discussing funding opportunities across the state. A coordinated funding plan will ensure constituents across the state are receiving the most financial benefit as possible.

Respondents that selected "other" indicated they would benefit from support in the forms of:

- Workforce opportunities to support Ohio EPA initiatives across 32 Appalachian counties
- Collaboration and sharing of resources to address challenges
- The consolidation of a central vendor list for electrification of fleet

Collaborating on existing GHG emission reduction measures is an important step in developing both this Plan and the CRP. Through forums such as this survey, Ohio EPA captures details around what emission reduction measures are currently being designed and implemented on

local levels. This sharing of information will allow us to learn from other communities and organizations, ultimately driving successful strategies to include in the CRP.

This survey also allowed Ohio EPA to capture contact information, both for LIDAC representatives and other organizations, that will be critical as the outreach and engagement plans evolve for the CRP. With the expanded emission reduction scope in the CRP, Ohio EPA will leverage the recommendations shared to help ensure those underrepresented communities and organizations looking for a seat at the table are brought into additional planning effort.

TACTICS FOR AN INCLUSIVE ENGAGEMENT APPROACH

Over the Plan development period, engagement opportunities (webinars, small group discussions and one-on-one discussions) have been primarily virtual to capitalize on the number of discussions conducted in a short period of time. This shift to online platforms has allowed Ohio EPA to reach a wider audience and has enabled individuals from all over Ohio to participate in the sessions. When promoting forums such as public webinars, Ohio EPA would leverage social media and the CPRG webpage to socialize the registration and value of participating in these feedback opportunities.

In line with this virtual format, Ohio EPA has made materials and recordings of webinars available to attendees, allowing individuals who were unable to attend the live session to view and hear the content at their own convenience.

To ensure that Ohio EPA meets the evolving needs of stakeholders, a series of questions in a public survey were created to document the preferences of how to engage. Among the various questions asked, Ohio EPA specifically inquired into the importance of having informative materials available in languages other than English. This was an important component, as Ohio EPA recognizes the need to cater to the diverse needs of the state, many of whom speak languages other than English.

Comprehensive Resiliency Plan

Beyond this Plan, the next step of this program will be to develop a Comprehensive Resiliency Plan (CRP), to be published no later than fall 2025. While the Plan has focused on priority sectors that represent significant emissions sources to the state, the CRP will cover all GHG emissions sources and sinks. The CRP will establish both near-term and long-term targets for GHG emissions reductions in each of these sectors and provide strategies and plans to achieve these goals.

The CRP will include:

1. **A GHG inventory** – This GHG inventory will build on the initial inventory included in this Plan, providing additional detail and granularity on the sources of emissions in Ohio;

2. **GHG emissions projections** – A projection of Ohio's emissions to 2050;

3. **GHG reduction targets**, covering all significant GHG emissions sources in the state;

4. **Quantified GHG reduction measures** – Quantified emissions reductions to achieve the GHG emissions targets laid out in the CRP, including a description of the targeted geographic area, implementation schedule and milestones, key implementing agencies, and identification of funding sources. These measures will cover each of the main GHG emitting sectors:
    a. Electricity generation and use
    b. Commercial, public, industrial, and residential buildings
    c. Transportation
    d. Industrial processes
    e. Agriculture
    f. Natural and working lands
    g. Waste and materials management;

5. A **benefits analysis** for the full geographic scope and population covered by the plan – this analysis will include a base year analysis of co-pollutants and quantified estimates of anticipated co-pollutant reductions associated with the GHG reduction measures, as well as a potential broader assessment of impacts, such as public health outcomes;

6. **LIDAC benefits analysis** – The extent to which the GHG reduction measures proposed in the CRP will reduce co-pollutants and provide other benefits for LIDACs;

7. A review of **authority to implement**;

8. A plan to **leverage other federal funding**; and,

9. A **workforce planning analysis.**

To inform the CRP, Ohio EPA will refresh the stakeholder engagement approach to better support the expanded scope of the comprehensive plan. Ohio EPA will continue to engage with constituents across the state of Ohio that were instrumental in developing the Plan, especially those representing underrepresented demographics. Ohio EPA will leverage the stakeholder recommendations captured during Plan planning discussions and the public survey, including, but not limited to:

- Soil and Water Conservation Districts
- Ohio Agriculture Conservation Initiative
- Ohio Weatherization Programs
- Appalachian Regional Commission
- Rural County Commissions
- Ohio Environmental Councils
- Ohio Organics Council
- Environmental Consultants
- Electrification Coalitions

As the scope of GHG emission sources expands for the CRP, Ohio EPA will identify where new partnerships need to be established to drive collaboration on GHG emissions data and potential reduction measures. Similar to the engagement for this Plan, Ohio EPA will continue to promote in-person and virtual meetings, provide web-based information, and engage in public forums, allowing for widely accessible information and participation from organizations and constituents across Ohio.

Acronyms and Abbreviations

ACRONYM	FULL FORM
AFC	Alternative Fuel Corridor
AFDC	Alternative Fuels Data Center
AVERT	Avoided Emissions and Generation Tool
BAU	Business-as-usual
BEV	Battery Electric Vehicle
BIL	Bipartisan Infrastructure Law
BMV	Bureau of Motor Vehicles
BPD	DOE's Building Performance Database
CAGR	Compound Annual Growth Rate
CAIP	Clean Air Improvement Program
CAP	Criteria Air Pollutant
CCUS	Carbon Capture, Utilization, and Storage
CEJST	Climate and Economic Justice Screening Tool
CFWR	Composting and Food Waste Reduction
CH4	Methane
CMAQ	Congestion Mitigation and Air Quality
CNG	Compressed Natural Gas
CO2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalents
Coops	Cooperative Electric Utilities
CPRG	Climate Pollution Reduction Grant
CRP	Comprehensive Resiliency Plan
CSP	Concentrated Solar Power
DERG	Diesel Emission Reduction Grant
DOE	Department of Energy
DOT	United States Department of Transportation
ECO-Link	Energy Conservation for Ohioans- Link
EIA	Energy Information Administration
EE	Energy Efficiency
EDA	Economic Development Administration
EPA	United States Environmental Protection Agency
EV	Electric Vehicle
EVITP	Electric Vehicle Infrastructure Training Program
EVSE	Electric Vehicle Supply and Equipment
FCEV	Fuel Cell Electric Vehicle
F-gases	Fluorinated Gases
FHA	Federal Housing Administration
FHWA	Federal Highway Administration

GHG	Greenhouse Gas
GLCAP	Great Lakes Community Action Partnership
GNA	GNA Clean Transportation & Energy Consultants
GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
HEV	Hybrid Electric Vehicles
HFCs	Hydrofluorocarbons
HOV	High Occupancy Vehicle
HVAC	Heating, Ventilation, and Air Conditioning
ICE	Internal Combustion Engine
IMAP	Individual Microcredential Assistance Program
IOUs	Investor-Owned Utilities
IRA	Inflation Reduction Act
LADCO	Lake Michigan Air Directors Consortium
LIDAC	Low-Income and Disadvantaged Communities
LNG	Liquified Natural Gas
LPG	Liquified Petroleum Gas
LULUCF	Land Use, Land-Use Change, and Forestry
MDHD	Medium- and Heavy-Duty
MMT	Million Metric Tons
MMTCO2	Million Metric Tons of Carbon Dioxide
MMTCO2e	Million Metric Tons of Carbon Dioxide Equivalents
MORPC	Mid-Ohio Regional Planning Commission
MPOs	Metropolitan Planning Organizations
MRCI	Midwest Region Carbon Initiative
MSA	Metropolitan Statistical Area
MSW	Municipal Solid Waste
MTCO2e	Metric Tons of Carbon Dioxide Equivalent
MVRPC	Miami Valley Regional Planning Commission
MWh	Megawatt- Hours
N2O	Nitrous Oxide
NATA	United States EPA National Air Toxics Assessment (NATA)
NEI	National Emission Inventory
NEVI	National Electric Vehicle Investment
NF3	Nitrogen Trifluoride
NH3	Ammonia
NO2	Nitrogen Dioxide
NOACA	Northwest Ohio Areawide Coordinating Agency
NOX	Nitrogen Oxides
NREL	National Renewable Energy Laboratory
OAQDA	Ohio Air Quality Development Authority
OAR	Office of Air and Radiation
OARC	Ohio Association of Regional Councils
ODNR	Ohio Department of Natural Resources

ODOD	Ohio Department of Development
ODOT	Ohio Department of Transportation
OEM	Original Equipment Manufacturer
OEPA	Ohio Environmental Protection Agency
OKI	Ohio-Kentucky-Indiana
OMB	Office of Management and Budget
OWT	Ohio Office of Workforce Transformation
PACE	Property Assessed Clean Energy
PFAs	Per-and Polyfluoroalkyl Substances
PFCs	Perfluorocarbons
PHEV	Plug-in Hybrid Electric Vehicle
PM2.5	Particulate Matter 2.5 micrometers
PRP	Priority Resiliency Plan
PUCO	Public Utilities Commission of Ohio
PV	Photovoltaic
R10	R-Value of 10 (insulation value)
RAISE	Rebuilding American Infrastructure with Sustainability and Equity
RCRA	Resource Conservation and Recovery Act
ResStock	Residential Stock
RNG	Renewable Natural Gas
RPS	Renewable Portfolio Standard
RSEI	Risk-Screening Environmental Indicators
S&P	Standard & Poor's
SEIA	Solar Energy Industries Association
SF6	Sulfur Hexafluoride
SIT	State Inventory Tool
SO2	Sulfur Dioxide
SOC	Standard Occupational Classification
SOPEC	Sustainable Ohio Public Energy Council
SOx	Sulfur Oxides
TAP	Transportation Alternatives Program
TMACOG	Toledo Metropolitan Area Council of Governments
TSDF	Treatment, Storage, and Disposal Facilities
U.S.	United States
U.S. Bike Route	United States Bike Route
U.S. EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
WtE	Waste-to-Energy
ZEV	Zero Emission Vehicle

Appendix I: Coordination and Outreach Log

The following Table 10 showcases Ohio EPA's log of stakeholder engagement including one-on-one discussions, small group discussions, focus groups, and public webinars.

Table 9. Outreach and Coordination Log

DATE	MEETING / TOPIC(S) DISCUSSED	ORGANIZATIONS INVOLVED (IN ADDITION TO OHIO EPA)
6/14/2023	Ohio CPRG Managers Meeting	• Ohio MPOs
6/20/2023	CPRG Interagency Assistance	• Public Utilities Commission of Ohio (PUCO) • Department of Agriculture • Ohio Department of Transportation (ODOT) • Ohio Department of Natural Resources (ODNR) • Ohio Air Quality Development Authority (OAQDA)
7/14/2023	Ohio CPRG Managers Meeting	• Ohio MPOs
7/24/2023	ODOT Resilience Improvement Plan	• ODOT
8/1/2023	Ohio CPRG Managers Meeting	• Ohio MPOs
9/6/2023	Ohio CPRG Managers Meeting	• Ohio MPOs
9/6/2023	Conveners Network Meeting	• Conveners Network • Additional State Governments
9/26/2023	Conveners Network Meeting	• Conveners Network • Additional State Governments
9/27/2023	Lake Michigan Air Directors Consortium (LADCO) CPRG Meeting	• LADCO

10/5/2023	Overview of Ohio EPA's CPRG Program and Discussion of Points of Collaboration	• Sustainable Ohio Public Energy Council (SOPEC)
10/24/2023	Overview of Ohio EPA's CPRG Program and Discussion of Points of Collaboration	• Duke Energy
10/24/2023	Overview of Ohio EPA's CRPG Program	• Ohio Governor's Office
10/30/2023	Overview of Ohio EPA's CPRG and Discussion of Points of Collaboration	• NiSource • Columbia Gas
10/31/2023	Overview of Ohio EPA's CPRG and Discussion of Points of Collaboration	• Rural Action
11/9/2023	Ohio CPRG Managers Meeting	• City of Dayton • City of Cleveland • City of Columbus • MVRPC • OKI • NOACA • Green Umbrella
11/16/2023	Ohio EPA's CPRG Program Public Webinar (recording may be accessed here: https://youtu.be/f47yRf59phE)	• Organizations spanning the state, including Ohio Agencies, businesses, manufacturers, utilities, local governments, local planning councils, non-profits, and grassroot organizations
11/21/2023	Overview of Ohio EPA's CPRG, Initial Review of Emissions Data, and Discussion Regarding Dayton's Current Plan and Sustainability Planning	• City of Dayton, • Miami Valley Regional Planning Commission (MVRPC)
11/27/2023	Overview of Ohio EPA's CPRG and Discussion of Points of Collaboration	• Public Utilities Commission of Ohio (PUCO)

11/28/2023	Overview of Ohio EPA's CPRG, Initial Review of Emissions Data, and Discussion Regarding Columbus's Current PCAP and Sustainability Planning	• City of Columbus • Mid-Ohio Regional Planning Commission (MORPC)
11/29/2023	Overview of Ohio EPA's CPRG and Discussion of Points of Collaboration	• Ohio Association of Regional Councils (OARC)
12/5/2023	Overview of Ohio EPA's CPRG and Discussion of Points of Collaboration	• Toledo Metropolitan Area Council of Governments (TMACOG)
12/8/2023	Overview of Ohio EPA's CPRG, Initial Review of Emissions Data, and Discussion Regarding Cincinnati's Current Plan and Sustainability Planning	• City of Cincinnati • Ohio-Kentucky-Indiana (OKI) Regional Council of Governments
12/14/2023	Overview of Ohio EPA's CPRG and Discussion of Points of Collaboration	• Department of Agriculture
1/3/2024	Virtual Power Plan	• OAQDA • SOPEC • City of Dayton • MVRPC
1/4/2024	Overview of Ohio EPA's CPRG, Initial Review of Emissions Data, and Discussion Regarding Cleveland's Current Plan and Sustainability Planning	• City of Cleveland • Northwest Ohio Areawide Coordinating Agency
1/5/2024	CPRG Implementation Project	• OAQDA
1/8/2024	Battery Storage Projects in Appalachian Ohio	• OAQDA • Hecate Energy

1/10/2024	CPRG Program Focus Group to Review Priority Resiliency Plan Reduction Measures and LIDAC Considerations	• City of Athens • City of Toledo • City of Akron • City of Canton • Lucas County • SOPEC • Time to Recycle • Great Lakes Community Action Partnership (GLCAP)
1/11/2024	Educational Discussion of the CPRG Program and Plan Objectives	• ICANDO • Ohio State University
1/11/2024	Review of Initial Electric Power Reduction Measures	• Ohio Air Quality Development Authority (OAQDA)
1/12/2024	Review of Initial Building Reduction Measures	• Ohio Homes
1/12/2024	CPRG and Vehicle Electrification	• City of Cleveland • OAQDA
1/16/2024	Follow-up Discussion Regarding Initial Review of Emissions Data, and Discussion Regarding Cleveland's Current Plan and Sustainability Planning	• City of Cleveland • NOACA
1/17/2024	Overview of Ohio EPA's CPRG and Discussion of Points of Collaboration	• Holcim
1/18/2024	Overview of Ohio EPA's CPRG and Discussion of Points of Collaboration	• GNA Clean Transportation & Energy Consultants

1/19/2024	Review of Initial Transportation Reduction Measures	• Ohio Department of Transportation (ODOT)
1/25/2025	Follow-up Discussion of the City of Akron's Sustainability Initiatives and Opportunities for Alignment	• City of Akron
1/30/2024	Overview of Ohio EPA's CPRG and Discussion of Points of Collaboration	• Buckeye Hills Regional Council
2/21/2024	CPRG Plan Review and Q&A Public Webinar (recording may be accessed here: https://youtu.be/4AAnfE8vpro)	• Organizations spanning the state, including Ohio Agencies, businesses, manufacturers, utilities, local governments, local planning councils, non-profits, and grassroot organizations

Appendix II: GHG Inventory Supporting Documentation

In calculating the State of Ohio's Greenhouse Gas inventory, U.S. EPA's SIT was utilized. Default values from this tool were used to calculate emissions from all relevant sectors to Ohio, save for two sectors (transportation and electric power). To customize the outputs of the tool, data on total vehicle miles traveled (VMT) for Ohio vehicles in 2019 from the Ohio Bureau of Motor Vehicles was substituted to calculate the CO_2 emissions from mobile combustion. Data on Ohio's electric power generation, sourced for the 2019 Form EIA-923, was also used to customize the electric power data in the SIT.[105] Use of this custom data did not create significant variances between the default tool outputs.

Below, comparisons between both the SIT customized and default inventories, as well as U.S. EPA state-level GHG Inventory, can be found (see Table 1 for the state-level data breakdown).[106] Results from the SIT customized inventory largely aligned with the U.S. EPA data apart from three categories:

- **International Bunker Fuels:** This category is not included within the U.S. EPA State Level GHG Inventory
- **Stationary Combustion:** The sectors that contribute to U.S. EPA's Stationary Combustion module emissions are Commercial, Residential, Industry, and most significantly the Electric Power Industry. While the SIT does calculate stationary combustion in each of these areas, emissions are only included for N_2O and CH_4. CO_2 emissions are calculated within the "CO_2 from Fossil Fuel Combustion" section, and not broken out separately for Stationary Combustion. This results in a lower shown value within the Stationary Combustion module of the SIT.
- **Natural Gas and Oil Systems:** The U.S. EPA State Level GHG Inventory has three categories contributing to the Natural Gas and Oil Systems Category (MMTCO2e): Natural Gas Systems (8.5), Petroleum Systems (2.2), and Abandoned Oil and Gas Wells (1.1). Likewise to Stationary Combustion, the SIT only calculates CH_4 emissions associated with Natural Gas and Oil Systems emissions, lowering the SIT's count relative to the U.S. EPA state-level data.

[105] Form EIA-923 detailed data with previous form data (EIA-906/920) – U.S. Energy Information Administration (EIA)

[106] https://www.epa.gov/ghgemissions/state-ghg-emissions-and-removals

Table 10. Comparison of Ohio GHG emissions

2019 EMISSIONS SUMMARY BY SECTOR

	SIT CUSTOM		SIT DEFAULT			U.S. EPA STATE GHG		
Emissions (MMTCO2E)	Emissions	% of Total	Emissions	% of Total	% Difference from Custom	Emissions	% of Total	% Difference from Custom
Energy	198.72	90%	193.92	90%	-2%	198.03	89%	0%
CO2 from Fossil Fuel Combustion	192.81	87%	188.01	87%	-3%	183.39	83%	-5%
Residential	18.36	8%	18.36	8%	0%	18.23	8%	-1%
Commercial	12.28	6%	12.28	6%	0%	13.13	6%	7%
Industrial	29.08	13%	29.08	13%	0%	24.64	11%	-15%
Transportation	63.21	29%	60.07	28%	-5%	59.98	27%	-5%
Electric Utilities	69.11	31%	67.46	31%	-2%	67.42	30%	-2%
International Bunker Fuels	0.77	0%	0.77	0%	0%	0.00	0%	-100%
Stationary Combustion	0.72	0%	0.72	0%	0%	1.29	1%	80%
Mobile Combustion	0.61	0%	0.62	0%	1%	0.65	0%	7%
Coal Mining	0.89	0%	0.89	0%	0%	0.89	0%	0%
Natural Gas and Oil Systems	3.68	2%	3.68	2%	0%	11.80	5%	221%
Industrial Processes	15.10	7%	15.10	7%	0%	15.13	7%	0%

Agriculture	11.54	5%	11.54	5%	0%	12.63	6%	9%
LULUCF	(10.95)	-5%	(10.95)	-5%	0%	(10.34)	-5%	-6%
Waste	6.44	3%	6.44	3%	0%	6.58	3%	2%
Municipal Solid Waste	5.30	2%	5.30	2%	0%	5.29	2%	0%
Wastewater	1.15	1%	1.15	1%	0%	1.29	1%	13%
Indirect CO2 from Electricity Consumption*	88.20	-	88.20	-	0%	-	-	-
Gross Emissions by SIT Sector Totals	231.80	100%	227.01	100%	-2%	232.37	100%	0%
Sinks	(10.95)	-	(10.95)	-	-	(10.34)	-	-
Net Emissions	220.86	100%	216.06	100%	-2%	222.03	100%	-1%

Table 11. U.S. EPA Ohio GHG emissions in MMTCO$_2$e by Sector[107]

SIT TOOL CATEGORY MAPPING	SECTOR/SOURCE	2019	2021
	Transportation	62.0	56.5
Transportation	CO_2 from Fossil Fuel Combustion	60.0	54.7
Industrial Processes	Substitution of Ozone Depleting Substances	1.3	1.1
Mobile Combustion	Mobile Combustion	0.5	0.4
Industrial Processes	Non-Energy Use of Fuels	0.3	0.3
	Electric Power Industry	68.5	68.2
Electric Utilities	CO_2 from Fossil Fuel Combustion	67.4	66.9
Stationary Combustion	Stationary Combustion	0.9	0.9
N/A	Incineration of Waste	NO	NO
Industrial Processes	Electrical Equipment	0.1	0.1
Industrial Processes	Other Process Uses of Carbonates	0.1	0.1
	Industry	48.4	46.7

[107] Data were obtained from U.S. EPA's State-level GHG inventories file State-GHG_Trends_Emissions__Sinks_Economic_Sector_08312023.xlsx, which was accessed on 1/29/24. This data set is available at <https://www.epa.gov/ghgemissions/state-ghg-emissions-and-removals>.

NO = Not occurring

Symbols:

"-" indicates that the value has not be estimated at this time or is not applicable to the State

"+" indicates that the value does not exceed 0.005 MMT CO_2E

Industrial Processes	CO_2 from Fossil Fuel Combustion	24.6	23.3
Natural Gas and Oil Systems	Natural Gas Systems	8.5	7.9
Industrial Processes	Non-Energy Use of Fuels	3.1	2.3
Natural Gas and Oil Systems	Petroleum Systems	2.2	4.0
Coal Mining	Coal Mining	0.8	0.5
Industrial Processes	Iron and Steel Production	1.4	1.2
Industrial Processes	Cement Production	0.5	0.6
Industrial Processes	Substitution of Ozone Depleting Substances	1.2	1.1
Industrial Processes	Petrochemical Production	0.3	0.2
Industrial Processes	Lime Production	1.2	1.1
Industrial Processes	Ammonia Production	0.5	0.4
Industrial Processes	Nitric Acid Production	0.2	0.3
Natural Gas and Oil Systems	Abandoned Oil and Gas Wells	1.1	1.1
Wastewater	Wastewater Treatment	0.1	0.1
Industrial Processes	Urea Consumption for Non-Agricultural Purposes	0.2	0.2
Mobile Combustion	Mobile Combustion	0.2	0.2
Coal Mining	Abandoned Underground Coal Mines	0.1	0.1
N/A	Adipic Acid Production	NO	NO
Industrial Processes	Carbon Dioxide Consumption	0.2	0.2
N/A	Electronics Industry	NO	NO
Industrial Processes	N_2O from Product Uses	0.1	0.1

Stationary Combustion	Stationary Combustion	0.1	0.1
Industrial Processes	Other Process Uses of Carbonates	0.1	0.1
N/A	Fluorochemical Production	NO	NO
N/A	Aluminum Production	NO	NO
N/A	Soda Ash Production	NO	NO
Industrial Processes	Ferroalloy Production	0.7	0.7
Industrial Processes	Titanium Dioxide Production	0.3	0.2
N/A	Caprolactam, Glyoxal, and Glyoxylic Acid Production	NO	NO
Industrial Processes	Glass Production	0.1	0.1
Industrial Processes	Magnesium Production and Processing	0.1	0.1
N/A	Zinc Production	NO	NO
N/A	Phosphoric Acid Production	NO	NO
N/A	Lead Production	NO	NO
Municipal Solid Waste	Landfills (Industrial)	0.5	0.5
Industrial Processes	Carbide Production and Consumption	+	+
	Agriculture	13.6	13.4
Agriculture	N_2O from Agricultural Soil Management[1,2]	7.5	7.0
Agriculture	Enteric Fermentation	2.8	2.8
Agriculture	Manure Management	2.2	2.1
Commercial	CO_2 from Fossil Fuel Combustion	1.0	1.3
Agriculture	Rice Cultivation	NO	NO
Agriculture	Urea Fertilization	0.1	0.1
Agriculture	Liming	NO	NO

Mobile Combustion	Mobile Combustion	0.0	0.0
Agriculture	Field Burning of Agricultural Residues[1,2]	0.0	0.0
Stationary Combustion	Stationary Combustion	+	+
	Commercial	20.2	19.9
Commercial	CO_2 from Fossil Fuel Combustion	12.1	11.3
Municipal Solid Waste	Landfills (Municipal)	4.8	5.4
Industrial Processes	Substitution of Ozone Depleting Substances	2.0	1.9
Wastewater	Wastewater Treatment	1.2	1.2
Agriculture	Composting	0.0	0.0
Stationary Combustion	Stationary Combustion	0.1	0.1
Stationary Combustion	Anaerobic Digestion at Biogas Facilities	0.0	0.0
	Residential	19.5	18.2
Residential	CO_2 from Fossil Fuel Combustion	18.2	17.0
Industrial Processes	Substitution of Ozone Depleting Substances	1.0	1.0
Stationary Combustion	Stationary Combustion	0.3	0.2
	Total Emissions (Sources)	232.4	222.8
LULUCF	Land-Use, Land-Use Change, and Forestry (LULUCF) Sector Net Total	(10.3)	(10.6)
Net Emissions (Sources and Sinks)		**222.0**	**212.2**

Table 12. Fossil Fuel Types Captured in Emissions Inventory for Electric Power, Buildings, and Other Energy Sectors[108]

RESIDENTIAL	COMMERCIAL	INDUSTRIAL	TRANSPORTATION	ELECTRIC POWER	OTHER ENERGY[109]
• Coal • Natural Gas • Distillate Fuel • Kerosene • Hydrocarbon • Gas • Liquids	• Coal • Natural Gas • Distillate Fuel • Kerosene • Hydrocarbon • Gas • Liquids • Motor • Gasoline • Residual Fuel	• Coking/other coal • Natural Gas • Distillate Fuel • Kerosene • LPG • Motor Gasoline • Residual Fuel • Lubricants • Asphalt/Road Oil • Crude Oil • Feedstocks • Misc. Petroleum Products • Petroleum Coke • Pentanes Plus • Still Gas • Special Naphthas • Unfinished Oils • Waxes • Aviation Gasoline Blending Components • Motor Gasoline Blending Components	• Coal • Natural Gas • Distillate Fuel • Hydrocarbon Gas Liquids • Motor Gasoline • Residual Fuel • Lubricants, • Aviation Gasoline • Jet Fuel, Kerosene • Jet Fuel, Naphtha	• Coal • Natural Gas • Distillate Fuel • Residual Fuel • Petroleum Coke	• Jet Fuel, Kerosene • Distillate Fuel • Residual Fuel

[108] Fuel types are listed as per the SIT user guide for the CO2FFC module.

[109] International bunker fuels only.

Appendix III: GHG Reduction Measures Supporting Documentation

GHG reduction calculation methodology is documented within this Appendix for each priority measure alongside key assumptions and considerations for enhancement for Ohio's CRP. While each measure has unique assumptions and CRP considerations, the following apply to all priority measures:

KEY ASSUMPTIONS:

- Baseline business-as-usual (BAU) emissions remain level 2025 – 2050 to Ohio's 2019 GHG inventory, where 2019 is the latest year available that is not a year impacted by COVID-19.
- 2019 or otherwise, the latest year available for data, is assumed to be a proxy for 2024 GHG emissions or trends.
- Adoption rates based on historical trends are assumed to apply to future projections.
- Structure of potential Implementation Grants is illustrative for GHG reduction modeling, and subject to change for any potential Implementation Grant applications, as is the requested award value and receipt of award subject to change.

OPPORTUNITIES TO REFINE FOR OHIO'S CRP:

- For each priority measure in the Plan, one or two emission reduction scenarios were considered based on activities and assets impacted. For the CRP, GHG reduction measures will be expanded to be inclusive of all activities with direct emission reduction potentials.
- Data for the CRP related to customizing the GHG inventory, calculating GHG projections, and modeling GHG reductions will begin to be inventoried following submission of the Plan. GHG projections will be calculated for:

Table 13. Projection Data and Calculation Considerations for CRP

PROJECTION TYPE	DATA AND CALCULATION CONSIDERATIONS
BAU	Integrate annual growth factors such as population growth, vehicle registration growth, net change in buildings square footage including demolition and new construction, etc. to the respective sectors and sources of emissions impacted.
Modified BAU – State Implementation actions	Integrate growth factors based on impacts of existing State policies that impact future years (such as Ohio's Renewable Portfolio Standard (RPS)) or planned State policies and State administered programs such as NEVI public charger expansion and expected expansion of ZEV adoption. [110]
Modified BAU – Statewide actions	Integrate growth factors based on impacts of existing Municipal and Metropolitan Statistical Area (MSA) policies that impact future years (such as Ohio's Renewable Portfolio Standard (RPS)) or planned Municipal/MSA policies and programs such as those included in other Ohio MSA Priority Climate Action Plans.
Select Decarbonization Measure	Calculate the near-term (2025 – 2030) and long-term (2030 – 2050) GHG emission reductions for each reduction measure included in this Plan and any additional measures included in the CRP, including the impacts of each direct implementation activity. Any measures awarded to Ohio via the Implementation Grants application will be included (to the State among other organizations including Municipalities and MSAs). Additionally, geographic-specific analyses at the county level will be considered where relevant to the measure.
Decarbonization Pathway	Calculate cumulative GHG emission reductions near- and long-term for the combined impact of decarbonization measures aligned to GHG reduction targets to be set by the State during the CRP planning period
Sector Decarbonization Pathway	Calculate cumulative GHG emission reductions near- and long-term for the combined impact of decarbonization measures for a specific sector aligned to any sector-specific GHG reduction targets to be set by the State during the CRP planning period

[110] Ohio Electric Vehicle Infrastructure Deployment Plan

MEASURE	METHODOLOGY	POTENTIAL IMPLEMENTING AGENCIES
#1 Zero Emission Light-Duty Vehicles	**Identifying the current market and growth** Ohio light-duty vehicle registration data from the Alternative Fuels Data Center (AFDC) was analyzed for the time-period available 2016 – 2022.[111] Annual growth rates for battery electric vehicles (BEV) and plug-in / hybrid electric vehicles (PHEV/HEV) were evaluated and the compound annual growth rate (CAGR) for the six-year period calculated to serve as an estimated adoption rate for future BEV and PHEV growth. CAGRS for Ohio were compared to U.S. trends and were largely consistent:	• Ohio Department of Transportation • Ohio Environmental Protection Agency

VEHICLE CATEGORY	OH CAGR (%) 2016 – 2022	U.S. CAGR (%) 2016 – 2022
PHEV/HEV	11%	11%
BEV	54%	43%
Total Vehicles	0.31%	1%

Forecasting 2025 – 2030 adoption

These CAGRS were then applied annually to the year prior to estimate 2025 – 2030 number of PHEVs and BEVs, respectively that are new to the market, converting from ICE vehicles (e.g., 2025 estimated based on the CAGR multiplied by the latest year reported AFDC vehicle registration data).

Calculating GHG emission reductions

U.S. EPA's Avoided Emissions and Generation Tool (AVERT) v4.2 was then used to calculate CO_2 and co-pollutant emission reductions based on the number of additional BEV and PHEV vehicle registrations respectively, taking the average new vehicle registrations from 2025 – 2030. Registrations were assumed to replace existing vehicles with the marginal (0.31%) growth in net new vehicles.

[111] Alternative Fuels Data Center: Vehicle Registration Counts by State (energy.gov)

Considering additional GHG emission reductions

Next, an estimate was made for how many additional BEVs, and PHEVs, would be adopted for every $500 of grant, subsidy, and or tax credit provided to purchasers of light-duty passenger vehicles. Literature reviews and peer-reviewed journal articles that report an average 2% adoption rate for every $500 in financial assistance.[112,113]

Recognizing there is already a $7,500 federal EV incentive, it was assumed for this estimate of additional GHG reductions that on average that the State would provide:

TYPE OF VEHICLE	MODELED POTENTIAL INCENTIVE
BEV	$3,500
PHEV	$1,500
Average	$2,500

If the State of Ohio were to win a $200,000,000 low-end Tier A implementation grant award, this would equate to a maximum of 80,000 new BEVs/PHEVs in Ohio with expected annual growth rates of 2% per every $500 across BEVs and PHEVs, respectively. *(Note: this is not representative of a precise Implementation Grant project, but a scenario for which to calculate additional GHG emission reduction potential).*

TYPE OF VEHICLE	ANNUAL GROWTH IF 2% INCREASE PER $500 INCENTIVE
BEV	15%
PHEV	6%

[112] Evaluating Electric Vehicle Policy Effectiveness and Equity | Annual Review of Resource Economics (annualreviews.org)

[113] Subsidizing low- and middle-income adoption of electric vehicles: Quasi-experimental evidence from California - ScienceDirect

BEV and PHEV additional growth rates were applied to existing registrations to determine 2025 converted BEVs and PHEVs and beyond to estimate 2026 – 2030 converted BEVs and PHEVs. This results in approximately 60,000 new BEVs and PHEVs in Ohio by 2030. Thus, remaining potential funds could support additional vehicles, private charging infrastructure, outreach, education, workforce development, and other technical assistance.

The average of the additional expected BEVs and PHEVs from 2025 – 2030 were then entered in AVERT to calculate additional avoided CO_2 and co-pollutant emissions per year, which were summed to calculate cumulative 2025 – 2030 estimated emission reductions.

For 2030 – 2050 emission reductions, the CAGR was not considered, but rather additional BEVs/PHEVs converted across the 20 years was assumed to be four times the anticipated adoption 2030 – 2050.[114]

MEASURE-SPECIFIC ASSUMPTIONS

While electric vehicles were the focus on this calculation for this Plan, other zero emission vehicle (ZEV) types can be considered for the CRP such as green hydrogen fuel cell, or partially clean other alternative fuels like renewable natural gas (RNG) and biodiesel. Ohio may decide to define ZEV and what types of vehicles are included differently as well especially in terms of eligibility for any future policies, programs, or projects including any Implementation Grants.

[114] Projections for the proportion of renewables on the grid 2030 – 2050 and proportion of vehicles that are ZEV expected on the road 2030 – 2050 with CAGRs applied annually surpasses penetration rates considered feasible for a long-term emission reduction estimate; feasibility for long-term adoption rates and emission reductions will be further assessed in the CRP.

When calculating in AVERT, expected MW of solar and wind was including in the ZEV expansion reduction calculation (see Renewable Electricity Generation methodology below)
The following are AVERT specific assumptions (full methodology can be found here):
Considers additional electricity generation emissions required to charge ZEVs as well as reductions in tailpipe exhaust emissions.
EVs get more efficient with newer model years (2025 model year replacing existing vehicles was the setting utilized.
Uses Ohio's regional electricity grid's carbon intensity (with input renewable modifications).
EVs get more efficient with newer model years (2025 model year replacing existing vehicles was the setting utilized).
Default time of day and days of the week charging demand and the ratio of light-duty passenger cars versus trucks
Nationwide average vehicle miles traveled (VMT) of 11,543 miles in each year per light-duty vehicle.
PHEVs run 54% on electricity and 46% from fossil fuel.
CH_4 and N_2O emissions are negligible compared to the magnitude of CO_2, which is the only GHG for which AVERT accounts.
Measure-Specific Opportunities to Refine for Ohio's CRP
Estimate CH_4 and N_2O emission reductions outside of AVERT
Adjust BEV and PHEV growth assumptions alongside renewable electricity assumptions based on GHG Projections (including having multiple scenarios)
Calculate cumulative emissions based on precise estimated vehicles adopted each year rather than a 5-year average adoption rates

#2 Zero Emission Medium/Heavy-Duty Vehicles

Identifying the current market and growth

Buses were selected as the medium/heavy-duty (MHD) asset of focus for GHG reduction calculations for this Plan aligned with the U.S. EPA AVERT tool's capabilities; however, this will be expanded to cover other MHD asset classes for the CRP. Ohio BMV Vehicle Registration data for 2022 was utilized as a proxy for 2024 to determine the total number of buses.[115]

Calculating GHG emission reductions

Next, indicative prices for diesel and electric transit and school buses were collected;[116]

$500,000 for a diesel transit and $750,000 for an electric transit bus

$110,000 for a diesel transit and $250,000 for an electric transit bus

With an average financial assistance of $500,000 per bus, if the State of Ohio were to win a $200,000,000 low-end Tier A implementation grant award, this would equate to 400 new electric buses *(Note: this is not representative of a precise Implementation Grant project, but a scenario for which to calculate additional GHG emission reduction potential)*.

Electric transit buses and electric school buses were then entered in AVERT v4.2 to calculate additional avoided CO_2 and co-pollutant emissions. The number of vehicles selected by type, 40 transit buses and 360 electric school buses, each reflect a reported 4% of the annual vehicle sales in the Mid-Atlantic Ohio region from AVERT (with there being a smaller number of new transit buses or conversion of existing buses being required each year).

MEASURE-SPECIFIC ASSUMPTIONS

- Ohio Department of Transportation
- Ohio Environmental Protection Agency

[115] Ohio BMV

[116] Electric buses for mass transit seen as cost effective | American Public Power Association

While electric vehicles were the focus on this calculation for this Plan, other zero emission vehicle (ZEV) types can be considered for the CRP such as green hydrogen fuel cell, or partially clean fuels like renewable natural gas (RNG) and biodiesel. Ohio may decide to define ZEV and what types of vehicles are included differently as well especially in terms of eligibility for any future policies, programs, or projects including any Implementation Grants.
When calculating in AVERT, expected MW of solar and wind was including in the ZEV expansion reduction calculation (see Renewable Electricity Generation methodology below))
The following are AVERT specific assumptions (full methodology can be found here):
Considers additional electricity generation emissions required to charge ZEVs as well as reductions in tailpipe exhaust emissions.
EVs get more efficient with newer model years (2025 model year replacing existing vehicles was the setting utilized.
Uses Ohio's regional electricity grid's carbon intensity (with input renewable modifications).
EVs get more efficient with newer model years (2025 model year replacing existing vehicles was the setting utilized).
Default time of day and days of the week charging demand left unchanged.
Nationwide average vehicle miles traveled (VMT) of 12,000 miles in each year per bus and 43,647 miles in each per transit bus
CH_4 and N_2O emissions are negligible compared to the magnitude of CO_2, which is the only GHG for which AVERT accounts.
Measure-Specific Opportunities to Refine for Ohio's CRP
Estimate CH_4 and N_2O emission reductions outside of AVERT.

	Adjust electric transit and school bus growth assumptions alongside renewable electricity assumptions based on GHG Projections (including having multiple scenarios). Calculate cumulative emissions based on precise estimated vehicles adopted each year.	
#3 Transportation Efficiency	**Identifying the current market and growth** Modal transportation shifts away from fossil fuel vehicles to less carbon intensive public transit, biking, and walking mode shares was the focus of the Transportation Efficiencies GHG reduction calculations for the Plan; however, this will be expanded to cover other transportation efficiencies for the CRP. ODOT's Walk.Bike.Ohio Existing Conditions Summary Report (2020) definitions the current share of commuting in Ohio that's by walking and biking.[117]	• Ohio Department of Transportation • Municipal / Regional Transit Agencies • Municipal / Regional Planning Agencies

TRANSPORTATION TYPE	PROPORTION OF OHIO COMMUTING MILES (%)
Bike	0.3%
Walk	2.2%
Bike + Walk	2.5%

Forecasting adoption and GHG emission reductions

ODOT reports that if the current share of commuting miles by biking and walking were to increase by 1.1% total, then 340,000 $MTCO_2e$ would be mitigated annually. While a 1.1% increase is a target, the Northeast Ohio Areawide Coordinating Agency (NOACA) reports that combined public-transit, biking, and walking VMT is expected to increase from 6.3%

[117] WBO_ExistingConditionsSummary_Final.pdf (ohio.gov)

to 7% by 2030, totaling a 0.7% increase.[118] Comparing a 0.7% to a 1.1% increase (0.7% / 1.1%) and ODOT's GHG mitigation potential of 340,000 $MTCO_2e$, there would still be a 216,364 MTCO2e reduction by 2030.

Considering additional GHG emission reductions

Scenario: Bike expansion was the focus of the Transportation Efficiencies additional GHG reductions scenario for the Plan; however, this will be expanded to cover other transportation efficiencies for the CRP. Bikes and specifically e-bikes represent are a zero-carbon mode of travel shift, with electricity consumption emissions from e-bikes considered negligible. 119 A shift from motor vehicles such as cars to public transit is another mode shift, for example, that will be evaluated further for the CRP.

This additional GHG reduction scenario considers if the State of Ohio were to win a $200,000,000 low-end Tier A implementation grant award. (Note: this is not representative of a precise Implementation Grant project, but a scenario for which to calculate additional GHG emission reduction potential).

Costs: Median e-bike prices are reportedly $1,305.50 and there have been multiple government directed incentive programs across the nation that have subsidized costs to expand this low-carbon transit option. Average incentive provided across programs analyzed in this peer-reviewed study was nearly $500, which covers one-third to one-half of an e-bikes cost.120 Therefore, assuming a 50% cost share incentive program with median e-bike costs of $1,305.50, the State could supply approximately 306,396 Ohioans e-bikes, assumed to be deployed in 2025.

Relevant Vehicle Miles Traveled and Trips: To calculate associated carbon reductions, e-bikes were assumed to be only used for commuting twice a day for trips less than one

[118] 9911f1_93e865ff216d4aadad50005dc0fc3cfb.pdf (filesusr.com)

[119] Impacts of e-bike ownership on travel behavior: Evidence from three northern California rebate programs - ScienceDirect

[120] Impacts of e-bike ownership on travel behavior: Evidence from three northern California rebate programs - ScienceDirect

mile (recognizing the limitations of e-bikes for longer mileage travel). FHWA data was used to determine the total numbers of annual miles traveled and annual trips in the U.S. under one mile.121 To then calculate the proportion of these miles attributable the Ohioans commuting population, the total Ohio Employed (5,591,400) from the U.S. Bureau of Labor Statistics122 was divided by the total U.S. Population from the Census Bureau123 (11,759,697) to estimate Ohio's proportional share of 4% for annual miles and trips traveled that are less than one mile (< 1) .

Next, studies on commuter habits have shown that those with e-bikes will displace anywhere from 20% to 86% of their car trips.124 Taking the low-end of this range, assuming 20% of Ohio's 4% share of commuting miles on < 1-mile trips are replaced by e-bikes, 71 million vehicle millions would be converted from assumedly gasoline passenger car to "zero" emission e-bikes.

Emission Reduction Calculations: To calculate the emissions associated with this reduction in gasoline passenger car vehicle miles, average miles per gallon for a U.S. passenger car from the U.S. EPA of 25.4 mpg was applied,125 and then multiplied by the U.S. EPA GHG Emission Factors Hub, Table 2 Mobile Combustion CO2 factor for motor gasoline of 8.78 kgCO2 per gallon consumed. This output represents the total potential for e-bike emission reductions if 20% of all miles traveled in trips < 1 mile were to be switched to e-bike.

To assess reasonable adoption, the number of new e-bikes (306,396) that could be delivered by a potential implementation grant was assumed to be the total number of reasonable new users. Assuming commuters travel twice a day, every day on trips < 1 mile, there would be approximately 1,057,579 total potential e-bike candidates in the

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121 NHTS Data Extraction Tool (ornl.gov)

122 Ohio Economy at a Glance (bls.gov)

123 U.S. Census Bureau QuickFacts: Ohio

124 The impact of e-cycling on travel behaviour: A scoping review - PMC (nih.gov)

125 EPA Report: U.S. Cars Achieve Record High Fuel Economy and Low Emission Levels as Companies Fully Comply with Standards | US EPA

	State. The total 306,396, new e-bikes purchased by users would then equate to 29% of users. Thus, 29% of the < 1 mile trip commuting miles by car would be reduced to "zero" emissions. **MEASURE-SPECIFIC ASSUMPTIONS** ODOT's carbon reduction calculation reflects a blended biking, walking, and public transit emission reduction potential **MEASURE-SPECIFIC OPPORTUNITIES TO REFINE FOR OHIO'S CRP** Estimate CH_4 and N_2O emission reductions alongside CO_2 in addition to calculating the marginal electricity consumption emissions attributable to e-bikes	
#4 Renewable Electricity Generation	**Identifying the current market and growth** Solar Energy Industries Association (SEIA) Ohio state data was utilized to evaluate current megawatts (MW) of solar installed and five-year growth projections. These projections were then used to calculate an annual growth rate of 24% based on current MW installed.[126] To evaluate the proportion of utility-scale versus distributed rooftop, Project Sunroof reported Ohio rooftop installations were subtracted from total SEIA reported installations.[127] To then estimate MW of utility-scale solar versus distributed rooftop, the average size of a rooftop system was calculated based on EIA reported annual electricity consumption in kilowatt hours (kWh)[128] and Ohio peak sunlight hours of 4.15 whereby kWh per year is divided by 365 days in a year multiplied by peak sunlight hours.[129] The average Ohio rooftop system size of 6.79kW was then multiplied by total rooftop systems to calculate an estimated 19 MW of rooftop solar in Ohio, which was subtracted from total SEIA reported MW installed in the state (for which the remainder was assumed to be utility-scale).	• Ohio Environmental Protection Agency • Ohio Air Quality and Development Authority • Utilities • Municipal / Regional Planning Agencies

[126] Ohio Solar | SEIA

[127] Project Sunroof - Data Explorer | Ohio

[128] Residential Energy Consumption Survey Dashboard (arcgis.com)

[129] Sunlight Hours Rank | TurbineGenerator

- Ohio Public Utilities Commission

Forecasting 2025 – 2030 Adoption

SEIA reported annual growth rate of 24% was assumed to apply the same to both utility and rooftop systems. For wind, where there were no growth projections, U.S. Energy Information Agency (EIA), Ohio state wind MW hours (MWh) generation data was analyzed to calculate a 2016 – 2022 six-year CAGR growth trend of 17% akin to the CAGR used for the light-duty ZEV analysis.[130] Annual growth rates for wind, utility-scale solar, and distributed rooftop solar, were then applied to current MWs to estimate annual additional MWs 2025 – 2030.

Calculating GHG emission reduction

U.S. EPA's AVERT v4.2 was then used to calculate CO_2 and co-pollutant emission reductions based on the average number of new MWs across wind and solar 2025 – 2030 where solar was divided into utility-scale and distributed rooftop solar.

Considering additional GHG reductions

Next, an estimate was made for how many additional renewable MW could be deployed; for the Plan a utility-scale solar scenario was evaluated whereby if the State were to win a $200,000,000 low-end Tier A implementation grant award, this would equate to 300 MW additional utility-scale solar assuming 50% matching upfront costs with utility-solar capital development costs from the U.S. Department of Energy (DOE) National Renewable Energy Laboratory (NREL). [131] *(Note: this is not representative of a precise Implementation Grant project, but a scenario for which to calculate additional GHG emission reduction potential).*

[130] Electricity data browser - Net generation for all sectors (eia.gov)

[131] Index | Electricity | 2022 | ATB | NREL

	MEASURE-SPECIFIC ASSUMPTIONS AVERT Assumptions (full methodology can be found here) **MEASURE-SPECIFIC OPPORTUNITIES TO REFINE FOR OHIO'S CRP** Estimate CH_4 and N_2O emission reductions alongside CO_2 While utility-scale solar was the technology focus for the emission reduction calculation, other types of solar and renewable energy sources could be considered for expansion (utility-scale solar does not duplicate potential residential federal solar funding through Solar for All)	
#5 Building Energy Efficiency	**Identifying the current market** Both residential and then commercial and industrial (C&I) building markets were assessed for potential energy efficiency (EE) emission reductions. For residential buildings, NREL's State Level Residential Building Stock and Energy Efficiency & Electrification Packages Analysis (ResStock)[132] was used to assess the number of residential households in Ohio (4.5 million) and their characteristics, meanwhile for commercial buildings, the DOE's Building Performance Database (BPD) was used to assess C&I building characteristics and a conservative estimated for total number of reported C&I buildings (< 1 million) in lieu of state-specific data for the Plan (something which will be sought out for the CRP analyses). **Calculating GHG emission reductions – Residential Buildings** For residential buildings, ResStock was used to calculate the average emission savings for an Ohio household (a weighted average across single-family, multi-family, and mobile housing stick) to implement basic and enhanced energy efficiency as well as minimum and high efficiency electric heat pumps (see #6 Clean Heating). Basic / minimum efficiency options were averaged with the enhanced / high efficiency options to calculate the average median emission savings for EE and electrification, respectively. ResStock considers many building aspects to calculate savings including building age and geographic location (e.g., Ohio's Climate Zone).	• Ohio Environmental Protection Agency • Municipal / Regional Planning Agencies • Department of Development • Utilities

[132] State Level Residential Building Stock and Energy Efficiency & Electrification Packages Analysis | Tableau Public

RESIDENTIAL UPGRADE	MEDIAN EMISSION SAVINGS (%)	ESTIMATED CAPITAL COSTS ($) PER RESIDENTIAL HOUSEHOLD
EE	21%	$44,175[133]
Electrification	37%	$5,500[134]

Next, an estimate was made for how many Ohio households could be targeted for EE and electrification, respectively; if the State were to win a $200,000,000 low-end Tier A implementation grant award for both EE and electrification, this would equate to 4,527 homes enhanced with EE and 36,364 homes receiving electrification assuming 100% of capital costs are covered (e.g., such as a targeted program for LIDAC familiar). *(Note: this is not representative of a precise Implementation Grant project, but a scenario for which to calculate additional GHG emission reduction potential).*

The median emission savings for each were then multiplied by the percent of total Ohio households targeted for EE and electrification to calculate the emission reduction potential against Ohio's 2019 baseline residential building emissions.

Calculating GHG emission reductions – C&I Buildings

For C&I buildings, similar emission reduction potentials from EE and electrification were sourced alongside costs. Where costs were supplied per square foot, the BPD reported average C&I square footage of 58,937 was assumed to be the building size to calculate estimated capital costs per C&I buildings.

[133] Report: Deep Retrofits Can Halve Homes' Energy Use and Emissions | ACEEE

[134] How Much Does Heat Pump Installation Cost? (2023 Guide) (homeinspector.org)

C&I UPGRADE	MEDIAN EMISSION SAVINGS (%)	ESTIMATED CAPITAL COSTS ($) PER C&I BUILDING
EE	45%[135]	$9.9 million[136]
Electrification	37%[137]	$1.2 million[138]

Next, an estimate was made for how many Ohio C&I buildings could be targeted for EE and electrification, respectively; if the State were to win a $200,000,000 low-end Tier A implementation grant award for both EE and electrification, this would equate to 40 C&I buildings receiving enhanced with EE and 323 C&I buildings receiving electrification assuming a 50% capital cost share. *(Note: this is not representative of a precise Implementation Grant project, but a scenario for which to calculate additional GHG emission reduction potential).*

The median emission savings for each were then multiplied by the percent of total Ohio C&I buildings targeted for EE and electrification to calculate the emission reduction potential against Ohio's 2019 baseline combined C&I building emissions.

MEASURE-SPECIFIC ASSUMPTIONS

Costs and emission savings specific to commercial buildings such as commercial office buildings are also applicable to industrial buildings.

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[135] Average energy and emission reduction potentials from three common DOE reported C&I EE measures 1) Occupancy Sensors Wireless Occupancy Sensors for Lighting Controls: An Applications Guide for Federal Facility Managers (energy.gov); 2) LED Lighting LED Lighting | Department of Energy and 3) Programmable Smart Thermostats Programmable Thermostats | Department of Energy

[136] In lieu of C&I specific EE costs, the difference in cost of a residential compared to C&I electrification was applied to the residential EE costs

[137] Restock savings was used as a proxy in lieu of C&I specific emission reduction potentials

[138] The Building Electrification Technology Roadmap - New Buildings Institute

	Only one year's worth of emission reductions is accounted for assuming buildings are retrofitted by 2030; however, emissions would be even greater if buildings were retrofitted prior to 2030. **MEASURE-SPECIFIC OPPORTUNITIES TO REFINE FOR OHIO'S CRP** Collect Ohio specific labor and installation costs from contractors to tailor EE and electrification costs.	
#6 Clean Heating	See #5 for calculation steps. Building electrification was selected as the clean heating GHG reduction scenario for the Plan; however, for the CRP this can be expanded to include other clean heating options such as ground-source geothermal heat pumps.	• See # 5
#7 Composting	**Identifying the current market** Ohio EPA's Economic Impact Potential of Recycling in Ohio Final Report from 2019 was used to assess the different waste streams in the state, in order to determine the volume of organic waste that would be subject to potential composting.[139] Organic waste includes food and yard waste. **ANNUAL ORGANIC WASTE DISPOSED IN OHIO (TONS)** / **PROPORTION OF TOTAL WASTE DISPOSED IN OHIO (%)** 2,291,521 / 23.9% Out of this total tonnage of organic waste, the GHG Inventory results revealed that 64% is already being diverted from producing emissions through composting oxidation, flaring and waste to energy; therefore, only 36% or nearly 800,000 tons of this waste remain to target for composting, whereby they would be diverted from landfills producing methane emissions. **Calculating GHG emission reductions**	• Ohio Environmental Protection Agency • Local waste operators • Municipal / Regional Planning Agencies

[139] Ohio Report Final021119

	Next, an estimate was made for how many commercial composting facilities could be installed if the State were to win a $200,000,000 low-end Tier A implementation grant award. Based on capital costs of $800,000 per facility that processes 1,000 tons annually, the State would be able to support 250 new facilities covering 100% of costs.[140] *(Note: this is not representative of a precise Implementation Grant project, but a scenario for which to calculate additional GHG emission reduction potential).* With 250 facilities each processing 1,000 tons annually, this yields another 250,000 tons of organic waste that avoids landfills, which is an 11% decrease from baseline tons of organic waste disposed. This percent decrease was then multiplied by total gross landfill emissions (15 MMTCO2e) to estimate the additional avoided emissions from more composting. **MEASURE-SPECIFIC ASSUMPTIONS** Only one year's worth of emission reductions is accounted for assuming facilities are operational by 2030; however, emissions would be even greater if facilities are operational prior to 2030 **MEASURE-SPECIFIC OPPORTUNITIES TO REFINE FOR OHIO'S CRP** Assess specific landfill operations to target	
#8 Clean Waste-to-energy	**Identifying the current market** Ohio EPA's Economic Impact Potential of Recycling in Ohio Final Report from 2019 was used to assess the different waste streams in the State, to determine the volume of organic waste that would be subject to potential WtE.[141] Organic waste includes food and yard waste. **ANNUAL ORGANIC WASTE DISPOSED IN OHIO (TONS)** | **PROPORTION OF TOTAL WASTE DISPOSED IN OHIO (%)**	• Ohio Environmental Protection Agency • Local waste operators • Municipalities • Municipal / Regional

[140] PROOF ACC SolidWaste-CompostFacility-Brochure (accgov.com)

[141] Ohio Report Final021119

2,291,521	23.9%	Planning Agencies

Out of this total tonnage of organic waste, the GHG Inventory results revealed that 64% is already being diverted from producing emissions through composting oxidation, flaring and waste to energy; therefore, only 36% or nearly 800,000 tons of this waste remain to target for WtE, whereby they would be diverted from landfills producing methane emissions. Another source of WtE could be agriculture livestock manure.

Calculating GHG emission reductions

Next, an estimate was made for how many landfill WtE as well as agriculture anaerobic digestor facilities could be installed if the State were to win a $200,000,000 low-end Tier A implementation grant award. This award was assumed to be split across the two WtE modalities with one fifth the funding going to landfill WtE (since this sector is already being targeted by composting) and four firths the funding going to agriculture WtE operations. *(Note: this is not representative of a precise Implementation Grant project, but a scenario for which to calculate additional GHG emission reduction potential).*

Landfill WtE

Based on capital costs of $23 million per 10MW landfill WtE facility that processes 28 tons of waste per kW amounting to 227,400 tons of landfill waste avoided annually per 10MW facility.[142] With one fifth of the $200,000,000 low-end Tier A implementation grant award, Ohio could cover all funding for 2 landfill WtE facilities. In total, this would avoid over 600,000 tons of organic waste landfilled annually which is a 26% reduction in total tons landfilled and consequently estimated to be a 26% reduction in gross waste emissions. Only annual emissions are accounted for assuming these projects are installed and operational by 2030; however, emissions would be even greater if projects were completed prior to 2030.

[142] Fact Sheet | Landfill Methane | White Papers | EESI

It is also estimated that 70% of all current landfill WtE operations today produce electricity versus utilizing WtE for heating or fuel[143] with 300 kWh of electricity production per 1 ton waste.[144] With an annual production capacity factor of 0.95 for landfill WtE operations, there would be 8,322 kWh of production annually per kW.[145] Therefore, alongside calculation emission reductions from avoided organic waste in landfills, emission reductions from kWh of additional biogas for electricity generation were also estimated. Total annual kWh was multiplied by Ohio's regional grid emission factor; however, emission reductions to electric power are negligible < 1% compared to the waste sector emission reductions.

Agricultural WtE

The approximate volume of manure per an average anaerobic digestor operation was sourced alongside costs.[146] Based on capital costs of $250,000 per WtE facility, the state could fund 640 facilities with four fifths the $200,000,000 award. This amounts to approximately 13% of state's total livestock manure.[147] This proportion then served as an estimate for the emission reduction potential. Like the landfill WtE, electricity generation or heating emissions from anaerobic digestion were also assumed to be negligible.

MEASURE-SPECIFIC ASSUMPTIONS

Only one year's worth of emission reductions is accounted for assuming facilities are operational by 2030; however, emissions would be even greater if facilities are operational prior to 2030

MEASURE-SPECIFIC OPPORTUNITIES TO REFINE FOR OHIO'S CRP

Assess specific landfill and agricultural operations to target

[143] Fact Sheet | Landfill Methane | White Papers | EESI

[144] FAQs | Anaerobic Digestion (biogas-info.co.uk)

[145] Microsoft Word - CLL Feasibility Report-FINAL 21 Jun 13.docx (az.gov)

[146] Anaerobic Digestion Cost – Plus Gate Fees and Other Rules of Thumb (anaerobic-digestion.com)

Appendix IV: Additional Analysis for Light-Duty ZEV Reduction Measure

INTERSECTION WITH OTHER FUNDING AVAILABILITY

Many of the priority measures included in this Plan expand upon or complement existing programs. Ohio EPA has explored federal and non-federal funding sources to determine whether these sources could fund each priority measure and whether such funding is sufficient to fully implement the measure. This section describes the results of this analysis for the priority measure to expand light-duty ZEVs that the State is considering for implementation.

CURRENT PROGRAMS

- **NEVI:** The federal government allocated $140 million in NEVI formula funds to Ohio under the BIL.[148] The program, which is overseen and administered by ODOT, will be used to fill charging gaps alongside Ohio's interstate highway system, with the goal of providing a charger at least every 50 miles and ensuring that 90% of Ohioans live within 25 miles of NEVI compliant chargers.[149]
  - **Relationship to priority measure:** The NEVI program is designed to increase access to publicly available fast chargers, which remains a key strategy for increasing EV range and lowering barriers to purchasing EVs. An S&P survey from 2023 identified charging concerns as the second most important concern for respondents against buying an electric vehicle. Termed "range anxiety" – concerns over EV charger range and length of time to charge top consumer concerns regarding EV purchases and are considered a major barrier to purchasing EVs.[150]
  - **Current state:** Thus far, the program has distributed two rounds of funding, which will support the installation of approximately 51 publicly available fast chargers. Additional funding is expected to commence once charging stations on federally required corridors are complete. The future funds, which ODOT expects will be distributed in two rounds, will commence once Ohio is certified as Fully Built out by the Joint Office of Energy and Transportation.
  - **Future state and ability to support the priority measure:** As identified in the Ohio Electric Vehicle Infrastructure Deployment Plan.
    - ODOT's goals for NEVI, in accordance with FHWA guidance, will focus on building out FHWA Designated AFCs, then seek to expand to regional and local routes of significance, equity-based destination charging, and freight charging locations. Maintaining consistency with the prior fiscal year, there have been no changes to the strategic direction, goals, or milestones.
    - The State's NEVI plan has been identified by key stakeholders as a vital part of this priority measure, as the ability to access publicly available chargers across the State is likely to assuage "range anxiety" for many would-be purchasers of

[148] National Electric Vehicle Infrastructure Formula Program (NEVI) (ohio.gov)

[149] DriveOhio_NEVI_Plan_2023-07_28_Round7_removed.pdf

[150] Affordability tops charging and range concerns in slowing EV demand | S&P Global (spglobal.com)

EVs. Importantly, research shows that availability of charging infrastructure largely increases preference for EVs.[151]

- The current NEVI plan is focused on several AFCs, which may not include the most helpful charging locations to commuters in Ohio. Notably, NEVI do not cover private residential, commercial and other public non-AFC charger locations, which may need additional funding support to gain widespread adoption.

- **IRA EV and FCEV Tax Credits:** Although not technically a program to be administered by the state of Ohio, IRA tax credits are an important part of the funding support provided by the U.S. government. The various financial incentives are designed to boost the adoption of ZEVs and the expansion of charging/alternative fuels infrastructure. Consumers can benefit from tax credits up to $7,500 for new and $4,000 for used EV or FCEV purchases, as well as a 30% credit (up to $1,000) for home charging / alternative fuels installations. Businesses can receive up to $7,500 in tax credits for purchasing commercial EVs / FCEVs and up to $100,000 for installing alternative fuels refueling / charging stations. These incentives aim to reduce upfront costs, increase EV adoption, and expand charging infrastructure.
  - Relationship with priority measure: Stakeholders have consistently identified electric vehicles as the priority zero emission vehicle type for adoption across the state. In the context of Ohio's ongoing efforts to increase electric vehicle adoption, the IRA funding provides significant financial support to both consumers and businesses. By making EVs more affordable and competitive with traditional gasoline vehicles and promoting the development of accessible charging infrastructure, this federal funding aligns with Ohio's electrification initiatives and encourages residents and organizations to transition to zero emission transportation options. Importantly, the funding aims to significantly reduce EV costs, addressing a major concern among potential buyers. According to the S&P survey, nearly half of the respondents believe that the current prices of electric vehicles are too high.152
  - Current state: as of the beginning of 2024, all aforementioned tax credits are currently available and funded.
  - Future state and ability to support the priority measure: Financial incentives have been identified by stakeholders as a key approach to increasing EV adoption. However, as EVs remain highly priced relative to ICE vehicles, it is unclear if the federal funding is sufficient for widespread EV adoption in Ohio. Ohio offers inspection exemptions to ZEV drivers and does not offer other financial incentives at the State level to drive down the price of EVs, which may make it difficult to make the price competitive enough with ICE vehicles. As of 2023, EVs only represent 0.33% of Ohio registrations.153 To meet the modelled GHG emission reductions, the State may need to consider additional subsidies/incentives.

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[151] Transportation Research Record (TRR) 2020

[152] Affordability tops charging and range concerns in slowing EV demand | S&P Global (spglobal.com)

[153] Alternative Fuels Data Center: Vehicle Registration Counts by State (energy.gov)

[159] Bureau of Labor Statistics September 2023 Quarterly Census of Employment and Wages (QCEW)

[160] Bureau of Labor Statistics National Industry-Occupation Employment Matrix

FUNDING GAPS

- **Charging Infrastructure:** Charging infrastructure has received funding through NEVI and IRA tax grants. Additional funding may need to be considered to offset the high upfront costs associated with developing charging infrastructure.
- **Vehicle Purchases:** The IRA provides funding for EV/FCEV tax credits through 2032. Current federal tax incentives vary depending upon vehicles purchased and price. However, additional funding may need to be considered to offset the high upfront costs associated with purchasing electric vehicles.
- **Education and Workforce Planning:** The IRA does not allocate specific funding for education related to light-duty electric vehicles. IIJA funding has been used to support education and training plans. Under the NEVI plan, ODOT identified specific career pathways that are critical to the EV ecosystem. However, additional funding may be needed to support the development of robust education and training programs. Additional information on workforce planning is described herein.
- **Customer Acquisition:** No specific federal funding streams were identified to support the customer acquisition process or to improve messaging around electric vehicles.

WORKFORCE PLANNING ANALYSIS

WORKFORCE PLANNING

The priority measures included in this Plan will result in the creation of high-quality jobs for Ohioans. This section details Ohio's strategies and commitments to ensure job quality, strong labor standards, and a diverse, highly skilled workforce for implementation of the priority measures.

WORKFORCE OVERVIEW

As of September 2023, the Ohio Labor Force comprised approximately 5.8 million individuals, of which 96.5% were employed and 3.5% were unemployed. While the state's population increased 1.0% from 2018 to 2023, the growth in employment was only 0.4%, which lagged the U.S. national average employment growth of 4.4% in the same period.[159] However, the Bureau of Labor Statistics predicts that employment in Ohio is expected to increase by 1.9% from 2023 to 2027[160].

Demographically, Ohio is in line with national averages for age diversity with approximately 4% fewer millennials and approximately 5% more retirement and pre-retirement age individuals. Ohio's demographic concentration of racial diversity is significantly lower than the national average with less than half the racially diverse population expected for an area of its size.[154]

WORKFORCE PARTNERSHIPS & MESSAGING OPPORTUNITIES

State Commerce & Labor Agencies: Ohio EPA can explore partnering with the ODOT via their Drive Ohio initiative. Drive Ohio's Electric Vehicle Infrastructure Deployment Plan for the NEVI Formula Program plans to create an EV charging framework and network across the state of Ohio. As the goals of Drive Ohio's plan complement the Ohio EPA's priority measure of

[154] Bureau of Labor Statistics Current Employment Statistics (CES)

expanding light-duty ZEVs in Ohio, so too do the workforce considerations, commitment to good job creation (as defined in the U.S. Economic and Development Administration's (EDA) Good Jobs Challenge), upskilling and training requirements considerations. Drive Ohio has already secured $140 million over five years in funding for their implementation plan in the amount of $140 million over five years and is in phase two of implementation.[155] Ohio EPA may also partner with ODOT to increase the impact of their program and scale the best practices as they relate to labor, safety, training, and installation standards.

Additionally, Ohio EPA can evaluate partnering with JobsOhio, and by extension the Ohio Department of Development (ODOD), OhioMeansJobs, and the Ohio Department of Commerce to effectively communicate and advertise newly created good jobs anticipated from the priority measure, disseminate training program details, and facilitate education and outreach to underserved communities.

Educational Institutions & Training Programs: There are over 120 schools in Ohio that offer degrees or certificates related to the anticipated roles needed to implement light-duty ZEV expansion across the state.[156] Ohio EPA may work with institutions to supplement automotive-related programs and curricula with ZEV-specific training and education resources and support outreach for participation in local areas, especially within underserved communities.

Labor Unions: Ohio EPA will consider working with ODOT to leverage the Electrical Industry Training Centers and International Brotherhood of Electrical Workers to prioritize training in electric vehicle supply and equipment (EVSE) installation, provide additional EVSE certifications for electricians via NEVI's Electric Vehicle Infrastructure Training Program (EVITP) national curriculum, and reimburse those certifications via the Ohio TechCred program for employers of electrical contractors in Ohio.

Ohio Governor's Office of Workforce Transformation (OWT): Ohio EPA may partner with the Ohio Governor's OWT to execute on and utilize their many existing workforce-specific initiatives to further the impact of Ohio EPA's priority measures, including Individual Microcredential Assistance Program (IMAP), Industry Sector Partnership Grants, State Approved Industry Recognized Credentials, High School Tech Internship Pilot Program, TechCred, Top Jobs, Ohio to Work, Choose Ohio First, Career Pathways Resource, Career Resource Navigator, Innovative Workforce Incentive Program and ApprenticeOhio.

ANTICIPATED LABOR CHANGES, STRENGTHS, RISKS & OPPORTUNITIES

Increasing light-duty electric vehicles in Ohio requires additional vehicle and parts manufacturing to meet expected demand, specialized repair and maintenance, and expansion of the electric vehicle charging infrastructure. While many career pathways will be affected by the expansion of light-duty electric vehicle expansion, the main occupations impacted (defined by Standard

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[155] DriveOhio_NEVI_Plan_2023-07_28_Round7_removed.pdf

[156] National Center for Education Statistics, Integrated Postsecondary Education System (IPEDS); National Center for Education Statistics, Office of Educational Research and Improvement for the CIP – SOC crosswalk, Classification of Instructional Programs Crosswalk to Standard Occupational Classification

Occupational Classification (SOC) code) will be Production occupations (SOC 51), Installation, Maintenance, and Repair occupations (SOC 49), and Construction and Extraction occupations (SOC 47).[157]

Because of Ohio's significant footprint in the automotive industry (internal combustion engines (ICE), parts manufacturing, maintenance, etc.), the shift to EV will decrease the demand for ICEs and therefore displace workers who are producing ICE-specific products and services.[158] However, it simultaneously creates a substantial opportunity to shift the existing ICE workforce into similar roles for EVs, allowing them to leverage their existing skillsets in addition to upskilling or reskilling to meet the requirements of EV production and maintenance. Additionally, there is an opportunity to transition workers who are not currently working in the industry but who have skillsets like those required for EV production/maintenance and EV infrastructure installation.

- **EV & EVSE Manufacturing and Production:** Automakers (original equipment manufacturers (OEMs), suppliers, etc.) across the world are investing over $860 billion (over $200 billion in the U.S.) by 2030 in the transition to EVs.[159] Simultaneously, numerous federal grants and programs have been rolled out to facilitate the transition by providing financial incentives to consumers and companies to purchase electric vehicles (e.g., IRA incentives, state and federal tax credits).

- The increased demand for EVs prompts manufacturers to increase production and expand their capabilities. Ohio's place as a major player in automotive manufacturing in not only the Midwest but considering the entire country, Ohio positions itself well to see the workforce and economic development impacts of the transition. Ohio has the second largest workforce in the nation for motor vehicle and parts manufacturing and is home to major automotive suppliers, OEMs, and assembly facilities including Honda, Ford, GM, and Fiat Chrysler. Recent EV investments by automakers in the state are creating new jobs, for example:[160]
  - LG and Honda's battery plant in Columbus (~2,500 jobs)[161]
  - Hyperion's fuel cell facility in Columbus (~700 jobs)[162]
  - Forsee Power's North American headquarters in Columbus (~150 jobs)[163]
  - SEMCORP's lithium-ion battery component facility in Sidney (~1,200 jobs)[164]
  - Mobis North America's battery assembly plant in Toledo (~185 jobs)[165] and

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[157] Bureau of Labor Statistics National Industry-Occupation Employment Matrix

[158] https://www.jobsohio.com/ohio-leads-in-electric-vehicles

[159] Automakers electric vehicle investment plans (reuters.com)

[160] https://www.jobsohio.com/industries/automotive

[161] Honda to Invest in Ohio for Electric Vehicle Production (jobsohio.com)

[162] https://www.dispatch.com/story/business/2022/02/01/hyperion-add-700-jobs-far-west-side-hydrogen-fuel-cell-facility/9296467002/#:~:text=A%20California%20company%20plans%20to,.%2C%20which%20closed%20in%202020

[163] https://www.forseepower.com/press-release/forsee-power-to-establish-north-american-headquarters-and-battery-systems-gigafactory-in-the-columbus-ohio-27-06-2022/#:~:text=A%20scalable%203%2DGWh%20manufacturing,North%20American%20headquarters%20and%20Gigafa

[164] https://www.jobsohio.com/news-press/semcorp-to-produce-critical-lithium-ion-battery-component-in-sidney

[165] https://www.jobsohio.com/news-press/mobis-north-america-chooses-toledo-for-electric-battery-assembly-plant

- Ford's EV manufacturing plant in Sidney (~1,800 jobs).[166]

- **EV Charging Infrastructure Expansion and Maintenance:** As organizations like Drive Ohio continue to implement their NEVI Formula programs, the EV landscape will expand via the installation of standalone accessible EV charging stations, installation of EVSE-compatible wiring in new buildings, upgrades to such wiring in existing buildings, and continued maintenance of charging stations. This need presents an opportunity for electrical workers and service technicians in the installation, maintenance, and repair occupations (SOC 49) and well as the construction and extraction occupations (SOC 47).

As not all workers currently in these occupations may possess the EV-specific specialized skills required to transition into the needed roles, there is an opportunity for integration with the automotive sector for the purposes of training, upskilling, and certifying technicians. As several occupations have overlapping skillsets, there is further opportunity to recruit, upskill and certify talent from adjacent occupations and industries. In the long term, this creates additional employment opportunities and career pathways for workers in the automotive, manufacturing, construction, and utilities industries.

For electrical workers and other transitioning workers to work on commercial projects in the state of Ohio, they are required to be licensed. In accordance with the minimum standards set forth by NEVI, all electricians installing, operating, or maintaining EVSE must have: (i) certification from EVITP, (ii) graduation or a continuing education certificate from a registered apprenticeship program for electricians that includes charger-specific training and is developed as a part of a national guideline standard approved by the Department of Labor in consultation with the Department of Transportation, or (iii) for projects requiring more than one electrician, at least one electrician must meet the requirements above, and at least one electrician must be enrolled in an electrical registered apprenticeship program.[167]

- **EV Repair & Maintenance:** In addition to a skilled workforce for erecting, retrofitting, and maintaining EV charging stations, the influx of EVs among individuals and companies will be followed by an increased need for maintenance and repairs. This creates an opportunity for workforce development among vehicle service technicians, mechanics, and similar roles. In 2023, there were more than 10,200 job postings for automotive service technicians and mechanics in Ohio, indicating a high demand for talent and an opportunity for workforce development in this area.[168] Additionally, the complexity of EVs will require additional training and continuing education on proper maintenance techniques, component parts, and software. Technicians and mechanics can take advantage of the existing suite of technical training programs and continuing education resources available to them in the state of Ohio, including online instructional resources, post-secondary vocational programs, community colleges, and courses to supplement current automotive training and continuing education curricula with EV-specific content. There is also opportunity for automakers and

[166] https://governor.ohio.gov/media/news-and-media/Governor-DeWine-Ford-Motor-Company-Announce-1800-New-Jobs-to-Assemble-New-Commercial-Electric-Vehicle-06022022

[167] Federal Register :: National Electric Vehicle Infrastructure Standards and Requirements

[168] Lightcast, 2023

automotive industry employers to incentivize hiring by subsidizing these EV training and continuing education programs.

EQUITY AND UNDERSERVED COMMUNITIES

While there are many opportunities for workforce development due to the expansion of light-duty ZEVs in Ohio in the form of job creation, upskilling and training, there are also barriers to those in underserved communities. Upskilling, training programs, and continuing education courses for electricians and automotive technicians and service workers can be costly and time-consuming, with EVIT certification requiring 8,000 hours of electrical field experience and continuing upskilling courses at community colleges costing thousands of dollars.[169] Workers may also lose out on wages due to the time commitment and availability of relevant courses required to pursue certifications.

Ohio's Governor's Office of Workforce Transformation has programs and initiatives in place to alleviate the cost burden of programs for underserved communities. Programs include the Individual Microcredential Assistance Program (IMAP) which helps Ohioans who are low income, partially unemployed, or totally unemployed participate in a training program to receive a credential at no cost; OhioMeansJobs.com which is Ohio's free online career counseling center that connects businesses to job seekers and provides career services to all Ohioans; and the Ohio to Work initiative which consists of career service professionals who provide job-seekers with free guidance and resources to get them on the path to finding a stable career.

WORKFORCE FUNDING NEEDS

Ohio has significant infrastructure and support for workforce planning and development. To drive Plan implementation, it will be most efficient to leverage this robust network of partners across the state. Therefore, potential resources would be incremental to amplify and scale these programs. We expect that additional funding will be necessary to support:

- **Additional instructional support:** Ohio's network of educational institutions offering this training are often constricted in their offerings by the availability of qualified instructors and one innovative approach is to partner with agencies to share resources into programs on a part time basis through grants and incentives.
- **Additional advertising:** To drive participation, Ohio EPA can consider leveraging the Jobs Ohio communication channels with focus on underserved communities and those in roles which are expected to have significant skills overlap with new roles and/or may be in lower demand in future.
- Ohio EPA may also consider some unique programs that address barriers to work, such as lost wages during training time, transportation, and other matters. We can work with the Governor's OWT to pilot and channel funding towards these areas to drive adoption and participation, particularly in underserved communities.

As mentioned above, Ohio has several organizations actively working on workforce related matters that are aligned to the workforce needs discussed previously. Ohio EPA can partner

[169] https://evitp.org/

with these organizations to support the need for upskilling, training, hiring, and outreach to underserved communities. Specific examples include:

- Drive Ohio's initiatives to create good jobs through upskilling and training is already funded and into the implementation period. Ohio EPA can work to increase its impact and scale it with the additional need associated with Plan implementation.
- Jobs Ohio and the associated regional organizations have channels to effectively communicate the opportunities and drive awareness and participation in training and certification programs.
- Ohio's educational institution network and training programs already are embedded within their communities and are offering the degrees, certificates, designations, and microcertificates/microcredentials required for EV-related jobs.
- Ohio's labor unions and manufacturing associations have programs to develop skills for their membership (e.g., EVSE certifications)
- Governor's OWT provides a number of programs that support the overall development of the state's workforce, including addressing rapid upskilling and on-the-job training

Ohio has several coordination points to ensure collaboration across the state's workforce development programs. The Office of Workforce Transformation already coordinates activities across the state through OhioMeansJobs county offices in partnership with regional and local stakeholders.

Specific collaboration opportunities are noted above. Further to add that sector-based strategies may include partnering with trade organizations like the Ohio Manufacturers' Association (OMA) to scale programs through their membership, as well.

Much of the curricula exists to support the identified training and certifications, but not at the scale required. Across the state, educational institutions and training programs are interested to offer such programs and scale existing programs. Additionally, while new curricula are likely not required, there may be opportunities to rethink the structure of such programs to accelerate paths to certification, offer more programs that accommodate alternate schedules, or partner with employers to create on-the-job training opportunities.

University of Dayton

March 15, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: [University of Dayton] Support the State of Michigan's CPRG Coalition Proposal for the Midwest Industrial Decarbonization Challenge, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, University of Dayton , affirm our commitment to work with the State of Michigan in its partnership with states of Illinois, Minnesota, Ohio and Wisconsin to carry out a regional effort to reduce industrial emissions in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse the Midwest Industrial Decarbonization Challenge objective to reduce greenhouse gas (GHG) emissions from the region's top polluting, hard-to-decarbonize industries.

We understand the role the application contemplates we will play as a university research entity. We are ready, willing and able to carry out the roles and responsibilities contemplated should we enter into a contract with our partnering state agency in Ohio in the event EPA awards the grant for the Midwest Industrial Decarbonization Challenge to the State of Michigan. Through the Midwest Industrial Decarbonization Challenge program period, we anticipate collaborating with the State to deliver incentives programs to reduce industrial GHG emissions, including but not limited to industrial energy efficiency, fuel-switching, and innovative technologies. Our commitment extends to supporting program development and implementation of industrial emission reduction strategies.

The proposed GHG reduction measures will achieve significant cumulative GHG reductions, provide substantial community benefits in low-income and disadvantaged communities, and complement other funding sources to maximize both GHG reductions and community benefits. Because many industrial facilities are located in or upwind of low-income and disadvantaged communities (LIDAC), we know that improvements to the environmental performance of industrial facilities in the region will bring benefits to LIDAC communities. We understand that the states in the coalition are committed to achieving such benefits.

We understand industrial decarbonization because we work with industrial facilities in Ohio to provide technical and analytical support, including assessments of measures that can be undertaken at those facilities to reduce the use of fossil fuels and otherwise reduce emissions, often saving money in the process. The role anticipated for us under the Midwest Industrial Decarbonization Challenge is a natural scaling-up of the work we are already doing.

We have considerable expertise in this area. We are attaching to this letter the CVs of our leadership and principal staff.

University of Dayton

The University of Dayton Industrial Assessment Center (UD-IAC) was established in 1981. Since then, the UD-IAC has completed 1,082 industrial energy assessments for the Department of Energy. The program has enjoyed stable and dedicated leadership throughout its tenure.

The challenge of modernization and decarbonization is faced across the manufacturing sector across the Midwest region. Modernization is a particular challenge for the labor force in the Midwest among Small and Medium-sized Manufacturers (SMMs). Industry 4.0 promises to deliver advancements requiring expertise and flexibility to realize them fully. The IAC program is well-suited to deliver on these needs, providing education on advanced manufacturing practices to the student workforce and facility personnel. Creating targeted new practices will allow for continual learning and improvement for IAC clients, driving workforce development among participants.

The UD-IAC is committed to an ethic of continuous improvement and leverages its more than 43 years of experience and knowledge to achieve academic excellence, conduct innovative research, and champion DOE initiatives.

We are enthusiastic about partnering with the State of Ohio to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Jun-Ki Choi, Ph.D.
Associate Professor, Mechanical and Aerospace Engineering / Renewable and Clean Energy
Director, US Department of Energy's Industrial Assessment Center (UD-IAC)
Director, Sustainable Manufacturing Laboratory (SuMaLa)
University of Dayton
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

COGNIZANT AGENCY
NEGOTIATION AGREEMENT

State of Michigan
Department of Environment,
Great Lakes, and Energy
Lansing, MI

Date: August 10, 2023

Filing Ref: October 21, 2022

The indirect cost rates contained herein are for use on grants and contracts with the Federal Government to which 2 CFR Part 200 applies, subject to the limitations contained in the Circular and in Section II, A below.

SECTION I: RATES

Type	Effective Period From	To	Rate	Base
Fixed	10/1/2023	9/30/2024	16.65%	(a)

Basis for Application
(a) Direct salaries and wages and fringe benefits.

Treatment of Fringe Benefits: Fringe benefits applicable to direct salaries and wages are treated as direct costs and charged in accordance with rates established by the State.

SECTION II: GENERAL

A. LIMITATIONS: The rates in this Agreement are subject to any statutory and administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the department/agency or allocated to the department/agency by an approved cost allocation plan were included in the indirect cost pool as finally accepted; such costs are legal obligations of the department/agency and are allowable under governing cost principles; (2) The same costs that have been treated as indirect costs have not been claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment; and (4) The information provided by the department/agency which was used to establish the rates is not later found to be materially incomplete or inaccurate by the Federal Government. In such situations the rate(s) would be subject to renegotiation at the discretion of the Federal Government.

B. CHANGES. The final rate contained in this agreement is based on the organizational structure and the accounting system in effect

at the time the proposal was submitted. Changes in the organizational structure or changes in the method of accounting for costs which affect the amount of reimbursement resulting from use of the rate in this agreement, require the prior approval of the authorized representative of the responsible negotiation agency. Failure to obtain such approval may result in subsequent audit disallowances.

C. THE FIXED RATE contained in this agreement is based on an estimate of the cost, which will be incurred during the period for which the rate applies. When the actual costs for such a period have been determined, an adjustment will be made in the negotiation following such determination to compensate for the difference between the cost used to establish the fixed rate and that which would have been used were the actual costs known at the time.

D. NOTIFICATION TO FEDERAL AGENCIES: Copies of this document may be provided to other Federal agencies as a means of notifying them of the agreement contained herein.

E. SPECIAL REMARKS: Please confirm your acceptance of the terms of the indirect cost rate agreement by signing and returning this letter to me. Please retain a copy for your records.

ACCEPTANCE

The undersigned official warrants that he/she has the proper authority to execute this agreement on the behalf of the State Agency:

Paul McDonald Digitally signed by Paul McDonald Date: 2023.08.11 15:34:53 -04'00'

(Signature)

Paul McDonald

(Name)

Chief Financial Officer

(Title)

MI Environment, Great Lakes, and Energy

(Agency)

(Date)

By the Federal Agency:

JACQUELINE SMITH Digitally signed by JACQUELINE SMITH Date: 2023.08.11 11:12:42 -04'00'

(Signature)

National Policy, Training and Compliance Division
U.S. Environmental Protection Agency

Negotiated by: Rose Piard-Hylton
Telephone: (202) 564-4427

MI HEALTHY CLIMATE

Implementing the MI Healthy Climate Plan

MICHIGAN'S PRIORITY CLIMATE ACTION PLAN

EGLE MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

March 2024

MICHIGAN DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY

This report is available digitally at Michigan.gov/EGLE

EGLE promotes the equitable treatment and meaningful involvement of Michigan's residents regarding the development, implementation, and enforcement of laws, regulations, and policies. Equitable treatment means that no group of people bears a disproportionate share of the negative consequences resulting from governmental, industrial, or commercial operations and policies. Meaningful involvement means all people have an opportunity to participate in decisions that affect their environment and/or health.

To request this material in an alternative format, contact EGLE-Accessibility@Michigan.gov or call 800-662-9278.

This project has been funded wholly or in part by the United States Environmental Protection Agency (EPA) under assistance agreement 00E03462 to Michigan Department of Environment, Great Lakes, and Energy. The contents of this document do not necessarily reflect the views and policies of the EPA, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

CONTENTS

DEFINITIONS AND ACRONYMS

DEFINITIONS

Priority Climate Action Plan (PCAP): a narrative report that includes a focused list of near-term, high-priority, and implementation-ready measures to reduce GHG pollution and an analysis of GHG emissions reductions.

Comprehensive Climate Action Plan (CCAP): a narrative report that provides an overview of the grantees' significant GHG sources/sinks and sectors, establishes near-term and long-term GHG emission reduction goals, and provides strategies and identifies measures that address the highest priority sectors to help the grantees meet those goals.

Greenhouse Gas (GHG) Inventory: a list of emission sources and sinks and the associated emissions quantified using standard methods.

Low Income / Disadvantaged Communities (LIDACs): communities with residents that have low incomes, limited access to resources, and disproportionate exposure to environmental or climate burdens. Although the Inflation Reduction Act does not formally define LIDACs, EPA strongly recommends grantees use the Climate and Economic Justice Screening Tool and the Environmental Justice Screening and Mapping Tool to identify LIDACs in their communities. These tools identify LIDACs by assessing indicators for categories of burden: air quality, climate change, energy, environmental hazards, health, housing, legacy pollution, transportation, water and wastewater, and workforce development.

Metropolitan Statistical Area (MSA): A geographic entity delineated by the Office of Management and Budget for use by federal statistical agencies. Metropolitan statistical areas consist of the county or counties (or equivalent entities) associated with at least one urban area of at least 50,000 population, plus adjacent counties having a high degree of social and economic integration with the core as measured through commuting ties. Metropolitan statistical areas as defined by the U.S. Census 2020 MSA population.

State: One of the 50 U.S. states and the District of Columbia and Puerto Rico.

Acronyms

AVERT	AVoided Emissions and geneRation Tool
BEVs	Battery electric vehicles
BIL	Bipartisan Infrastructure Law
CCAP	Comprehensive Climate Action Plan
CEJST	Climate and Economic Justice Screening Tool
CH_4	Methane
CO_2	Carbon dioxide
CO_2FFC	Carbon dioxide from Fossil Fuel Combustion
CO	Carbon monoxide
CPRG	Climate Pollution Reduction Grant
CRS	Carbon Reduction Strategy
DOE	United States Department of Energy
DTMB	Michigan Department of Technology, Management & Budget
EAT	Energy Auditor Training
EGLE	Michigan Department of Environment, Great Lakes, and Energy
EJScreen	EPA's Environmental Justice Screening and Mapping Tool
EPA	Environmental Protection Agency
EPS	Energy Policy Simulator
ETIP	Energy Transition Impact Project
EVSE	Electric vehicle supply equipment
EWR	Energy Waste Reduction
F-gases	Fluorinated greenhouse gases
FPL	Federal Poverty Line
GHG	Greenhouse gas
GHGRP	Greenhouse Gas Reporting Program
GVMC	Grand Valley Metro Council
HVAC	Heating, ventilation, and air conditioning

ICEs	Internal combustion engines
IIJA	Infrastructure Investment and Jobs Acts
IRA	Inflation Reduction Act
LIDAC	Low-income and disadvantaged community
LEO	Michigan Department of Labor and Economic Opportunity
LPO	Loan Program Office
LULUCF	Land Use, Land Use Change, and Forestry
MAC-EJ	Michigan Advisory Council on Environmental Justice
MDARD	Michigan Department of Agriculture and Rural Development
MDHHS	Michigan Department of Health and Human Services
MDOT	Michigan Department of Transportation
MHCP	MI Healthy Climate Plan
MMTCO2E	Million metric tons of carbon dioxide equivalent
MiEJScreen	Michigan's Environmental Justice Screening and Mapping Tool
MTEG	Michigan Tribal Environmental Group
MW	Megawatt
NEVI	National Electric Vehicle Infrastructure
NF_3	Nitrogen trifluoride
NOx	Nitrogen oxides
N_2O	Nitrous Oxide
NREL	National Renewable Energy Laboratory
OCE	EGLE's Office of Climate and Energy
PACE	Powering Affordable Clean Energy
PCAP	Priority Climate Action Plan
PFC	Perfluorocarbon
PM2.5	Particulate matter
RAISE	Rebuilding American Infrastructure with Sustainability and Equity
RECI	Resilient and Efficient Codes Implementation

RFI	Request for Information
R-STEP	Renewable Energy Siting through Technical Engagement and Planning
SEMCOG	Southeast Michigan Council of Government
SF_6	Sulfur hexafluoride
SIT	EPA's State Inventory Tool
SMART	Strengthening Mobility and Revolutionizing Transportation
SOx	Sulfur oxides
TREC	Training for Residential Energy Contractors
UCPB	Utility Consumer Participation Board
UP	Michigan's Upper Peninsula
VOC	Volatile organic compound
WAP	Weatherization Assistance Program

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EXECUTIVE SUMMARY

This document outlines the State of Michigan's Priority Climate Action Plan (PCAP), developed as part of the EPA's Climate Pollution Reduction Grant Program. Michigan's PCAP closely follows the framework and key strategies laid out in the MI Healthy Climate Plan (MHCP). The PCAP involved statewide community engagement and development of a greenhouse gas (GHG) inventory to establish priority reduction measures, quantify potential GHG emission reductions, analyze benefits for low-income and disadvantaged communities (LIDACs), and provide commentary on the authority to implement the identified measures, intersection with other funding opportunities, and information about the workforce required to realize the measures.

Of these elements, the key outcomes include:

- **Community Engagement:** Extensive statewide community engagement efforts, including public meetings, surveys, and focus groups, identified key priorities and concerns including topics around environmental justice and all areas of Michigan's economy.
- **Michigan's GHG Emissions Inventory:** As of 2019, Michigan's net GHG emissions were 166.73 MMTCO2E, a 15% decrease from the baseline year of 2005. The Energy inventory sector remains the largest emitter, followed by Industrial Processes and Waste.
- **Priority Reduction Measures:** GHG reduction measures were evaluated and prioritized for the PCAP in the following sectors:
  - Electricity Generation
  - Commercial and Residential Buildings
  - Transportation
  - Industry

  The selected reduction measures identify several strategic priorities inclusive of renewable energy deployment, expansion of energy efficiency, electrification of the transportation and built environment, increased access to public transit, emphasis on methane reductions, and more.
- **LIDAC Benefits Analysis:** The PCAP prioritizes measures that benefit LIDACs by reducing emissions, improving air quality, and creating clean energy jobs. These communities often experience disproportionate negative impacts from climate change and pollution, and the PCAP aims to analyze and address these disparities through its priority reduction measures.
- **Next steps**: Refinement of several areas to build off PCAP learnings in development of the Comprehensive Climate Action Plan (CCAP) include deeper analysis in all areas of the PCAP, additional engagement with communities across the state, preparation for implementation grant applications, and more.

The PCAP represents a significant opportunity in Michigan's efforts to address climate change and create a more sustainable future for all residents through the implementation of the MI Healthy Climate Plan. It is important to note that achieving these ambitious goals will require sustained commitment, collaboration, and investment from all levels of government, businesses, and communities.

1. INTRODUCTION

1.1 Climate Pollution Reduction Grant (CPRG) Overview

The United States Environmental Protection Agency (EPA) issued planning grants under Phase I of the Climate Pollution Reduction Grant (CPRG) program to support interested states, metropolitan statistical areas (MSAs), tribes, and territories to develop and implement plans for reducing greenhouse gas (GHG) emissions and other harmful air pollutants. The State of Michigan's Department of Environment, Great Lakes, and Energy (EGLE) received a $3 million planning grant to write both a Priority and Comprehensive Climate Action Plan due in early 2024 and mid-2025, respectively. The Priority Climate Action Plan (PCAP) provides the State of Michigan with funds to, at a minimum, develop a GHG inventory, select and quantify priority near-term GHG reduction measures, perform a low-income and disadvantaged communities (LIDAC) benefits analysis, and review the authority to implement selected GHG reduction measures. A Comprehensive Climate Action Plan (CCAP) will be developed following the completion of this PCAP to build upon these elements and expand to include an updated GHG inventory, GHG emissions projections and reduction targets, a statewide community benefits analysis, additional community engagement, and comprehensive reduction measures.

EGLE is consistently searching for ways to bring sustainable solutions to Michigan to reduce greenhouse gas emissions, opening the opportunity to improve the lives of Michiganders through economic and health benefits. EPA's CPRG program is another opportunity for the State of Michigan to define near-term goals and spur action in implementing the MHCP key strategies. Developing a PCAP allows eligible entities to apply for CPRG Implementation Funds to implement the priority reduction measures with the main objective to reduce greenhouse gases through policies and programs that focus on near-term, high impact reductions.

NOTE: There are recommendations throughout this document that may help in guiding individual application processes for eligible entities applying to the CPRG implementation grant.

1.2 PCAP Overview and Definitions

The State of Michigan's PCAP covers all requirements as stipulated by the EPA in the following structure:

1. **Introduction:** Inclusive of PCAP document components, EGLE's high-level approach to the CPRG Program and the PCAP, the scope of this document, and methods used to develop each PCAP component.
2. **State Context:** Inclusive of details around the existing MI Healthy Climate Plan
3. **PCAP Elements:** Inclusive of the GHG inventory, an overview of statewide LIDACs, and each selected GHG reduction measure with its associated reduction measure description and quantification, LIDAC qualitative and quantitative community benefits analysis, a review of authority to implement, intersection with other funding availability, and a workforce planning analysis.
4. **Conclusion and Next Steps:** Inclusive of commentary on the strategy to develop the CCAP including a more detailed analysis on PCAP elements.

1.3 Scope of the PCAP

The geographic territory for EGLE's CPRG program covers the entire State of Michigan. Engagement sessions as part of the CPRG and the GHG inventory reached all regions of the state. In parallel, key sectors were identified for focus on the near-term PCAP requirements. These sectors represent the highest-emitting sectors in Michigan and oftentimes, the greatest ability to achieve near-term GHG reduction impact as emphasized by the EPA. The key sectors prioritized in the PCAP are as follows:

1. Electricity Generation
2. Commercial and Residential Buildings
3. Transportation
4. Industry

These sectors use language as suggested by the EPA[1], which align with key recommendations in the MHCP:

EPA Sector	MHCP Key Recommendation
Electricity Generation	Clean the Electric Grid
Commercial and Residential Buildings	Repair and Decarbonize Homes and Businesses
Transportation	Electrify Vehicles and Increase Public Transit
Industry	Drive Clean Innovation in Industry

[1] EPA Program Guidance

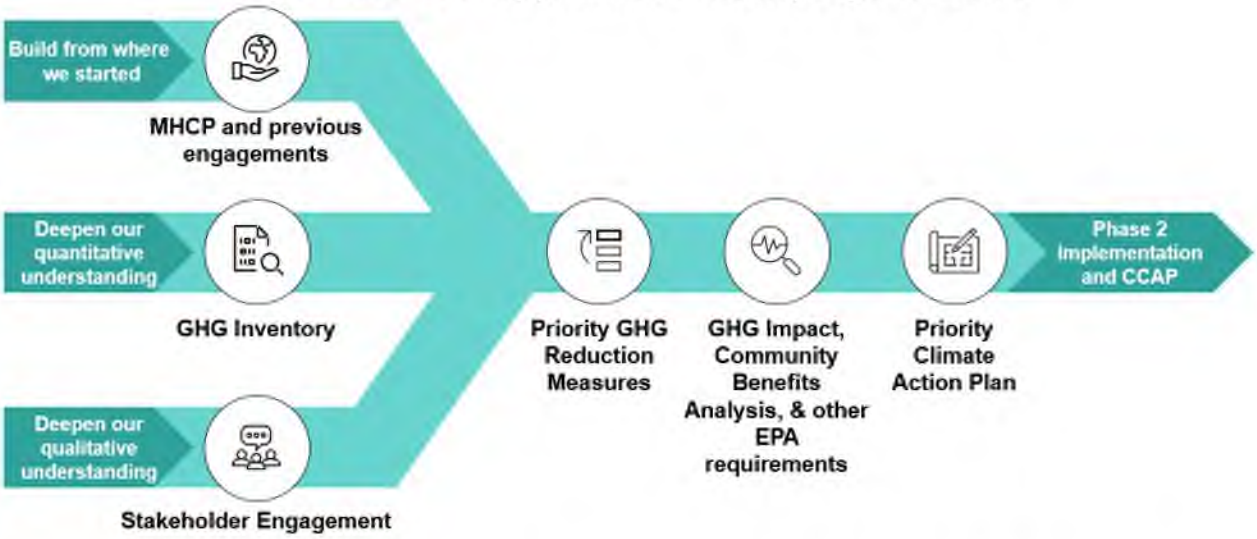
2. APPROACH TO DEVELOPING THE PCAP

The State of Michigan's approach to developing the PCAP is depicted in Figure 1: EGLE's approach to developing the PCAP. The PCAP is intended to help the State build upon and continue implementation of the MI Healthy Climate Plan released in 2022 while keeping the EPA strategic goals for the CPRG program top of mind. The MHCP is the state's roadmap with key actions to reach its goal of carbon neutrality by 2050, and is centered around the following six pillars:

1. Committing to Environmental Justice and Pursuing a Just Transition
2. Cleaning the Electric Grid
3. Electrifying Vehicles and Increasing Public Transit
4. Repairing and Decarbonizing Homes and Businesses
5. Driving Clean Innovation in Industry
6. Protecting Michigan's Land and Water

Several committees, plans, and follow-on commitments have been made to progress Michigan's journey towards carbon neutrality, illustrated more in depth in the following section. Michigan builds from the foundation established by the MHCP development process along with previous engagements to align CPRG requirements with existing initiatives, accelerating progress and amplifying impact.

Figure 1: EGLE's approach to developing the PCAP.



The CPRG program is an opportunity for Michigan to deepen both the qualitative and quantitative understanding of the impact of GHG emissions on the State with a focus on the priorities outlined in the MHCP. Qualitatively, Michigan was able to understand current barriers, needs, and solutions towards MHCP implementation through multiple novel and ongoing community engagement and a LIDAC benefits analysis. From a quantitative perspective, EGLE developed a GHG inventory to better understand the State's emissions profile and then, prioritize and quantify GHG reduction measures in addition to quantifying LIDAC benefits. The

culmination of these analyses, along with initial workforce and funding analyses, further enables the understanding of Michigan's needs in securing a sustainable future and realizing its long-term vision for individuals, families, and the State more broadly (described in **Figure 2**).

The CPRG program is an opportunity for Michigan to reach this long-term vision by augmenting existing actions and priorities within the state. Thus, EGLE carefully considered the EPA strategic goals and CPRG objectives and priorities while developing each action related to this PCAP. For example, upon prioritizing reduction measures, EGLE evaluated the durability, replicability, and near-term GHG reduction impact of potential measures. More details around the approach to collaboration, engagements, and analyses are described below.

Figure 2: The intended outcomes of the State's priority reduction measures exactly mirror those listed in the MHCP.

2.1 Collaboration and Community Engagement Methodology

Throughout the CPRG PCAP process, the State of Michigan has developed various ways to engage communities and maintain ongoing collaboration with the goal of creating a holistic, inclusive PCAP composed of Michigan's highest priority needs influenced by citizens and experts alike.

EGLE has long-standing collaborative relationships with several entities that continued and broadened to incorporate PCAP-specific discussions. For instance, as Southeast Michigan Council of Government (SEMCOG) and Grand Valley Metro Council (GVMC) were the two Michigan MSAs that received funding to develop their own PCAPs, EGLE met with SEMCOG and GVMC on a biweekly basis to share approach, status, and provide overall collaboration and

alignment throughout the process. Separately, Michigan met with all twelve of Michigan's federally recognized tribal governments regularly and bi-weekly with those tribes that received a CPRG planning grant. Some other entities with ongoing relationships that provided input on the PCAP whether directly or indirectly include the Michigan Advisory Council on Environmental Justice (MAC-EJ), Upper Peninsula (UP) Clean Energy Coalition, Catalyst Communities, Council on Climate Solutions, EGLE Climate Liaisons, interagency groups, community members, regional planning districts, municipalities, utilities, universities, students, labor unions and associations, and more.

EGLE organized additional engagement as part of the PCAP process with three main objectives:

1. Educate and excite communities about sustainability goals and progress occurring in the state
2. Inform priority reduction measure selection and understand barriers and solutions for the implementation of reduction measures across key sectors through the lived experiences of affected communities
3. Play a role to organize projects with near-term focus on prioritizing high GHG emissions reductions initiatives

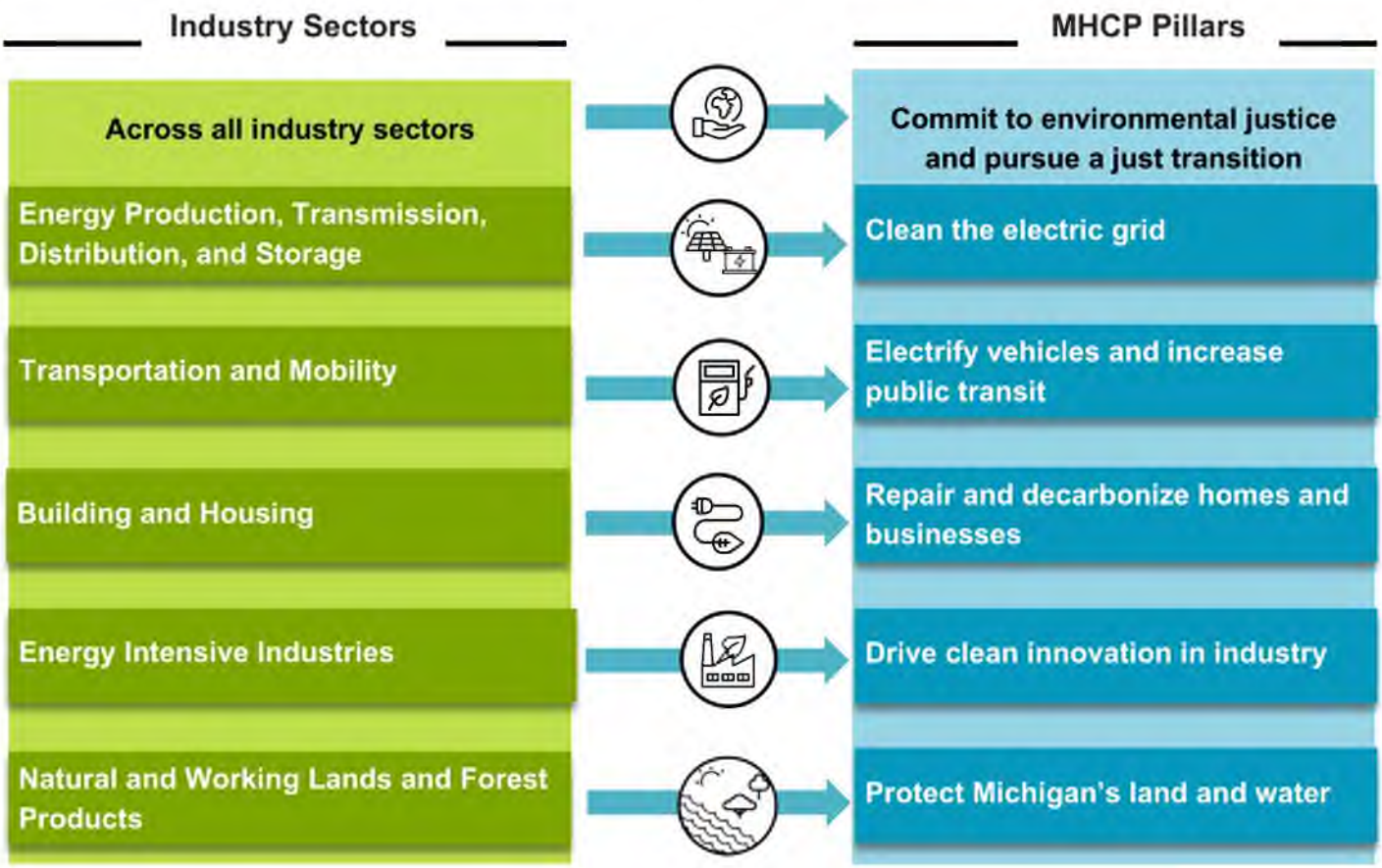
Community engagement content and activities were also developed with consideration of EGLE's core principles including empathy, equity, accessibility, transparency, continuous improvement, and place-based engagement for all engagement sessions. As part of ongoing collaboration and continuous improvement, EGLE released a Request for Information (RFI) to seek input from the public on topics related to community engagement and implementation of the MHCP. The feedback received from this RFI was used to develop the objectives and incorporated into the PCAP community engagement sessions.

The community engagement objectives and core principles were to be completed and incorporated within five in-person engagement sessions held for the public in different regions throughout the State (Detroit, Grand Rapids, Flint, Marquette, and Petoskey) and two virtual public listening sessions to capture ideas from as many people as possible while remaining aligned with EPA's PCAP deadline. One additional in-person session was held in Acme to gather specific input from Michigan's federally recognized tribes during a quarterly Michigan Tribal Environmental Group (MTEG) meeting. To accomplish these goals and principles, the in-person community engagement content and interactive exercises were iterated several times in preparation for facilitation and to achieve successful outcomes. EGLE made a deliberate effort to ensure that voices from low-income, disadvantaged, and historically underserved communities were included in these sessions.

To prioritize gaining community member feedback for each engagement session, events were held in the evening and locations were chosen with local partners, close to venues with public transit access in order to increase participation. Additionally, general locations were selected with low income and disadvantaged communities in mind. Of the six counties with the highest amount of census tracts identified as LIDACs, five of them are within close proximity to Detroit and Flint, comprising 55% of all census tracts identified by CEJST as LIDACs. The remaining county is Kent County, where the Grand Rapids engagement was held. Petoskey and Marquette also have identified LIDAC census tracts. Michigan's Upper Peninsula, where the Marquette engagement was held, is also identified by the DOE as a Priority Energy Community, meaning supplemental resources are provided to these communities as they are vulnerable to coal job loss impacts.[2]

EGLE focused most of each session on the group activity and discussion. As a result, about 25% of the time spent was used to educate and excite communities about Michigan's climate plans and progress and 75% of the time was spent on group activities. The sessions were organized around the MI Healthy Climate Plan pillars that correspond to key industry sectors as shown in Figure 3.

Figure 3: Industry sectors corresponding to the six pillars of the MHCP.



[2] energycommunities.gov/priority-energy-communities/

Prior to the group activity portion, the in-person sessions began with information on the MI Healthy Climate Plan, Climate Pollution Reduction Grant, other climate-related state programs, as well as other opportunities to get or stay involved. The interactive activities included the following:

Figure 4: In-person engagement session held in Detroit in November 2023.

1. **Breakout Group Activity**: Two rounds of participants selecting a key industry sector they want to discuss. As stated in the MI Healthy Climate Plan, each sector lists specific goals to achieve by 2030. Participants were tasked with discussing barriers, potential solutions, and benefits that may be realized by these solutions to achieve the goals set out in the MI Healthy Climate Plan.
2. **Gallery Walk**: Participants viewed the responses from the breakout group activity for all key sectors, added additional comments where they felt necessary, and uplifted any responses which they found most important, whether they be barriers, solutions, or benefits.
3. **Report-out**: All participants came together as one group to discuss key takeaways or popular topics discussed throughout the session.

Figure 5: In-person engagement session held in Petoskey in December 2023.

The sessions concluded with additional information and resources to stay up to date on progress. The in-person engagement sessions that occurred within the MSAs that received EPA CPRG planning grants were facilitated in collaboration with the lead agencies receiving the awards, SEMCOG and GVMC.

Virtual listening sessions were similar to an open-forum comment period for Michiganders to discuss any topic as it related to prioritization of measures for inclusion in the PCAP and broader MI Healthy Climate Plan implementation. To provide context and accomplish education around Michigan goals and progress in climate-related initiatives, each session began like the in-person sessions with a discussion of the MI Healthy Climate Plan, Climate Pollution Reduction Grant, other climate-related state programs, and other opportunities to get or stay involved prior to starting the open forum portion. The open forum portion consisted of participants raising their hand and taking turns to discuss any climate-related topic area they wish. Each participant had three minutes to speak to encourage feedback from all attendees on the call. Virtual listening sessions concluded by providing information and resources to stay involved with the MI Healthy Climate Plan.

2.2 GHG Inventory Methodology

The 2024 Michigan Greenhouse Gas Emissions Inventory was developed by EGLE to offer increased transparency and commitment to Michigan's sustainability goals. The purpose of the inventory is to provide the MI Healthy Climate Plan and other initiatives in pursuance of the Plan's goals with a quantifiable baseline of comparison for emissions reductions.[3]
The 2024 GHG Inventory is the second of two inventories developed for the State of Michigan, the first of which was developed in 2005 and compared emissions between 1990 and 2002.[4] Michigan's 2024 inventory examines 2005 and 2019 GHG emissions and overall trends from 1990 to 2019. The 2024 GHG Inventory was developed using the EPA's State Inventory Tool (SIT) (February 2023 version, with data updated through 2020) as a framework, while replacing and supplementing default emission data with state-specific data where appropriate. For more information on the methodology behind the greenhouse gas inventory, refer to the SIT Methodology which can be found via the module user guides available on the EPA's website.[5]

NOTE: For those applying for implementation grants within the State of Michigan under the EPA's CPRG program, please use 2019 as your reference year for emission data to ensure consistency between applications and comparability in emissions reduction calculations.

2.3 Priority Reduction Measure Selection and Quantification Methodology

Priority GHG Reduction Measures were selected and quantified based upon a rigorous process to vet and estimate the potential impact on Michigan's GHG emissions. To evaluate reduction measures, input was collected from numerous engagements with various groups including but not limited to:

- Catalyst Communities Initiative
- Request for Information on Community Engagement
- Public Call for Projects Form
- Council on Climate Solutions: Workgroup Recommendations[6]
- CPRG Engagement In-Person Engagement Sessions
- CPRG Engagement Virtual Listening Sessions
- Request for Information on the Implementation of the MI Healthy Climate Plan
- UP Energy Task Force Committee Recommendations
- Ad-hoc submittals to EGLE-OCE@Michigan.gov

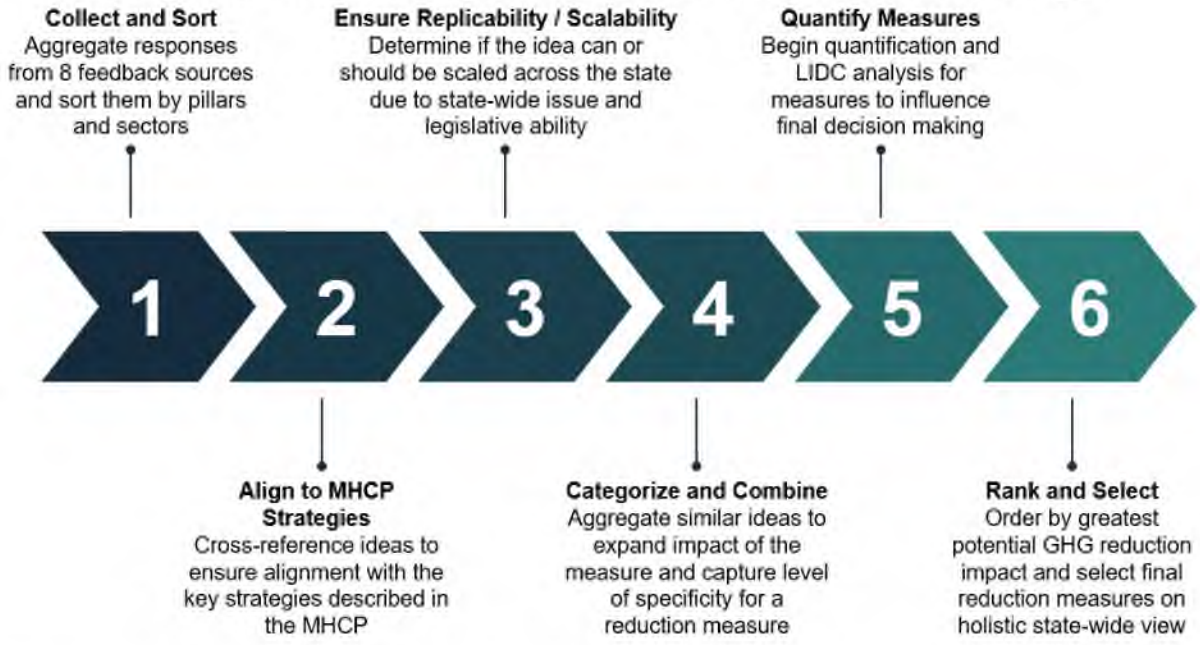
[3] mhcp-egle.hub.arcgis.com/
[4] css.umich.edu/publications/research-publications/michigan-greenhouse-gas-inventory-1990-and-2002
[5] epa.gov/statelocalenergy/state-inventory-and-projection-tool
[6] michigan.gov/egle/about/Groups/Council-on-Climate-Solutions/Workgroup-Recommendations

Selection and prioritization of GHG reduction measures considered approximately 800 ideas provided by feedback received across engagement sessions, recommendations, and individual submittals. These 800 ideas were then sorted into the 6 pillars described in the MHCP before being evaluated. They then moved through the prioritization framework as described in Figure 6 to best identify the measures that were aligned to the MHCP, replicable across the state, had the greatest GHG reduction impact potential, and aligned with other CPRG requirements as established by the EPA.

By following this framework, EGLE aimed to:

- Focus on Michigan's highest-emitting sectors with the goal of high-impact, near-term GHG emissions reductions
- Continue the momentum the MHCP started by aligning initiatives
- Abide and prioritize by EPA requirements to best position Michigan to receive CPRG implementation funds

Figure 6: EGLE's Priority Reduction Measure Selection Methodology



All received and ongoing feedback will be re-evaluated for the CCAP as changes in the legislative, economic, and technological environments occur upon development.

Quantifying priority reduction measures followed six steps to carry out the analyses:

1. Investigate emissions reduction source per reduction measure and best available quantification tool (whether federal, peer-reviewed, etc.)
2. Collect applicable data from reliable sources and existing MHCP goals, documenting assumptions related to data collection
3. Quantify emissions using the best identified tool

4. Validate emissions quantification with secondary tool as possible, documenting variances in quantification tool assumptions
5. Record the estimated annual emissions reduction, emissions reductions from 2024-2030, and emissions reductions from 2024-2050 for each priority reduction measure
6. Contextualize and include key assumptions in the write-up for each priority reduction measure

Quantification was completed across sectors, isolating emissions reductions across measures. Affected sectors for one reduction measure quantification were included where possible. Effects on one reduction measure were not compounded if another reduction measure were assumed to be implemented.

2.4 LIDAC Benefits Analysis Methodology

The LIDAC benefits analysis is composed of three primary sections:

1. Understanding of low-income and disadvantaged communities across the State of Michigan
2. Research and analysis around the hardest-hitting areas for LIDACs across the State of Michigan
3. Analysis of the specific quantitative and qualitative nature of effects on emissions reductions for each priority reduction measure

The tools used in the LIDAC analysis include the Climate and Economic Justice Screening Tool (CEJST), the EPA's Environmental Justice Screening and Mapping Tool (EJScreen), and MiEJScreen, the State of Michigan's environmental justice screening tool. Each census tract deemed low-income and/or disadvantaged by the following EPA definition according to posted CPRG guidance was included in the overall analysis. A list of all identified census tracts can be found in **Appendix C: CEJST Census Tracts**.

LIDAC Definition:

1. Any census tract that is included as disadvantaged in the CEJST
2. Any census block group that is at or above the 90th percentile for any of EJScreen's Supplemental Indexes when compared to the nation or relevant state
3. Any geographic area within tribal lands as included in EJScreen

Following the analysis and comparison of how these three tools interact, research and analysis were completed to understand the greatest potential benefits communities may realize from implementation of the reduction measures, and the MHCP as a whole. These areas include air quality and public health, energy burden, workforce, and climate resilience. The benefits analysis then talks about the components included within each reduction measure including co-pollutants, avoided deaths by race, avoided lost workdays, avoided respiratory symptoms and bronchitis, avoided hospital admissions, and avoided minor restricted activity days. All priority

reduction measures aimed to quantify each of these areas, though, due to the variety of tools used in emissions reduction quantification, this is not always the case.

2.5 Review of Authority Methodology

The Michigan PCAP is designed to identify implementation ready and high-priority actions that can be taken to reduce GHG emissions in the near-term. The focus is on measures that can be implemented using existing authority, without the need for significant legislative changes. The PCAP measures are drafted with replicability and scalability in mind, allowing for various implementation approaches involving different state agencies or local governments. Additional context on Michigan's authority to implement measures, while not exhaustive, are further described in Section 4.4 and in each priority measure in Section 5.

2.6 Intersection with Other Funding Availability

Each priority reduction measure includes a subsection describing any existing federal funding the State of Michigan has received to implement projects related to specific measures. This analysis was completed by researching an exhaustive list of available federal funding opportunities for each measure and categorizing their status with the State of Michigan into received funds, applying for funds, planning to apply, did not receive funds, or did not apply. Additional context on the coordinated efforts Michigan manages to receive funds and implement the MHCP are described in Section 4.6 and in each priority measure in Section 5.

2.7 Workforce Planning Analysis

Each priority reduction measure includes a subsection detailing current and changing workforce metrics. The existing number of jobs in broad categories (e.g., renewable energy, energy efficiency, etc.) are included in each measure along with the types of jobs to be created and the projected change in number of jobs by implementing the measure, where possible. All information was researched or analyzed using the Energy Policy Simulator. Additional context on the existing workforce planning activities occurring within Michigan, while not exhaustive, are briefly described in Section 4.6 and in each priority measure in Section 5.

3. STATE CONTEXT

Michigan's GHG emissions come from a wide variety of sources, including the burning of coal and natural gas to produce electricity; the use of diesel and gasoline for transportation; heating of homes and buildings; industrial processes in industry; methane and other emissions from waste; and agricultural processes.

The State of Michigan's Executive Directive 2020-10 spurred the development and creation of the MI Healthy Climate Plan. The MHCP was released in April 2022 and developed with input from hundreds of Michigan residents, including leaders and advocates in environmental justice, public transit, local food, climate action, business, labor, academia, government, and people of all political persuasions and walks of life.

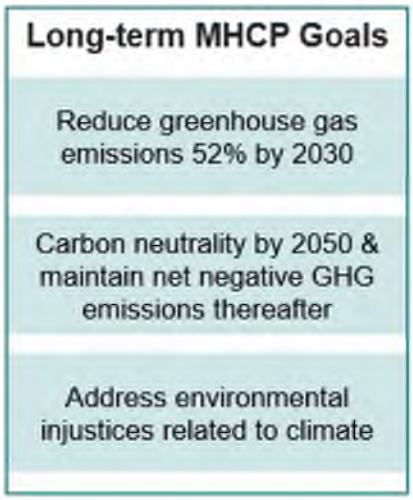
Figure 7: The seven objectives of the MHCP.

The MHCP lays out a pathway for Michigan to reach 100% carbon neutrality by 2050 to avert the worst impacts of the climate crisis, create good-paying jobs, and build a healthier, more prosperous, equitable, and sustainable Michigan for all Michiganders. It has seven objectives as listed in Figure 7.

The MHCP outlines key strategies across Michigan's economic sectors. It strongly emphasizes environmental justice to ensure Michigan's climate strategies uplift every portion of the State, including individuals and communities that have borne the brunt of climate impacts as well as associated criteria air pollutants and are at the greatest risk of being left behind in the transition ahead. Due to the robust research and development that went into the creation of the MHCP, all CPRG PCAP components use the data and information in the MHCP as a foundation for prioritizing and decision making on the State's near-term priorities. Executive Directive 2020-10 spurred several initiatives led by EGLE today such as the formation of councils, workgroups, opportunities for comment, and state grant programs which helped create the MHCP and now, they help progress the implementation of the MHCP. EGLE sees the EPA's CPRG program as an opportunity to bolster the MHCP and implement its key strategies. Therefore, the different components of this PCAP align with the goals set out in the MHCP.

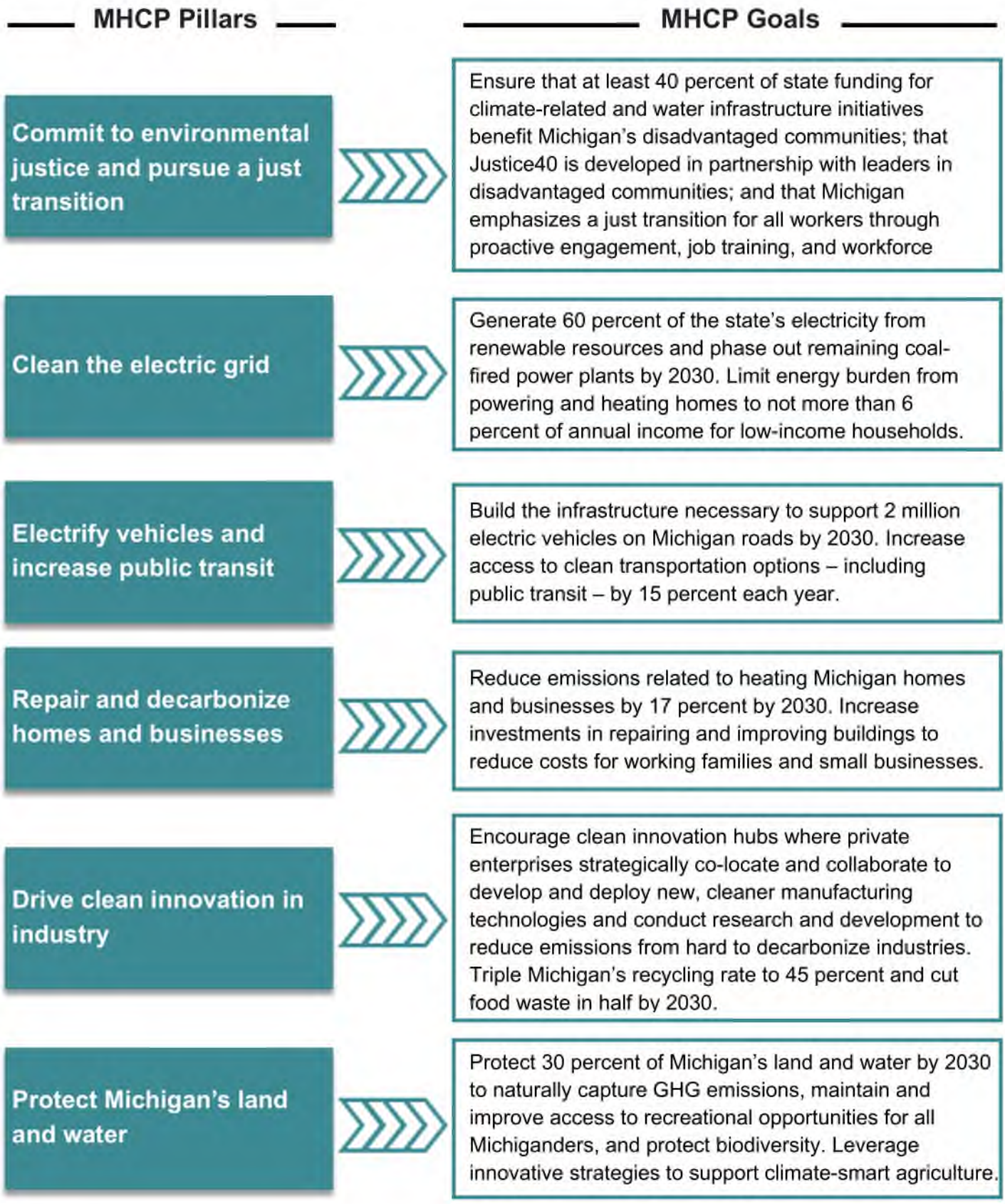
The MHCP identifies what needs to happen for Michigan to reach carbon neutrality by 2050, with a priority on actions from now until 2030. It focuses most heavily on the areas in Michigan where the biggest, most rapid gains in GHG reductions can be made, namely energy, transportation, and buildings. The CPRG offered an opportunity to refresh Michigan's GHG Inventory. The inventory shows that Michigan's net GHG emissions as of 2019 are 166.73 $MMTCO_2E$ which is an overall decrease of approximately 15% since the baseline year of 2005, as used in the MHCP. Electric utilities and transportation lead in CO_2 emissions from fossil fuel combustion, accounting for 35% and 32% of total CO_2 emitted, respectively. The MHCP groups the climate actions needed to achieve the State's goals into six categories, each with targeted sub-goals as shown in Figure 9.

Figure 8: MI Healthy Climate Plan's long-term goals



2023 marked a transformative year for Michigan in the ability to implement the MHCP and transition to a sustainable economy due to the passing of several legislative initiatives. A series of bills were passed to mandate implementation of key provisions in the MHCP. These legislative wins include commitments to clean energy standards, renewable energy goals, expanded options for rooftop solar, energy efficiency initiatives, and measures to address environmental justice and workforce development. The legislation signed by Governor Whitmer in July and November 2023 positions Michigan as a national clean energy leader, including advancing priorities including, increasing renewable energy deployment, lowering energy costs, prioritizing environmental justice, and securing living wages for clean energy workers. These efforts aim to meet ambitious climate goals while supporting economic growth and equity in Michigan's transition to a cleaner energy future. For more information about the recent legislation, please view MI Healthy Climate Plan 2023 Report.

Figure 9: MI Healthy Climate Plan's sector-specific goals organized by MHCP Pillar



4. PCAP ELEMENTS

This section discusses the results of:

1. Michigan's 2024 GHG Inventory
2. Community Engagement
3. LIDAC Benefits Analysis
4. Review of Authority to Implement Measures
5. Funding Opportunities in Michigan
6. Workforce Planning in Michigan

These findings directly aided in the selection of the priority reduction measures, further detailed in Section 5.

4.1 Greenhouse Gas Inventory

The State of Michigan completed its first GHG inventory in 2005 supported by the Center for Sustainable Systems at the University of Michigan.[7] The first inventory focused on profiling GHG emissions from 1990 and 2002 across the state. This subsequent inventory will contribute an updated methodology and corresponding calculations to the years previously covered and focus the analysis on GHG emissions across Michigan for the years of 2005 and 2019.

Since the original inventory was published, sustainability continues to be of ever-increasing importance given the threat of irreversible climate change and drastic weather events. In September 2020, Governor Whitmer signed Executive Directive 2020-10, which committed Michigan to achieve economy-wide carbon neutrality no later than 2050 and then maintain net-negative greenhouse gas emissions thereafter. The governor also reaffirmed the goals in Executive Directive 2019-12, which committed Michigan to pursue at least a 26-28% reduction below 2005 levels in GHG emissions by 2025. In addition to the goals set by these directives, Michigan joined 24 other states and Puerto Rico – under the umbrella of the U.S. Climate Alliance – in committing to an interim goal of a 52% GHG reduction by 2030.[8] In alignment with these goals, EGLE has developed this inventory to increase transparency surrounding the current state of GHG emissions, as well as provide a common and consistent baseline of comparison when analyzing potential emission reduction opportunities.[9]

Both iterations of the State of Michigan's GHG inventory use the EPA's State Inventory Tool (SIT) as a main source of data and modeling.[10] The SIT relies on data from both state and federal sources and consists of 11 modules, the makeup of which is shown in Table 1, to

[7] css.umich.edu/publications/research-publications/michigan-greenhouse-gas-inventory-1990-and-2002
[8] usclimatealliance.org/members/
[9] mhcp-egle.hub.arcgis.com/
[10] epa.gov/statelocalenergy/state-inventory-and-projection-tool

calculate state-wide GHG emissions. The SIT also includes a synthesis module to perform an inventory sector-based analysis of each module, and consequently organizes them into a single emission profile for a given state. The SIT provides default data from 1990 – 2020 which this inventory uses as the base for analysis, adding in state-specific data where default data is either unavailable or better represents Michigan's emissions activity. For detailed descriptions of data sources and other methodology, please refer to EPA's posted SIT documentation[11].

Table 1: Gases Emitted by Inventory Sector and Corresponding SIT Module

Inventory Sector	SIT Module	What gases are included?
Energy	CO_2 from Fossil Fuel Combustion Module	CO_2 from fossil fuel combustion for residential, commercial, industry, transportation, electric utilities economic sectors
	Stationary Combustion Module	CH_4 and N_2O emissions for residential, commercial, industrial, and electric utilities economic sectors
	Mobile Combustion Module	CH_4, N_2O for gasoline highway, diesel highway, non-highway, alternate fuel vehicles
	Coal Module	CH_4 for coal mining production *(not applicable to MI)*
	Natural Gas and Oil Module	CH_4 and N_2O for natural gas production, transmission, distribution, venting and flaring, and oil production, refining, and transportation
Industrial Processes	Industrial Processes Module	CO_2 for cement manufacturing, lime manufacturing, limestone and dolomite use, soda ash production, iron & steel production, and urea consumption
		N_2O for nitric acid production
		F-gases for ODS substitutes, semiconductor manufacturing, and distribution systems
Agriculture	Agriculture Module	CO_2 from liming
		CH_4 from enteric fermentation
		N_2O from manure management (direct and indirect soil management)
Waste	Solid Waste Module and Wastewater Module	CO_2 from waste combustion
		CH_4 from landfills
		N_2O from waste combustion
Land Use, Land Use Change, and Forestry	LULUCF Module	CO_2 sinks from net forest carbon flux, urban trees, and landfilled yard trimmings and food scraps
		N_2O from settlement soils

[11] epa.gov/statelocalenergy/download-state-inventory-and-projection-tool

The Energy sector comprises five modules including Carbon Dioxide (CO_2) from Fossil Fuel Combustion (across economic sectors including Residential, Commercial, Industrial, Transportation, Electric Power, and International Bunker Fuels), and additional modules which produce methane (CH_4), nitrous oxide (N_2O) and fluorinated greenhouse gases (F-Gases, consisting of hydrofluorocarbons (HFC), perfluorocarbons (PFC), nitrogen trifluoride (NF_3), and sulfur hexafluoride (SF_6)). These include Stationary Combustion (economic sectors which emit fossil fuels and wood including Residential, Commercial, Industrial, and Electric Power), Mobile Combustion (including Gasoline, Diesel, Non-Highway, and Alternative Fuel Types), Coal Mining, and Natural Gas & Oil. Additional analyses have been performed in the Electricity and Transportation sectors to translate the inventory sector approach to an economic sector approach. The State is committed to continued improvement and development of the inventory on an annual basis as new data and updated methodologies continue to become available.

NOTE: For those applying for implementation grants within the State of Michigan under the EPA's CPRG program, please use 2019 as your reference year for emission data to ensure consistency between applications and comparability in emissions reduction calculations.

4.1.1 Summary Results

Michigan's net GHG emissions as of 2019 equaled 166.73 $MMTCO_2E$, an overall decrease of approximately 15% since the baseline year of 2005 used in the MHCP. Figure 11 summarizes GHG emissions by inventory sector from 1990 to 2019. Energy, Industrial Processes, and Waste inventory sectors all experienced a reduction in emissions. Agriculture was the only inventory sector to experience an increase in emissions, with a 23% increase between 2005 and 2019. The Energy sector remains the largest emitting sector, making up 87% of Michigan's emissions in 2019 (see Figure 10). Refer to Refer to Appendix A: GHG Inventory Detailed Tables for a detailed look at GHG emissions by sector in 2005 and 2019.

Figure 10: Proportion of the State of Michigan's GHG emissions by inventory sector in 2019 as a percentage, demonstrating Energy as the highest emitting sector

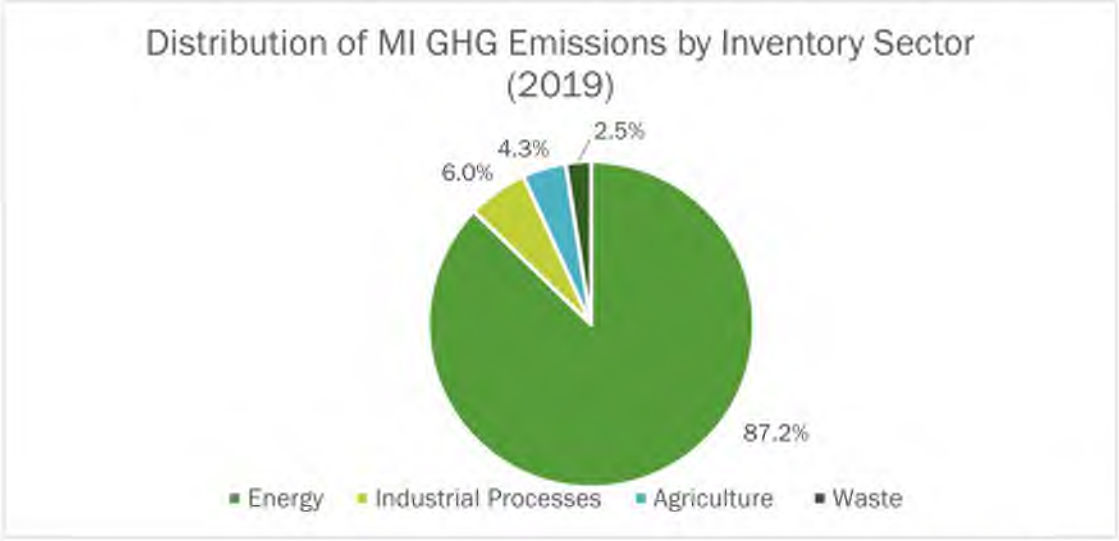
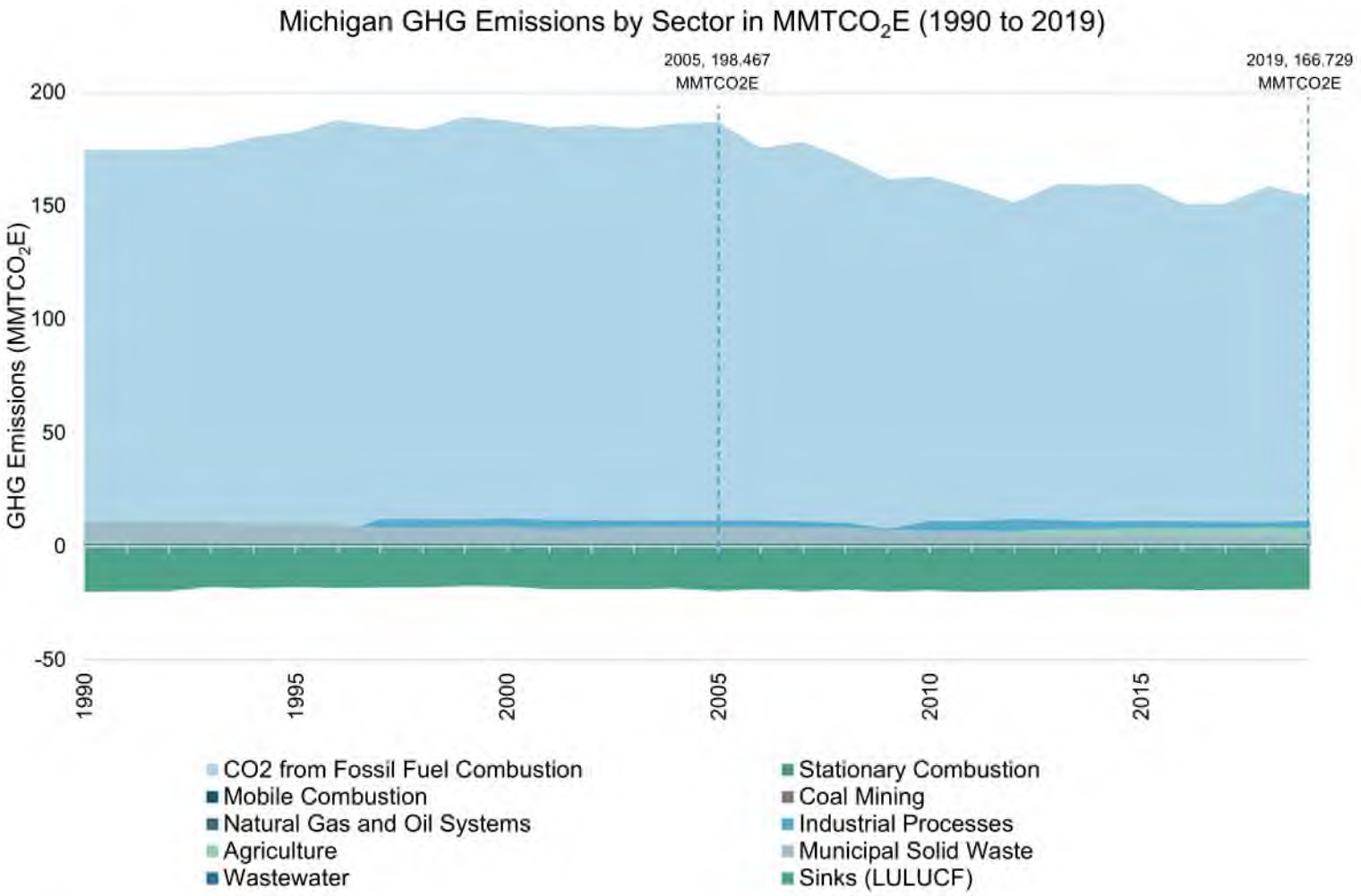


Figure 11: Michigan GHG Emissions by SIT Module in MMTCO2E (1990 to 2019)



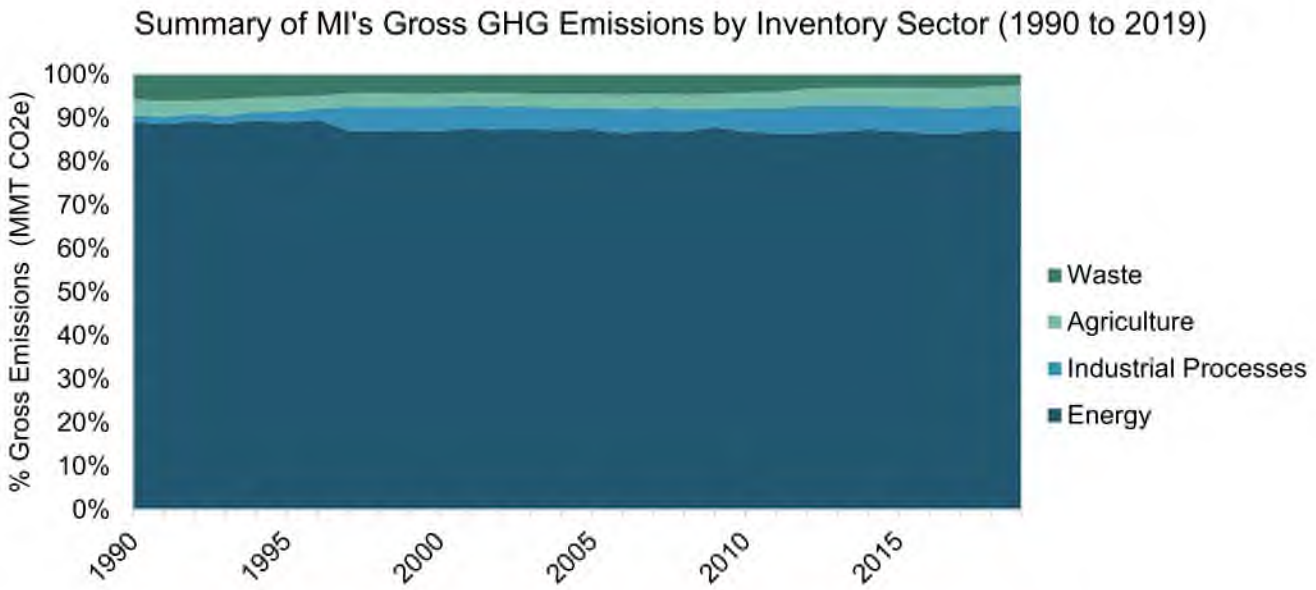
4.1.2 Detailed Results

GHG Emissions Trends

Quantifying and tracking annual GHG emissions as well as sector-based trends is critical to setting GHG reduction targets and developing a healthier, more equitable, and sustainable economy for Michiganders. Understanding where Michigan's emissions are most prevalent helps direct resources and efforts towards the largest emitting sectors as Michigan works in both the near- and long-term to prioritize deployment of sustainable technologies, policies, and programs.

Figure 12 shows the proportion of GHG emissions by inventory sector as a percentage of total GHG emissions from 1990 to 2019 for the State of Michigan. Inventory sectors include Waste, Agriculture, Industrial Processes, and Energy. As shown, Energy accounts for nearly 90% of Michigan's overall GHG emissions, and is made up from the following SIT modules:

Figure 12: The State of Michigan's GHG emissions by inventory sector between 1990 and 2019 as a percentage of overall emissions



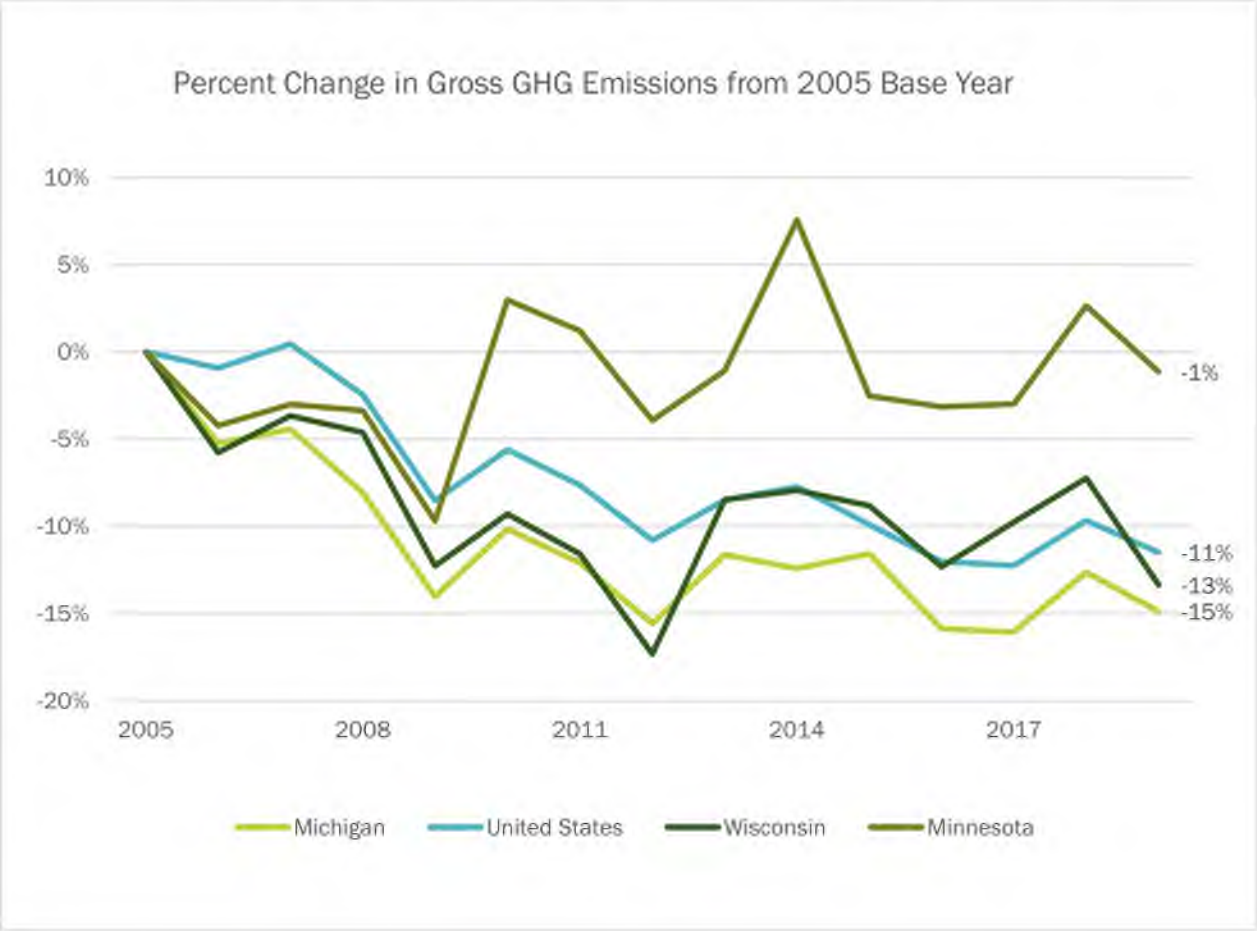
I. CO_2 from Fossil Fuel Combustion (CO_2FFC) (CO_2 emissions from fossil fuel combustion across economic sectors)
II. Stationary Combustion (CH_4 and N_2O)
III. Mobile Combustion (CH_4 and N_2O)
IV. Coal Mining (CH_4)
V. Natural Gas and Oil Systems (CH_4)

CO_2FFC makes up the vast majority of emissions (98.9% of emissions) from the Energy sector, followed by Natural Gas and Oil Systems which makes up 3.4%, and Stationary Combustion and Mobile Combustion with less than 1% of overall emissions in this sector.

Indirect CO_2 emissions from Electricity Consumption was excluded from total calculation values to avoid double counting emissions from the CO_2FFC module. The Land Use, Land Use Change, and Forestry (LULUCF) sector is not accounted for in net GHG emissions as they remove carbon dioxide from the atmosphere and thus, are not shown in Figure 12 as a percentage of total net emissions.

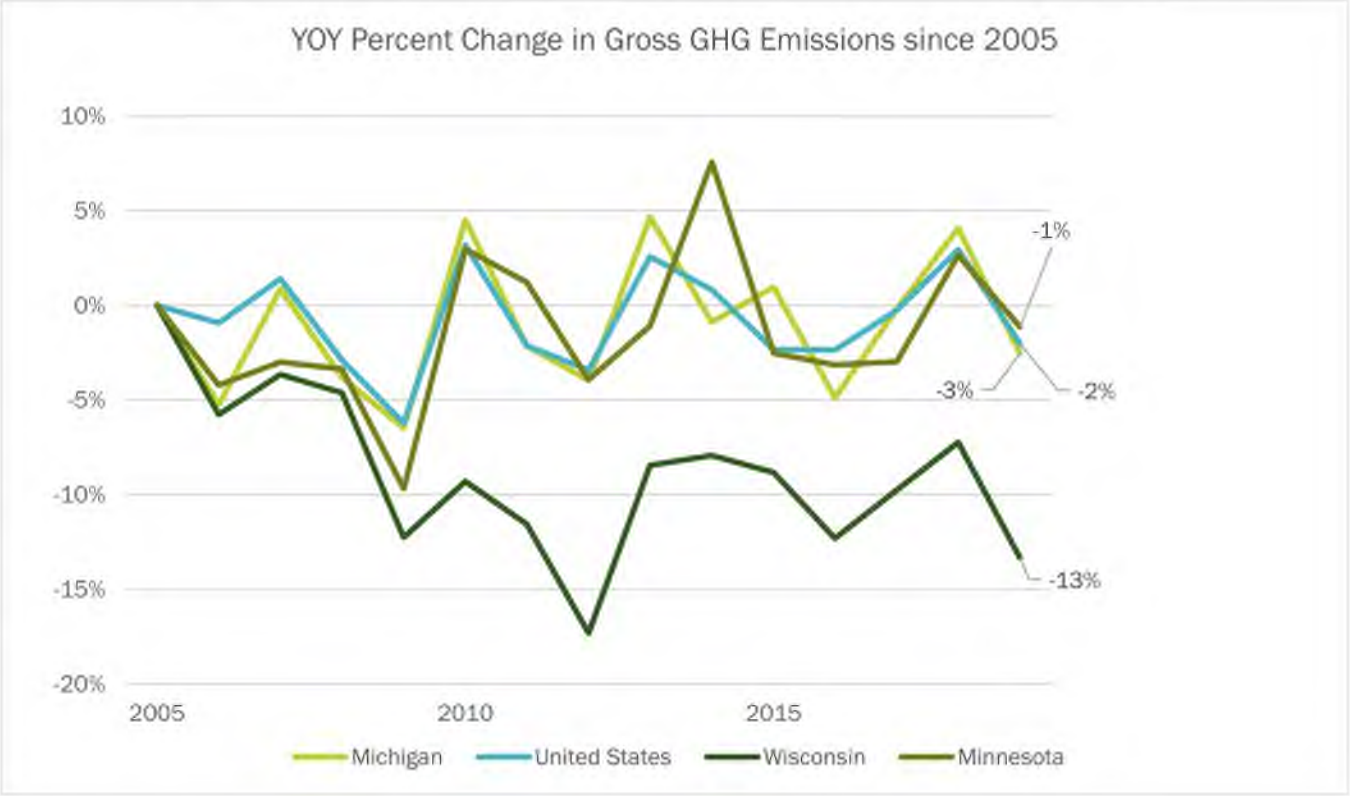
Figure 13 shows the change in gross GHG emissions from 2005 levels between the United States, Michigan, and other Midwest states. Despite some variability, a downward trend in Figure 13 shows a steady decline in Michigan's cumulative emissions since 2005. In 2019, Michigan's GHG emissions fell 15% below 2005 levels, compared to the U.S. 11% overall decline. Michigan's GHG emissions had a greater reduction than both Minnesota and Wisconsin as peer states based on 2005 levels.

Figure 13: Comparison of the percent change in Gross GHG Emissions across Michigan, the United States, and other Midwest States since 2005



Alternatively, Figure 14 shows variability demonstrated by a year-over-year percentage change in emissions rather than the ultimate downward trend shown in Figure 13. A year-over-year analysis demonstrates how emission levels change when compared to the previous year, as opposed to comparing each year individually to a standard baseline. For example, Michigan's year-over-year emissions decreased by 2% from 2018 to 2019, while emissions in 2019 were 15% lower than those in 2005. The United States, Michigan, and Minnesota trendlines show similar trends in variability, fluctuating between positive and negative emissions every two to three years. Wisconsin shows consistent reductions since 2005 year over year, though there is variability in the size of reduction. Both the U.S. and Michigan experienced a stagnation in emission changes from 2008-2009, and subsequently reached an 11% YOY increase the following year in 2010. This emphasizes that year over year emissions generally follow a volatile pattern, while trending downward overall.

Figure 14: Comparison of the year-over-year (YOY) percent change in Gross GHG Emissions across Michigan, the United States, and other Midwest states since 2005



GHG Emissions Distribution by Gas

This section will take a deep dive into the different GHGs most prevalent in Michigan, the proportion of each of them, and what inventory sectors contribute most to each gases' emissions. GHGs act as a blanket which cover the Earth's atmosphere and cause warming, however, each greenhouse gas warms the Earth at different rates. Differences in rates are expressed via Global Warming Potential (GWP) which are the result of a GHG's ability to absorb energy ("radiative efficiency") and how long they stay in the atmosphere ("lifetime"). To gain additional information on global warming potentials, please refer to the EPA's site: epa.gov/ghgemissions/understanding-global-warming-potentials.

The EPA primarily uses the 100-year GWPs from IPCC Fifth Assessment Report (AR5) per international reporting standards. 100-year GWP is based on energy absorbed by a gas over 100 years. Another common reference is the 20-year GWP which assesses the energy absorbed by a gas over 20 years and is prioritized for gases with shorter lifetimes. For gases with lifetimes shorter than that of CO_2, the 20-year GWP will be larger than a 100-year GWP. Using CH_4 as an example, which has a short lifetime, it's 100-year GWP is 28 (according to IPCC AR5) while it's 20-year GWP is around 81-83.

Below is a summary view of the GWP for relevant GHGs to show the potential warming consequences for each according to a 100-year GWP. Carbon dioxide has a GWP of 1 since it is the most prevalent GHG and is often used as a baseline of comparison to evaluate the impact of other GHGs.

Table 2: Global Warming Potential for GHGs discussed in the State of Michigan's GHG inventory[12]

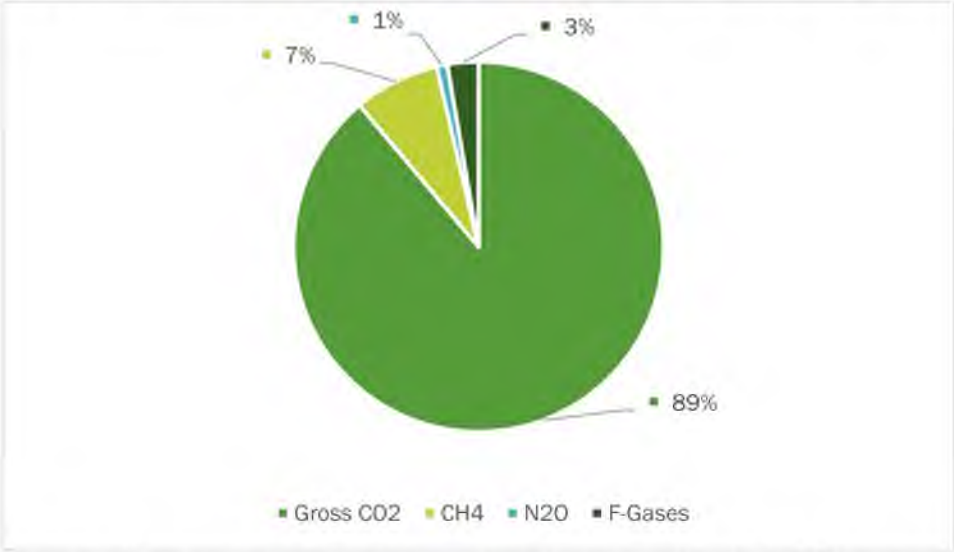
Greenhouse Gas	100-year Global Warming Potential
Carbon Dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous Oxide (N_20)	265
Hydrofluorocarbons (HFC)	4-12,400
Perfluorocarbons (PFC)	6,630 – 11,100
Sulfur hexafluoride (SF_6)	23,500
Nitrogen trifluoride (NF_3)	16,100

Despite CO_2 being the greatest source of GHG emissions in the state, the other GHGs assessed in this inventory have far greater GWP. Even with low proportions of the overall emissions, F-Gases (HFC, PFC, SF_6, and NF_3), often have GWPs over 1000, meaning they warm the Earth more than CO_2 over the same period of time. Emission reduction measures must pay attention to what GHGs they will impact and take special care to prioritize their reduction across the state.

Looking across the distribution of GHG emissions after adjusting all gases to a CO_2 equivalency (CO_2E) as shown in Figure 15, CO_2 emissions represent approximately 89% of overall GHG emissions in the State of Michigan. Methane is the second most present gas at 7%, followed by F-Gases (3%) and nitrous oxide (1%). Reference **Figure 16** for more details on the GHG emissions by gas in the State of Michigan.

[12] ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf

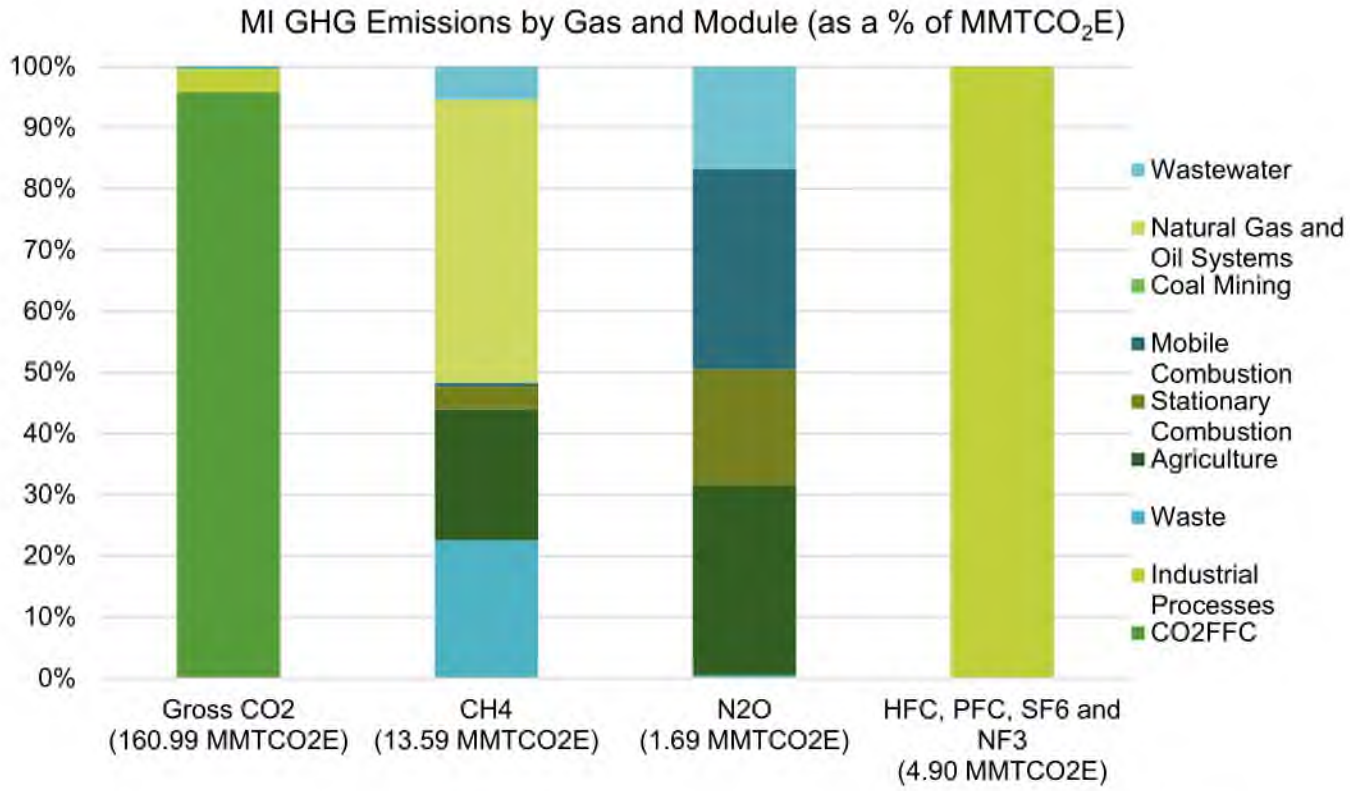
Figure 15: Distribution of GHG as a percentage of 2019 Gross Emissions



Around 90% of gross CO_2 emissions are accounted for within the CO_2FFC module within the Energy sector, while 10% come from industrial processes such as cement production, lime manufacturing, limestone and dolomite use, and iron & steel production.

The Natural Gas and Oil Systems module, Waste sector, and Agriculture sector contribute the most to CH_4 emissions, while N_2O is primarily attributed to the Mobile Combustion module and Agriculture sector. All F-Gases are attributed to the Industrial Processes sector as shown in Figure 16.

Figure 16: Distribution of Gas Types in Michigan by SIT Module in 2019



When exploring how these four GHG types have evolved between 2005 and 2019, CO_2 and N_2O decreased by 19% and 31%, respectively, while CH_4 and F-Gases increased by 4% and 14%, respectively. These emission profile changes may be due to lack of data prior to 2010 for certain modules such as Natural Gas & Oil, or simply due to a base increase in Agriculture and Industrial Processes, as some examples.

GHG Emissions by Inventory Sector

The Energy sector is by far the largest emitting inventory sector, representing 87.21% of Michigan's emissions profile in 2019, as shown in Figure 10. All sectors or modules are shown in **Table 3** and **Figure 17,** demonstrating their contribution to overall emissions in Michigan. The Energy sector is represented by five SIT modules – CO_2FFC, Stationary Combustion, Mobile Combustion, Coal Mining, and Natural Gas and Oil Systems – that will each be explored in the following sections. **Figure 18** displays the contribution of each SIT module towards overall Energy sector emissions.

Table 3: Impact Rank of GHG Emissions by Sector and Module in 2019

Sector or Module	Rank (in $MMTCO_2E$)
CO_2 from Fossil Fuel Combustion*	1
Industrial Processes	2
Agriculture	3
Natural Gas and Oil Systems*	4
Waste	5
Stationary Combustion*	6
Mobile Combustion*	7
Coal Mining*	8

**Specifies SIT modules part of the Energy inventory sector*

Figure 17: Proportion of GHG Emissions by Sector or Module in the State of Michigan in 2019

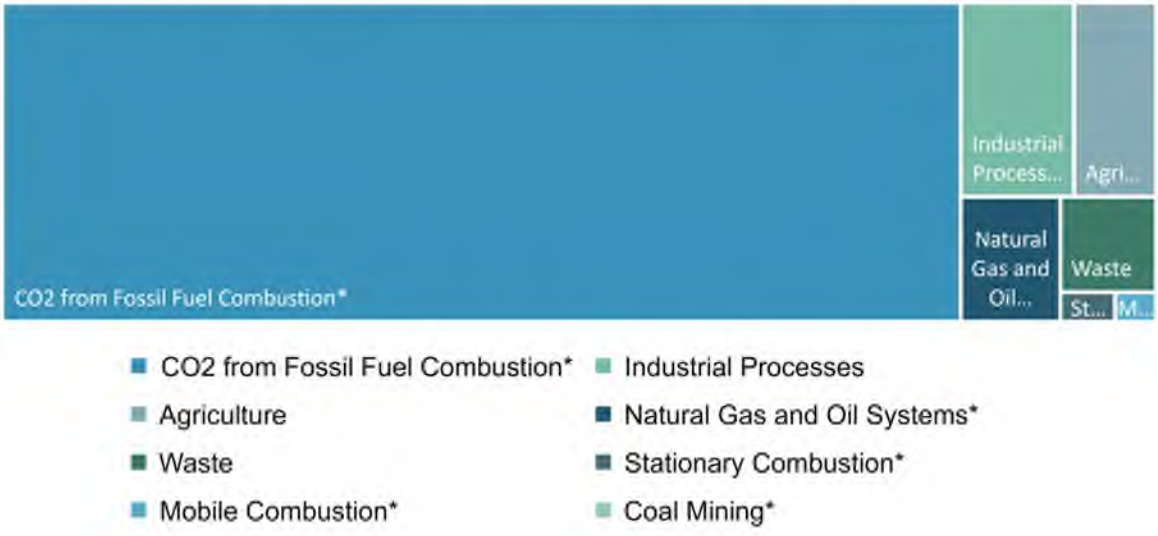
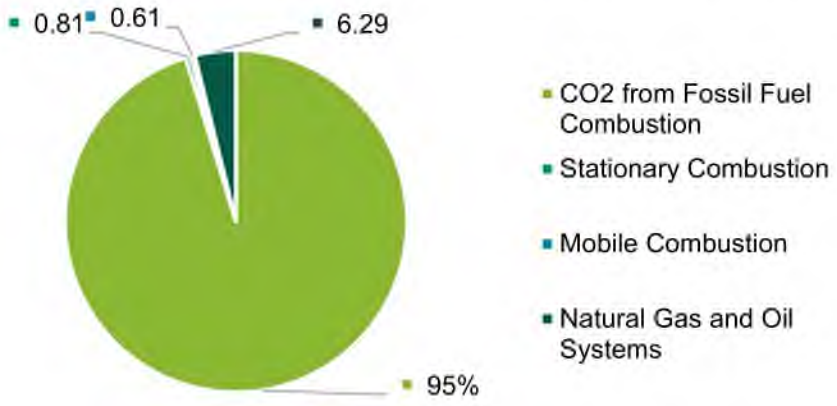


Figure 18: Breakdown of Energy Inventory Sector by SIT Module in 2019



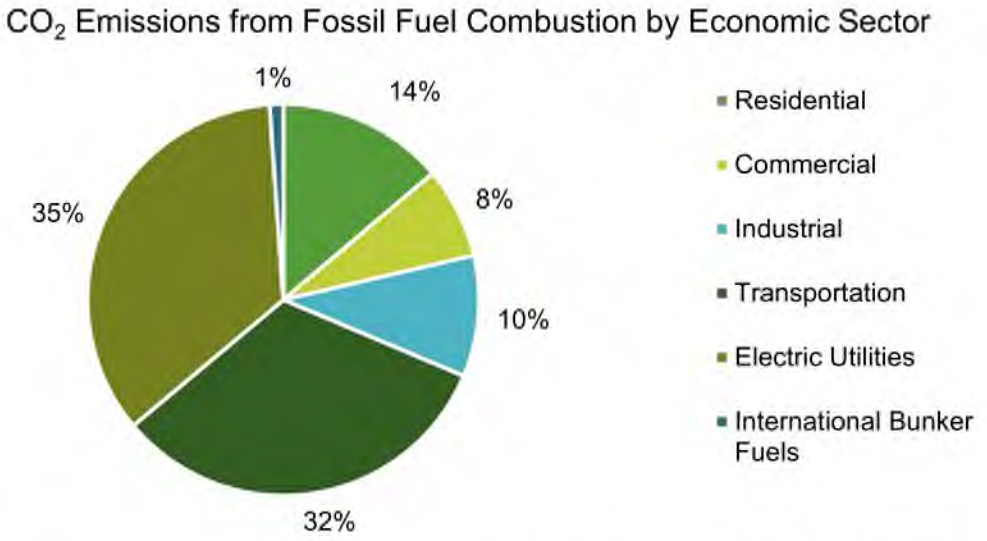
Energy

Carbon Dioxide Emissions from Direct Fossil Fuel Combustion

Carbon Dioxide Emissions from direct Fossil Fuel Combustion (CO_2FFC) is the largest emitting SIT module in Michigan for the GHG inventory and is included within the Energy inventory sector. CO_2 from Fossil Fuel Combustion is analyzed by economic sector, given its large contribution to the Energy emissions inventory sector. Economic sector analysis is pertinent to understand how the majority of GHG emissions are divided within the energy sector.

CO_2FFC emissions decreased by 17% overall from 2005 to 2019 with four of the six economic sectors (Residential, Commercial, Industrial, Transportation, Electric Utilities, and International Bunker Fuel) reducing emissions cumulatively across four different fuel types. Coal and petroleum CO_2 emissions decreased across all economic sectors from 2005 to 2019, whereas natural gas emissions increased. Table 4 shows 2005 and 2019 emissions data along with the percentage change between 2005 and 2019 across all six economic sectors and all three fuel types.

Figure 19: Proportion of CO2FFC emissions by Economic Sector in Michigan in 2019



Gross CO_2FFC emissions are heavily dependent on several factors from varying economic sectors, including overall energy demand, energy generation mix and capacity, and number of import/exports of energy demand in that year. Combustion from Electric Utilities was the highest emitting economic sector accounting for 35% of the overall CO_2 emissions from Fossil Fuel Combustion, closely followed by the Transportation sector at 32% (Figure 19).

Unsurprisingly, there has been a large decrease of carbon dioxide emissions from coal across all economic sectors, with a cumulative decrease of 46% between 2005 and 2019 (Table 4). Only the Electric Utilities and Industrial sectors generated emissions via coal combustion in 2019, with coal combustion decreasing by 45% between 2005 and 2019 in the Electric Utilities sector. Decrease of coal consumption is likely due to its increased cost, as compared to other energy sources such as natural gas which saw a cumulative increase of CO_2 emissions by 14% across economic sectors. Electric Utilities was observed to have the greatest increase in natural gas emissions between 2005 and 2019, likely due to its substitution for coal; however, the Residential economic sector remains the largest contributor of CO_2 emissions from natural gas at 18.58 $MMTCO_2E$, or 86.26% of all natural gas CO_2 emissions.

Petroleum fluctuates in its contribution to CO_2 emissions across all sectors, but overall saw a decrease in cumulative emissions by 9% from 2005 to 2019. A large increase in petroleum emissions occurred across the Commercial sector (83%), Electric Utilities sector (41%), and International Bunker Fuels sector (285%). The remaining economic sectors saw a decrease in petroleum emissions by 37% for Residential and 8% for both Industrial and Transportation. Despite the fluctuations, the cumulative decrease observed for petroleum is in in large part due to the 8% decrease in Transportation sector emissions, where petroleum makes up ~97% of CO_2 emissions in 2019.

Table 4: Total CO_2 Emissions from Fossil Fuel Combustion ($MMTCO_2E$) in Michigan

Emissions ($MMTCO_2E$)	2005	2019	% Change (2005 to 2019)
Residential	23.99	21.54	-10%
Coal	0.03	0.00	-100%
Petroleum	4.66	2.96	-37%
Natural Gas	19.30	18.58	-4%
Commercial	10.59	11.75	11%
Coal	0.33	0.00	-100%
Petroleum	0.86	1.58	83%
Natural Gas	9.40	10.17	8%
Industrial	20.62	15.63	-24%
Coal	4.42	1.82	-59%
Petroleum	4.97	4.56	-8%
Natural Gas	11.23	9.25	-18%
Transportation	55.20	50.74	-8%
Coal	0.00	0.00	-
Petroleum	53.70	49.14	-8%
Natural Gas	1.50	1.60	7%
Electric Utilities	76.50	54.57	-29%
Coal	68.69	38.04	-45%
Petroleum	0.78	1.10	41%
Natural Gas	7.03	15.42	119%
International Bunker Fuels	0.45	1.75	285%
Petroleum	0.45	1.75	285%
Total	**186.89**	**154.24**	**-17%**
Coal	73.46	39.87	-46%
Petroleum	64.98	59.34	-9%
Natural Gas	48.45	55.03	14%

Stationary Combustion

Stationary Combustion is the 3rd smallest module included in the energy inventory sector in Michigan, accounting for 0.43% of Michigan's overall GHG emissions in 2019. Between 2005 and 2019, emissions from this module decreased by 11%.

Across economic sectors, Electric Utilities and Industrial decreased in both CH_4 and N_2O emissions while the Residential and Commercial sectors increased both CH_4 and N_2O emissions. Emissions of N_2O and CH_4 decreased by 30% and increased by 19%, respectively (Table 5).

The Residential economic sector accounts for 50% of emissions from the Stationary Combustion module in 2019 as the primary emitter of CH_4, amounting to 0.36 $MMTCO_2E$ or 72% of CH_4 emissions from stationary combustion in 2019. Electric Utilities emit N_2O three times as much as any other economic sector within this module, leading to it being the second-highest emitting economic sector within Stationary Combustion in 2019. In comparison, the Commercial and Industrial sectors make up only a small portion of overall emissions from Stationary Combustion when accounting for methane and nitrous oxide (Table 5).

Table 5: Total CH_4 and N_2O Emissions from the Stationary Combustion Module in Michigan ($MMTCO_2E$)

Emissions ($MMTCO_2E$)	2005	2019	% Change (2005 to 2019)
Residential	0.32	0.41	28%
N_2O	0.05	0.05	16%
CH_4	0.27	0.36	30%
Commercial	0.07	0.09	19%
N_2O	0.01	0.01	14%
CH_4	0.06	0.07	20%
Industrial	0.12	0.10	-15%
N_2O	0.07	0.06	-15%
CH_4	0.05	0.04	-14%
Electric Utilities	0.34	0.21	-40%
N_2O	0.31	0.18	-42%
CH_4	0.04	0.03	-22%
Total	**0.85**	**0.81**	**-6%**
N_2O	0.43	0.30	-30%
CH_4	0.42	0.50	19%

Mobile Combustion

Mobile Combustion was the 2nd smallest emitting module of GHG emissions in Michigan in 2019, included under the Energy inventory sector at 0.33% of overall emissions in the state. The Mobile Combustion module measures CH_4 and N_2O across transportation. Between 2005 and 2019, CH_4 and N_2O emissions for Mobile Combustion decreased by 56%, equating to cumulative emissions decrease of ~0.076 $MMTCO_2E$. This value is equivalent to removing approximately 16,522 cars off the road. In large part this was due to a significant decrease in Gasoline Highway Passenger Car emissions, which decreased by 0.42 $MMTCO_2E$ or 55.38% of the total decrease in Mobile Combustion emissions from 2005 to 2019.

Michigan's Mobile Combustion accounting is separated into four categories: Gasoline Highway, Diesel Highway, Non-Highway, and Alternative Fuel Vehicles with subcategories of specific vehicle types for each.

Table 6 shows the emissions profile for each category and subcategory for 2005 and 2019.

Among the categories, Diesel Highway, Non-Highway, and Alternative Fuel Vehicles all increased in CH_4 and N_2O emissions, while Gasoline Highway was the only vehicle category to decrease in CH_4 and N_2O emissions from 2005 to 2019. The Non-Highway and Gasoline Highway categories claim the vast majority of CH_4 and N_2O emissions in the Mobile Combustion module.

The largest cumulative increase in CH_4 and N_2O emissions from Mobile Combustion came from Diesel Highway vehicles with over 0.08 $MMTCO_2E$, or 783% from 2005 to 2019. Heavy-Duty (HD) Vehicles are primarily responsible for this increase but all vehicle types under Diesel Highway CH_4 and N_2O emissions increased between these two reference years.

Under the Gasoline Highway category, Passenger Cars were responsible for the majority of CH_4 and N_2O emissions in 2019 as compared to other vehicle types, despite decreasing CH_4 and N_2O emissions by 72% since 2005 levels. All vehicle types included in Gasoline Highway vehicles have decreased their CH_4 and N_2O emissions since 2005.

Table 6: Total CH_4 and N_2O Emissions from Mobile Sources in Michigan ($MMTCO_2E$)

Fuel/Vehicle Type Emissions ($MMTCO_2E$)	2005	2019	% Change (2005 to 2019)
Gasoline Highway	1.130	0.248	-78%
Passenger Cars	0.586	0.166	-72%
Light-Duty Trucks	0.504	0.071	-86%
Heavy-Duty Vehicles	0.038	0.011	-72%
Motorcycles	0.001	0.000	-70%
Diesel Highway	0.011	0.094	783%
Passenger Cars	0.000	0.002	1713%
Light-Duty Trucks	0.000	0.004	777%
Heavy-Duty Vehicles	0.010	0.081	739%
Heavy-Duty Buses	0.001	0.008	1416%
Non-Highway	0.224	0.263	18%
Boats	0.011	0.032	177%
Locomotives	0.002	0.001	-43%
Farm Equipment	0.025	0.026	1%
Construction Equipment	0.057	0.075	32%
Aircraft	0.013	0.037	180%
Other*	0.114	0.092	-19%
Alternative Fuel Vehicles	0.001	0.001	82%
Light Duty Vehicles	0.000	0.000	18%
Heavy Duty Vehicles	0.000	0.000	67%
Buses	0.001	0.001	85%
Total	**1.365**	**0.607**	**-56%**

Natural Gas & Oil

The Natural Gas & Oil sector is the 4th largest emitting module in Michigan's 2024 GHG inventory, included under the Energy inventory sector. Between 2005 and 2019, CH_4 and N_2O emissions increased by 381% for a cumulative 6.29 $MMTCO_2E$ emitted in 2019. This large increase can be attributed to the addition of state-specific data since 2010. Oil emissions include CH_4 and N_2O emissions from production, refining, and transportation within the state of Michigan. CH_4 and N_2O emissions from the Natural Gas sector represent emissions from gathering, transmission and distribution. Table 7 demonstrates both CH_4 and N_2O emissions for Natural Gas and Oil in 2005 and 2019.

Table 7: Natural Gas and Oil CH_4 and N_2O Emissions in Michigan ($MMTCO_2E$)

Emissions ($MMTCO_2E$)	2005	2019	% Change (2005 to 2019)
Natural Gas	1.18	6.23	427%
Oil	0.12	0.06	-52%
Total	**1.31**	**6.29**	**381%**

Coal Mines

Michigan does not have any operational coal mines, with the last mine closing in 1952. Therefore, data is excluded for this module. An opportunity for further analysis may be done on residual emissions from abandoned coal mines, but no data has been found to support this analysis.

Industrial Processes

Industrial Processes emissions remained relatively flat from 2005 to 2019, decreasing by 2% overall. Industrial Processes cumulatively make up the 2nd largest emitting inventory sector in Michigan. They include non-direct combustion GHG emissions related to the handling and use of certain chemicals in processes such as cement production, lime manufacturing and iron & steel production. Industrial Processes account for 5.97% of Michigan's overall emissions in 2019. Table 8 demonstrates Industrial Processes emissions by type for 2005 and 2019.

Industrial Processes emissions are categorized across three greenhouse gas types:

a. Carbon Dioxide emissions
b. Nitrous Oxide emissions
c. HFC, PFC, SF_6 and NF_3 (F-Gases) emissions

Non-combustion related carbon dioxide emissions from industrial processes decreased by 13%, largely due to the decrease in cement manufacturing and iron & steel production that make up the majority of these emissions.

Emissions from F-Gases increased from 2005 to 2019 by 14% due to the replacement of Ozone Depleting Substances (ODS) with F-gas substitutes. F-gas substitutes for ODS are often found in refrigeration, air-conditioning, and aerosol applications. F-Gases have high global warming potentials as compared to other greenhouse gas types included in Industrial Processes, so though the amount of F-Gas emissions may not be large, their ability to retain heat in the atmosphere over their lifetime is what contributes to their large Global Warming Potential (refer to Table 2). Other processes including Semiconductor Manufacturing and Electric Power Transmission and Distribution Systems decreased in overall emissions but are comparatively low to ODS substitutes, clarifying the aggregate increase.

Nitric acid production data is not available for the State and therefore, is excluded in this Inventory. In addition, adipic acid is not produced in Michigan and thus, not included in the inventory.

Table 8: GHG Emissions related to Industrial Processes in Michigan ($MMTCO_2E$)

Emissions ($MMTCO_2E$)	2005	2019	% Change (2005 to 2019)
Non-Combustion Related Carbon Dioxide Emissions	7.072	6.182	-13%
Cement Manufacture	2.126	1.600	-25%
Lime Manufacture	-	0.341	-
Limestone and Dolomite Use	0.251	0.475	89%
Soda Ash**	0.087	0.060	-32%
Aluminum Production, CO2*	-	-	-
Iron & Steel Production	4.596	3.692	-20%
Ammonia Production*	-	-	-
Urea Consumption	0.011	0.014	27%
Nitrous Oxide Emissions	-	-	-
Nitric Acid Production*	-	-	-
Adipic Acid Production**	-	-	-
F-Gases	4.291	4.898	14%
ODS Substitutes	3.986	4.779	20%
Semiconductor Manufacturing	0.045	0.002	-95%
Magnesium Production*	-	-	-
Electric Power Transmission and Distribution Systems	0.260	0.116	-55%
HCFC-22 Production*	-	-	-
Aluminum Production, PFCs*	-	-	-
Total	**11.363**	**11.080**	**-2%**

*Data is unavailable via SIT, additional state-specific data is needed
**Adipic Acid Production and Soda Ash Manufacturing do not occur in the State of Michigan and therefore, no emissions are accounted for (Soda Ash Consumption is accounted for)

Transportation

The transportation sector makes up 32% of CO_2 emissions across the CO_2FFC module. To allow for a holistic view of the Transportation sector, inclusive of CH_4 and N_2O emissions related to Mobile Combustion, emissions data from both groups of emissions were combined and are represented in Table 9.

In 2019, non-highway vehicles made up 43% of transportation's GHG emissions. Gasoline Highway vehicles make up slightly less than half of the overall GHG emissions for Transportation at 41% of total emissions shown in Figure 20. Gasoline Passenger Cars had the greatest emissions contribution of any vehicle type, making up 27.4% of total Transportation emissions and 67% of Gasoline Highway vehicles overall, as shown in Table 9.

Non-Highway vehicle emissions are spread across construction equipment and the "other" category which includes Snowmobiles, Small Gasoline Powered Utility Equipment, and Heavy-Duty Diesel-Powered Utility Equipment, Aircrafts, Boats, and Farm Equipment. Construction equipment makes up 28% of Non-Highway Transportation emissions and 12% of total GHG emissions. Diesel Highway vehicles make up 16% of total emissions, mainly sourced from HD vehicles (vehicles greater than 8,500 lbs.).[13] Alternative Fuel vehicles remain the smallest percentage of GHG emissions, making up less than 0.05% the total.

Overall, most fuel and vehicle types have increased in GHG emissions from 2005 to 2019 – however, Gasoline Highway emissions have reduced by 55%, with the greatest reduction from light-duty (LD) trucks (<8,500 lbs.). 99% of total emissions for Transportation were from CO_2 emissions, while CH_4 and N_2O emissions made up 1% of overall emissions.

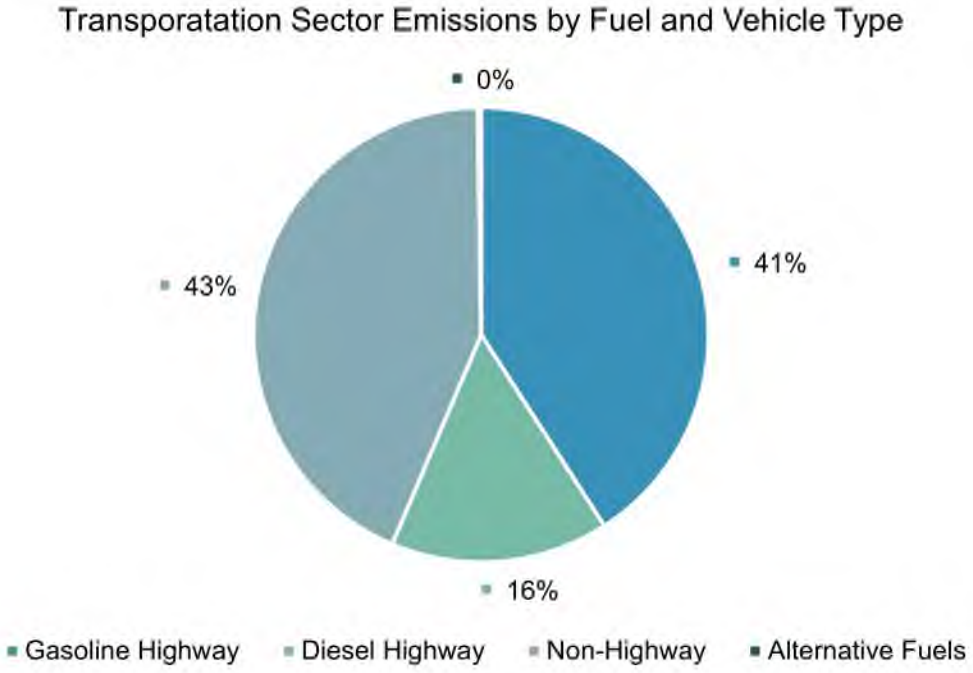
Table 9: Transportation Sector Emissions by Fuel and Vehicle Type in Michigan ($MMTCO_2E$)

Fuel Type/Vehicle Type ($MMTCO_2E$)	2005	2019	% of Total Emissions (2019)	% Change (2005 to 2019)
Gasoline Highway	46.824	20.994	41%	-55%
Passenger Cars	24.286	14.072	27%	-42%
Light-Duty Trucks	20.901	5.969	12%	-71%
Heavy-Duty Vehicles	1.580	0.918	2%	-42%
Motorcycles	0.057	0.035	0%	-38%
Diesel Highway	0.442	7.966	16%	1702%
Passenger Cars	0.004	0.147	0%	3601%
Light-Duty Trucks	0.018	0.321	1%	1690%
Heavy-Duty Vehicles	0.398	6.810	13%	1612%
Heavy-Duty Buses	0.022	0.688	1%	2994%
Non-Highway	9.264	22.269	43%	140%
Boats	0.473	2.672	5%	465%
Locomotives	0.100	0.117	0%	16%
Farm Equipment	1.050	2.167	4%	106%
Construction Equipment	2.364	6.376	12%	170%
Aircraft	0.552	3.155	6%	472%
Other*	4.726	7.783	15%	65%
Alternative Fuel Vehicles	0.032	0.121	0%	272%
Light Duty Vehicles	0.001	0.002	0%	141%
Heavy Duty Vehicles	0.001	0.003	0%	241%
Buses	0.031	0.116	0%	277%
Total	**56.563**	**51.350**	-	**-9%**

[13] afdc.energy.gov/data/10380

Figure 20: Total GHG Emissions for Transportation Sector (includes CO2FFC & Mobile Combustion modules) in Michigan in 2019

NOTE: 0% of total emissions signifies emissions less than 0.05%



Electricity Sector

The Electricity sector includes electricity generated and consumed within Michigan, as well as imports and exports (refer to Table 10 and

Figure ***21***). Though this inventory is primarily inventory sector-based, this section will aid in illustrating indirect CO_2 emissions from Electricity Combustion as well.

The Electricity sector is the greatest emitter of CO_2 from fossil fuel combustion in the State of Michigan, emitting 35% of total CO_2 from fossil fuel combustion, equivalent to 54.57 $MMTCO_2E$. To gather total direct electricity generation, this inventory collects electric power data from both stationary combustion activities and CO_2 from fossil fuel combustion. Stationary combustion makes up a small portion of overall direct electricity generation (.03%), making the total equal to 54.75 $MMTCO_2E$ in 2019. From 2005 to 2019, there was a 29% reduction in electricity generation GHG emissions.

The EIA's State Energy Data System (SEDS) provides detailed import and export data via the EIA's State Electricity Profiles.[14] Using these data, this inventory considers the net import and export of electricity into the State of Michigan both between states and internationally (international imports are typically from Canadian power plants). In 2005, an overall net export of interstate electricity trade resulted in a reduction of 1.99 $MMTCO_2E$ emissions based on

[14] eia.gov/electricity/state/Michigan/

negative net international and interstate imports. Conversely, in 2019, there was an overall net import of electricity resulting in 5.51 $MMTCO_2E$ increase in GHG emissions accounted for in the State (Table 10 and Figure 22). Please refer to EPA's posted SIT documentation[15] and the EIA's posted SEDS database documentation[16] for additional information on net imports.

The EPA's State Inventory Tool provides analysis of Indirect CO_2 emissions from Electricity Consumption by sector; however, it is important to note that end-use sector consumption is not reflected in total GHG emissions for the state due to overlap with electricity generation. Overall, the inventory reflects a 32% reduction in electricity consumption by end-use sector from 2005 to 2019. Specifically, the Industrial, Residential, and Commercial end-use sectors all reflected emissions reductions between 29% and 36% (See Table 11). The Commercial sector represented the greatest GHG emissions from electricity consumption with 18.34 $MMTCO_2E$. **Appendix A** details the specific end-use activities across Residential, Commercial, Industrial and Transportation sectors.

Despite electricity making up the largest portion of CO_2 emissions from fossil fuel combustion across the State, electricity generation and consumption have seen a decline in emissions for every year since 2008, while imports of electricity have been oscillating as certain years have net exports verses imports (see Figures 21 and 22).

Table 10: Electricity Sector Emissions by Generation, Imports, and End-Use Consumption ($MMTCO_2E$)

Electricity Sector Emissions ($MMTCO_2E$)	2005	2019	% Percent Change from 2005 to 2019
Total Direct Electricity Generation	76.84	54.77	-29%
Stationary Combustion from Electric Power (CH_4 and N_20)	0.34	0.21	-40%
CO_2 from FFC from Electric Power	76.50	54.57	-29%
Total Net Imports	-1.99	5.51	-377%
Net Interstate Trade	-0.80	4.36	-642%
Net International Imports	-1.18	1.15	-197%
Indirect CO_2 from Electricity Consumption	72.16	49.05	-32%

[15] epa.gov/statelocalenergy/download-state-inventory-and-projection-tool
[16] eia.gov/state/seds/

Table 11: Indirect CO_2 from Electricity Consumption by Sector*

Indirect CO2 from Electricity Consumption (MMTCO2E)	2005	2019	% Change (2005 to 2019)
Residential	23.582	16.226	-31%
Commercial	25.871	18.340	-29%
Industrial	22.699	14.477	-36%
Transportation	0.003	0.003	-4%
Total	**72.16**	**49.05**	**-32%**

*Refer to Appendix A - Table 3 for list of end-uses by sector

Figure 21: Total Electricity Generation, Interstate Trade, and End-Use Consumption in Michigan from 2005 to 2019

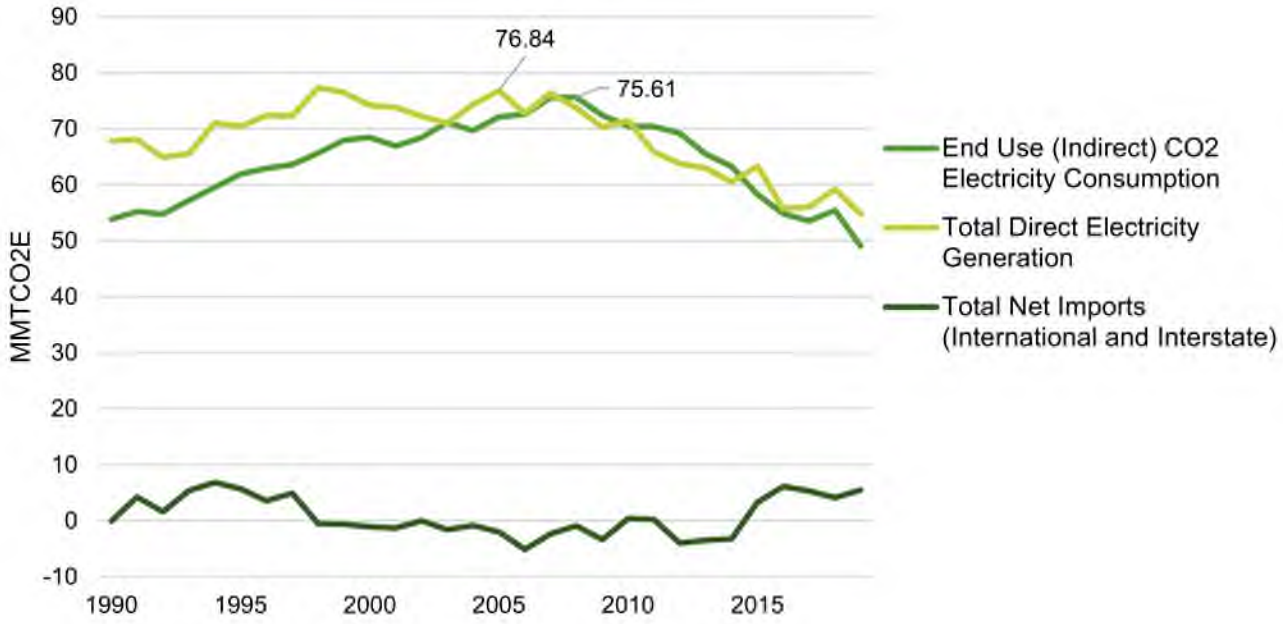


Figure 22: Net Total, Interstate, and International Electricity Imports in Michigan from 1990 – 2019

4.2 Community Engagement Outcomes

As a result of community engagement, EGLE facilitated five in-person public engagement sessions across the state and two virtual public listening sessions. All sessions were hosted in the evening between 6-8pm local time. The in-person sessions were held at the following venues in the respective towns:

1. Detroit – Zero Net Energy Center – International Brotherhood of Electrical Workers Local 58
2. Grand Rapids – Dan & Pamela DeVos Center for Interprofessional Health
3. Flint – Michigan State University College of Human Medicine
4. Marquette – Northern Michigan University
5. Petoskey – North Central Michigan College

One additional engagement session was held during the quarterly Michigan Tribal Environmental Group (MTEG) meeting in Acme at the Grand Traverse Resort.
Outcomes of the in-person and virtual sessions solicited approximately 400 attendees who provided ~1,500 comments. In addition, more than 600 pieces of feedback were received during the gallery walk exercise which helped to highlight the most important topics discussed during the sessions. 350 of the 1,500 comments received were in line with existing considerations for EGLE as part of the PCAP process, insinuating that Michiganders have a firm vision of what they want to see as part of MHCP implementation. The comments also provided 237 new

reduction measure ideas which were evaluated as part of the reduction measure prioritization framework. A feedback survey circulated to attendees following the sessions indicated:

90%
of attendees increased their understanding of the MHCP

90%
of attendees found the breakout group activities engaging

75% +
of attendees indicated they are interested in attending future EGLE events

Figure 23: Common topics discussed during engagement sessions held between November and December 2023

Engagements were facilitated by providing clear expectations of the intended outcomes of the session to demonstrate transparency and focused on place-based engagements to meet communities where they are. EGLE strives for continuous improvement, as demonstrated by requesting feedback via surveys to attendees. A subset of major themes that emerged across engagement sessions are depicted in Figure 23.

The last piece of engagement EGLE organized through its PCAP development in relation to the CPRG PCAP Phase was releasing a draft list of priority reduction measures for public comment prior to PCAP submission. EGLE received 66 responses from the open comment period. The feedback indicated that more explicit consideration should be given to LIDACs, and EGLE has incorporated this feedback into each reduction measure as a result. Additionally, there were several comments or clarification questions regarding what is and is not included in some of the measures. For instance, if rental properties apply to Reduction Measure #4 describing household decarbonization. To clarify these comments, the summary included within each reduction measure provides example entities or use-cases that may be implemented. However, these examples are not exhaustive and there are several other entities or infrastructure that may fall within reduction measures.

4.3 LIDAC Benefits Analysis

The State of Michigan has many areas that are identified as low income disadvantaged communities. Many of these communities are also disproportionally negatively impacted by injustices in categories including climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development. To identify communities throughout the country facing especially negative impacts in these areas, the White House Council on Environmental Quality developed the Climate and Economic Justice Screening Tool (CEJST), a geospatial mapping tool which highlights disadvantaged census tracts across all 50 states, the District of Columbia, and the U.S. territories.

The CEJST screening tool methodology considers a census tract to be disadvantaged if it meets one of two requirements:

1. They are in census tracts that meet the thresholds for at least one of the tool's categories of burden
2. They are on land within the boundaries of Federally Recognized Tribes

Based on the CEJST screening tool, the State of Michigan has 996 census tracts that are identified as disadvantaged, making 35% of Michigan communities considered low income and disadvantaged. The map shown in Figure 24 provides an illustration of how widespread the identified disadvantaged communities are throughout the State of Michigan.

Within the 996 census tracts identified as disadvantaged, four of the census tracts were identified as disadvantaged due to tribal overlap. These tracts are located in Isabella County and at least 99% of the census tract is within Federally Recognized Tribal Areas.

In addition to the CEJST screening tool, the 996 identified disadvantaged census tracts were also analyzed using the EPA's Environmental Justice Screening and Mapping Tool (EJScreen). The EJScreen provides the EPA with a nationally consistent dataset and approach for combining environmental and demographic socioeconomic indicators. The EJScreen also includes information on supplemental indexes, which provides a combination of environmental and socioeconomic information based on thirteen specific environmental indicators, including: Particulate Matter 2.5 (PM2.5), Ozone, Diesel Particulate Matter, Air Toxics Cancer Risk, Air Toxics Respiratory Hazard Index, Toxic Releases to Air, Traffic Proximity, Lead Paint, RMP Facility Proximity, Hazardous Waste Proximity, Superfund Proximity, Underground Storage Tanks, and Wastewater Discharge. Based on the EJScreen tool, many of the 996 identified disadvantaged census tracts within the State of Michigan were also ranked in the 90th national percentile for seven out of the thirteen specific environmental indicators as described in Table 12.

Figure 24: Map of Michigan State showing the LIDACs among three different tools

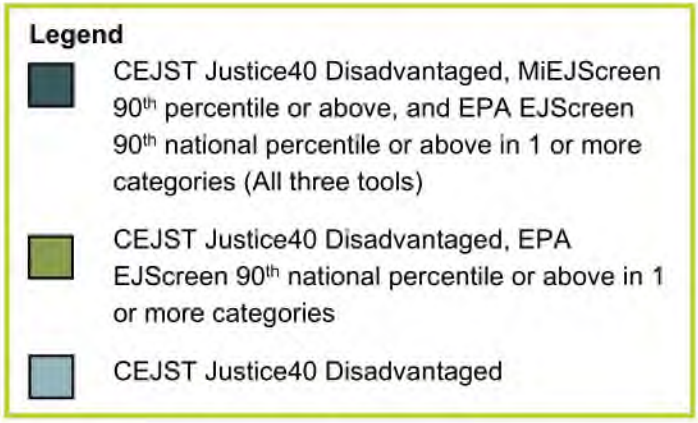
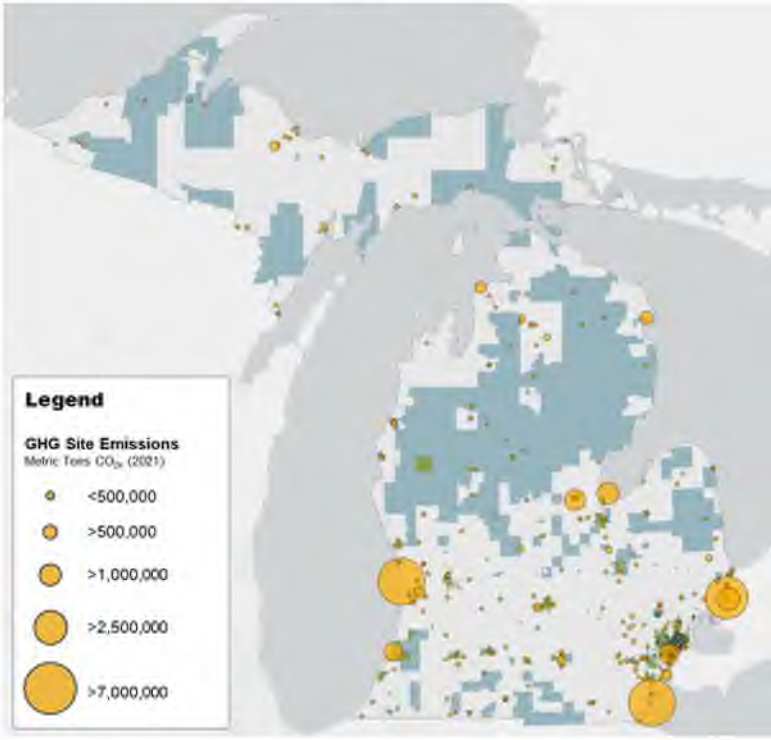


Table 12: Environmental and socioeconomic information from EPA's EJScreen corresponding to the number of census tracts in Michigan affected by those indicators.

Supplemental Indexes (EJScreen) 90TH National Percentile

Indicator	Number of Census Tracts
Traffic Proximity	226 census tracts
Lead Paint	366 census tracts
Hazardous Waste Proximity	16 census tracts
Superfund Proximity	125 census tracts
RMP Facility Proximity	107 census tracts
Wastewater Discharge	47 census tracts
Underground Storage Tanks	492 census tracts

Figure 25: Overlay of the State of Michigan's LIDACs with the highest emitting facilities in the state.



The majority of Michigan's GHG emissions are located in multiple clusters throughout the state. Figure 26 provides a representative view of GHG site emissions throughout the State of Michigan. The clusters represent the GHG site emissions based on metric tons emitted within the geographical area. As the maps show, many of the low income and disadvantaged communities throughout the State of Michigan are impacted by these clusters.[17]

The State of Michigan has engaged with community members and leaders throughout many of the identified disadvantaged communities. These engagements have included a variety of different methodologies, including surveys, questionnaires, in-person and virtual forums to ensure that the concerns and desired outcomes for the low income and disadvantaged communities throughout the state were identified. The in-person sessions held in the cities of Detroit, Grand Rapids, Flint, Marquette, Petoskey, and Acme collectively contain 505 of the 996 disadvantaged census tracts representing nearly 51% of the LIDACs within the state. Additionally, the two virtual sessions held were attended by individuals representing over 100 communities, and approximately 13% of those registered were from LIDACs based on zip codes provided.

4.3.1 Climate Impacts and Risks in LIDACs

Air Quality and Public Health

Residents in Michigan, especially in the southwest of Detroit, experience heavy pollution emitted from a variety of different sources. For example, the southwest and surrounding areas of Detroit are home to many factories, such as oil refineries and automobile manufacturing facilities. The emissions from these facilities, combined with daily automobile, truck traffic and other environmental stressors can adversely affect the health of those in the community. There are over 150 sites in southwest Detroit alone that release chemicals and particles which result in air pollution. These sites emit dangerous chemicals and particles such as PM2.5, sulfur dioxide, nitrous oxide and ozone. These air pollutants have caused increases in the asthma hospitalization rates in southwest Detroit and the surrounding areas, which are nearly triple the state average.[18]

Michigan anticipates that the investment in the priority climate action measures will provide benefits to LIDAC communities. Further, Michigan commits to involving and engaging LIDAC community members early and often throughout the planning process to influence decision-making. As a result, it is anticipated that the overall public health of residents will see improvements in these communities.

Based on available data from the CEJST screening tool, many of the identified LIDAC census tracts across the state also have adult residents with major health concerns that adversely impact their quality of life. Table 13 below shows the number of identified LIDAC census tracts

[17] epa.gov/ghgreporting
[18] iqair.com/us/usa/michigan

in which 90% or more of the adult residents have either asthma, diabetes, or coronary heart disease. The chart also provides information on the number of adults living with these serious health conditions across all identified LIDAC census tracts.

Table 13: Health conditions among low-income disadvantaged communities

Health Condition	# Census Tracts 90th National Percentile or Above	# of adults 18 or older in All LIDAC Census Tracts
Asthma	677	1,286,397
Diabetes	350	1,477,425
Heart Disease	324	800,560

Studies have shown that many of these health conditions can be linked to poor air quality, which is a consistent issue facing many communities located in LIDAC census tracts throughout the state. As these communities begin to engage and take part in projects and initiatives designed to improve overall air quality, the residents in many of the identified LIDAC areas should begin to realize tangible improvements in the overall health of the residents.

Energy Burden

Energy burden is a measure of the proportion of household income spent on energy costs, and in Michigan, this issue disproportionately affects economically vulnerable families. Michigan households with an income below the Federal Poverty Line (FPL) spend 18% of their income on energy, compared to an average of 3% for the overall population.[19] The financial impact is evident as these families allocate a substantial portion of their earnings to meet basic energy needs. Energy burden contributes to a cycle of poverty by limiting resources for other essential needs such as healthcare, education, and housing.

Recognizing the urgency of addressing energy burden, the State of Michigan has set ambitious goals to alleviate the strain on low-income families. EGLE has spearheaded initiatives to enhance energy efficiency, promote renewable energy sources, and provide financial assistance to vulnerable communities to limit energy burden from powering and heating homes to not more than 6% of annual income for low-income households. Programs such as the Weatherization Assistance Program (WAP) aim to improve energy efficiency in low-income homes, reducing energy consumption and subsequently lowering utility bills. Additionally, Michigan's Community Action Agencies collaborate to implement outreach and education programs to inform residents about available resources, energy-saving practices, and financial assistance options, fostering a comprehensive approach to alleviate energy burden. For every $1 invested in reducing energy waste in MI homes – through more efficient windows, lighting, and other energy-saving

[19] US DOE

technologies – homeowners save more than $3.20 in reduced future energy bills.[20] Energy efficiency also reduces energy burden by as much as 2%, translating into more than $400 in annual savings for households.[21]

In 2023, clean energy legislation in Michigan doubled funding for the Utility Consumer Participation Board (UCPB), which provides resources for organizations to advocate on behalf of ratepayers before the Michigan Public Service Commission, specifically for environmental justice and high energy burden communities. By funding more robust participation, these increased resources will continue to help mitigate energy burden among Michigan families, despite progress already trending in the right direction. The average energy burden between 2022 and 2023 decreased by 3% for households whose income is 0%-100% of the FPL. Although, the distribution of average annual energy cost and average energy burden across income categories as defined by the FPL remain relatively consistent between 2022 and 2023, accentuating the disproportionate impacts felt by LIDACs.

Addressing energy burden in low-income communities presents an opportunity to enhance overall well-being, with impacts on economic, social, and health. Weatherizing and repairing homes emerge as pivotal strategies, encompassing improvements such as insulation, air sealing, and energy-efficient appliance upgrades. Such measures not only result in immediate cost savings for families but also contribute to a more sustainable environment. Furthermore, investing in energy efficiency initiatives not only reduces energy bills but also enhances the comfort and health of homes, creating a positive ripple effect on the residents' overall quality of life. Getting access to these technologies and improvements for Michigan's low-income and disadvantaged communities continues to be a challenge and requires a concerted effort from government agencies, non-profit organizations, and private sector partners. By implementing these opportunities, Michigan can pave the way for a more equitable and sustainable energy landscape, fostering resilience and improved living conditions for its most vulnerable citizens.

Workforce

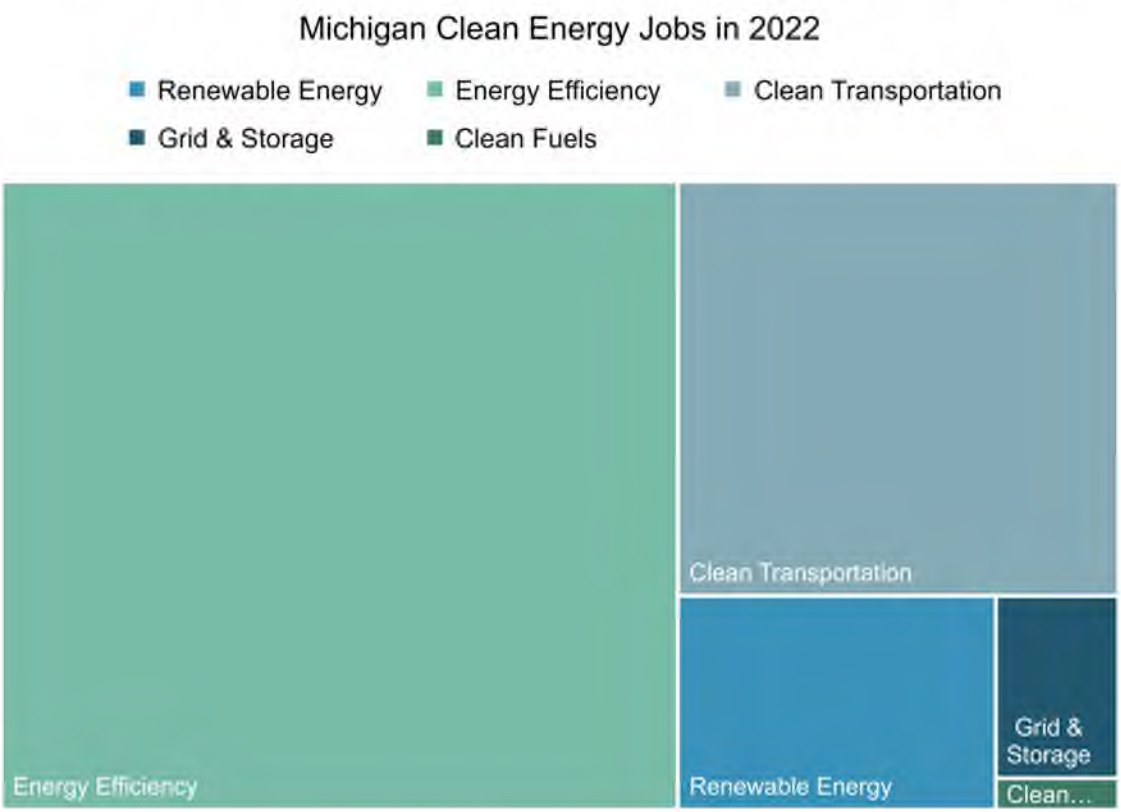
Michigan leads the Midwest states in clean energy jobs with nearly 124,000 Michigan residents employed by clean energy companies at the end of 2022. Michigan ranked 5th in the nation for clean energy jobs in 2022 after growing nearly 5% year-over-year, and the industry is poised for continued growth due to federal climate investments passed last year.

Table 14: Michigan Clean Energy Jobs in 2022, totaling 123,983 jobs

Clean Energy Job Categories	Number of Jobs in 2022
Renewable Energy	12,002
Energy Efficiency	75,085
Clean Transportation	32,271
Grid & Storage	3,944
Clean Fuels	682

[20] michigan.gov
[21] ACEEE

Figure 26: Michigan Clean Energy Jobs in 2022, totaling 123,983 jobs



Currently, clean energy jobs now account for over 40% of all energy workers in America[22], and it is anticipated that this upward trend will continue. As Michigan implements initiatives designed to promote renewable energy, energy efficiency, clean vehicles, grid modernizations and other pollution reduction initiatives, clean energy jobs are expected to continue to grow. The majority of the clean energy jobs in Michigan fall into the sector categories described in Table 14 and Figure 27[23].

The largest sector in Michigan's clean energy industry is energy efficiency, comprising over 60 percent of the state's clean energy workforce. Workers in Michigan's energy efficiency industry manufacture ENERGY STAR-rated appliances, install efficient lighting, heating, ventilation, and air conditioning (HVAC) systems, and install advanced building materials in homes and commercial buildings. Additionally, as more automakers and their suppliers continued to shift to electric vehicles, the clean transportation sector saw an increase in employment of over 14 percent in 2022 in Michigan[24].

Since August 2022, there has been more than $20 billion in investments for clean energy projects throughout the State of Michigan, which has resulted in the creation of more than 13,500 jobs[25]. As more communities in identified LIDAC census tracts continue to implement

[22] Clean Jobs America 2023
[23] Clean Jobs Midwest
[24] Clean Jobs Midwest
[25] Clean Jobs for MI

clean energy projects, it is anticipated that the number of clean jobs available to LIDAC members will continue to grow, especially with the prioritization of local hiring. Several bills passed in Michigan in 2023 consider environmental justice and workforce development holistically. For example, new laws stipulate strong labor standards for clean energy projects, prioritize worker benefits in long-term utility plans, and encourage diverse workforce hiring from environmental justice and low-income communities.

Climate Resilience

As global temperatures continue to rise, the State of Michigan, as well as other areas throughout the country, have experienced land, water, and atmospheric changes. These changes create an increasing risk to the livelihood of Michigan residents. Michigan communities have already been exposed to changing and intensifying weather patterns, and as shifts in climate, economics and technology continue to rapidly occur, it is imperative that local governments proactively and innovatively seek out ways to understand and address the anticipated challenges that these shifts will bring to communities and residents throughout the state to ensure community resiliency.

Climate concerns in Michigan include extreme heat, heavy precipitation and flooding, air pollution, impacts to the Great Lakes and natural ecosystems, and impacts to agriculture.[26] Communities in identified LIDAC areas are often more vulnerable to climate impacts due to several factors, including historic practices of redlining and land use decisions. Climate impacts can exacerbate existing health and social inequities. For example, extreme heat can exacerbate asthma symptoms and other pulmonary illnesses because it amplifies air pollutants and particulate matter. Heat also amplifies ground-level ozone levels, which are associated with higher hospitalization rates for asthma, more severe allergic reactions, and premature deaths for people with heart and lung disease. As previously discussed, many LIDAC areas have poor air quality and high rates of asthma. As heat indexes continue to reach record levels, this can increase the need for public health care services in LIDACs which may be ill-equipped to address these heightened healthcare needs, placing LIDAC residents at further risk.

Heavy rains and flooding are another area of concern for LIDAC areas, as they increase the likelihood of runoff, which can weaken public infrastructure, pollute bodies of water and spread water-borne illnesses and infections throughout the community. Water-borne diseases and poor drinking water quality are public health issues that can affect thousands of people in LIDAC areas prone to flooding. Flooded homes, if not properly and quickly cleaned up, can create unhealthy conditions for residents as they can lead to the development of mold and reduce indoor air quality.[27] Mental health problems can increase after people experience extreme weather events, such as floods.[28]

[26] What Climate Change Means for Michigan, EPA, August 2016
[27] Michigan Climate and Health Profile Report, 2015, MDHHS
[28] CDC.gov

As LIDAC community leaders continue to engage in conversations with the State of Michigan about resiliency strategies and initiatives, collaboratively the state can work to reduce climate change risks and improve overall resiliency for LIDAC residents.

Tribal Climate Impacts and Risks in Michigan

Michigan recognizes that tribal nations have also faced disproportionate burdens in our fossil fuel economy and are especially vulnerable to the impacts of climate change because of their deep ties to the land and reliance on hunting, fishing, and gathering. Oil spills and other such contamination have impacted significant resources like wild rice. The changing climate threatens the sustainability of the Great Lakes fishery which tribal fishers rely upon to earn a living and feed their families. Many cultural practices and traditions require access to species, like the maple tree, that are put at risk by climate change. Michigan's climate strategies and actions must honor, embrace, benefit, and not interfere with the cultural heritage and treaty rights of federally recognized tribal nations in Michigan and preserve the fragile balance of the Great Lakes ecosystem at the heart of that heritage and those rights.

In the implementation of the PCAP and CCAP, for programs and projects that are located near tribal lands, tribal governments should be included in robust outreach and communication efforts. As applicable, EGLE will follow the Department Policy and Procedure 09-031, "Consultation and Coordination with Indian Tribal Governments." Additionally, EGLE will continue to work with and coordinate efforts with tribes and tribal consortiums that are implementing their own PCAPs and CCAPs.

4.3.2 Analyzing LIDAC Quantitative Benefits

The implementation of the priority reduction measures will provide a crucial step towards environmental justice, mitigating the disproportionate impacts low income and disadvantaged communities often face. The impact measurements on the LIDACs were chosen due to their tangible benefit on the health, economic well-being, and overall quality of life of individuals within these communities. The following metrics are quantified in the discussion of the priority reduction measures in Section 5. Due to the statewide scope of this PCAP, these benefits can be reasonably expected to affect all census tracts listed in **Appendix C: CEJST Census Tracts** when considering the priority reduction measures emission reduction impact at an aggregated level.

> **Emissions by Pollutant (including co-pollutant)**: Tracking emissions by pollutant, including co-pollutants such as sulfur oxides (SOx), nitrogen oxides (NOx), particulate matter (PM2.5), volatile organic compounds (VOC), and carbon monoxide (CO), is crucial for environmental justice. Different pollutants have distinct health and environmental effects, and certain populations, especially those in lower-income and disadvantaged communities, may be disproportionately exposed to higher concentrations of specific pollutants. For example, PM2.5 and VOCs can trigger asthma and other respiratory

issues, while NOx and SOx contribute to acid rain and respiratory problems, which can disproportionately impact communities living near industrial facilities.

Avoided Deaths by Race: Avoidable deaths by race sheds light on the unequal environmental burdens faced by different communities. Different racial groups can have varying degrees of vulnerability to environmental hazards due to factors like housing quality and access to healthcare. By minimizing air pollution and improving overall air quality, the risk of respiratory diseases and cardiovascular issues decreases. By looking at preventable deaths linked to harmful pollution, we can pinpoint communities that bear a disproportionate burden. This approach allows policymakers to develop targeted interventions that address specific community needs.

Avoided Lost Workdays: Lower-income communities often bear the brunt of health-related challenges, leading to increased absenteeism from work. Lost workdays capture the immediate and ongoing economic harm caused by environmental issues, which is crucial for communities often dealing with financial insecurity. This metric captures the short-term health issues, respiratory problems, and mental health impacts that significantly disrupt lives and causes an economic toll on LIDACs. Implementation of GHG reduction measures should reduce the occurrences of respiratory illnesses, resulting in fewer lost workdays, impacting the economic well-being of individuals in these communities, and fostering greater productivity and financial stability.

Avoided Respiratory Symptoms and Bronchitis: Greenhouse gas reduction measures play a pivotal role in reducing air pollution, a major contributor to respiratory issues and bronchitis. Respiratory issues like coughs, wheezing, and shortness of breath are often early indicators of exposure to environmental pollutants. Tracking avoided cases of these symptoms provides an early warning system for potential long-term health problems like chronic respiratory diseases or asthma. Tracking avoided respiratory symptoms also captures the day-to-day burdens faced by communities living in polluted environments. Additionally, reducing the prevalence of respiratory symptoms not only enhances the overall health of individuals in lower-income communities but also alleviates the burden on healthcare systems, leading to a more equitable distribution of health resources.

Avoided Hospital Admissions: This metric highlights the significant burden of illness caused by environmental factors and encompasses a wide range of health problems from acute respiratory infections to chronic conditions exacerbated by pollution. Avoided hospital admissions provides a more comprehensive picture of environmental health impacts. In addition, hospital admissions are expensive, both for individuals and healthcare providers. Tracking avoided admissions reveals the substantial economic burden placed on communities disproportionately exposed to environmental hazards.

Avoided Minor Restricted Activity Days: Unlike more severe outcomes such as deaths and hospital admissions, this metric captures the subtler, everyday impacts of environmental hazards on people's lives. This includes days when individuals experience symptoms like headaches, fatigue, or mild respiratory issues that restrict their usual activities like exercise or outdoor time. Access to clean air promotes a healthier lifestyle and enhances the overall quality of life for community members. Tracking minor restricted activity days can highlight the cumulative burden of exposure to pollution. A single day of feeling unwell might seem minor, but the repeated occurrence can significantly impact mental well-being and quality of life, particularly for children and vulnerable populations.

4.4 Review of Authority to Implement Measures

The State of Michigan has the authority to implement the priority action GHG reduction measures identified in this document. In alignment with direction from the EPA, the PCAP prioritizes measures that have achievable, significant GHG reductions within the program period. To achieve this, the State of Michigan has current implementation authority, and many measures are voluntary and implementation ready, building on existing programs. In addition, the PCAP incorporates measures that have potential to be scaled up and positively impact Michigan communities state-wide, especially those in or adjacent to LIDACs as designated by the EPA.

The Michigan state constitution (Const. 1963, Art. V, § 2, Eff. Jan. 1, 1964) established the concept of 20 principal departments and gave the governor authority to reorganize. Governor Engler created the Department of Environmental Quality in EO 1995-18, which was one of the original 20 principal departments referenced in the state constitution and subsequently allocated by the legislature. Governor Whitmer's Executive Order 2019-06 renamed the Michigan Department of Environmental Quality (MDEQ) as the Michigan Department of Environment, Great Lakes, and Energy (EGLE) effective April 22, 2019. The mission of EGLE is to protect Michigan's environment and public health by managing air, water, land, and energy resources.

To implement many of these measures, additional financial support will be necessary. The State of Michigan has the authority to receive and accept "any grant, devise, bequest, donation, gift or assignment of money, bonds or choses in action, or of any property, real or personal" per MCL §§ 21.161. In addition, MCL §§ 18.1384 authorizes EGLE to follow state budget processes to apply for and receive, and appropriate federal funds.

4.5 Funding Opportunities in Michigan

Recent investments by the federal government through the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA) are an opportunity for Michigan to implement the key strategies of the MI Healthy Climate Plan and deliver outcomes that curb the worst impacts of climate change, improve public health, create economic opportunity, lower costs, shore up energy independence, protect our natural resources, and make investments to address historic, current, and future environmental injustices. These investments will also position Michigan's communities and Michiganders for leadership in the years and decades ahead.

Michigan has a highly coordinated effort to obtain funding for transitioning the state to a more sustainable future by implementing the key strategies described in the MHCP. The State coordinates across agencies pursuit of outcoming federal funding opportunities through the Michigan Infrastructure Office, with the Office of Climate and Energy leading coordination and pursuit of climate and clean energy related funding. This coordination includes weekly interagency meetings with agency principals, as well as frequent internal and external application collaborations. Opportunities relevant for entities across the state are also regularly shared out through a comprehensive network of contacts at universities, community-based organizations, tribal entities, and further. Several trackers and tools have been developed to find, coordinate, and keep track of the many funding opportunities flowing to entities from the aforementioned government legislation, as well as other recurring federal funding such as the State Energy Program. The State of Michigan regularly shares funding opportunities via public resources and invites public commentary around the use of federally pursued funds and programs via Requests for Information (RFIs) and other mediums. Further, state agencies regularly provide letters of support for applicants across the state. Cross-cutting to climate and energy, in late 2023 the state issued an RFI around the creation of a State Energy Finance Institution via the Energy Policy Act of 2005 Section 1703 managed by the U.S. Department of Energy's (DOE) Loan Program Office (LPO). Recent updates to this and other DOE LPO managed programs and IRS tax credits have expanded the opportunity for Michigan entities to receive funds and create impactful clean energy projects by decreasing the requirements for participation. The State of Michigan is in conversations with possible recipients and raising awareness across the state for these opportunities, and many more like the direct pay tax credits. EGLE's agile approach underscores the complex coordination and flexibility needed to secure maximum funding opportunities for the entire state.

Each priority reduction measure in Section 5 describes the relevant opportunities the State of Michigan has applied to, is evaluating as upcoming opportunities, and what funds have already been secured related to a particular measure.

4.6 Workforce Planning in Michigan

Clean Vehicles

Michigan's fastest-growing sector in 2022

+14.4% growth

The reduction measures described in the Priority Climate Action Plan, in tandem with the efforts being implemented by the MI Healthy Climate Plan, will require a skilled and prepared workforce to navigate the emerging changes across the economy. As described in the LIDAC Benefits Analysis section, Michigan leads the Midwest states in clean energy jobs at 123,983 jobs which saw 5% growth in 2022 across all sectors – twice as fast as the economy. Several projects under development in the state estimate the anticipated jobs that will be created from them such as the Midwest Alliance for Clean Hydrogen (MachH2) project projecting 13,600 direct jobs[29], and Ford Motor Company supporting 5,700 jobs in new electric vehicle manufacturing. Since the IRA, Michigan has secured a total of $21.3 billion in investment as of 2023. The projects funded by this amount and more anticipate the addition of 167,000 clean energy jobs[30] in total throughout the next decade.

The importance of bringing clean jobs to Michigan goes beyond the ability to implement the MHCP and reduce carbon emissions; it also brings an immense opportunity for economic growth for Michiganders. The clean energy legislation passed in 2023 had two callouts for growing a clean energy workforce:

1. Requires all projects approved in IRPs and renewable siting cases pay workers prevailing wage, enter into project labor agreements, and utilize Department of Labor certified apprenticeships.
2. Encourages diverse workforce development and hiring from environmental justice and low-income communities for EWR programs.

The distinction between growing the clean energy workforce and growing the clean energy workforce with an emphasis on diversity and inclusion has great impact on environmental justice. Below describes the current workforce planning activities in Michigan as of Q1 2024.

- Michigan has several robust apprenticeship programs that are growing both in number of completions and nontraditional programs. These apprenticeship programs also have increasing participation in underrepresented demographic groups and create high-paying jobs across the state. As the shift towards a sustainable economy continues, so will the need for clean energy jobs and the ability to train individuals for those jobs through new apprenticeship programs. Read more in the Registered Apprenticeships in Michigan 2022 report.

[29] michiganbusiness.org/news/2023/12/hydrogen/
[30] climatepower.us/wp-content/uploads/sites/23/2023/10/200k-Clean-Energy-Boom_Michigan.pdf

- Governor Whitmer and the Michigan Department of Labor and Economic Opportunity (LEO) launched a Michigan Electric Vehicle Jobs Academy in 2023 to connect industry and talent in automotive and electrification roles.
- Michigan launched a MI Healthy Climate Corps program to advance the goals of the MHCP by building capacity in governments and nonprofit organizations, guiding federal and state resources to communities, and fostering networking and professional development opportunities for Corps members, building Michigan's workforce in climate action. This aligns with existing climate-focused AmeriCorps programs in the state.
- Michigan is a leader in the country in customized workforce training lead by LEO. With a newly appointed Community and Worker Economic Transition Office, the state can use this strength to tailor innovative programs for future clean energy workforce needs.[31]
- Goodwill Detroit is launching a Clean Technology Accelerator to pilot in Quarter 2 of 2024 for electric vehicle technicians. The program has the opportunity to expand to different locations along with energy efficiency, solar and storage, and heat pump technicians following the pilot.
- Several partnerships throughout Michigan make the above-described programs a reality, including but not limited to MI Energy Workforce Development Consortium, MI Energy Innovation Business Council, MI Energy Efficiency Contractors Association, Michigan Works!, and Center for Energy Workforce Development each of which help grow and develop workforce programs in the state.

In Section 5, the estimated number of jobs to be created by the priority reduction measures along with the types of jobs that will be needed are discussed as analyses allowed.

5. PRIORITY REDUCTION MEASURES BY KEY SECTOR

This section discusses the individual greenhouse gas reduction measures identified as part of the prioritized framework. Each measure includes the following analyses and quantifications:

- Reduction measure description and quantification, including key implementing agency or agencies, implementation schedule and milestones, and metrics for tracking progress.
- LIDAC qualitative and quantitative benefits analysis
- Review of authority to implement
- Intersection with other funding availability
- Workforce planning analysis

[31] michigan.gov/leo/bureaus-agencies/economic-transition

Each measure is intended to be applicable statewide. They are organized by the following sectors:

1. Electricity Generation
2. Commercial and Residential Buildings
3. Transportation
4. Industry

The following is a summary list of the priority reduction measures organized by key sector.

ID	Key Sector	Priority Reduction Measure
1	Electricity Generation	Drive clean energy deployment including improving siting for renewable energy and energy storage across Michigan, including on brownfields and former industrial sites and emphasizing equitable access for Michigan's LIDACs.
2	Electricity Generation	Invest in energy storage and necessary electric grid investments to enable earlier coal plant retirements and better integrate renewable energy into the electric grid.
3	Commercial and Residential Buildings	Drive building electrification and fuel-switching in existing buildings including an emphasis on LIDACs and electrifying households that currently rely on delivered fuels such as propane and home heating oil.
4	Commercial and Residential Buildings	Reduce household fossil energy use through home repairs, electrical upgrades for building and vehicle electrification, weatherization, and other energy waste reduction investments with an emphasis on ensuring equitable access.
5	Commercial and Residential Buildings	Decarbonize government and nonprofit facilities and infrastructure, with an emphasis on LIDACs, by reducing energy waste, investing in decarbonization solutions, and reducing emissions from fossil fuel combustion.
6	Transportation	Electrify state government, municipal, tribal, and other public fleets, prioritizing equitable access for Michigan's LIDACs.
7	Transportation	Support just access to public transit and non-motorized transportation options by improving infrastructure, and by increasing routes, frequency, and reliability of available options.

ID	Key Sector	Priority Reduction Measure
8	Transportation	Encourage adoption of electric vehicles by increasing deployment of electric vehicle charging infrastructure, prioritizing equitable access for Michigan's LIDACs.
9	Industry	Encourage industrial innovation to advance energy efficiency, fuel-switching, and deployment of cleaner manufacturing technologies prioritizing facilities in LIDACs that may receive significant benefits from reduced industrial sector emissions.
10	Industry	Reduce methane emissions from various sources, including but not limited to food waste, organics diversion, and wastewater treatment facilities with a focus on methane reduction strategies that will bring significant benefits for LIDACs.

5.1 Electricity Generation Reduction Measures

Michigan's power sector emitted 58.2 $MMTCO_2E$ in 2019. Compared to 2005 levels, the energy sector has reduced overall emissions by 24%. Michigan's electric power sector is primarily driven by natural gas generation (34%), followed by coal (29%), nuclear (22%), and renewable energy (12%) as of 2022[32]. Decarbonizing the electric power sector is a vital part to decarbonizing Michigan's economy. As other sectors deploy electrification technologies such as electric vehicles and heat pumps, the faster electricity generation is decarbonized, the higher impact we will have through emissions reductions. Michigan has ambitious goals in this regard to decarbonize the power sector and reduce energy burden in LIDACs while maintaining grid security.

Reduction Measure #1 - Drive clean energy deployment including improving siting for renewable energy and energy storage across Michigan, including on brownfields and former industrial sites and emphasizing equitable access for Michigan's LIDACs.

Reduction Measure Description and Quantification

Deploying clean energy to Michigan's electric grid will create significant emission reductions across all sectors of the economy. The energy sector inventory is Michigan's largest emitting sector, with the burning of fossil fuels to produce electricity as a major contributor to energy-derived emissions. As other energy subsectors, such as transportation and heating for buildings,

[32] eia.gov/state/print.php?sid=MI

increasingly electrify, the resource mix for generating electricity will play a transformational role in meeting Michigan's decarbonization goals.

Through this measure, Michigan will drive clean energy deployment through initiatives like incentivizing siting of utility-scale and distributed renewable energy and storage. For example, in 2023, Governor Whitmer allocated $30 million of the Fiscal Year 2024 budget to EGLE to launch Renewables Ready Communities, a program that incentivizes communities to host utility-scale renewables. Providing additional resources to this program and expanding it to include siting on brownfields and former industrial sites can catalyze Michigan's clean energy deployment. In addition, technical assistance and educational resources can address potential barriers to implementation through providing incentives to municipalities and clean energy developers, increasing community capacity, sharing siting and permitting best practices, and streamlining the siting process for renewable energy systems.

While the MHCP set the goal to generate 60% of the state's electricity from renewable resources by 2030, including a call for a 50% renewable energy standard by 2030 and increased investments in customer-driven renewable energy such as voluntary green pricing programs and distributed solar. To codify parts of the MHCP, state legislation passed in 2023 which requires 50% of electricity to be sourced by renewable energy by 2030, maintained Michigan's voluntary green pricing programs, and made changes to increase access to distributed solar across Michigan. Currently, 15% of Michigan's electricity is generated from renewable energy, which means reaching the 50% renewable energy standard by 2030 requires a 200%+ increase in renewable energy generation in the state between 2024 and 2030, resulting in significant GHG emission reduction potential. Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. Meeting the goals of the 2023 legislation and the MI Healthy Climate Plan will need the rapid build out of renewable energy and energy storage, which will require improvements in siting and permitting to enable an additional 5-6% more renewable energy generation coming online each year between 2024 and 2030.

Entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to investor-owned utilities, public utilities, electric cooperatives, tribes, renewable energy developers, and others. Metrics that may be used to track this reduction measure include the amount of renewable energy generated in the state, the number and size of renewable energy projects approved by entities such as the Michigan Public Service Commission (MPSC), the number of brownfield and other industrial sites remediated with plans for renewable energy or storage development, and other metrics as identified.

Driving clean energy deployment was quantified using RMI's Energy Policy Simulator. Major assumptions include:

1. This reduction measure allows for the state to reach their renewable energy standard of 50% by 2030, 60% by 2035, and renewable energy goal of 100% by 2050.
2. Estimates include a range of renewable energy technologies being deployed, including nuclear as a clean energy.

Table 15: Estimated GHG emission reductions as a result of priority reduction measure #1

Estimated Emissions Reductions	Time Scale
1.640 $MMTCO_2e$	Annual near-term average
20.856 $MMTCO_2e$	Between 2024 – 2030
42.651 $MMTCO_2e$	Between 2024 – 2050

Validation of this quantification was performed using EPA's AVERT tool with estimates of year-over-year renewable energy deployment across onshore wind, utility-scale solar, and rooftop solar.

Note: This reduction measure was quantified under a large umbrella of implementation strategies. When applying for implementation grants for specific projects, ensure the appropriate emissions are calculated to result in reductions of the specific project.

LIDAC Qualitative and Quantitative Benefits Analysis

By accelerating clean energy deployment in Michigan, the analysis reveals that we can expect a range of positive outcomes for low income and disadvantaged communities. Cumulative emissions are projected to decrease significantly for SOx and NOx translating to cleaner air, especially for front line communities formerly near industrial sites and power plants. Emissions are expected to decrease for VOCs and CO as well, improving overall air quality and reducing the risk of chronic diseases. The cumulative decrease in pollutants will drive overall improvements in air quality leading to fewer respiratory issues, resulting in fewer hospitalizations and lost workdays, improving the physical, mental, and economic well-being for LIDAC residents.

Table 16: Change in co-pollutants as a result of priority reduction measure #1 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-7.619	-3.487
NOx	-8.163	-13.347
PM2.5	0.874	4.657
VOC	-2.576	-3.881
CO	-48.632	-150.443

Figure 28: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #1

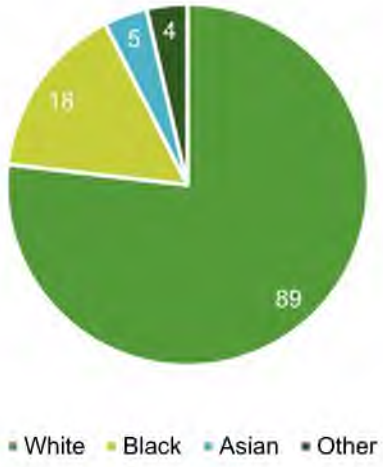


Figure 28: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #1

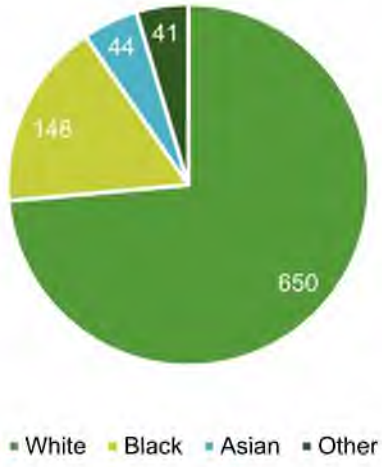


Table 17: Additional estimated community benefits in the near-term and long-term throughout Michigan as a result of priority reduction measure #1

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	7,156	54,854
Avoided Respiratory Symptoms and Bronchitis	2,500	19,203
Avoided Hospital Admissions	25	187
Avoided Minor Restricted Activity Days	42,516	325,763

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statutes in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" -- as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 -- which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan has both received and is waiting to hear back on multiple grant opportunities related to this reduction measure. The EPA awarded the State of Michigan $9.3 million in 2023 to cleanup brownfield sites[33], preparing the sites for reuse in the future. As part of the State and Tribal Response Program Grants, Michigan has also received funding from Brownfield categorical grants.[34] These funding opportunities are examples of efforts that will reduce barriers to siting renewable energy and energy storage on brownfields. Additionally, as a state program, EGLE currently offers grants and low-interest loans to promote the re-use of contaminated sites.

The State of Michigan is waiting to hear back on two other programs currently under review:

1. Solar for All through the Greenhouse Gas Reduction Fund
2. Renewable Energy Siting through Technical Engagement and Planning (R-STEP)

This measure also intends to leverage the complementary funding available through elective pay (sometimes called direct pay) of certain clean energy tax credits (§45Y, §48E). These tax credits only cover up to 30% of the projects contemplated under this measure, which may be insufficient for some projects to achieve a return on investment through cost-savings from energy bills. In addition to directly supporting projects through technical assistance and deployment of renewable energy and storage systems, this measure will also serve to educate Michiganders on the available tax credits and provide technical assistance to communities in designing such systems. As a result, this measure will catalyze widespread adoption of renewable energy and storage systems.

Workforce Planning Analysis

Currently in Michigan, there are approximately 12,000 renewable energy jobs across five different technologies[35]. By increasing renewable energy generation across the state, Michigan will create jobs across the value chain in manufacturing, professional services, maintenance, engineering, and more fields. This reduction measure is estimated to increase renewable energy jobs to around 22,000 (increase by about 10,000 jobs) by 2030[36].

[33] EPA
[34] java.epa.gov/acrespub/stvrp/
[35] Clean Jobs Midwest
[36] Energy Policy Simulator

Reduction Measure #2 - Invest in energy storage and necessary electric grid investments to enable earlier coal plant retirements and better integrate renewable energy into the electric grid.

Reduction Measure Description and Quantification

Investing in and implementing energy storage not only facilitates the integration of additional renewable energy sources but also enables phased retirement of remaining coal plants in the State of Michigan. It is necessary to widely deploy grid-scale energy storage to maintain energy security within the state and decarbonize the electric grid. The clean energy legislation passed in 2023 requires the study of long-duration storage and establishes a new energy storage standard of 2,500 megawatts (MW), making Michigan one of just a few states that require energy storage standards. Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. A major milestone to achieve this measure includes closing all coal-fired power plants by 2030 which would equate to interim milestones of removing about 1,050 MW of coal-fired capacity per year between 2024 and 2030.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to state government, local municipalities, tribes, utilities, battery energy storage developers, and others. Metrics that may be used to track this reduction measure include tracking the closure timeline of coal plants located within Michigan, the number, location, and size of battery storage projects approved by entities such as the Michigan Public Service Commission, localized air pollution surrounding corresponding coal plants, and other metrics as identified.

Table 18: Estimated GHG emission reductions as a result of priority reduction measure #2

Estimated Emissions Reductions	Time Scale
2.794 $MMTCO_2e$	Annual near-term average
16.762 $MMTCO_2e$	Between 2024 – 2030
23.593 $MMTCO_2e$	Between 2024 – 2050

This measure was quantified using EPS under the following assumptions:

1. The deployment of grid-scale energy storage at a rate of 1,050 MW per year allows for remaining coal-fired power plants to phase out by 2030
2. Phase-out is completed on a linear implementation schedule beginning in 2025
3. Grid-scale electricity storage was set to 30% of overall possible deployment by 2030 (though this policy scenario had no effect on emissions reductions)

Validation of this quantification occurred under manual calculation of displacing all coal-fired electricity generation with zero-emission electricity generation using 2022 generation data.

LIDAC Qualitative and Quantitative Benefits Analysis

Investing in grid-scale energy storage and necessary electric grid upgrades in Michigan will generate benefits for low-income and disadvantaged communities. By accelerating the retirement of coal plants and better integrating renewable energy sources, this measure can lead to substantial improvements in air quality, health, economic opportunities, and overall well-being. There is a projected decrease in pollutant emissions for SOx, NOx, and CO, translating to cleaner air. This will significantly reduce respiratory problems, asthma attacks, and cardiovascular diseases, leading to fewer hospital admissions and improved health outcomes for residents, especially those living near coal plants.

Table 19: Change in co-pollutants as a result of priority reduction measure #2 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-15.129	-7.810
NOx	-10.753	-10.396
PM2.5	0.910	5.426
VOC	-0.006	2.720
CO	-50.749	-149.636

Figure 30: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #2

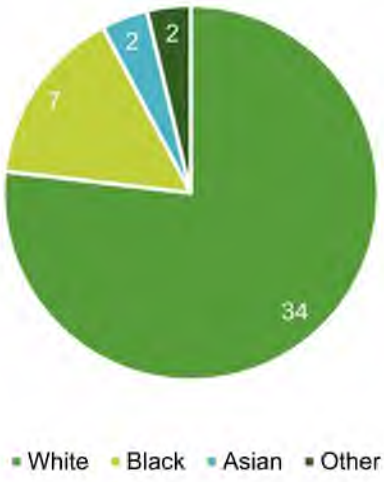


Figure 29: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #2

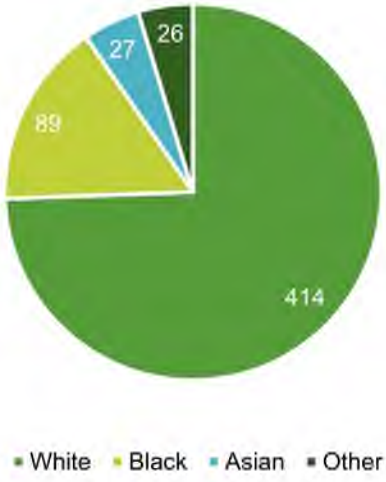


Table 20: Additional estimated community benefits in the near- and long-term throughout Michigan as a result of priority reduction measure #2

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	2,748	34,261
Avoided Respiratory Symptoms and Bronchitis	958	11,950
Avoided Hospital Admissions	10	118
Avoided Minor Restricted Activity Days	16,331	203,553

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statutes in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" – as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 – which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, Michigan was granted awards from three separate programs related to grid resilience and reliability fitting within Priority Reduction Measure #2. Recipients for these programs include the state, municipalities, and utilities and total over $100 million dollars. For example:

1. GRIP: Program Upgrading our Electric Grid and Ensuring Reliability and Resiliency / Grid Innovation Program (awarded to Consumers and DTE)
2. Powering Affordable Clean Energy (PACE) (awarded to municipalities)
3. Preventing Outages and Enhancing the Resilience of Electric Grid Grants (awarded to EGLE)

The State also pursued the Solar and Wind Grid Services and Reliability Demonstration opportunity but was not granted an award.

Workforce Planning Analysis

There are currently about 3,900 grid and storage jobs in Michigan. By driving renewable energy and energy storage integration into the electric grid, Michigan will create electrician, manufacturing, engineering, general and operations management, and construction jobs. This

reduction measure is estimated to increase energy storage jobs to a peak of approximately 11,400 in 2031[37]. Supporting coal plant workers with retraining programs and relocation assistance will be crucial to ensure a smooth transition to a clean energy future and avoid exacerbating existing economic disparities. Currently the Michigan Department of Treasury runs the Energy Transition Impact Project (ETIP), which helps communities impacted by the closure of energy facilities by developing strategies to assist in expanding job opportunities, remediating sites, and mitigating related economic and socio-economic dislocations. In 2023, Senate Bill 519 established the Office of Worker and Community Economic Transition within LEO to assist workers, communities, and employers during the transition to clean energy.

5.2 Commercial and Residential Buildings Reduction Measures

Michigan's built environment was the third highest-emitting sector in 2019. The 2024 GHG Inventory shows emissions from commercial and residential buildings contributed to 33.3 $MMTCO_2E$ to carbon dioxide emissions from fossil fuel combustion. Emissions related to the built environment are primarily due to use of heating fuels such as natural gas, propane, and oil. The best ways to decarbonize commercial and residential buildings is to electrify homes and implement energy efficient appliances and components. A major precursor to this, however, is ensuring the proper repair and weatherization of buildings and residences are incorporated to get the most out of energy-efficient equipment. Several other benefits result from having a strong and sustainable building stock including reduced energy bills, increased climate resilience, and increased health and well-being.

Reduction Measure #3 - Drive building electrification and fuel-switching in existing buildings including an emphasis on LIDACs and electrifying households that currently rely on delivered fuels such as propane and home heating oil.

Reduction Measure Description and Quantification

The MHCP aims to reduce emissions related to heating Michigan homes and businesses by 17% by 2030. According to research from Rewiring America, at least 39% of Michigan households—or 1.5 million households—could save a total of $710 million a year on energy bills if they were using modern heat pump space heaters and heat pump water heaters instead of their current appliances, which use electric resistance, fuel oil, or propane. That's an average savings per household of $460 each year. Half of the households with immediate savings potential are considered low- and moderate-income. The switch to electric heating and other appliances may also yield health benefits, as described in the LIDAC section of this reduction measure. Therefore, delivered fuels such as propane and home heating oil are two target areas to reduce emissions within this reduction measure. While the State of Michigan has several existing initiatives related to decarbonizing homes and buildings including the WAP, Sacred

[37] Energy Policy Simulator

Spaces Clean Energy Grants, Energy Waste Reduction (EWR) Programs, and more, these programs need additional assistance to reduce emissions in the built environment sector. Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. A major milestone to achieve this measure includes reducing emissions related to heating homes and buildings by 17% by 2030. This goal equates to reducing heating emissions in buildings by 2-3% each year between 2024 and 2030.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to investor-owned utilities, public utilities, electric cooperatives, Michigan residents, businesses, municipalities, tribes, and others. Metrics that may be used to track this reduction measure include the change in emissions from the residential sector related to fossil fuel combustion, the amount of electrified components sold (e.g., heat pumps) over time, the number of applications received by existing building electrification programs – especially those that focus on LIDACs, and other metrics as identified.

Table 21: Estimated GHG emission reductions as a result of priority reduction measure #3

Estimated Emissions Reductions	Time Scale
1.047 MMTCO$_2$e	Annual near-term average
6.280 MMTCO$_2$e	Between 2024 – 2030
25.808 MMTCO$_2$e	Between 2024 – 2050

Quantification of this reduction measure was calculated using EPS where four different policy levers were used to estimate the emissions reductions across commercial and residential buildings. The first policy lever includes retrofitting 37% of all existing commercial buildings and 25% of all existing residential buildings in Michigan between 2024 and 2030 for more efficient heating, cooling, and envelope components. The second policy lever is building component electrification which assumes a linear implementation between 2024 and 2050 where 25% of heating, appliance, and other building components that would normally be non-electric, be sold as electric. Two other policy levers were modeled, though they had no effect on the emissions quantification piece of the model. They included a rebate for efficient products and research and development in the near-term for fuel-use reduction.

Validation of this reduction measure is yet to be completed due to lack of quality data to both complete a second calculation and compare it accurately to the EPS model. Note, there is overlap in emissions reduction totals between reduction measure #3 and reduction measure #4.

LIDAC Qualitative and Quantitative Benefits Analysis

Driving building electrification and fuel-switching in existing buildings, particularly focusing on households reliant on delivered fuels like propane and home heating oil should positively impact low income and disadvantaged communities in Michigan. By transitioning from delivered fuels to clean electricity, households experience significant reductions in indoor and outdoor air pollution, The projected decrease in NOx, CO and VOCs results in fewer respiratory illnesses, asthma attacks, and cardiovascular problems. The improved health outcomes translate to fewer missed workdays, and other measures for a better quality of life for residents.

Table 22: Change in co-pollutants as a result of priority measure #3 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-0.512	6.606
NOx	-1.230	-12.628
PM2.5	-1.352	-1.493
VOC	-2.287	-6.007
CO	-56.851	-179.159

Figure 31: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #3

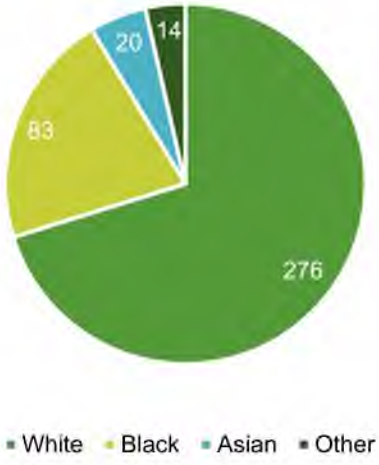


Figure 32: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #3

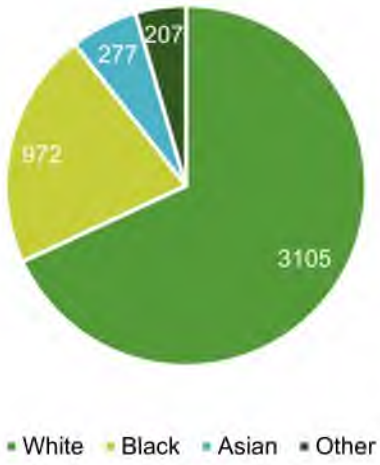


Table 23: Additional estimated community benefits in the near- and long-term throughout Michigan as a result of priority reduction measure #3

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	25,488	295,273
Avoided Respiratory Symptoms and Bronchitis	8,976	104,047
Avoided Hospital Admissions	80	928
Avoided Minor Restricted Activity Days	151,083	1,750,287

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statutes in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" – as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 – which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan has received funding for two different grant programs related to commercial and residential decarbonization including the Energy Efficiency Revolving Loan Fund Capitalization Grant Program (awarded $12.7 million) and Building Codes Implementation for Efficiency and Resiliency ($9.6 million) with partners. Additionally, two Michigan companies have received $22 million to scale up electric heat pump manufacturing from the U.S. DOE. There are currently two other opportunities pending an award decision:

1. Energy Auditor Training (EAT) Program (Section 40503)
2. Technical Assistance for the Adoption of Building Energy Codes

The State plans to apply for the Assistance for Latest and Zero Building Energy Code Adoption (Round 1) (Section 50131) program. The State applied for the Building Energy Codes: Resilient and Efficient Codes Implementation (RECI) program but was not granted funding.

Workforce Planning Analysis

Michigan's largest clean energy job sector is energy efficiency with over 75,000 jobs across Energy STAR and Efficient Lighting, HVAC, High Efficiency HVAC, Advanced Materials, and more sectors[38]. This reduction measure, related to driving building electrification and fuel-switching in existing commercial and residential buildings, will create jobs for electricians,

[38] Clean Jobs Midwest

engineers, technicians, customer service representatives, and more in the state. The estimated increase in jobs for this measure is set to peak in 2030 at around 103,000 newly created jobs.

Reduction Measure #4 - Reduce household fossil energy use through home repairs, electrical upgrades for building and vehicle electrification, weatherization, and other energy waste reduction investments with an emphasis on ensuring equitable access.

Reduction Measure Description and Quantification

This priority reduction measure solely focuses on residential building decarbonization given the higher proportion of GHG emissions from residential buildings and their reliance on fossil-fuel burning fuels compared to commercial buildings. The EPA shares, "Michigan is among the top five states in residential sector petroleum use and ranks first in residential sector consumption of propane"[39]. Decarbonizing Michigan buildings will require baseline investments in repairing Michigan's homes; stronger requirements, incentives, and financing options for energy efficiency and waste reduction; and evaluation and adoption of innovative home heating alternatives, including electrification. Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. A major milestone to achieve this measure includes reducing emissions related to heating homes and buildings by 17% by 2030. This goal equates to reducing heating emissions in buildings by 2-3% each year between 2024 and 2030.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to investor-owned utilities, public utilities, electric cooperatives, Michigan residents, third party installation and maintenance contractors, and others. Metrics that may be used to track this reduction measure include home repair and electrification components sold over a period of time, the number of applications received by existing electrification programs, electricity usage and demand over time, and other metrics as identified.

Table 24: Estimated GHG emission reductions as a result of priority reduction measure #4

Estimated Emissions Reductions	Time Scale
1.260 $MMTCO_2e$	Annual near-term average
7.562 $MMTCO_2e$	Between 2024 – 2030
24.463 $MMTCO_2e$	Between 2024 – 2050

[39] EIA

Quantifying this reduction measure was limited to residential properties in Michigan (i.e., excludes commercial buildings) but includes both rural and urban properties. Much like reduction measure #3, the emissions reductions were calculated using EPS with very similar policy levers. The first policy lever used was retrofitting 25% of all existing residential buildings in Michigan between 2024 and 2030 for more efficient heating, cooling, and envelope components. The second policy lever was building component electrification that assumes a linear implementation between 2024 and 2050 where 100% of heating, appliance, and other building components that would normally be non-electric, be sold as electric. The last policy lever modeled was a rebate for efficient projects which had no effect on the emissions change given it enables implementation of GHG reduction strategies but does not directly result in lowering emissions.

Validation of this reduction measure is yet to be completed due to lack of quality data to both complete a second calculation and compare it accurately to the EPS model. Note, there is overlap in emissions reduction totals between reduction measure #3 and reduction measure #4.

LIDAC Qualitative and Quantitative Benefits Analysis

Low income and disadvantaged communities benefit from targeted home repairs, electrical upgrades, weatherization, and other energy waste reduction investments. There is a projected reduction in emissions particularly in NOx, CO, and VOCs that will result in cleaner air and fewer respiratory illnesses like asthma and bronchitis, reduced hospital admissions, and overall improved health outcomes for LIDAC residents. An additional benefit that can be expected from weatherization and home repair investments is increased comfort by reducing summer heat stress and ensuring warmth in the winter, particularly helpful for vulnerable population segments like the elderly and young children. Energy efficient homes also translates to lower energy costs, alleviating a portion of the financial burden on low-income households and contributing to longer term economic stability. Efforts should be made to preserve existing affordable housing and tenant protections to ensure that home upgrades and electrification do not have adverse impacts on LIDAC households.

Table 25: Change in co-pollutants as a result of priority measure #4 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-1.000	6.569
NOx	-3.427	-11.837
PM2.5	-1.689	0.245
VOC	-3.628	-4.161
CO	-66.543	-168.706

Figure 33: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #4

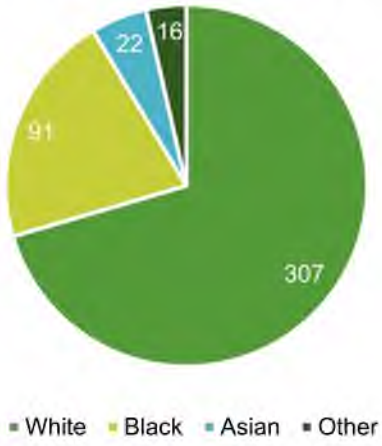


Figure 34: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #4

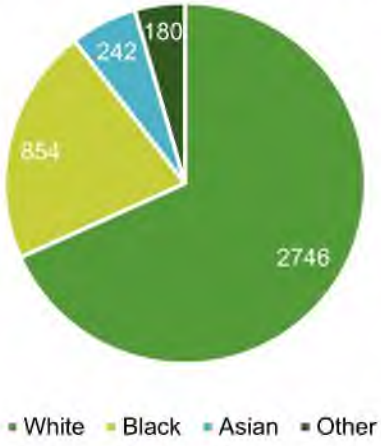


Table 26: Additional estimated community benefits in the near- and long-term throughout Michigan as a result of priority reduction measure #4

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	28,213	260,324
Avoided Respiratory Symptoms and Bronchitis	9,943	91,741
Avoided Hospital Admissions	89	819
Avoided Minor Restricted Activity Days	167,234	1,543,121

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statutes in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" -- as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 – which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan received $211 million in 2023 to carry out the Consumer Home Energy Rebate Program. Additionally, in 2023, the Michigan Department of Health and Human Services (MDHHS) received $183 million for the WAP, providing the opportunity for program expansion that will allow people living in multifamily units access to funds (in addition to others). EWR programs have also been a focus of electric and natural gas utilities in recent years. In 2022, utilities spent a combined $517 million on EWR programs that will lower emissions and save ratepayers money.

The State is awaiting an award decision on the Training for Residential Energy Contractors (TREC) (50123) program to expand the clean energy workforce.

Workforce Planning Analysis

Across the state of Michigan, there are currently over 100,000 jobs available across the clean energy sectors associated with this measure including energy efficiency, solar energy, and electric vehicles. Michigan is expected to see additional job creation in these areas across the value chain[40]. Examples include, solar panel and EV installers and technicians, electricians, green building retrofitter, engineers, and more. It is estimated that this reduction measure will result in an increase in jobs related to residential building decarbonization by approximately 21,000 by 2030[41].

Reduction Measure #5 - Decarbonize government and nonprofit facilities and infrastructure, with an emphasis on LIDACs, by reducing energy waste, investing in decarbonization solutions, and reducing emissions from fossil fuel combustion.

Table 27: Estimated GHG emission reductions as a result of priority reduction measure #5

Estimated Emissions Reductions	Time Scale
0.050 $MMTCO_2e$	Annual near-term average
0.251 $MMTCO_2e$	Between 2024 – 2030
0.502 $MMTCO_2e$	Between 2024 – 2050

Reduction Measure Description and Quantification

Decarbonizing government-owned and nonprofit facilities and infrastructure is an opportunity to pave the way for other commercial and residential buildings to reduce their carbon footprint. Supporting deployment of renewable energy and storage systems for local government buildings can reduce energy costs and provide resilience in case of an electric grid outage. This measure has several potential benefits to Michiganders such as:

- Sharing of best practices to business-owners and residents looking to decarbonize in the future
- Technology maturity for newer, expensive equipment (e.g., heat pumps) that result in potential cost savings for others who implement later on in maturity
- Potential reallocation of or reduced costs to constituents who indirectly fund operational costs of these facilities

[40] Clean Jobs Midwest
[41] Energy Policy Simulator

Specific implementation schedule and milestones will be determined by those implementing this measure. Implementing entities may track milestones by achieving a 2-3% reduction in emissions each year for buildings undergoing decarbonization initiatives as part of this reduction measure.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to state government, local municipalities, tribes, nonprofits, investor-owned utilities, public utilities, electric cooperatives, and others. Metrics that may be used to track this reduction measure include natural gas consumption and electricity use of government and nonprofit facilities over time, applications received by eligible electrification programs, the number of electrification components sold over time, and other metrics as identified.

Quantifying this reduction measure took a manual approach to collect data about energy use and operations from municipalities and apply it to cities and counties across Michigan. Using an average ratio of energy consumption among municipal buildings per capita, this factor was applied to the population throughout Michigan to model the estimated emissions. This approach was taken given the lack of actual building and energy data from Michigan government buildings. The calculations were made under the following assumptions:

1. Assumes a 20% improvement in building energy efficiency by 2030
2. Assumes a 40% improvement in building energy efficiency by 2050
3. Streetlight infrastructure was excluded
4. Nonprofit facilities were excluded

The National Renewable Energy Laboratory's (NREL's) ComStock Analysis Tool[42] was used to validate this reduction measure and shows a similarity in the order of magnitude of expected emission reductions. Differences in the data sets used and underlying assumptions prevent a direct comparison from being possible. Improvements to this quantification are possible with actual data from government-owned buildings in Michigan including but not limited to energy profile, building components such as square footage, and other data.

LIDAC Qualitative and Quantitative Benefits Analysis

Quantification of the LIDAC benefits was not possible for this reduction measure. It will likely result in similar benefits as reduction measures three and four such as improved air quality and a healthier environment for people using those facilities, though the quantity would alter based on the scale differences of each measure. Long-term energy savings from efficiency upgrades to public and nonprofit facilities will free-up resources for other community investments and potentially lead to lower costs for public services that benefit LIDAC residents.

[42] nrel.gov/buildings/comstock.html

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statutes in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" -- as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 -- which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan received $2.7 million in funding from the Energy Efficiency and Conservation Block Grant Program - State Formula program that directly aligns with this reduction measure to decarbonize government-owned buildings. In overlap with Priority Reduction Measure #3, the state plans to apply for the Assistance for Latest and Zero Building Energy Code Adoption (Round 1) (Section 50131) program. The EPA "Greenhouse Gas Reduction Fund" and the Federal Emergency Management Agency "Building Resilient Infrastructure and Communities" are two additional funding sources but are not believed to be duplicative due to different program foci.

Workforce Planning Analysis

The current jobs available and profiles to be created as a result of this reduction measure is similar to reduction measures #3 and #4. There is data lacking in the estimated increase of jobs in this reduction measure, however, it is estimated to be lower than the similar reduction measures in the built environment due to the smaller footprint of government-owned buildings in the state compared to the entirety of the residential and commercial sectors. There is likely overlap in the amount of jobs accounted for in the aforementioned reduction measures and with this one.

5.3 Transportation Reduction Measures

The transportation sector is the second highest emitting sector behind the energy sector in Michigan as of 2019 with a total of 51.4 $MMTCO_2E$. Transportation emissions are primarily due to the combustion of petroleum products such as gasoline and diesel in light-duty vehicles and freight trucks. In November 2023, the Michigan Department of Transportation (MDOT) released a statewide Carbon Reduction Strategy (CRS) report to explore initiatives to reduce statewide transportation sector carbon emissions that reflect the carbon reduction needs and preferences in the state. Several initiatives are underway to decarbonize different subsectors of the transportation sector, both funded by the CRS and separately. A zero-emission ferry conversion, development of EV battery manufacturing facilities, and multi-state EV charger deployment are examples of some ongoing projects.

Reduction Measure #6 - Electrify state government, municipal, tribal, and other public fleets, prioritizing equitable access for Michigan's LIDACs.

Reduction Measure Description and Quantification

As a step towards decarbonizing the transportation sector, Governor Whitmer recently called for a transition of the state government fleet to zero emission vehicles under Executive Directive No. 2023-5. The Governor called for the conversion of the state fleet to reach zero emissions by 2033 for light-duty vehicles and by 2040 for medium- and heavy-duty vehicles. This reduction measure aims to launch this Executive Directive to action while lowering emissions, growing demand for EV production, and reducing net costs. Including municipal, tribal, other public fleets, in addition to the electrification of school buses, in this measure is an opportunity for other large fleets to make the transition. It builds off existing plans to decarbonize fleets such as the BIL's Clean School Bus Program that will help transition school buses to zero emission vehicles. Thanks to the new Executive Directive, Michigan does not anticipate any major obstacles in the implementation schedule or milestones associated with this measure. The state government fleet currently has approximately 14,000 vehicles. In order to reach a zero-emission fleet by 2033, transiting approximately 1,500 vehicles per year to zero-emission vehicles could serve as interim milestones to achieve this reduction measure.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to state government, local municipalities, tribes, public schools, public universities, and others. Metrics that may be used to track this reduction measure include the number of electrified vehicles owned or leased by state government and other applicable entities, the number of EV chargers installed on government- and publicly-owned property, the number of entities engaging in bulk-buy programs, and other metrics as identified.

Table 28: Estimated GHG emission reductions as a result of priority reduction measure #6

Estimated Emissions Reductions	Time Scale
0.285 $MMTCO_2e$	Annual near-term average
1.519 $MMTCO_2e$	Between 2024 – 2030
7.571 $MMTCO_2e$	Between 2024 – 2050

Fleet electrification was quantified using EPA's AVERT tool. Major assumptions include:

1. Electrification of the State fleet is calculated using Michigan State Fleet Plans from DTMB
2. Municipal fleets and school buses are accounted for in the emission reduction calculation, tribal fleets or other major public fleets are not accounted for in this emission reduction
3. Focus is on emission reductions for light-duty vehicles and school buses across the State by 2030, medium and heavy duty vehicles are not quantified given lack of access to federal tools
4. Electric vehicles are added to displace new internal combustion engine (ICE) vehicles on the road
5. The manufacturing of EV batteries and recycling are not considered

Validation of these emissions reduction will be performed using comparable state data for fleet electrification.

Note: This reduction measure quantifies municipal fleets using representative fleet data for different population sizes across the State of Michigan. When applying for specific projects, ensure the appropriate emissions are calculated to result in reductions due to completion of the specific project.

LIDAC Qualitative and Quantitative Benefits Analysis

Transitioning from gasoline-powered vehicles to electric vehicles significantly reduces emissions of harmful pollutants like NOx and VOCs producing cleaner air for communities historically plagued by traffic-related pollution. This shift holds the potential to reduce respiratory illnesses like asthma and bronchitis and to improve overall health outcomes. In addition, the quieter operation of electric vehicles compared to gasoline-powered counterparts has a dual impact — minimizing noise pollution in neighborhoods and creating more peaceful environments for residents particularly those living near transit routes. This transition not only offers a quieter, less polluted urban landscape but also has the potential to transform public spaces, creating pedestrian-friendly areas that encourage outdoor activities, ultimately revitalizing community life. To ensure equity in the transition of the State fleet, the DTMB EV Plan should prioritize focus of fleet transition for fleet vehicles within Justice40 communities, high-density areas, and historically disadvantaged communities with higher pollution rates. In addition, to ensure that fleets are transitioned properly, siting electric vehicle supply equipment (EVSE) on state-controlled property in LIDACs will be a focus.[43]

[43] Executive Directive 2023-5

Table 29: Change in co-pollutants as a result of priority measure #6 in thousand metric tons of emissions

Pollutant*	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	0.064	0.332
NOx	-1.221	-6.076
PM2.5	0.009	0.043
VOC	-0.364	-1.966
CO	N/A	N/A

**Calculated via AVERT tool, does not include all co-pollutants from EPS*

Table 30: Additional estimated community benefits in the near- and long-term throughout Michigan as a result of priority reduction measure #6

Community Benefits	2024-2030 Cumulative Value*	2024-2050 Cumulative Value*
Avoided Lost Workdays	9,615	79,137
Avoided Respiratory Symptoms and Bronchitis	3,412	28,077
Avoided Hospital Admissions	31	149,984
Avoided Minor Restricted Activity Days	57,011	469,252

**Values are calculated in EPA's COBRA tool using the annual emissions for final implementation year of fleet transition (from AVERT). Additional analysis for year over year benefits given the implementation schedule is needed to show data change overtime.*

Review of Authority to Implement

In addition to the statutes in Section 4.4 and other relevant laws, the State of Michigan has existing legislative and regulatory authority to implement this measure without additional action.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, 55 school districts within the State of Michigan have received funds through the Clean School Bus Program to electrify their school bus fleets. Additionally, the State has applied for the 2023 Clean School Bus Rebate Program and is currently awaiting award decisions.

Other complementary funding sources include:

- Volkswagen settlement grants
- Federal and state-funded EV purchase rebates
- Federal Transit Administration's Low or No Emission and Grants for Buses and Bus Facilities Competitive Programs
- Diesel Emissions Reduction Act

- FEMA Congestion Mitigation and Air Quality Improvement Program
- Inflation Reduction Act Clean Ports
- Federal Highway Administration Charging and Fueling Infrastructure Discretionary Grant
- Inflation Reduction Act Alternative Fuel Vehicle Refueling Property Credit Direct Pay

Workforce Planning Analysis

Michigan currently has over 32,000 jobs in clean transportation. By electrifying government and other public fleets, this measure will create jobs as technicians, electricians, engineers, EV workers, infrastructure service jobs, transportation service jobs, and construction jobs.[44]

Reduction Measure #7 - Support just access to public transit and non-motorized transportation options by improving infrastructure, and by increasing routes, frequency, and reliability of available options.

Reduction Measure Description and Quantification

Michigan's current public transit system is comprised of 78 public transit agencies that transported 30 million passengers across the state in 2022[45]. Increasing the accessibility of public transit for both motorized and non-motorized modes was a very popular topic among the MHCP community engagement sessions held towards the end of 2023. In order to accomplish the expansion of Michigan's public transit network, upgrades and improvement to existing infrastructure is necessary. By improving and upgrading infrastructure, Michigan can increase routes, frequency, and reliability among public transit services for the Michigan public, who have experienced longer commute times in recent years[46]. Incentivizing the use of public transit can help displace individual passenger cars on the road and ultimately reduce emissions, commute time, and traffic on the roads.

Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. While an increase in public transit ridership and use of non-motorized transportation solutions will reduce emissions by displacing use of ICE vehicles, increased access to public transit will increase emissions from transit buses. Thus, this measure incorporates electrification of transit buses across the state to ensure a transition to clean infrastructure by 15% each year, as prioritized in the MHCP.

Example entities that may participate in implementing this reduction measure include but are not limited to state government, local municipalities, tribes, transit authorities, and others. Metrics that may be used to track this reduction measure include the number of registered vehicles within an area, ridership of public transit, the amount of money spent on developing infrastructure, sales data of vehicle batteries and public transit vehicles, and other metrics as identified.

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[44] Clean Jobs Midwest
[45] Michigan Transit
[46] U.S. Department of Transportation

Table 31: Estimated GHG emission reductions as a result of priority reduction measure #7

Estimated Emissions Reductions	Time Scale
1.162 $MMTCO_2e$	Annual near-term average
7.000 $MMTCO_2e$	Between 2024 – 2030
12.018 $MMTCO_2e$	Between 2024 – 2050

Quantification of increased access to public transit uses RMI's Energy Policy Simulator tool. Additional analysis of bus electrification uses AVERT tool. Major assumptions include:

1. Increased access of public transit is quantified using "mode shifting" policies which analyze emission reductions for passenger cars and SUVs who choose non-motorized and public transit options
2. MDOT's Michigan Ridership Reports were used to understand the total number of transit buses in the State of Michigan[47]

Validation of this measure used comparisons to similar frameworks such as the Carbon Reduction Strategy report by MDOT to replicate quantification given increased access to public transit.

Note: this reduction measure was quantified within the larger "mode shifting" which may include additional non-motorized factors in the emission reduction calculation. When applying for specific projects, ensure the appropriate emissions are calculated to result in reductions due to completion of the specific project.

LIDAC Qualitative and Quantitative Benefits Analysis

Michiganders who take public transportation spend an extra 67.7% of their time commuting and non-White households are 5.6 times more likely to commute via public transportation[48]. Improving infrastructure to enable more robust public transit and expanded non-motorized transportation options offers a cascade of benefits to low income and disadvantaged communities such as health, economic opportunity, and overall well-being. The projected reductions in harmful pollutants like NOx and CO translate to significant improvements in air quality, directly impacting residents' health particularly for people living near busy roads where there is expected to be major reductions in cases of respiratory symptoms and bronchitis. Improved transportation access fosters economic empowerment and social mobility. Expanded public transit networks, especially those in underserved areas, connect residents to job opportunities, educational institutions, healthcare facilities, and other essential services they may have previously lacked access to.

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[47] Michigan Department of Transportation
[48] transportation.gov/briefing-room/bipartisan-infrastructure-law-will-deliver-michigan

Table 32: Change in co-pollutants as a result of priority measure #7 in thousand metric tons of emissions

Pollutant*	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-1.031	7.368
NOx	-12.408	-27.762
PM2.5	1.366	5.492
VOC	-4.512	-1.474
CO	-96.832	-186.676

** Includes EPS and COBRA pollutants to account for increased access and electrification of transit*

Figure 35: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #7

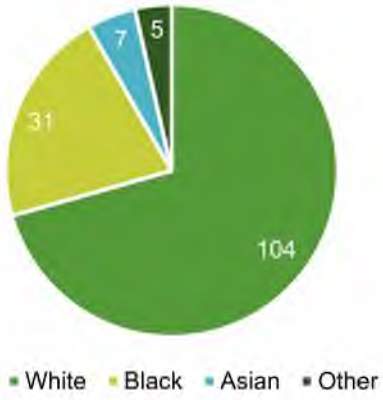
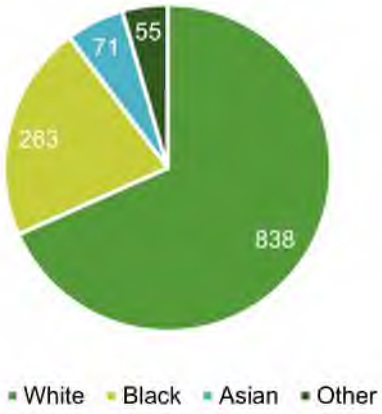


Figure 36: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #7



NOTE: Avoided deaths may be conservative estimate based on lack of data in one of the tools used in quantification

Table 33: Additional estimated community benefits in the near- and long-term throughout Michigan as a result of priority reduction measure #7

Community Benefits	2024-2030 Cumulative Value*	2024-2050 Cumulative Value*
Avoided Lost Workdays	9,458	78,457
Avoided Respiratory Symptoms and Bronchitis	3,357	27,841
Avoided Hospital Admissions	30	250
Avoided Minor Restricted Activity Days	56,079	465,212

** Values include both EPS (for updating infrastructure) and COBRA (for electrifying transit) benefits. COBRA outputs assume the benefits of the final implementation year, therefore, the benefits all buses have been transitioned for each year. Additional analysis is needed to understand the overtime benefits given a 15% MHCP implementation schedule.*

Review of Authority to Implement

In addition to the statutes in Section 4.4 and other relevant laws, the State of Michigan has existing legislative and regulatory authority to implement this measure without additional action and plans to orient implementation around existing areas of authority. Local governments and regional authorities also have significant authority to implement.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, Michigan has been awarded funds from three different federal grant programs to expand public transit:

1. Strengthening Mobility and Revolutionizing Transportation (SMART) Grant (awarded approximately $7 million to State and municipal entities (see FY 2022 awards below))
    a. Michigan Department of Transportation ($3.1 million)
    b. City of Detroit ($2 million)
    c. Oakland County
2. Rebuilding American Infrastructure with Sustainability and Equity (RAISE) (multiple awards received by the State and statewide entities over the course of the awards (see FY 2023 awards below))
    a. Michigan Department of Labor and Economic Opportunity ($8.5 million)
    b. City of Pontiac ($16.3 million)
    c. City of Jackson ($6.8 million)
3. Reconnecting Communities Pilot Program (awarded approximately $34 million to the State and City of Kalamazoo)

Workforce Planning Analysis

Currently, the State of Michigan has over 32,000 clean transportation jobs and the advanced transportation sector grew 21% from 2021 to 2022. By continuing to improve infrastructure and support access to public transit, Michigan will create jobs in transportation services, construction, and engineering, as well as for electricians, technicians, and EV workers[49]. Job growth for this measure is expected to increase to approximately 37,000 by 2030 with this reduction measure[50].

[49] Clean Jobs Midwest

[50] Energy Policy Simulator

Reduction Measure #8 - Encourage adoption of electric vehicles by increasing deployment of electric vehicle charging infrastructure, prioritizing equitable access for Michigan's LIDACs.

Reduction Measure Description and Quantification

Michigan currently has over 50,000 battery electric and hybrid vehicles registered in the state supported by just over 3,000 public charging ports. According to the MI Future Mobility Plan, another 100,000 chargers will need to be installed and supported to reach the MHCP goal of bringing 2 million electric vehicles on Michigan roads by 2030. While Michigan has several ongoing initiatives related to deploying charging infrastructure, such as the Charge Up Michigan Program, the rate at which chargers need to be deployed to reach MHCP 2030 goals is too high for existing programs as they stand today to accomplish. Increasing the access and security to those making the switch to electric vehicles is a vital way to reach successful deployment. In addition, addressing the charging infrastructure gaps along key commercial corridors can help support a region-wide transition to electric medium- and heavy-duty vehicles in Michigan and across the mid-west.

Table 34: Estimated GHG emission reductions as a result of priority reduction measure #8

Estimated Emissions Reductions	Time Scale
0.509 $MMTCO_2e$	Annual near-term average
3.052 $MMTCO_2e$	Between 2024 – 2030
13.489 $MMTCO_2e$	Between 2024 – 2050

Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. Interim milestones to achieving this measure could include deploying approximately 300,000 BEVs (inclusive of light-duty, medium-duty, and heavy-duty vehicles) per year between 2024 and 2030. Alternatively, deploying approximately 16,000 EV chargers per year between 2024-2030 within the state to help support the transition to electric vehicles could be used as milestones depending on the specific projects created out of this priority reduction measure.

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to state government, local municipalities, tribes, electric vehicle charging infrastructure installers/contractors, Michigan residents, transportation agencies, and others. Metrics that may be used to track this reduction measure include the number of available public electric vehicle chargers, the number of electric vehicles registered in Michigan, gasoline and diesel sales data, air quality, and other metrics as identified.

Quantifying the emissions impact on deploying electric vehicle charging infrastructure was estimated using AVERT and was based on the following assumptions:

1. EV charging deployment will result in Michigan reaching their goal of bringing 2 million electric vehicles on Michigan roads by 2030 and all registered vehicles in MI as of 2022 transition to zero-emission vehicles by 2050
2. All remaining EVs deployed are assumed to be all-electric and light-duty vehicles to serve as a conservative estimate compared to a range of light-duty, medium-duty, and heavy-duty vehicles being deployed
3. There was no change in the existing electric power generation fuel mix in the state (i.e., initiatives related to clean energy deployment are not considered and the existing fuel mix is assumed to remain constant)
4. Omits emissions related to battery energy efficiency improvements and greenhouse gases outside of carbon dioxide

Validation of this reduction measure quantification was completed with manual calculation of displacing ~300,000 internal combustion engines (ICEs) per year with new battery electric vehicles (BEVs) and estimating the approximate GHGs emitted per typical ICE per year.

LIDAC Qualitative and Quantitative Benefits Analysis

Quantification of the avoided deaths by race was not possible for this reduction measure. It will likely result in similar benefits as reduction measures six and seven such as the significant reduction of harmful pollutants like NOx and SOx, leading to cleaner air and fewer respiratory illnesses, though the quantity would alter based on the scale differences between each measure.

Table 35: Change in co-pollutants as a result of priority measure #8 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-0.001	-0.004
NOx	-0.016	-0.070
PM2.5	-0.001	-0.006
VOC	-0.038	-0.164
CO	**N/A**	**N/A**

Table 36: Avoided estimated community benefits in the near-term and long-term as a result of priority reduction measure #8

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	7	39
Avoided Respiratory Symptoms and Bronchitis	2	13
Avoided Hospital Admissions	0	0
Avoided Minor Restricted Activity Days	39	235

Review of Authority to Implement

The State of Michigan has existing legislative and regulatory authority to implement this measure without additional action. In addition to the statues in Section 4.4 and other relevant laws, the "Clean and Renewable Energy and Energy Waste Reduction Act" – as amended most recently in 2023 – provides authority to implement this measure along with PA 3 of 1939 – as amended most recently in 2023 – which provides the authority for the Michigan Public Service Commission to regulate investor-owned utilities in the state to support the deployment of EV charging infrastructure.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan has received $110 million as part of the National Electric Vehicle Infrastructure (NEVI) Formula Program to deploy charging infrastructure across the state. The State is awaiting award decisions for the Electric Vehicle Charger Reliability and Accessibility Accelerator Program through the IIJA. There is an existing state program EGLE manages to advance strategic deployment of EV infrastructure along Lake Michigan.

Other complementary funding sources include:

- Volkswagen settlement grants
- Federal and state-funded EV purchase rebates
- EPA's Clean School Bus program
- Federal Transportation Administration's Low or No Emission and Grants for Buses and Bus Facilities Competitive Programs
- Diesel Emissions Reduction Act
- FEMA Congestion Mitigation and Air Quality Improvement Program
- Inflation Reduction Act Clean Ports
- Federal Highway Administration Charging and Fueling Infrastructure Discretionary Grant
- Inflation Reduction Act Alternative Fuel Vehicle Refueling Property Credit Direct Pay

Workforce Planning Analysis

Governor Whitmer has helped Michigan build on leadership in mobility. She worked to win big projects and create thousands of good-paying jobs, such as a historic $7B investment from GM, creating and retaining 5,000 jobs; a $1.7B investment from electric vehicle battery manufacturer LG Energy Solution, creating 1,200 jobs; and a $2B investment from Ford that will create more than 3,200 jobs. Michigan currently has approximately 32,000 jobs in the clean transportation space[51], with the largest hub in Detroit. As the state continues to increase deployment of electric vehicle charging infrastructure, the following jobs will be created: electricians, technicians, engineers, transportation services jobs, and grid specialists. Projected job creation was unable to be estimated for this reduction measure. In 2023, Senate Bill 519 established the Office of Worker and Community Economic Transition within LEO to assist workers, communities, and employers during the transition to clean energy, including internal combustion engine vehicle workers and workers in the supply chain for internal combustion engine vehicles. This Office can provide further support and analysis to understand and mitigate workforce impacts.[52]

5.4 Industry Reduction Measures

Michigan's industry sector accounted for 15% of overall GHG emissions in 2019. Emissions from industrial processes amounted to 11.1 $MMTCO_2E$ and energy related emissions from industrial processes was an additional 15.6 $MMTCO_2E$. The state's industrial sector is remarkably diverse, and makes critical products like iron, steel, cement, chemicals, and food using specific manufacturing processes that can cause on-site GHG emissions, often require a lot of power, and involve GHG emissions in their supply chains.

Reduction Measure #9 - Encourage industrial innovation to advance energy efficiency, fuel-switching, and deployment of cleaner manufacturing technologies prioritizing facilities in LIDACs that may receive significant benefits from reduced industrial sector emissions.

Reduction Measure Description and Quantification

Industrial decarbonization is a key area of focus for Michigan as one of the national leaders in manufacturing jobs and output[53]. Energy efficiency is a vital tool that can help Michigan's industrial sector reduce GHG emissions while keeping energy costs reasonable. Additionally, many industrial facilities have a high potential for process electrification, while other high-heat processes require fuel-switching to cleaner fuels (such as green hydrogen), and certain processes require deploying cleaner manufacturing technologies, including but not limited to carbon capture, utilization, and storage. The top ten highest GHG emitting industrial facilities

[51] Clean Jobs Midwest
[52] legislature.mi.gov/documents/2023-2024/billanalysis/Senate/htm/2023-SFA-0519-G.htm
[53] Business Facilities' 19th Annual Rankings Report: State Rankings

outside of power plants produced over 8 $MMTCO_2E$ in 2022, representing a major opportunity to reduce emissions from top emitting facilities as they pave the way for others to follow.

Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. In partnership with existing institutions, such as the Michigan State University Industrial Assessment Center, this measure would initially support site assessments and predevelopment costs for many of Michigan's industrial facilities. Decarbonization projects at facilities of varying sizes would be undertaken thereafter, prioritizing the projects that result in the greatest emission reductions.

Table 37: Estimated GHG emission reductions as a result of priority reduction measure #9

Estimated Emissions Reductions	Time Scale
0.597 $MMTCO_2e$	Annual near-term average
5.887 $MMTCO_2e$	Between 2024 – 2030
15.529 $MMTCO_2e$	Between 2024 – 2050

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to manufacturers, industrial plants, and others. Metrics that may be used to track this reduction measure include the change in natural gas and electricity usage of industrial facilities over time, emissions of various greenhouse gases via existing reporting programs, localized air pollution, and other metrics as identified.

Industrial decarbonization strategies such as fuel-switching, energy efficiency improvements, and investments in clean manufacturing technology were quantified using RMI's EPS tool. The following assumptions served as the base of the quantification:

1. Focus on industrial decarbonization outside of power plants to avoid double counting with other electricity specific reduction measures
2. The 10 highest emitting industrial users were distinguished using Greenhouse Gas Reporting Program (GHGRP) data and include minerals, metals, refineries, petroleum and natural gas systems, pulp and paper, and non-fluorinated chemicals industries[54]

Validation of this reduction measure quantification will be completed with manual calculation using comparative data for other similar sized industrial sites.

[54] EPA GHG Reporting

Note: The quantification included policies related to industrial energy efficiency, fuel-switching, and clean manufacturing for the top 10 industries (besides power plants). When applying for specific projects, ensure appropriate emissions are quantified.

LIDAC Qualitative and Quantitative Benefits Analysis

Cleaner manufacturing technologies and fuel-switching lead to significant reductions in emissions of harmful pollutants like NOx, SOx, and CO in traditionally overburdened communities located near industrial facilities. Transitioning to cleaner industrial processes will also generate demand for new skills and expertise that can create new workforce opportunities in areas like conducting energy audits and implementing the energy saving strategies they identify.

Table 38: Change in co-pollutants as a result of priority measure #9 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-1.433	5.805
NOx	-2.272	-4.160
PM2.5	1.305	5.199
VOC	-0.698	0.753
CO	-48.531	-149.659

Figure 37: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #9

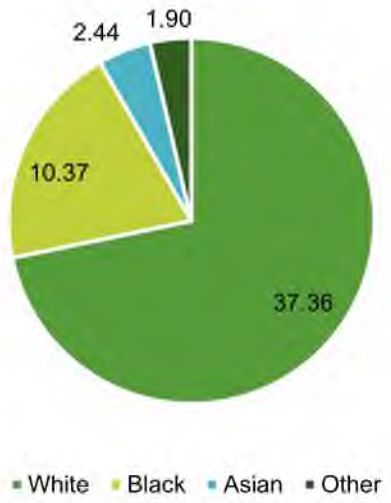


Figure 38: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #9

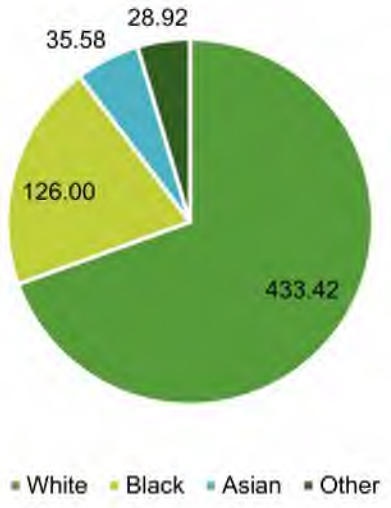


Table 39: Avoided estimated community benefits in the near-term and long-term as a result of priority reduction measure #9

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	3,335	39,897
Avoided Respiratory Symptoms and Bronchitis	1,180	14,107
Avoided Hospital Admissions	11	129
Avoided Minor Restricted Activity Days	19,767	236,484

Review of Authority to Implement

In addition to the statutes in Section 4.4 and other relevant laws, the State of Michigan has existing legislative and regulatory authority to implement this incentive-based measure without additional action.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, the State of Michigan has received funding through the Regional Clean Hydrogen Hubs Program as part of the Midwest Hydrogen Hub to expand the production, processing, delivery, storage, and end-use of hydrogen which is applicable to the fuel-switching component of this priority reduction measure.

In addition, this measure intends to fill gaps in funding left after implementation of the federal 48C Clean Manufacturing Tax Credit. That program is currently funded at a $4 billion level, applications were due in December 2023, and winners of 48C credits are not yet known. The 48C program is expected to leave an abundance of unfunded projects to spur innovation and reduce emissions. This coalition grant program will build on the 48C grants and focus on projects that do not get 48C funding.

Workforce Planning Analysis

In Michigan, there are approximately 75,000 energy efficient jobs and almost 700 clean fuels jobs[55]. As the state strives to advance energy efficiency and fuel-switching in heavy industry, it will create jobs across the value chain in manufacturing, innovation consulting, business development, construction, engineering, and more. Job creation from this reduction measure can expect about 4,347 new jobs in the year 2050.

[55] Clean Jobs Midwest

Reduction Measure #10 - Reduce methane emissions from various sources, including but not limited to food waste, organics diversion, and wastewater treatment facilities with a focus on methane reduction strategies that will bring significant benefits for LIDACs.

Reduction Measure Description and Quantification

Methane emissions, while a relatively small portion of Michigan's GHG emissions, have a significantly higher warming potential compared to CO_2, stressing the importance of mitigating their release into the atmosphere. The inventory sectors that emit the highest amounts of CH_4 include Natural Gas and Oil Systems, Agriculture, and Waste. This reduction measure may focus on methane reductions from any emitting inventory sector with significant methane emissions, but for the purposes of quantification, prioritizes food waste, organics diversion, and wastewater.

Regarding the implementation schedule and milestones for this measure, EGLE does not anticipate any major obstacles. Michigan has a goal to reduce food waste by 50% from 2005 levels by 2030. Currently in development is a Michigan Food System Waste Reduction Road Map to inform decision makers of policies and programs related to reducing food waste.

Table 40: Estimated GHG emission reductions as a result of priority reduction measure #10

Estimated Emissions Reductions	Time Scale
0.858 $MMTCO_2e$	Annual near-term average
5.147 $MMTCO_2e$	Between 2024 – 2030
13.827 $MMTCO_2e$	Between 2024 – 2050

Example entities that may participate in implementing this reduction measure (but are not necessarily eligible to apply directly for CPRG implementation grants) include but are not limited to landfill owners, wastewater treatment facilities, compost companies, tribes, municipalities, universities, and others. Metrics that may be used to track this reduction measure include the change in reported methane emissions from industrial sites, the amount of methane vented and flared, the amount of food waste diverted from landfills, and other metrics as identified.

Quantification of this reduction measure was calculated using RMI's EPS tool and the EPA's recent report "Quantifying Methane Emissions from Landfilled Food Waste"[56]. The baseline assumptions include:

1. All food waste is calculated via municipal solid waste emissions from the EPA's SIT data and EPA's finding that 58% of fugitive methane emissions in municipal solid waste landfills are from food waste

[56] epa.gov/land-research/quantifying-methane-emissions-landfilled-food-waste

2. Wastewater baseline data are taken from the SIT
3. A 50% reduction in wastewater is also assumed (based on 2005 levels) in addition to reduction by 50% for food waste

Validation of this reduction measure was completed through addressing additional EPS policies and how they relate to emission goals, based on the SIT. Note, the SIT does not include state-specific data but uses EPA estimates and national proportions to calculate both waste and wastewater data.

LIDAC Qualitative and Quantitative Benefits Analysis

Reducing methane emissions from diverse sources – including food waste, organic waste diversion, and wastewater treatment facilities – has the potential to improve the lives of Michigan's LIDAC residents. Reducing methane emissions, even at a seemingly small scale within communities, leads to reduced pollutants, especially CO, and improves air quality and enhances overall health and well-being. Landfills and wastewater treatment facilities are often the source of unpleasant odors from the release of compounds that accompany methane such as hydrogen sulfide. Diverting organic waste to anaerobic digestion facilities minimizes the release of odorous compounds. Reducing these emissions creates a more pleasant environment in surrounding communities, which are often historically disadvantaged. In addition, implementing solutions like anaerobic digestion for food waste conversion requires infrastructure upgrades and operational staff, generating green jobs in local communities.

Table 41: Change in co-pollutants as a result of priority measure #9 in thousand metric tons of emissions

Pollutant	Change in Cumulative Emissions (2024-2030)	Change in Cumulative Emissions (2024-2050)
SOx	-0.891	7.429
NOx	-0.783	0.576
PM2.5	1.687	6.341
VOC	-0.178	2.269
CO	-45.358	-142.737

Figure 39: Avoided deaths categorized by race between 2024 and 2030 as a result of priority reduction measure #10

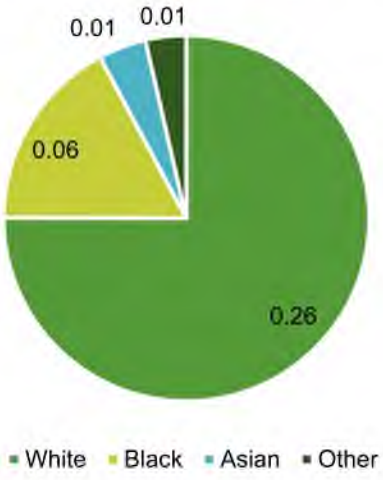


Figure 40: Avoided deaths categorized by race between 2024 and 2050 as a result of priority reduction measure #10

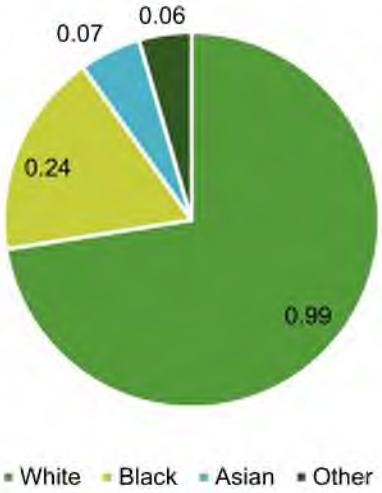


Table 42: Avoided estimated community benefits in the near-term and long-term as a result of priority reduction measure #9

Community Benefits	2024-2030 Cumulative Value	2024-2050 Cumulative Value
Avoided Lost Workdays	22	87
Avoided Respiratory Symptoms and Bronchitis	8	30
Avoided Hospital Admissions	0	0
Avoided Minor Restricted Activity Days	128	516

Review of Authority to Implement

In addition to the statutes in Section 4.4 and other relevant laws, the State of Michigan has existing legislative and regulatory authority to implement this measure without additional action.

Intersection with Other Funding Availability

In addition to the broader coordination of funding opportunities across Michigan as noted in Section 4.5, EGLE was awarded $5 million as part of the Methane Emissions Reduction Program funded through the IRA that helps monitor air pollution, enhance climate resilience, and decrease adverse health effects in LIDACs.

Workforce Planning Analysis

This reduction measure relating to methane emissions reduction will have an effect on jobs in farming, food processing and manufacturing, grocery retail, food service, and more. This is the only reduction measure to estimate a decrease in net jobs by as low as 4,300 fewer jobs by 2050[57]. However, the aforementioned Community and Worker Economic Transition Office in LEO is meant to support workers from industries impacted by the clean energy transition and could provide analysis, planning, and support to mitigate adverse workforce impacts.

6. CONCLUSION AND NEXT STEPS

EGLE continues to oversee all components required to implement the strategies laid out in the MHCP. This requires complex management to obtain funds, incentivize progress, operate and promote programs, and much more. The potential outcome to establish Michigan as a clean energy leader in economic development, jobs, and overall well-being for citizens makes further progress an imperative.

As we look forward to making groundbreaking advancements in the areas discussed herein, EGLE will work to make the following additions or improvements both as part of the CPRG Program and upon MHCP implementation holistically.

- Incorporate natural and working lands sectors into relevant components of the CCAP.
- Increase meaningful engagement across the state by better incorporating equity and accessibility into future community engagements.
- Ensure tribes are included in outreach for PCAP and CCAP related programs and projects that are located near tribal lands. Outreach will include, but not be limited to:
    - Continuing to meet and collaborate with tribes and tribal consortiums on implementing PCAPs and CCAPs.
    - Continuing to include EGLE's MHCP and CPRG updates at quarterly MTEG meetings.
    - Ensuring tribes are notified of funding opportunities that could assist in implementing PCAP and CCAP strategies.
- Improve upon the data in the GHG inventory by:
    - Sorting data into an Economic Sector GHG inventory approach,
    - Engaging communities for Michigan specific data collection (e.g., utilities) (to replace default state-specific data sources) for the following SIT modules: agriculture, wastewater, municipal solid waste, electricity consumption, and,
    - Developing a dynamic, open-source data visualization dashboard, updated regularly.

[57] Energy Policy Simulator

- Perform a deeper analysis related to LIDAC and statewide community benefits, using local partnerships and experts to create a more robust assessment of the effects air pollution, energy burden, jobs, and climate resilience have on communities and incorporate learnings into decision-making.
- Continue to expand the funding opportunities assessment to holistically understand the streams of funding flowing to what industry sectors for what projects and programs.
- Further examine the existing and required workforce planning activities across the state beginning with overarching estimates in each industry sector, existing programs and planning activities, specific opportunities for LIDAC workers, and additional programs required to ensure a sufficient workforce is equipped to realize MHCP goals and a just transition.
- Perform a scenario analysis across reduction measures to estimate the complex nature of how initiatives interact with one another. Institute conservative, moderate, and aggressive estimates to deepen understanding of a range of possibilities along the timeline to 2050.

This Priority Climate Action Plan embodies Michigan's urgent response to the escalating challenges of climate change, echoing the urgent call to action outlined in the MI Healthy Climate Plan. As climate-related impacts increasingly affect Michiganders, failure to act decisively will exacerbate existing disparities and environmental injustices. However, by embracing the PCAP's strategic measures, including immediate actions to achieve a 52% reduction in greenhouse gas emissions by 2030 and laying the groundwork for full decarbonization by 2050, Michigan can seize a transformative opportunity. Oversight and implementation of the PCAP by the Office of Climate and Energy within EGLE, supported by advisory bodies and transparent reporting mechanisms, will ensure accountability and progress toward our shared goals. Through resolute leadership, inclusive participation, and collaboration among all parties involved, we can build a more equitable, healthy, prosperous, and sustainable future for all Michiganders.

APPENDIX A: GHG INVENTORY DETAILED TABLES

Appendix Table 1:
Summary of GHG Emissions for Michigan by Inventory Sector ($MMTCO_2E$)

Inventory Sector ($MMTCO_2E$)	2005	2019	% of Gross Emissions (2019)	% Change (2005 to 2019)
Energy	190.42	161.94	87.21%	-15%
CO_2 from Fossil Fuel Combustion	186.89	154.24	83.06%	-17%
Stationary Combustion	0.85	0.81	0.43%	-6%
Mobile Combustion	1.36	0.61	0.33%	-56%
Coal Mining	0.00	0.00	0.00%	-
Natural Gas and Oil Systems	1.31	6.29	3.39%	381%
Industrial Processes	11.36	11.08	5.97%	-2%
Agriculture	6.55	8.05	4.33%	23%
Waste	9.77	4.62	2.49%	-53%
Municipal Solid Waste	8.78	3.62	1.95%	-59%
Wastewater	0.99	1.01	0.54%	1%
Gross Emissions	218.10	185.69	-	-15%
Sinks (LULUCF)	-19.63	-18.96	10.21%	-3%
Net Emissions	**198.47**	**166.73**	-	**-16%**

Appendix Table 2:
Total GHG Emissions for Michigan by Greenhouse Gas in 2005 and 2019

Emissions ($MMTCO_2E$)	2005	2019	% of Gross Emissions (2019)	% Change (2005 to 2019)
Gross CO_2	194.61	160.99	88.86%	-17%
CO_2 from Fossil Fuel Combustion	186.89	154.24	85.14%	-17%
Industrial Processes	7.07	6.18	3.41%	-13%
Waste	0.61	0.54	0.30%	-12%
Agriculture	0.04	0.03	0.01%	-28%
Sinks (LULUCF)	-19.73	-19.05	-11%	-3%
Net CO_2*	*174.89*	*141.93*	*78%*	*-19%*
CH_4	13.07	13.59	7.50%	4%
Stationary Combustion	0.42	0.50	0.28%	19%
Mobile Combustion	0.13	0.09	0.05%	-33%
Coal Mining	0.00	0.00	0.00%	-
Natural Gas and Oil Systems	1.31	6.29	3.47%	381%
Agriculture	2.34	2.91	1.61%	24%
Waste	8.15	3.07	1.69%	-62%
Wastewater	0.72	0.74	0.41%	3%
N_2O	2.46	1.69	0.93%	-31%
Stationary Combustion	0.43	0.30	0.17%	-30%
Mobile Combustion	1.24	0.52	0.29%	-58%
Industrial Processes	0.00	0.00	0.00%	-
Agriculture	0.42	0.49	0.27%	18%
Waste	0.01	0.01	0.00%	-27%
Wastewater	0.27	0.27	0.15%	-2%
F-Gases	4.29	4.90	2.70%	14%
Industrial Processes	4.29	4.90	2.70%	14%
Gross Emissions	**214.44**	**181.16**	**-**	**-16%**
Net Emissions (Sources and Sinks)	**194.71**	**162.11**	**-**	**-17%**

** Carbon dioxide sinks in the environment are categorized under land-use, land-use change and forestry thus, are subtracted from Gross CO_2 emissions. Net CO_2 = gross CO_2 emissions - sinks. NOTE: Dashes signify that the value is not counted. Coal mining production in the State of Michigan stopped by 1952, therefore, no emissions are accounted for.*

Appendix Table 3: Indirect CO2 from Electricity Consumption by End-Use Sector with Detailed Uses ($MMTCO_2E$)

End-Use Sector	2005	2019	% Change (2005 to 2019)
Residential	23.58	16.23	-31%
Space Heating	1.28	2.51	96%
Air-conditioning	3.59	1.80	-50%
Water Heating	1.88	1.93	3%
Refrigeration	3.16	1.29	-59%
Other Appliances and Lighting	13.67	8.69	-36%
Commercial	25.87	18.34	-29%
Space Heating	1.45	0.52	-64%
Cooling	2.10	2.06	-2%
Ventilation	3.69	3.02	-18%
Water Heating	0.37	0.07	-80%
Lighting	8.94	3.39	-62%
Cooking	0.33	0.52	55%
Refrigeration	3.17	2.73	-14%
Office Equipment	0.66	0.74	12%
Computers	1.47	1.69	15%
Other	3.70	3.61	-2%
Industrial	22.70	14.48	-36%
Indirect Uses-Boiler Fuel	0.22	0.22	3%
Conventional Boiler Use	0.21	0.22	7%
CHP and/or Cogeneration Process	0.01	0.00	-100%
Direct Uses-Total Process	17.87	11.57	-35%
Process Heating	3.08	1.63	-47%
Process Cooling and Refrigeration	1.56	1.19	-24%
Machine Drive	11.93	7.42	-38%
Electro-Chemical Processes	1.05	0.98	-6%
Other Process Use	0.25	0.35	39%
Direct Uses-Total Nonprocess	4.36	2.51	-42%
Facility HVAC	2.03	1.18	-42%
Facility Lighting	1.77	0.95	-46%
Other Facility Support	0.47	0.26	-45%
Onsite Transportation	0.06	0.09	48%
Other Nonprocess Use	0.03	0.03	-11%
Other	0.25	0.17	-32%
Transportation	0.003	0.003	-4%

End-Use Sector	2005	2019	% Change (2005 to 2019)
Automated Guideway	0.003	0.002	-39%
Bus (charged batteries)	0	0	-
Cable Car	0	0	-
Commuter Rail	0	0	-
Heavy Rail	0	0	-
Inclined Plane	0	0	-
Light Rail	0	0	-
Trolleybus	0	0	-
Other	0	0.001	-
TOTAL	**72.16**	**49.05**	-32%
Residential	23.58	16.23	-31%
Commercial	25.87	18.34	-29%
Industrial	22.70	14.48	-36%
Transportation	0.003	0.003	-4%

Comparison of Michigan's 2024 Inventory using EPA's SIT and the EPA's annual Inventory of U.S. Greenhouse Gas Emissions and Sinks and the Inventory of U.S. Greenhouse Gas Emissions and Sinks by State

Appendix Table 4:
Difference between Michigan's 2024 Inventory and EPA's Annual Inventories*

Inventory Sector ($MMTCO_2E$)	2005 (SIT)	2005 (EPA Annual Inventories)	Difference between SIT and EPA Annual Inventories (2005)	2019 (SIT)	2019 (EPA Annual Inventories)	Difference between SIT and EPA Annual Inventories (2019)
Energy	190.418	196.408	-5.991	161.935	158.805	3.131
Industrial Processes	11.363	12.988	-1.626	11.080	14.055	-2.975
Agriculture	6.548	8.523	-1.975	8.047	10.769	-2.722
Waste	9.771	9.974	-0.203	4.624	7.005	-2.381
Gross Emissions	218.100	227.166	-9.067	185.687	190.549	-4.862
Sinks (LULUCF)	-19.633	-15.785	-3.848	-18.958	-15.263	-3.695
Net Emissions	198.467	212.109	-13.643	166.729	175.371	-8.642

**2024 Inventory uses EPA's SIT and EPA's Annual Inventories include the Inventory of U.S. Greenhouse Gas Emissions and Sinks and the Inventory of U.S. Greenhouse Gas Emissions and Sinks by State*[1]

[1] EPA Greenhouse Gas Inventory Data Explorer

APPENDIX B: SUMMARY TABLE OF PRIORITY REDUCTION MEASURES

The below table describes the associated emission reduction quantification and review of authority to implement for each priority reduction measure described in Section 5. Priority Reduction Measures by Key Sector.

ID	Key Sector	Priority Reduction Measure	Estimated Emissions Reductions		
			Annual near-term average	Between 2024 – 2030	Between 2024 – 2030
1	Electricity Generation	Drive clean energy deployment including improving siting for renewable energy and energy storage across Michigan, including on brownfields and former industrial sites and emphasizing equitable access for Michigan's LIDACs.	1.640	20.856	42.651
2	Electricity Generation	Invest in energy storage and necessary electric grid investments to enable earlier coal plant retirements and better integrate renewable energy into the electric grid.	2.794	16.762	23.593
3	Commercial and Residential Buildings	Drive building electrification and fuel-switching in existing buildings including an emphasis on LIDACs and electrifying households that currently rely on delivered fuels such as propane and home heating oil.	1.047	6.280	25.808
4	Commercial and Residential Buildings	Reduce household fossil energy use through home repairs, electrical upgrades for building and vehicle electrification, weatherization, and other energy waste reduction investments with an emphasis on ensuring equitable access.	1.260	7.562	24.463

ID	Key Sector	Priority Reduction Measure	Estimated Emissions Reductions		
			Annual near-term average	Between 2024 – 2030	Between 2024 – 2030
5	Commercial and Residential Buildings	Decarbonize government and nonprofit facilities and infrastructure, with an emphasis on LIDACs, by reducing energy waste, investing in decarbonization solutions, and reducing emissions from fossil fuel combustion.	0.050	0.251	0.502
6	Transportation	Electrify state government, municipal, tribal, and other public fleets, prioritizing equitable access for Michigan's LIDACs.	0.285	1.519	7.571
7	Transportation	Support just access to public transit and non-motorized transportation options by improving infrastructure, and by increasing routes, frequency, and reliability of available options.	1.162	7.000	12.018
8	Transportation	Encourage adoption of electric vehicles by increasing deployment of electric vehicle charging infrastructure, prioritizing equitable access for Michigan's LIDACs.	0.509	3.052	12.646
9	Industry	Encourage industrial innovation to advance energy efficiency, fuel-switching, and deployment of cleaner manufacturing technologies prioritizing facilities in LIDACs that may receive significant benefits from reduced industrial sector emissions.	0.597	5.887	15.529
10	Industry	Reduce methane emissions from various sources, including but not limited to food waste, organics diversion, and wastewater treatment facilities with a focus on methane reduction strategies that will bring significant benefits for LIDACs.	0.858	5.147	13.827

APPENDIX C: CEJST CENSUS TRACTS

According to the EPA, low income and disadvantaged communities includes census tracts included in the Climate and Economic Justice Screening Tool (CEJST), census blocks above 90th national percentile in EJScreen Supplemental Indexes, or geographic areas within tribal lands (as included in EJScreen). Below are the **996 census tracts** which fall under one, or all, of these definitions as of 2010 Census.

County Name	Census tract 2010 ID
Alcona County	26001970100
Alcona County	26001970400
Alcona County	26001970500
Alcona County	26001970600
Alger County	26003000100
Allegan County	26005031000
Allegan County	26005031200
Alpena County	26007000100
Alpena County	26007000400
Alpena County	26007000500
Alpena County	26007000700
Alpena County	26007000800
Antrim County	26009960200
Antrim County	26009960700
Arenac County	26011970100
Arenac County	26011970200
Arenac County	26011970300
Arenac County	26011970400
Arenac County	26011970500
Baraga County	26013000100
Baraga County	26013000200
Bay County	26017280300
Bay County	26017280400
Bay County	26017280600
Bay County	26017280700
Bay County	26017280900
Bay County	26017281300
Bay County	26017285202
Bay County	26017285800
Bay County	26017286500
Bay County	26017286600

County Name	Census tract 2010 ID
Berrien County	26021000300
Berrien County	26021000400
Berrien County	26021000500
Berrien County	26021000600
Berrien County	26021002000
Berrien County	26021002100
Berrien County	26021002200
Berrien County	26021002300
Berrien County	26021002500
Berrien County	26021020200
Berrien County	26021020500
Berrien County	26021020600
Berrien County	26021020700
Berrien County	26021020900
Branch County	26023950200
Branch County	26023950800
Branch County	26023951200
Branch County	26023951400
Branch County	26023951600
Calhoun County	26025000200
Calhoun County	26025000300
Calhoun County	26025000500
Calhoun County	26025000600
Calhoun County	26025000700
Calhoun County	26025000800
Calhoun County	26025001000
Calhoun County	26025001100
Calhoun County	26025001300
Calhoun County	26025001400
Calhoun County	26025002100
Calhoun County	26025002600

County Name	Census tract 2010 ID
Calhoun County	26025002800
Calhoun County	26025003100
Calhoun County	26025003300
Calhoun County	26025003600
Calhoun County	26025004000
Calhoun County	26025004100
Cass County	26027002000
Cass County	26027002100
Charlevoix County	26029000200
Charlevoix County	26029001500
Cheboygan County	26031960200
Cheboygan County	26031960300
Cheboygan County	26031960700
Cheboygan County	26031960800
Chippewa County	26033970200
Chippewa County	26033970400
Chippewa County	26033970500
Chippewa County	26033970700
Chippewa County	26033970900
Chippewa County	26033980200
Chippewa County	26033980300
Clare County	26035000100
Clare County	26035000200
Clare County	26035000300
Clare County	26035000400
Clare County	26035000500
Clare County	26035000600
Clare County	26035000800
Clare County	26035000900
Clare County	26035001000
Clare County	26035001300
Clinton County	26037010203
Clinton County	26037010702
Clinton County	26037010901
Crawford County	26039960300
Crawford County	26039960400
Crawford County	26039960500
Delta County	26041970100

County Name	Census tract 2010 ID
Delta County	26041970800
Delta County	26041971000
Dickinson County	26043950500
Eaton County	26045020202
Eaton County	26045020901
Emmet County	26047970100
Emmet County	26047970800
Genesee County	26049000100
Genesee County	26049000200
Genesee County	26049000300
Genesee County	26049000400
Genesee County	26049000500
Genesee County	26049000600
Genesee County	26049000700
Genesee County	26049000800
Genesee County	26049000900
Genesee County	26049001000
Genesee County	26049001100
Genesee County	26049001200
Genesee County	26049001300
Genesee County	26049001400
Genesee County	26049001500
Genesee County	26049001600
Genesee County	26049001700
Genesee County	26049001800
Genesee County	26049001900
Genesee County	26049002000
Genesee County	26049002200
Genesee County	26049002300
Genesee County	26049002400
Genesee County	26049002600
Genesee County	26049002700
Genesee County	26049002800
Genesee County	26049002900
Genesee County	26049003100
Genesee County	26049003200
Genesee County	26049003300
Genesee County	26049003400

County Name	Census tract 2010 ID
Genesee County	26049003500
Genesee County	26049003600
Genesee County	26049003700
Genesee County	26049003800
Genesee County	26049004000
Genesee County	26049010110
Genesee County	26049010113
Genesee County	26049010115
Genesee County	26049010304
Genesee County	26049010305
Genesee County	26049010501
Genesee County	26049010502
Genesee County	26049010504
Genesee County	26049010811
Genesee County	26049010812
Genesee County	26049010910
Genesee County	26049010911
Genesee County	26049010912
Genesee County	26049011301
Genesee County	26049011302
Genesee County	26049011401
Genesee County	26049011508
Genesee County	26049011901
Genesee County	26049012003
Genesee County	26049012006
Genesee County	26049012007
Genesee County	26049012008
Genesee County	26049012100
Genesee County	26049012201
Genesee County	26049012202
Genesee County	26049012310
Genesee County	26049012311
Genesee County	26049012501
Genesee County	26049012503
Genesee County	26049012601
Genesee County	26049012602
Genesee County	26049013500
Genesee County	26049013600

County Name	Census tract 2010 ID
Gladwin County	26051000100
Gladwin County	26051000300
Gladwin County	26051000400
Gladwin County	26051000500
Gladwin County	26051000600
Gladwin County	26051000700
Gladwin County	26051000800
Gogebic County	26053950100
Gogebic County	26053950200
Gogebic County	26053950500
Gogebic County	26053950600
Gratiot County	26057000300
Gratiot County	26057000400
Gratiot County	26057000700
Gratiot County	26057001000
Hillsdale County	26059050200
Hillsdale County	26059050400
Hillsdale County	26059050600
Hillsdale County	26059050700
Hillsdale County	26059050800
Hillsdale County	26059051100
Hillsdale County	26059051200
Houghton County	26061000100
Houghton County	26061000200
Houghton County	26061000300
Houghton County	26061000400
Houghton County	26061000700
Huron County	26063950300
Huron County	26063950600
Huron County	26063951000
Huron County	26063951200
Ingham County	26065000100
Ingham County	26065000600
Ingham County	26065000700
Ingham County	26065000800
Ingham County	26065001200
Ingham County	26065001703
Ingham County	26065002000

County Name	Census tract 2010 ID
Ingham County	26065002101
Ingham County	26065002600
Ingham County	26065002800
Ingham County	26065003200
Ingham County	26065003301
Ingham County	26065003500
Ingham County	26065003602
Ingham County	26065003700
Ingham County	26065004302
Ingham County	26065005100
Ingham County	26065005201
Ingham County	26065005304
Ingham County	26065005402
Ingham County	26065006500
Ingham County	26065006600
Ingham County	26065006700
Ingham County	26065006800
Ionia County	26067030200
Ionia County	26067030300
Ionia County	26067031700
Ionia County	26067032100
Iosco County	26069000100
Iosco County	26069000300
Iosco County	26069000400
Iosco County	26069000500
Iosco County	26069000600
Iosco County	26069000700
Iosco County	26069000800
Iosco County	26069000900
Iron County	26071000300
Iron County	26071000400
Iron County	26071000500
Isabella County	26073000100
Isabella County	26073940100
Isabella County	26073940200
Isabella County	26073940400
Isabella County	26073940500
Isabella County	26073940600

County Name	Census tract 2010 ID
Jackson County	26075000100
Jackson County	26075000200
Jackson County	26075000400
Jackson County	26075000500
Jackson County	26075000600
Jackson County	26075000900
Jackson County	26075001000
Jackson County	26075001100
Jackson County	26075001200
Jackson County	26075001300
Jackson County	26075005000
Jackson County	26075005100
Jackson County	26075005500
Jackson County	26075005800
Jackson County	26075005900
Jackson County	26075006000
Jackson County	26075006900
Kalamazoo County	26077000100
Kalamazoo County	26077000201
Kalamazoo County	26077000202
Kalamazoo County	26077000300
Kalamazoo County	26077000600
Kalamazoo County	26077000900
Kalamazoo County	26077001000
Kalamazoo County	26077001100
Kalamazoo County	26077001504
Kalamazoo County	26077001507
Kalamazoo County	26077001702
Kalamazoo County	26077001803
Kalamazoo County	26077002201
Kalamazoo County	26077002903
Kalamazoo County	26077005501
Kalkaska County	26079950200
Kalkaska County	26079950400
Kalkaska County	26079950601
Kalkaska County	26079950602
Kent County	26081000800
Kent County	26081000900

County Name	Census tract 2010 ID
Kent County	26081001000
Kent County	26081001101
Kent County	26081001300
Kent County	26081001500
Kent County	26081001600
Kent County	26081001900
Kent County	26081002000
Kent County	26081002200
Kent County	26081002600
Kent County	26081002800
Kent County	26081003000
Kent County	26081003100
Kent County	26081003200
Kent County	26081003500
Kent County	26081003600
Kent County	26081003700
Kent County	26081003800
Kent County	26081003900
Kent County	26081004000
Kent County	26081004200
Kent County	26081004600
Kent County	26081010301
Kent County	26081010402
Kent County	26081011406
Kent County	26081012606
Kent County	26081012607
Kent County	26081012701
Kent County	26081012901
Kent County	26081013300
Kent County	26081013400
Kent County	26081013500
Kent County	26081013600
Kent County	26081013802
Kent County	26081014000
Kent County	26081014100
Kent County	26081014200
Kent County	26081014300
Kent County	26081014701

County Name	Census tract 2010 ID
Lake County	26085960100
Lake County	26085961100
Lake County	26085961200
Lake County	26085961300
Lapeer County	26087331000
Lapeer County	26087336500
Lapeer County	26087337500
Lapeer County	26087339500
Lenawee County	26091061301
Lenawee County	26091061302
Lenawee County	26091061400
Lenawee County	26091061600
Lenawee County	26091061800
Lenawee County	26091061900
Livingston County	26093722300
Livingston County	26093725100
Livingston County	26093742202
Mackinac County	26097950200
Mackinac County	26097950300
Mackinac County	26097950400
Mackinac County	26097950500
Macomb County	26099206700
Macomb County	26099222101
Macomb County	26099228100
Macomb County	26099230500
Macomb County	26099231400
Macomb County	26099231500
Macomb County	26099231600
Macomb County	26099231900
Macomb County	26099232300
Macomb County	26099232400
Macomb County	26099240000
Macomb County	26099241000
Macomb County	26099241200
Macomb County	26099241600
Macomb County	26099241700
Macomb County	26099245000
Macomb County	26099245100

County Name	Census tract 2010 ID
Macomb County	26099245200
Macomb County	26099245400
Macomb County	26099247100
Macomb County	26099247601
Macomb County	26099255300
Macomb County	26099255800
Macomb County	26099255900
Macomb County	26099256100
Macomb County	26099256500
Macomb County	26099256600
Macomb County	26099256700
Macomb County	26099256800
Macomb County	26099258200
Macomb County	26099258400
Macomb County	26099258600
Macomb County	26099258700
Macomb County	26099258800
Macomb County	26099258900
Macomb County	26099260100
Macomb County	26099260600
Macomb County	26099260800
Macomb County	26099262100
Macomb County	26099262300
Macomb County	26099262400
Macomb County	26099262500
Macomb County	26099262800
Macomb County	26099262900
Macomb County	26099263200
Macomb County	26099263400
Macomb County	26099263500
Macomb County	26099263600
Macomb County	26099263700
Macomb County	26099263800
Macomb County	26099263900
Macomb County	26099264000
Macomb County	26099264200
Macomb County	26099268100
Macomb County	26099268300

County Name	Census tract 2010 ID
Macomb County	26099268400
Macomb County	26099982200
Macomb County	26099982300
Manistee County	26101000100
Manistee County	26101000500
Manistee County	26101000600
Marquette County	26103000500
Marquette County	26103001900
Marquette County	26103002400
Mason County	26105950100
Mason County	26105950400
Mason County	26105950500
Mason County	26105950700
Mecosta County	26107960100
Mecosta County	26107960200
Mecosta County	26107960400
Mecosta County	26107960500
Mecosta County	26107960800
Mecosta County	26107960900
Mecosta County	26107961000
Menominee County	26109960100
Menominee County	26109960200
Menominee County	26109960300
Menominee County	26109960700
Midland County	26111290200
Midland County	26111290600
Midland County	26111291500
Midland County	26111291700
Missaukee County	26113960100
Missaukee County	26113960200
Missaukee County	26113960300
Missaukee County	26113960400
Monroe County	26115831200
Monroe County	26115831400
Monroe County	26115831800
Monroe County	26115831900
Monroe County	26115832100
Monroe County	26115832200

County Name	Census tract 2010 ID
Montcalm County	26117970200
Montcalm County	26117970300
Montcalm County	26117970400
Montcalm County	26117970800
Montcalm County	26117970900
Montcalm County	26117971000
Montmorency County	26119910100
Montmorency County	26119910200
Montmorency County	26119910300
Montmorency County	26119910400
Montmorency County	26119910500
Muskegon County	26121000300
Muskegon County	26121000401
Muskegon County	26121000402
Muskegon County	26121000500
Muskegon County	26121000601
Muskegon County	26121000800
Muskegon County	26121001200
Muskegon County	26121001300
Muskegon County	26121001402
Muskegon County	26121001902
Muskegon County	26121002000
Muskegon County	26121002100
Muskegon County	26121002601
Muskegon County	26121003100
Muskegon County	26121003200
Muskegon County	26121003300
Muskegon County	26121004200
Muskegon County	26121004300
Newaygo County	26123970100
Newaygo County	26123970300
Newaygo County	26123970500
Newaygo County	26123970700
Newaygo County	26123970800
Newaygo County	26123970900
Oakland County	26125135000
Oakland County	26125140900
Oakland County	26125141000

County Name	Census tract 2010 ID
Oakland County	26125141100
Oakland County	26125141200
Oakland County	26125141300
Oakland County	26125141400
Oakland County	26125141500
Oakland County	26125141600
Oakland County	26125141700
Oakland County	26125142000
Oakland County	26125142100
Oakland County	26125142200
Oakland County	26125142300
Oakland County	26125142400
Oakland County	26125142600
Oakland County	26125142700
Oakland County	26125144701
Oakland County	26125160300
Oakland County	26125160400
Oakland County	26125161400
Oakland County	26125162400
Oakland County	26125171300
Oakland County	26125171500
Oakland County	26125171600
Oakland County	26125172400
Oakland County	26125172500
Oakland County	26125175100
Oakland County	26125175200
Oakland County	26125175300
Oakland County	26125181000
Oakland County	26125181300
Oakland County	26125181600
Oakland County	26125198100
Oceana County	26127010300
Oceana County	26127010400
Oceana County	26127010500
Oceana County	26127010600
Ogemaw County	26129950100
Ogemaw County	26129950300
Ogemaw County	26129950400

County Name	Census tract 2010 ID
Ogemaw County	26129950500
Ogemaw County	26129950600
Ogemaw County	26129950900
Ontonagon County	26131970100
Ontonagon County	26131970200
Osceola County	26133970100
Osceola County	26133970200
Osceola County	26133970300
Osceola County	26133970400
Osceola County	26133970500
Oscoda County	26135970201
Oscoda County	26135970300
Oscoda County	26135970400
Oscoda County	26135970500
Presque Isle County	26141950200
Presque Isle County	26141950300
Presque Isle County	26141950400
Roscommon County	26143970100
Roscommon County	26143970200
Roscommon County	26143970300
Roscommon County	26143970500
Roscommon County	26143971000
Roscommon County	26143971100
Roscommon County	26143971200
Saginaw County	26145000100
Saginaw County	26145000200
Saginaw County	26145000400
Saginaw County	26145000600
Saginaw County	26145000700
Saginaw County	26145000800
Saginaw County	26145000900
Saginaw County	26145001000
Saginaw County	26145001100
Saginaw County	26145001200
Saginaw County	26145001300
Saginaw County	26145001400
Saginaw County	26145001500
Saginaw County	26145001600

County Name	Census tract 2010 ID
Saginaw County	26145001700
Saginaw County	26145001800
Saginaw County	26145001900
Saginaw County	26145002000
Saginaw County	26145002100
Saginaw County	26145010401
Saginaw County	26145010700
Saginaw County	26145011000
Saginaw County	26145011100
Saginaw County	26145011500
Saginaw County	26145011600
Saginaw County	26145011800
Saginaw County	26145012500
Saginaw County	26145012600
Sanilac County	26151970200
Sanilac County	26151970300
Sanilac County	26151970400
Sanilac County	26151970500
Sanilac County	26151970700
Sanilac County	26151970900
Sanilac County	26151971000
Sanilac County	26151971100
Sanilac County	26151971200
Schoolcraft County	26153000300
Shiawassee County	26155030500
Shiawassee County	26155030600
Shiawassee County	26155030700
Shiawassee County	26155030800
St. Clair County	26147620000
St. Clair County	26147621000
St. Clair County	26147622000
St. Clair County	26147623000
St. Clair County	26147624000
St. Clair County	26147625000
St. Clair County	26147626000
St. Clair County	26147628000
St. Clair County	26147629000
St. Clair County	26147634100

County Name	Census tract 2010 ID
St. Clair County	26147636000
St. Clair County	26147657100
St. Joseph County	26149040200
St. Joseph County	26149040400
St. Joseph County	26149040500
St. Joseph County	26149040600
St. Joseph County	26149040700
St. Joseph County	26149040800
St. Joseph County	26149041000
St. Joseph County	26149041200
Tuscola County	26157000600
Tuscola County	26157000700
Tuscola County	26157000900
Tuscola County	26157001000
Tuscola County	26157001100
Van Buren County	26159010200
Van Buren County	26159010400
Van Buren County	26159010500
Van Buren County	26159010600
Van Buren County	26159011300
Van Buren County	26159011400
Van Buren County	26159012000
Washtenaw County	26161400200
Washtenaw County	26161404200
Washtenaw County	26161407400
Washtenaw County	26161410100
Washtenaw County	26161410600
Washtenaw County	26161410700
Washtenaw County	26161410800
Washtenaw County	26161411900
Washtenaw County	26161412000
Washtenaw County	26161412100
Washtenaw County	26161412300
Washtenaw County	26161422900
Wayne County	26163500100
Wayne County	26163500200
Wayne County	26163500300
Wayne County	26163500400

County Name	Census tract 2010 ID
Wayne County	26163500500
Wayne County	26163500600
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County Name	Census tract 2010 ID
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County Name	Census tract 2010 ID
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County Name	Census tract 2010 ID
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County Name	Census tract 2010 ID
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County Name	Census tract 2010 ID
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County Name	Census tract 2010 ID
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County Name	Census tract 2010 ID
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County Name	Census tract 2010 ID
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Wayne County	26163588100
Wayne County	26163591501
Wexford County	26165380100
Wexford County	26165380200
Wexford County	26165380300
Wexford County	26165380600
Wexford County	26165380700
Wexford County	26165380800

MINNESOTA POLLUTION CONTROL AGENCY

520 Lafayette Road North | St. Paul, Minnesota 55155-4194 | 651-296-6300

800-657-3864 | Use your preferred relay service | info.pca@state.mn.us | Equal Opportunity Employer

March 13, 2024

Electronic Submission via EPA Portal

Administrator Michael Regan
U.S. Environmental Protection Agency
1200 Pennsylvania Ave NW
Washington, DC 20004

RE: Letter of Intent to Sign Coalition Memorandum of Agreement for Midwest Industrial Decarbonization Challenge (NOFO EPA-R-OAR-CPRGI-23-07)

Dear Administrator Regan:

The Minnesota Pollution Control Agency submits this letter of support for the State of Michigan's coalition application entitled "Midwest Industrial Decarbonization Challenge" in response to the U.S. Environmental Protection Agency's Notice of Funding Opportunity (NOFO) No. EPA-R-OAR-CPRGI-23-07. As required by the NOFO, as a member of the coalition, we intend to enter into a Memorandum of Agreement (MOA) with the Michigan Department of Environment, Great Lakes & Energy (EGLE) and the other members of the coalition that sets forth the specific roles and responsibilities of each partner agency as well as the other information called for by the NOFO. The EGLE expects to submit this MOA no later than July 1, 2024.

Minnesota's Climate Action Framework, published in 2022 establishes a vision for climate action that will make Minnesota carbon-neutral, resilient, and equitable. These three co-equal pillars of Minnesota's Framework guide our collaborative climate work. Our Priority Climate Action Plan was built off that foundation. Michigan similarly published its Healthy Climate Plan in 2022. Our plans align our two states with many shared goals for equitable climate action that supports a robust clean economy. This proposal connects strongly with the ambitions in those documents to be national leaders in collaborative climate action.

The proposed greenhouse gas (GHG) reduction measures will achieve significant cumulative GHG reductions, provide substantial community benefits in low-income and disadvantaged communities, and complement other funding sources to maximize both GHG reductions and community benefits. The State of Michigan, through the Office of Climate and Energy, has a commendable track record of effectively using state and federal grants while actively engaging with low-income and disadvantaged communities.

Given our shared goals and proven success in implementing equitable climate policies, we have full confidence in Michigan's ability to lead the development of the Midwest Industrial Decarbonization Challenge and achieve the objectives laid out in the application. These objectives include emissions reduction and mobilizing financing and private capital to address barriers to implementing clean and innovative industrial processes. Furthermore, this initiative will stimulate increased investment in clean industrial projects critical to achieving the state's climate objectives, particularly within historically underinvested communities facing longstanding challenges.

Michigan's proposal will strengthen regional collaboration to address climate change and further develop the Midwest's clean economy leadership. We are excited about the opportunity to significantly reduce GHG emissions and demonstrate new technology while also prioritizing the reduction of co-pollutants and supporting healthy communities in Minnesota and beyond.

We are pleased to join EGLE and our other regional partners in this coalition application and thank you for your consideration.

Sincerely,

Katrina Kessler

This document has been electronically signed.

Katrina Kessler, P.E.
Commissioner

KK/AJS:kj/rjp

Ohio Environmental Protection Agency

EPA.Ohio.gov

Mike DeWine, *Governor* Jon Husted, *Lt. Governor* Anne M. Vogel, *Director*

March 15, 2024

Hon. Michael Regan
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, DC 20004

Subject: Letter of Intent to Sign Coalition Memorandum of Agreement for
Midwest Industrial Decarbonization Challenge (NOFO EPA-R-OAR-CPRGI-23-07)

Dear Administrator Regan,

The Ohio Environmental Protection Agency submits this letter of support for the State of Michigan's coalition application entitled "Midwest Industrial Decarbonization Challenge" in response to EPA's Notice of Funding Opportunity (NOFO) No. EPA-R-OAR-CPRGI-23-07. As required by the NOFO, as a member of the coalition we intend to enter into a Memorandum of Agreement (MOA) with the Michigan Department of Environment, Great Lakes & Energy (EGLE) and the other members of the coalition that sets forth the specific roles and responsibilities of each partner agency as well as the other information called for by the NOFO. EGLE expects to submit this MOA no later than July 1, 2024.

We are pleased to join EGLE in this coalition application and thank you for your consideration.

Sincerely,

Anne M. Vogel
Director, Ohio EPA

STATE OF WISCONSIN
DEPARTMENT OF ADMINISTRATION
Tony Evers, Governor
Kathy Blumenfeld, Secretary
David Pawlisch, Division Administrator

March 18, 2024

Hon. Michael Regan
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, DC 20004

Subject: Letter of Intent to Sign Coalition Memoranda of Agreement for Midwest Industrial Decarbonization Challenge (NOFO EPA-R-OAR-CPRGI-23-07)

Dear Administrator Regan:

The Wisconsin Department of Administration, Office of Sustainability and Clean Energy submits this letter of support for the State of Michigan's coalition application entitled "Midwest Industrial Decarbonization Challenge" in response to the US Environmental Protection Agency's Notice of Funding Opportunity (NOFO) No. EPA-R-OAR-CPRGI-23-07. As required by the NOFO, as a member of the coalition we intend to enter into a Memoranda of Agreement with the Michigan Department of Environment, Great Lakes, and Energy (EGLE), along with other members of the coalition, that sets forth the specific roles and responsibilities of each partner agency as well as the other information called for by the NOFO. EGLE expects to submit this MOA no later than July 1, 2024.

We are pleased to join EGLE in this coalition application and thank you for your consideration.

Sincerely,

Maria Redmond
Wisconsin Department of Administration
Office of Sustainability and Clean Energy

Disadvantaged CT	County	State
26001970100	Alcona County	Michigan
26001970400	Alcona County	Michigan
26001970500	Alcona County	Michigan
26001970600	Alcona County	Michigan
26003000100	Alger County	Michigan
26005031000	Allegan County	Michigan
26005031200	Allegan County	Michigan
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26021020600	Berrien County	Michigan
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26023950200	Branch County	Michigan
26023950800	Branch County	Michigan

Source: CEJST Communities List

26023951200	Branch County	Michigan
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26023951600	Branch County	Michigan
26025000200	Calhoun County	Michigan
26025000300	Calhoun County	Michigan
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Source: CEJST Communities List

Disadvantaged CT	County	State
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17001000500	Adams County	Illinois
17001000700	Adams County	Illinois
17001000800	Adams County	Illinois
17003957600	Alexander Cour	Illinois
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17007010300	Boone County	Illinois
17013951200	Calhoun County	Illinois
17015960300	Carroll County	Illinois
17017960400	Cass County	Illinois
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17201004003 Winnebago Cou Illinois
17201980000 Winnebago Cou Illinois
17203030100 Woodford Cour Illinois

Disadvantaged CT	County	State
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27001770300	Aitkin County	Minnesota
27001770400	Aitkin County	Minnesota
27003050807	Anoka County	Minnesota
27003050901	Anoka County	Minnesota
27003051304	Anoka County	Minnesota
27003051501	Anoka County	Minnesota
27005450100	Becker County	Minnesota
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27005940000	Becker County	Minnesota
27007450500	Beltrami Count	Minnesota
27007450702	Beltrami Count	Minnesota
27007940001	Beltrami Count	Minnesota
27007940002	Beltrami Count	Minnesota
27011950300	Big Stone Coun	Minnesota
27013171202	Blue Earth Cou	Minnesota
27021940001	Cass County	Minnesota
27021940002	Cass County	Minnesota
27021960100	Cass County	Minnesota
27021960200	Cass County	Minnesota
27021960600	Cass County	Minnesota
27021960700	Cass County	Minnesota
27027020202	Clay County	Minnesota
27029000200	Clearwater Cou	Minnesota
27029000300	Clearwater Cou	Minnesota
27033270100	Cottonwood Cc	Minnesota
27033270400	Cottonwood Cc	Minnesota
27035951000	Crow Wing Cou	Minnesota
27035951100	Crow Wing Cou	Minnesota
27035951200	Crow Wing Cou	Minnesota
27037060105	Dakota County	Minnesota
27037060711	Dakota County	Minnesota
27045960500	Fillmore Count	Minnesota
27047180600	Freeborn Coun	Minnesota
27047180800	Freeborn Coun	Minnesota
27047180900	Freeborn Coun	Minnesota
27051070100	Grant County	Minnesota
27053000102	Hennepin Coun	Minnesota
27053001700	Hennepin Coun	Minnesota
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Source: CEJST Communities List

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27053980000	Hennepin Coun	Minnesota
27057070600	Hubbard Count	Minnesota
27061480100	Itasca County	Minnesota

27061940000	Itasca County	Minnesota
27067770900	Kandiyohi Coun	Minnesota
27067780500	Kandiyohi Coun	Minnesota
27067780800	Kandiyohi Coun	Minnesota
27069090100	Kittson County	Minnesota
27077460300	Lake of the Wo	Minnesota
27083360500	Lyon County	Minnesota
27083360700	Lyon County	Minnesota
27085950700	McLeod County	Minnesota
27087940100	Mahnomen Co	Minnesota
27087940300	Mahnomen Co	Minnesota
27091790600	Martin County	Minnesota
27095970100	Mille Lacs Coun	Minnesota
27095970200	Mille Lacs Coun	Minnesota
27097780100	Morrison Coun	Minnesota
27097780600	Morrison Coun	Minnesota
27099000100	Mower County	Minnesota
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27099000410	Mower County	Minnesota
27099000800	Mower County	Minnesota
27105105400	Nobles County	Minnesota
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27105105600	Nobles County	Minnesota
27109000100	Olmsted Count	Minnesota
27109000200	Olmsted Count	Minnesota
27109000300	Olmsted Count	Minnesota
27111960300	Otter Tail Coun	Minnesota
27111960500	Otter Tail Coun	Minnesota
27111960900	Otter Tail Coun	Minnesota
27111961300	Otter Tail Coun	Minnesota
27115950400	Pine County	Minnesota
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27119020200	Polk County	Minnesota
27119020700	Polk County	Minnesota
27123030400	Ramsey County	Minnesota
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27123040902	Ramsey County	Minnesota
27123042800	Ramsey County	Minnesota
27127750300	Redwood Coun	Minnesota
27131070800	Rice County	Minnesota
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27131070902	Rice County	Minnesota
27137001400	St. Louis County	Minnesota
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27137003700	St. Louis County	Minnesota
27137003800	St. Louis County	Minnesota
27137011200	St. Louis County	Minnesota
27137012200	St. Louis County	Minnesota
27137012400	St. Louis County	Minnesota
27137013000	St. Louis County	Minnesota
27137013100	St. Louis County	Minnesota
27137013800	St. Louis County	Minnesota
27137015600	St. Louis County	Minnesota
27139080400	Scott County	Minnesota
27145000302	Stearns County	Minnesota
27145000500	Stearns County	Minnesota

27145000801	Stearns County	Minnesota
27145011500	Stearns County	Minnesota
27147960400	Steele County	Minnesota
27151960200	Swift County	Minnesota
27151960400	Swift County	Minnesota
27153790100	Todd County	Minnesota
27153790200	Todd County	Minnesota
27153790300	Todd County	Minnesota
27153790600	Todd County	Minnesota
27159480300	Wadena Count	Minnesota
27161790500	Waseca County	Minnesota

Source: CEJST Communities List

Disadvantaged CT	County	State
39001770100	Adams County	Ohio
39001770200	Adams County	Ohio
39001770300	Adams County	Ohio
39001770400	Adams County	Ohio
39001770500	Adams County	Ohio
39001770600	Adams County	Ohio
39003012200	Allen County	Ohio
39003012300	Allen County	Ohio
39003012400	Allen County	Ohio
39003012600	Allen County	Ohio
39003012700	Allen County	Ohio
39003012900	Allen County	Ohio
39003013000	Allen County	Ohio
39003013200	Allen County	Ohio
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39003013600	Allen County	Ohio
39003013700	Allen County	Ohio
39003013800	Allen County	Ohio
39003014100	Allen County	Ohio
39005970200	Ashland County	Ohio
39005970300	Ashland County	Ohio
39005970400	Ashland County	Ohio
39005970500	Ashland County	Ohio
39005971100	Ashland County	Ohio
39007000102	Ashtabula Cour	Ohio
39007000103	Ashtabula Cour	Ohio
39007000400	Ashtabula Cour	Ohio
39007000500	Ashtabula Cour	Ohio
39007000601	Ashtabula Cour	Ohio
39007000603	Ashtabula Cour	Ohio
39007000701	Ashtabula Cour	Ohio
39007000703	Ashtabula Cour	Ohio
39007000704	Ashtabula Cour	Ohio
39007000801	Ashtabula Cour	Ohio
39007000900	Ashtabula Cour	Ohio
39007001200	Ashtabula Cour	Ohio
39007001301	Ashtabula Cour	Ohio
39007001302	Ashtabula Cour	Ohio
39007001400	Ashtabula Cour	Ohio
39009972600	Athens County	Ohio
39009972700	Athens County	Ohio
39009972800	Athens County	Ohio
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39009973500	Athens County	Ohio
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39013011500	Belmont Count	Ohio
39013011600	Belmont Count	Ohio
39013011700	Belmont Count	Ohio
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39013012000	Belmont Count	Ohio
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39015951400	Brown County	Ohio
39015951600	Brown County	Ohio
39015951700	Brown County	Ohio
39015951800	Brown County	Ohio
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39017014000	Butler County	Ohio
39017014100	Butler County	Ohio
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39017014600	Butler County	Ohio
39017014700	Butler County	Ohio
39019720200	Carroll County	Ohio
39021010400	Champaign Cou	Ohio
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39025041701	Clermont Coun	Ohio
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Source: CEJST Communities List

Disadvantaged CT	County	State
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55001950201	Adams County	Wisconsin
55001950700	Adams County	Wisconsin
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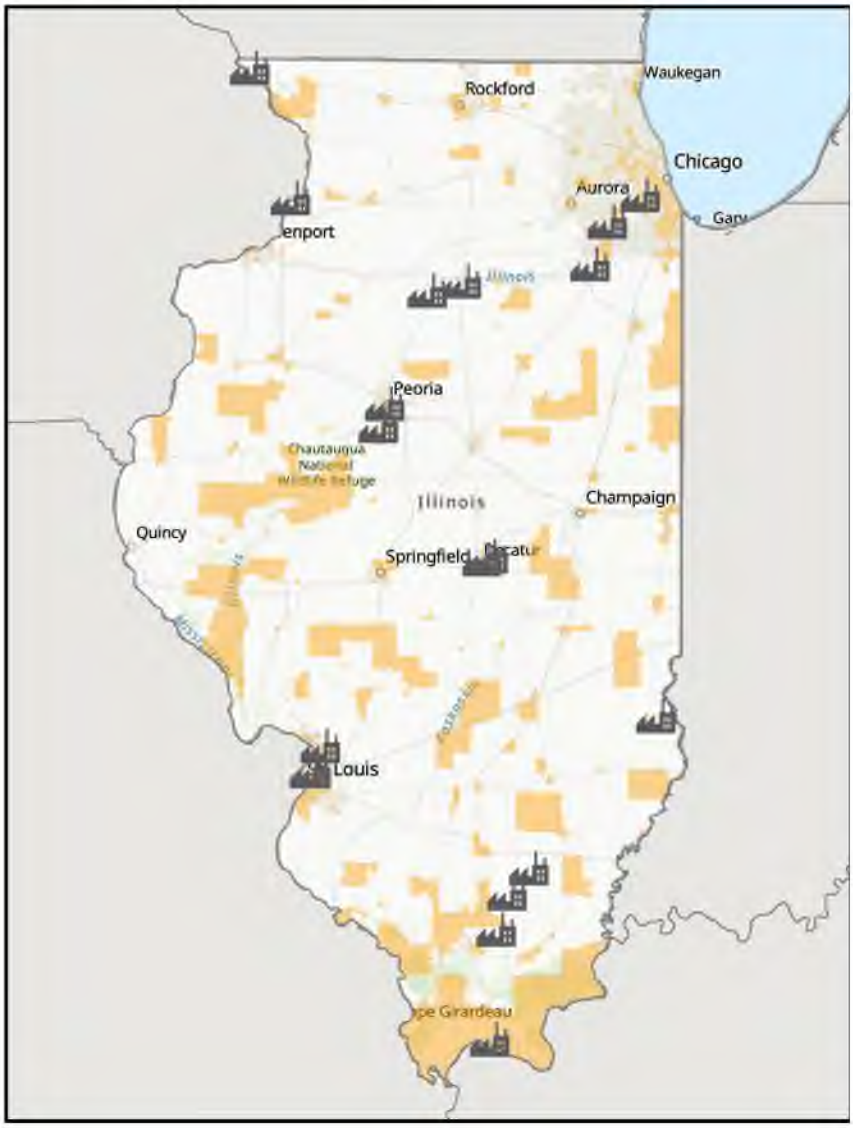
55141011400	Wood County	Wisconsin
55141011500	Wood County	Wisconsin
55141011600	Wood County	Wisconsin
55141011700	Wood County	Wisconsin

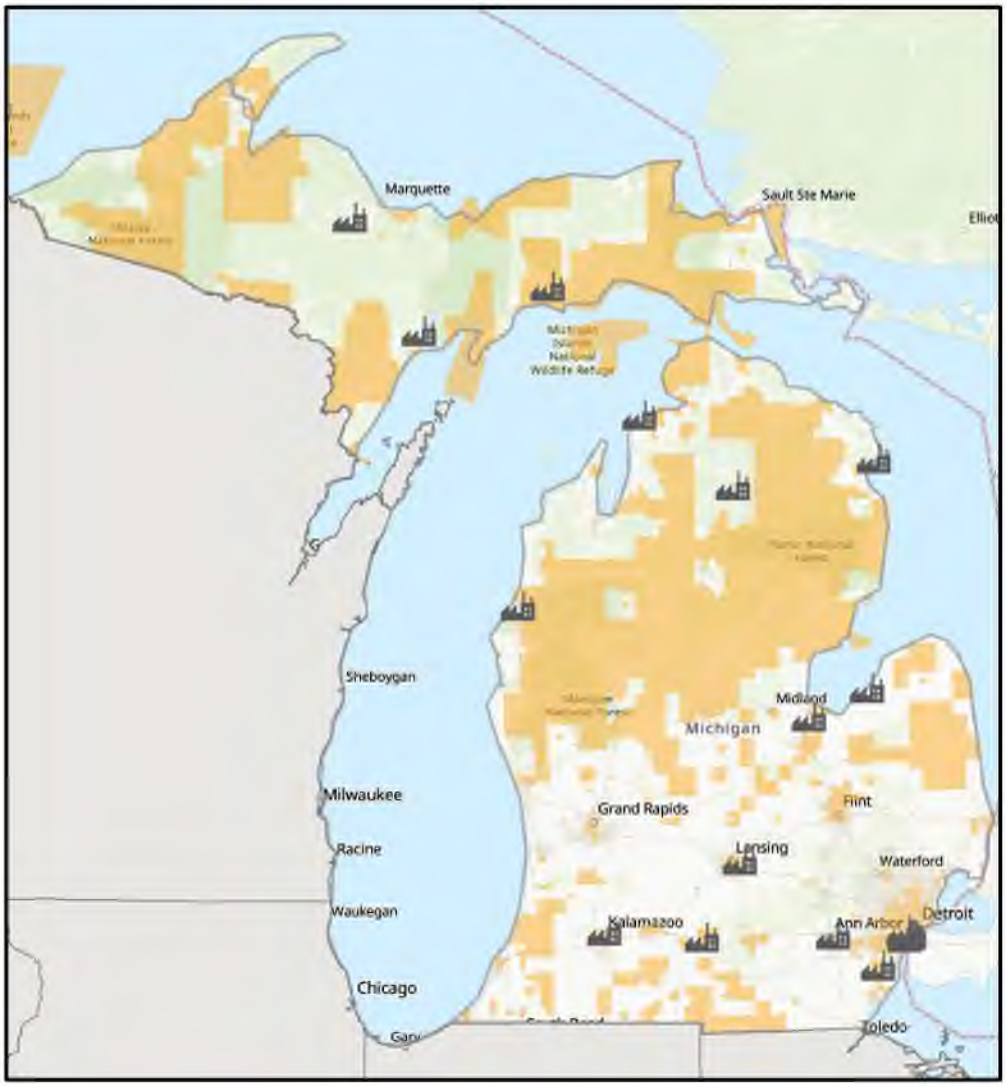
Illinois: CJEST CTs in the Vicinity of top-20 emitters

	LIDAC (CTs)				
1	17031640400	21	17115002903	41	17153971100
2	17031820300	22	17119400102	42	17179020800
3	17031820400	23	17119400200	43	17179020900
4	17031820501	24	17119400600	44	17179021101
5	17031820502	25	17119400700	45	17179021801
6	17031820605	26	17119400903	46	17181950500
7	17031823705	27	17119401000	47	17199021000
8	17033880300	28	17119401100	48	17199021100
9	17043845803	29	17119404000		
10	17055040500	30	17127970100		
11	17055040700	31	17143000100		
12	17087977800	32	17143000300		
13	17099962900	33	17143000500		
14	17099963300	34	17143000600		
15	17115000200	35	17143000900		
16	17115000300	36	17143001200		
17	17115000900	37	17143001600		
18	17115001000	38	17143002100		
19	17115001100	39	17143005000		
20	17115002100	40	17153971000		



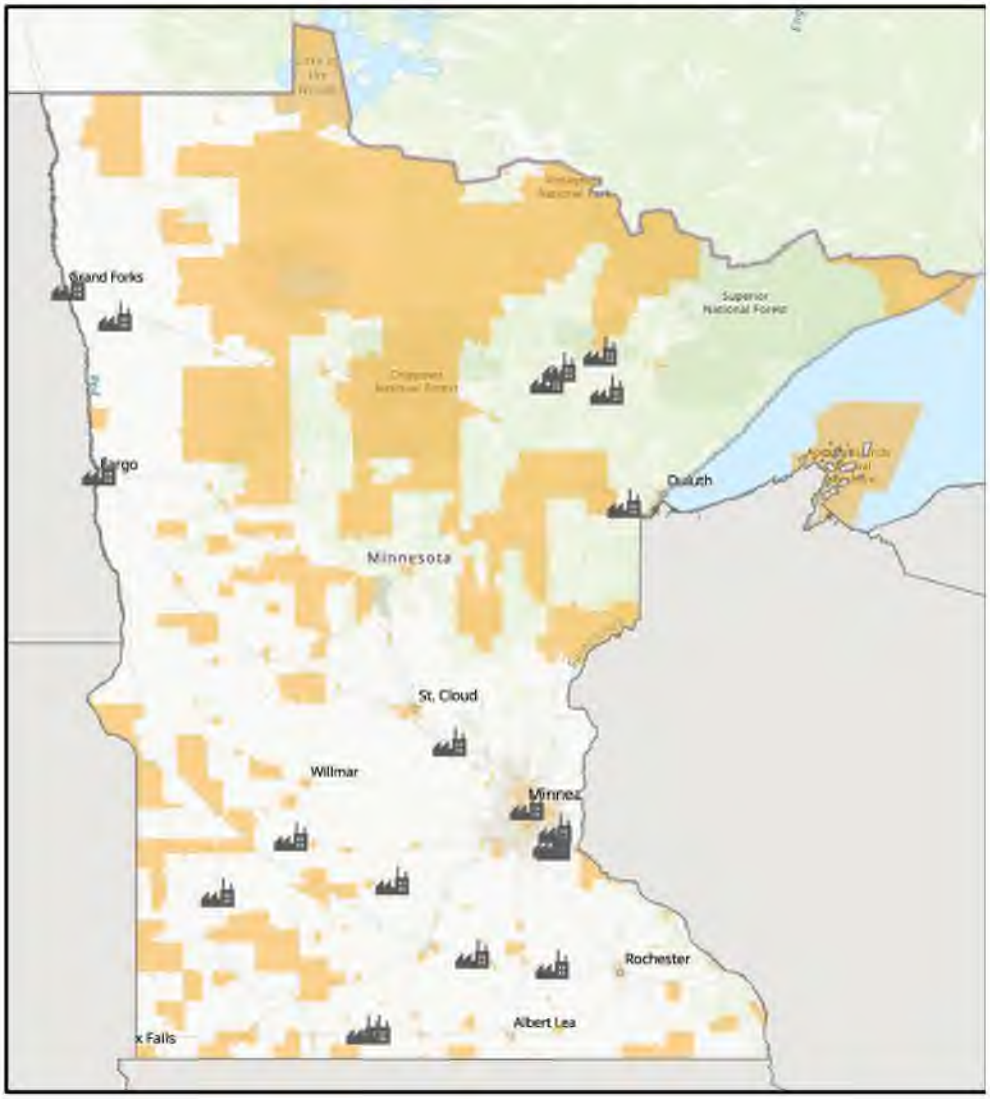
Michigan: CJEST CTs in the Vicinity of top-20 emitters

	LIDAC (QCTs)				
1	26007000500	21	26163521100	41	26163574100
2	26007000700	22	26163521300	42	26163574300
3	26007000800	23	26163521400	43	26163577000
4	26017280700	24	26163523100	44	26163577300
5	26017280900	25	26163523200	45	26163577400
6	26017286500	26	26163523300	46	26163577500
7	26025003300	27	26163523800	47	26163577600
8	26025003600	28	26163524300	48	26163578600
9	26029001500	29	26163524500	49	26163579100
10	26041970800	30	26163524700	50	26163579200
11	26065001200	31	26163524800	51	26163579300
12	26065002101	32	26163524900	52	26163579500
13	26065004302	33	26163525000	53	26163579600
14	26065006500	34	26163526100	54	26163579700
15	26077005501	35	26163526200	55	26163579800
16	26097950300	36	26163573300		
17	26103001900	37	26163573500		
18	26115831200	38	26163573600		
19	26153000300	39	26163573702		
20	26161400200	40	26163573900		



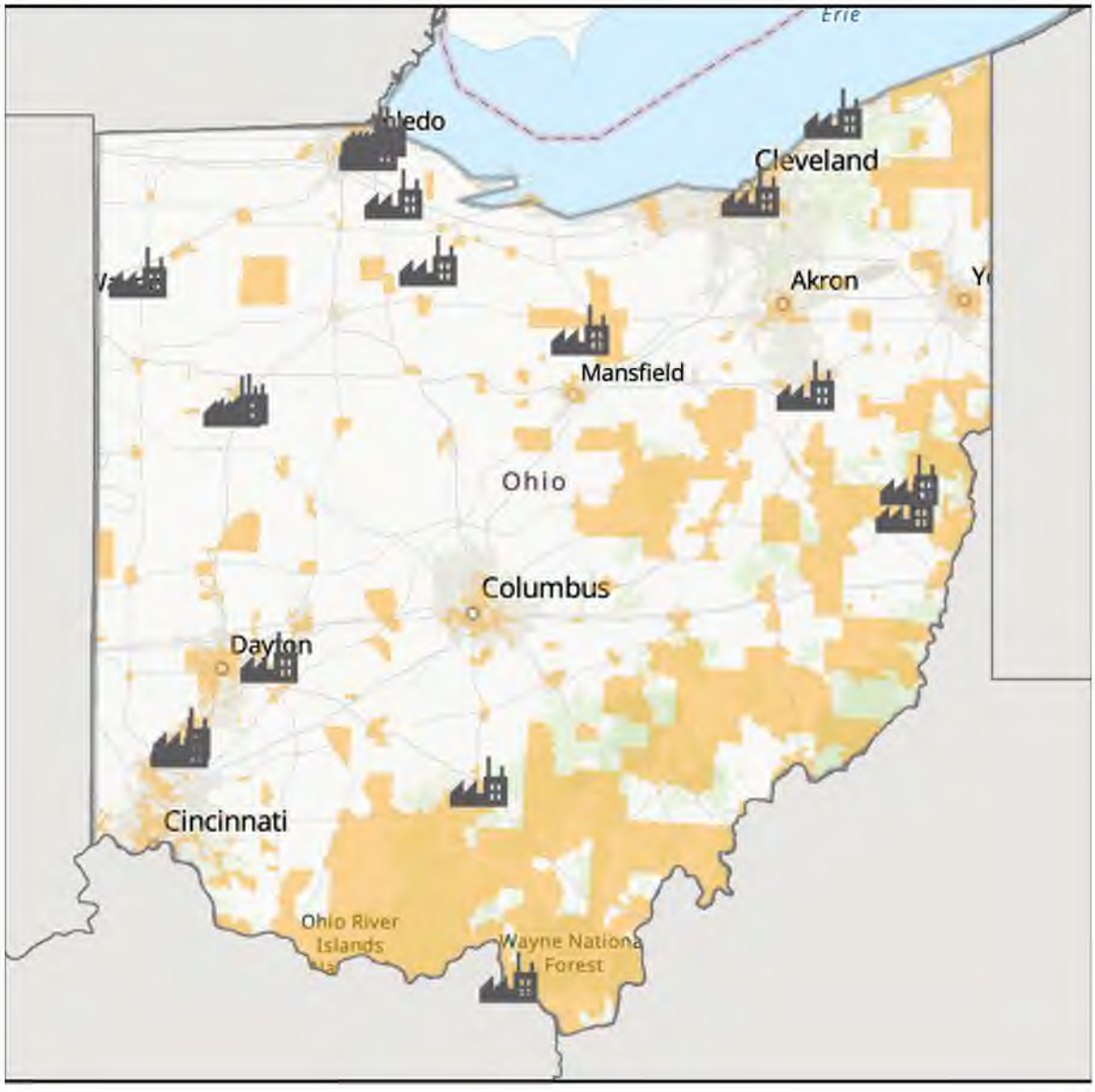
Minnesota: CJEST CTs in the Vicinity of top-20 emitters

	LIDAC (CTs)					
1	27017940000					
2	27027020202					
3	27053104800					
4	27053104900					
5	27053106200					
6	27053106400					
7	27061480400					
8	27083360500					
9	27091790600					
10	27119020200					
11	27119020700					
12	27137012200					
13	27137012400					
14	27137013000					
15	27137013100					



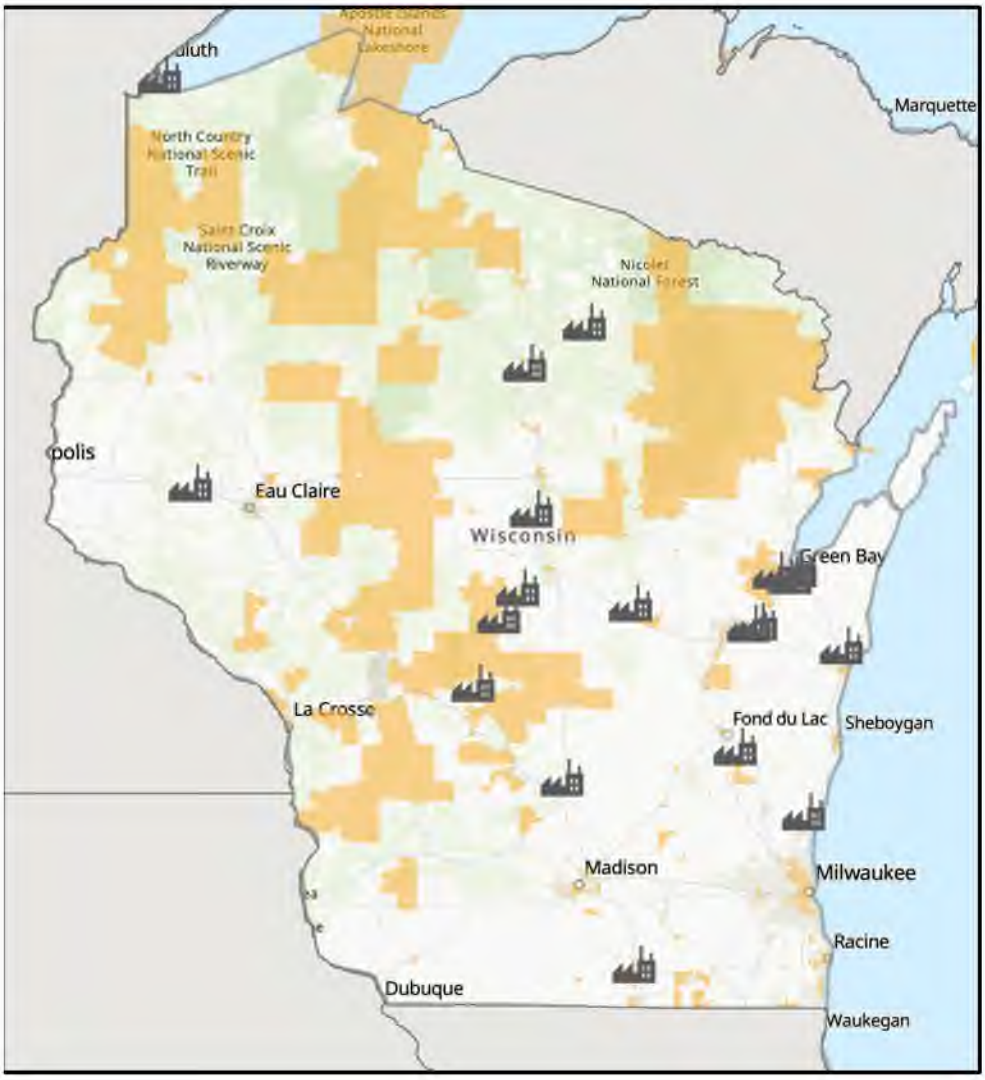
Ohio: CJEST CTs in the Vicinity of top-20 emitters

	LIDAC (CTs)						
1	39003012700	21	39035109701	41	39057240302	61	39141956400
2	39003012900	22	39035109801	42	39057240600	62	39141956500
3	39003013300	23	39035110501	43	39067975600	63	39141956800
4	39003013400	24	39035110801	44	39067975700	64	39145002800
5	39003013600	25	39035110901	45	39077916400	65	39151701200
6	39003013700	26	39035111202	46	39081011100	66	39151701300
7	39003013800	27	39035111500	47	39085204200	67	39151702500
8	39003014100	28	39035111600	48	39095001201		
9	39005970200	29	39035111700	49	39095001202		
10	39017013000	30	39035111800	50	39095002000		
11	39017013100	31	39035111902	51	39095004600		
12	39017013200	32	39035112100	52	39095004701		
13	39017013400	33	39035112200	53	39095004702		
14	39017013500	34	39035115100	54	39095004800		
15	39017013600	35	39035115400	55	39095004900		
16	39017013900	36	39035115700	56	39095005000		
17	39017014000	37	39035115800	57	39095005100		
18	39017014100	38	39035118602	58	39095005200		
19	39035104800	39	39035127501	59	39095005300		
20	39035108201	40	39035196100	60	39141956300		



Wisconsin: CJEST CTs in the Vicinity of top-20 emitters

	LIDAC (CTs)			
1	27137015600			
2	55009000100			
3	55009000200			
4	55009000500			
5	55009000700			
6	55009000800			
7	55009000900			
8	55009001100			
9	55009001200			
10	55009021303			
11	55031020300			
12	55031021100			
13	55057100100			
14	55087012200			
15	55105000100			
16	55105000400			
17	55105000600			
18	55141011000			
19	55141011200			



MICHIGAN STATE
UNIVERSITY

March 21, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: Michigan State University's Support the State of Michigan's CPRG Coalition Proposal for the Midwest Industrial Decarbonization Challenge, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, Michigan State University, affirm our commitment to work with the State of Michigan in its partnership with states of Illinois, Minnesota, Ohio, and Wisconsin to carry out a regional effort to reduce industrial emissions in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse the Midwest Industrial Decarbonization Challenge objective to reduce greenhouse gas (GHG) emissions from the region's top polluting, hard-to-decarbonize industries.

We have read the grant application and understand the rules the application contemplates we will play as a center. We are ready, willing and able to carry out the roles and responsibilities contemplated should we enter into a contract with the State of Michigan in the event EPA awards the grant for the Midwest Industrial Decarbonization Challenge. Through the Midwest Industrial Decarbonization Challenge program period, we anticipate collaborating with the State to deliver incentives programs to reduce industrial GHG emissions, including but not limited to industrial energy efficiency, fuel-switching, and innovative technologies. Our commitment extends to supporting program development and implementation of industrial emission reduction strategies.

The proposed GHG reduction measures will achieve significant cumulative GHG reductions, provide substantial community benefits in low-income and disadvantaged communities, and complement other funding sources to maximize both GHG reductions and community benefits. Because many industrial facilities are located in or upwind of low-income and disadvantaged communities (LIDAC), improvements to the environmental performance of industrial facilities in the region will bring benefits to LIDAC communities. We understand that the states in the coalition are committed to achieving such benefits.

We understand industrial decarbonization because we work with industrial facilities in Michigan to provide technical and analytical support, including assessments of measures that can be undertaken at those facilities to reduce the use of fossil fuels and otherwise reduce emissions, often saving money in the process. Over the past 2.5 years we have worked with over 65 companies and/or organizations within the Michigan area in this capacity. The role anticipated for us under the Midwest Industrial

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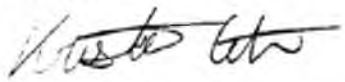
ENGINEERING
Department of Civil and Environmental Engineering
Michigan State University
Engineering Building
428 S. Shaw Lane, Room 3546
East Lansing, Michigan
48824
Phone: 517/355-5107
Fax: 517/432-1827
E-Mail: cee@egr.msu.edu
Website: www.egr.msu.edu/cee

Decarbonization Challenge is a natural scaling-up of the work we are already doing.

We have considerable expertise in this area. We are attaching to this letter the CVs of our leadership and principal staff.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,



Kristen S. Cetin
Director | MSU Industrial Assessment Center
Associate Professor | Department of Civil and Environmental Engineering
Michigan State University
cetinkri@msu.edu

CURRICULUM VITAE

Kristen Cetin, PhD, P.E., LEED AP BD+C
Michigan State University
484 S Shaw Ln
East Lansing, MI 48824

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ACADEMIC POSITIONS

Director, MSU Industrial Assessment Center	**2021-present**
Associate Chair for Faculty and Academic Staff Development, Michigan State University	**2023-present**
Associate Professor, Michigan State University	**2022-present**
Assistant Professor, Michigan State University	**2019-2022**
Assistant Professor, Iowa State University	**2016-2019**
Adjunct Professor, University of Georgia	**2015**

EDUCATION

Ph.D. Civil, Architectural & Environmental Engineering, University of Texas at Austin	**2012 - 2015**
M.S. Civil & Environmental Engineering, University of Maryland	**2009 - 2010**
B.S. Civil & Environmental Engineering, University of Maryland	**2005 - 2009**

FELLOWSHIPS & AWARDS

Excellence in Diversity, Equity and Inclusion Award, *Michigan State University*	**2024**
Honorable Mention, Best Technical Paper Award, *American Society of Civil Engineers*	**2023**
ASCE Journal of Civil Engineering Education	
Outstanding Reviewer, *American Society of Civil Engineers (ASCE)*	**2023**
ASCE Journal of Civil Engineering Education	
Withrow Excellence in Diversity Award, *Michigan State University, College of Engineering*	**2023**
Emerging Accomplishments	
NSF CAREER Award, *National Science Foundation*	**2022**
Withrow Junior Distinguished Scholar, *Michigan State University, College of Engineering*	**2022**
ASCE Journal of Civil Engineering Education - Editors Choice	**2022**
Investigating Problem-Solving Processes of Students, Faculty, and Practicing Engrs in Civil Engr	
ASCE ExCEED New Faculty Excellence in Teaching Award, *ASCE*	**2021**
Stephen J. Ressler Best Paper Award, ASCE, Civil Engr. Division, *ASEE*	**2021**
Engineering Faculty's Beliefs About Teaching and Solving Ill-structured Problems	
ASCE ExCEEd, Fellow, Assistant Mentor, *ASCE*	**2016 - 2019**
ASHRAE College of Fellows Award, *ASHRAE*	**2014 - 2015**

PUBLICATIONS, PROCEEDINGS & PRESENTATIONS *(primary student advisees are underlined)*

1. Roxas, A., Naik, A., Cetin, K., Anctil, A., Berghorn, G. (2024) Industrial Energy Efficiency and Decarbonization: Identifying Motivations and Barriers for Midwest Manufacturers. *2024 ASHRAE Winter Conference*, January 20-24, 2024
2. Kula, B., Roxas, A., Cetin, K.S., Anctil, A., Berghorn, G. (2023) Developing and Evaluating a Virtual Training Process for Energy Assessment Education *2023 American Society of Engineering Education Annual Conference & Exposition.* June 25-28, 2023
3. Kawka, E., Mahmud, R., Cetin, K. (2024) Data-Driven Residential Electric Vehicle Charging Behavior and Load Profile Modeling for Demand Response in the MISO Region *ASCE Journal of Architectural Engineering*, DOI: 10.1061/JAEIED.AEENG-1537
4. Dong, H., Vanage, S., Cetin, K. (2024) Sensitivity Analysis of Sensor Placement in Energy-Efficient, Grid-Interactive Ready Small Office Buildings with Dynamic Shading and Lighting Control. *Science and Technology of the Built Environment*, DOI: 10.1080/23744731.2023.2299175

5. Vanage, S., Dong, H., Cetin, K.. (2023) Visual comfort and energy use reduction comparison for different for shading and lighting control strategies in a small office building *Solar Energy*, 265, 112086 DOI: 10.1016/j.solener.2023.112086
6. Chu, Y., Guillante, P., Mitra, D., Mahmud, R., Cetin, K. (2023) Typical Academic Building Energy Model Development and Energy Saving Evaluation Using Occupant-Based Control. *Journal of Building Engineering*, 79, 107818 DOI: 10.1016/j.jobe.2023.107818
7. Santos, C., **Cetin, K.S.,** Salehi, H (2022) Energy-efficient technology retrofit investment behaviors of Midwest households in lower and higher income regions. *Sustainable Cities and Society* DOI: 10.1016/j.scs.2022.104141
8. Chu, Y., Mitra, D., O'Neill, Z., **Cetin, K.S.** (2022) Influential variables impacting the reliability of building occupancy sensor systems: a systematic review and expert survey. *Science and Technology of the Built Environment* DOI: 10.1080/23744731.2021.1993672
9. Akinci-Ceylan, S., **Cetin, K.S.,** Ahn, B., Surovek, A., Cetin, B. (2021) Investigating Problem Solving Steps of Students, Faculty, and Practicing Engineers in Civil Engineering. *Journal of Civil Engineering Education.* 148 (1), 04021014. *DOI: 10.1061/(ASCE)EI.2643-9115.0000054*

RESEARCH EXPERIENCE (Selected)

Building Training and Assessment Center (BTAC) *2024-2027*
PI: *Kristen Cetin* **Funding Agency:** *U.S. Department of Energy*
Total Budget: $900,000

Responding to Energy Insecurity in Arctic Housing Using a Community-Based Participatory Research *2023-2027*
PI: *Kristen Cetin* **Funding Agency:** *National Science Foundation*
Total Budget: $2.8 million

CAREER: Improving the Participation of Diverse Residential Buildings in Demand Side Management *2022-2027*
PI: *Kristen Cetin* **Funding Agency:** *National Science Foundation*
Total Budget: $508,515

Industrial Assessment Center at Michigan State University *2021-2026*
PI: *Kristen Cetin* **Funding Agency:** *U.S. Department of Energy*
Total Budget: $2.25 million

Simulation, Challenge Testing & Validation of Occupancy Recognition & CO_2 Technologies *2018 - 2022*
***PI:** Kristen Cetin* ***Funding Agency**: ARPA-E (U.S. DOE)*
Total Budget: $736,210

TEACHING EXPERIENCE

Michigan State University, *East Lansing, MI*

Design and Operation of Smart and Sustainable Buildings	*F23, F22, S20*
Energy and Sustainability Assessments of Industrial and Commerical Buildings	*S24, S23, S22*
Sustainable Civil and Environmental Engineering Systems	*F23, S23, F22, F21*
Sustainable Building Envelope Systems	*S21*

Iowa State University, *Ames, IA*

Research Methods in Civil Engineering	*F18*
Contractor Organization and Management of Construction	*S18, S19*
Modeling and Evaluation of Energy Performance of Buildings & Communities	*S16, S17, S18*
Senior Design/Capstone: Mechanical Design Technical Advisor	*F16,S17,F17,S18, S19*

Annick Anctil, PhD, Michigan State University
Department of Civil & Environmental Engineering, Michigan State University
East Lansing, MI; anctilan@msu.edu 517-432-4692

Professional Preparation

Institution	*Major/Area*	*Degree*	*Year*
Ecole Polytechnique Montreal	Materials Engineering	B.E.	2005
Rochester Institute of Technology	Materials Science & Engineering	M.S.	2007
Rochester Institute of Technology	Sustainability	Ph.D.	2011
Brookhaven National Laboratory	Environmental Engineering	Postdoc	2011-2012

Professional Experience

Associate Professor of Civil & Environmental Engineering Michigan State University 2021-present
Affiliated Faculty, AgBio research institute, Michigan State University 2022- present
Assistant Professor of Civil & Environmental Engineering Michigan State University 2014-2021
Assistant Professor, Environmental Engineering and Earth Sciences, Clemson University 2012-2014
Research Associate, National Photovoltaic Environmental Research Center, Brookhaven National Laboratory 2011-2012

Relevant Ongoing or Previous Grants

Received funding for more than 25 different projects for more than 12 million dollars from various funding sources, including NSF, USDA, Ford, Michigan EGLE, and DOE.

- *DOE- Energywerx (DOE-MESC)* 2024, Project last mile: US solar supply chain, PI Anctil, $100,000
- *Minnesota Department of Transportation (MnDOT)* (2022-2024) Evaluation of Gravel Stabilizer Used on Gravel Roads and Gravel Shoulders, PI Bora Cetin, $193,687
- *Ford Motor Company* (2022-2024), Circular Economy for EV battery, PI Annick Anctil, $200,000
- *DOE Industrial Assessment Center (DOE-IAC)* (2021-2026) Industrial Assessment Center at Michigan State University, PI Kristen Cetin, $ 1,750,000
- *National Science Foundation CAREER CBET: Environmental Sustainability* (2021-2026) Environmental Sustainability of Photovoltaics in the US, PI Annick Anctil, $435,911
- *Michigan Environment, Great Lake & Energy (EGLE),* Analyzing the benefits and challenges of 2nd-life batteries as storage systems for DCFC stations, PI Mehrnaz Ghamami, $120,000
- *National Science Foundation CBET: Environmental Sustainability* (2018-2021) Sustainable energy transition: Beyond material analysis, PI Annick Anctil, $302,035
- *Michigan Environment, Great Lakes & Energy (EGLE)* (2020-2021) Energy Storage Roadmap. PI Michigan Institute for Energy Innovation, $199,901
- *National Science Foundation: EFRI EP3* (2020-2024) Reincarnation of Polymers for the Circular Economy, PI John Dorgan, $2,000,000
- *USDA:* Developing Pathways Toward Sustainable Irrigation across the United States Using Process-based Systems Models (SIRUS), PI David Hyndman, $2,473,700

- *Ford Motor Company* (2018-2020) Interactive Decision Analysis Tool to Guide Life Battery Energy Storage System Options, PI Annick Anctil, $197,773
- *Ford Motor Company* (2016-2018) Second Life Potential and Environmental Benefit of EV Batteries in Photovoltaic Applications, PI Annick Anctil, $191,900
- *National Science Foundation CBET: Energy for Sustainability* (2015-2019) SUSCHEM: A Green Chemistry Approach to Organic and Transparent Photovoltaic Material Synthesis and Device Fabrication, PI Annick Anctil, $299,894

Refereed Journal Publications

More relevant

1. Yuan L, Nain, Preeti, Kothari M, **Anctil A**, " Material intensity and Life Cycle Impacts of Crystalline Silicon Photovoltaic Modules Over Time", Solar Energy, 269, (2024) 112336
2. **Anctil A**., Lee E, Lunt RR, "Net energy and cost benefit of transparent organic solar cells in building-integrated applications". Applied Energy 261, 114429 (2020)
3. Shukla S, Lee E, Lunt RR, **Anctil A**, "Comparison of environmental and cost benefit of phtalocyanine and heptametine based transparent organic photovoltaics for windows of commercial buildings in the United States", Sustainable Energy Technologies and Assessments, 53 (2022):102631
4. Kamath D, Shuklas S, Arsenault R, Kim HC, **Anctil A**, "Evaluating the cost and carbon footprint of second-life electric vehicle batteries in residential and utility-level applications ", Waste Management, 113, (2020)
5. Kamath D, Arsenault R, Kim HC, **Anctil A**, "Economic and Environmental Feasibility of Second Life Lithium-ion Batteries as Fast Charging Energy Storage", Environmental Science and Technology, 54 (11) (2020)

Other recent publications

1. Farina A, Kutay ME, Anctil A. Environmental assessment of asphalt mixtures modified with polymer-coated rubber from scrap tires. *Journal of Cleaner Production*, *418*, 138090. (2023).
2. Heidari M, **Anctil A**, "Country-Specific Carbon Footprint of Metallurgical Grade Silicon Production for Silicon Photovoltaics" Resources, Conservation and Recycling 180, 106171(2022)
3. Farina A. & **Anctil A**. "Material consumption and environmental impact of wind turbines in the USA and globally". Resources, Conservation and Recycling, 176, 105938 (2022).
4. Challa R, Kamath D, **Anctil A**, "Well-to-wheel greenhouse gas emissions of electric versus combustion vehicles from 2018 to 2030 in the US." Journal of Environmental Management 308 (2022): 114592.
5. Kamath D, Moore S, Arsenault R, Anctil A. A system dynamics model for end-of-life management of electric vehicle batteries in the US: Comparing the cost, carbon, and material requirements of remanufacturing and recycling. Resources, Conservation and Recycling. (2023) Sep 1;196:107061.

GEORGE H. BERGHORN, Ph.D., LEED AP, CGP

13095 Farm Lane • DeWitt, MI 48820 • 517.862.7821 • gberghorn@gmail.com

EDUCATION

Ph.D., Construction Management *2014*
Michigan State University, East Lansing, Michigan, USA
Dissertation Title: "Life Cycle Cost-Based Risk Model for Energy Performance Contracting Retrofits"
Fields of Specialization: Sustainability in the built environment, mass timber construction, construction project management, energy efficiency, life cycle analysis, risk management

M.S. Construction Management core course requirements completed *2007-2009*
(including undergraduate collateral courses)
Michigan State University, East Lansing, Michigan, USA

Master of Environmental Studies *1998*
Yale University School of Forestry and Environmental Studies, New Haven, Connecticut, USA
Fields of Specialization: Sustainability, resource policy, watershed forestry

Bachelor of Science (magna cum laude), Political Science and Earth Science *1996*
SUNY College at Brockport, Brockport, New York, USA

CURRENT PROFESSIONAL APPOINTMENTS

Michigan State University East Lansing, Michigan, USA
Assistant Professor of Construction Management August 2015-present
- Tenure Track January 2020-present
- Fixed-Term August 2015-December 2019

Program Director, MS in Construction Management August 2023-present
Research Director, Mass Timber @ MSU November 2021-present
Assistant Director, MSU Industrial Assessment Center (DOE-funded) August 2021-present
Core Faculty, Housing Education and Research Center August 2017-present
Adjunct Assistant Professor of Sustainable Wood Construction October 2018-present
Affiliate Faculty, Environmental Science and Policy Program August 2015-present

Berghorn Group (Sustainability and CM Consultation) Lansing, Michigan, USA
Principal September 2014-present (operated under different name since 1999)

Green Prisons Lexington, Kentucky, USA
Senior Sustainability Advisor January 2014-present

AWARDS AND HONORS

- Adams Academy Fellow (Michigan State University) 2019-2021
- Coach, 2020 National Champion NAHB Student Competition Team 2020
- Coach, 2019 National Champion NAHB Student Competition Team 2019

AWARDS AND HONORS, *continued*

- National Association of Home Builders 2019 Outstanding Educator 2019
- National Association of Home Builders 2018 Industry Research Subcommittee Presentation Best Submission Award 2018
- Coach, 2017 Champion ASC Region 3 Project Solutions Competition Team 2017
- ORISE Science and Technology Policy Fellowship (*Selected, Declined Offer*) 2014

PAST PROFESSIONAL APPOINTMENTS

Michigan State University East Lansing, Michigan, USA
Post-Doctoral Research Associate August 2014-July 2015
Doctoral Student January 2007-July 2014

- Conducted research related to sustainability and energy efficiency in the built environment.
- Research focused on sustainability related to building deconstruction and materials reuse, to include life cycle assessment and embodied energy.

Kendall College of Art and Design of Ferris State University Grand Rapids, Michigan, USA
Adjunct Graduate Faculty January 2015-May 2015

- Co-developed Building Systems Integration class for M.Arch. students; lead development of sustainability, building science, and energy systems/design with climate modules.
- Provided classroom and laboratory instruction as well as studio critiques.

Lansing Community College Lansing, Michigan, USA
Dean – Technical Careers Division May 2011-March 2014
Chairperson - Environmental, Design & Building Technologies Dept. June 2009-April 2011
Adjunct Professor – Environmental Science and Biology June 2003-May2005

- Led academic unit with a ~$10 million budget, over 125 FTE faculty and staff, 4,000 students, and over 50 academic programs.
- Increased unduplicated headcount by 64% through strategic realignment at zero net cost.

Michigan Forest Products Council Lansing, Michigan, USA
Director of Forest Policy July 2005-June 2009

Integrated Technical Services, Inc. Winslow, New Jersey, USA
Construction Project Manager December 2001-January 2003
Construction Site Superintendent September 2001-December 2001

Environmental Strategies Corporation Pittsburgh, Pennsylvania, USA
GIS Analyst and Environmental Scientist (Onsite Remedial Construction Technician and Site Remediation Technician/Manager) October 1998-September 2001

PROFESSIONAL CERTIFICATIONS

LEED AP, Green Building Certification Institute – August 2009-present.

Certified Green Professional, National Association of Homebuilders – October 2014-present.

RYAN GALLAGHER
4810 W. Taft Rd.
St. Johns, MI 48879

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galla150@msu.edu

PROFESSIONAL SUMMARY

I am a highly motivated & driven professional in the HVACR and energy management fields. I have over 19 years of combined experience in a variety of roles including estimating, project management, energy auditing, facilities operation, building automation, design, fieldwork, teaching, and research.

EDUCATION

Bachelor Degree: HVAC/R Engineering – GPA 3.92 2011
Ferris State University, Big Rapids, Michigan
- Summa Cum Laude

Associate Degree: HVAC/R Technology – GPA 3.91 2009
Lansing Community College, Lansing, Michigan
- Summa Cum Laude

EXPERIENCE

Michigan State University Infrastructure Planning & Facilities Aug. 2013-Present
East Lansing, Michigan
HVAC Controls Planner/Inspector/Analyst II/III – Project Services

- Estimate, schedule & manage installation of HVAC controls, mechanical & multi-craft projects
- Budget, plan & manage demand side energy conservation measure projects
- Administer contracts & direct mechanical, electrical & structural contractors on installation
- Design energy management control systems for teaching and research setting
- Develop & implement optimized sequences (HVAC, chilled water, steam, lighting, etc.)
- Strategize & prioritize funding for long term building automation & mechanical system upgrades
- Manage/supervise mechanical skilled trades installers & building automation technicians
- Prepare technical reports & detailed cost studies
- Collaborate & support skilled trades, engineers & administration with technical assistance
- Provide excellent customer service to the MSU campus community
- Assure compliance with ASHRAE standards, MSU standards and mechanical codes
- Communicate, schedule & plan shutdowns of critical electrical and mechanical systems
- Apply for energy rebates and work with utility companies on energy related projects

Industrial Assessment Center – Michigan State University Jan. 2022-Present
East Lansing, Michigan
Assistant Director/Assessment Leader

- Perform one day energy audit of manufacturing facilities and commercial buildings
- Generate energy conservation ideas and deliver detailed cost analysis report
- Provide oversight and training to engineering graduate and undergraduate students

Lansing Community College HVAC/R Department Aug. 2015-Present
Lansing, Michigan
HVAC/R Adjunct Instructor/Adjunct Associate Professor

- HVAC 100 – Fundamentals of HVAC
- HVAC 130 - Air Conditioning I
- HVAC 251 – Fundamentals of Direct Digital Controls
- Student mentorship & assist connecting students to industry careers

Michigan State University Infrastructure Planning & Facilities May 2011-Aug. 2013
East Lansing, Michigan
HVAC Controls Planner/Inspector/Analyst I – Building Performance Services

- Control, program, monitor, trend, report & troubleshoot HVAC/DDC systems
- Customer interface with building occupants on campus HVAC issues
- Implement energy conservation measures through DDC

Ferris State University Energy Center Sept. 2010-May 2011
Big Rapids, Michigan
Energy Auditor

- Pre & Post energy audits on new & existing homes
- Energy modeling

Michigan State University Infrastructure Planning & Facilities May 2010-Aug. 2010
East Lansing, Michigan
HVAC Controls Intern

- Install, retrofit & program HVAC Controls
- Select HVAC control products & modify HVAC control drawings

Ferris State University HVAC/R Department Sept. 2009-Dec. 2010
Big Rapids, Michigan
HVAC/R Teaching Assistant

- Create & prepare HVAC/R lab projects
- Teaching assistant in the HVAC/R lab

M.D. Refrigeration Jan. 2008-Oct. 2008
Mt. Pleasant, Michigan
HVAC/R Technician

- Diagnose & repair of commercial HVAC/R equipment
- Manage trouble calls
- Communicate with customers & respond to their HVAC/R issues

Lansing Community College HVAC/R Department Mar. 2007-Aug 2009
Lansing, Michigan
HVAC/R Lab Technician

- Diagnose, fix & maintain the HVAC/R lab equipment
- Teaching assistant, prepare labs and order lab supplies

Mills Refrigeration Jun. 2004-Mar. 2007
Lansing, Michigan
Preventative Maintenance Technician

- General HVAC/R preventative maintenance tasks
- Install parts & customer relations follow up

HONORS, CERTIFICATIONS & VOLUNTEER WORK

- 2021 MSU Supplier Diversity Task Force Committee Member
- 2020 LCC Online Teaching Certification
- 2017 Building Efficiency for a Sustainable Tomorrow Member
- 2016 Governor's Energy Excellence Award Honorary Mention
- 2013 Essentials of Project Management Certification
- 2012 – 2014 Michigan Skills USA HVAC/R Volunteer Judge
- 2010 ASHRAE Vice President, Ferris State University Student Chapter
- 2010 Michigan Skills USA HVAC/R Post-Secondary State Champion
- 2010 National Skills USA HVAC/R Post-Secondary National Champion
  -Cover story of The ACHR NEWS, August 2, 2010
  -Featured in RSES Journal, August 2010
- 2010 Light Commercial Refrigeration Industry Competency Exam
- 2009 Light Commercial A/C & Heating Industry Competency Exam
- 2007 EPA 608 Type I, II, 410A Certification

REFRENCES

Available upon request

UNIVERSITY OF ILLINOIS CHICAGO

March 21, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: University of Illinois Chicago Support of the State of Michigan's CPRG Coalition Proposal for the Midwest Industrial Decarbonization Challenge, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

We, the University of Illinois Chicago, affirm our commitment to work with the State of Michigan in its partnership with states of Illinois, Minnesota, Ohio and Wisconsin to carry out a regional effort to reduce industrial emissions in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse the Midwest Industrial Decarbonization Challenge objective to reduce greenhouse gas (GHG) emissions from the region's top polluting, hard-to-decarbonize industries.

We understand the role the application contemplates we will play as a university research entity. We are ready, willing and able to carry out the roles and responsibilities contemplated should we enter into a contract with the Michigan Department of Environment, Great Lakes, and Energy (Michigan EGLE) in the event EPA awards the grant for the Midwest Industrial Decarbonization Challenge to the State of Michigan. Through the Midwest Industrial Decarbonization Challenge program period, we anticipate collaborating with Michigan EGLE and the State of Illinois to deliver incentives programs to reduce industrial GHG emissions, including but not limited to industrial energy efficiency, fuel-switching, and innovative technologies. Our commitment extends to supporting program development and implementation of industrial emission reduction strategies.

The proposed GHG reduction measures will achieve significant cumulative GHG reductions, provide substantial community benefits in low-income and disadvantaged communities, and complement other funding sources to maximize both GHG reductions and community benefits. Because many industrial facilities are located in or upwind of low-income and disadvantaged communities (LIDAC), we know that improvements to the environmental performance of industrial facilities in the region will bring benefits to LIDAC communities. We understand that the states in the coalition are committed to achieving such benefits.

We understand industrial decarbonization because we work with industrial facilities in Illinois and the regional states of Michigan, Minnesota, Ohio and Wisconsin to provide technical and analytical support, including assessments of measures that can be undertaken at those facilities to reduce the use of fossil fuels and otherwise reduce emissions, often saving money in the process. The role anticipated for us under the Midwest Industrial Decarbonization Challenge is a natural scaling-up of the work we are already

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doing providing technical assistance to these industrial facilities in Phase 1. In addition, our institution is ready to lead the Phase 2 activities, overseeing and managing the competitive grant-making process of this proposal.

The University of Illinois Chicago (UIC), located in Chicago, Illinois, is an acclaimed research institution with 16 colleges dedicated to the discovery and distribution of knowledge. UIC provides the broadest access to the highest levels of intellectual excellence with UIC's mission to: create knowledge that transforms our views of the world and, through sharing and application, transforms the world; provide a wide range of students with the educational opportunity only a leading research university can offer; address the challenges and opportunities facing not only Chicago but all Great Cities of the 21st century, as expressed by our Great Cities Commitment; foster scholarship and practices that reflect and respond to the increasing diversity of the U.S. in a rapidly globalizing world; and train professionals in a wide range of public service disciplines, serving Illinois as the principal educator of health science professionals and as a major healthcare provider to underserved communities.

The UIC Office of the Vice Chancellor for Research (OVCR) advances and safeguards all research through a number of specialized units that together facilitate and ensure the integrity of exceptional research at UIC. One of the units is the OVCR Office of Sponsored Programs (OSP). OSP manages all sponsored projects throughout the complete lifecycle from proposal submission through award close-out. The OSP is experienced in the execution and management of large-scale consortium activities with an average of approximately 450 outgoing subawards annually for the past 5 fiscal years and in excess of 40 unique subawards under a single sponsored project. The OVCR also houses a university-wide shared grants management office, offering pre- and post-award services to researchers in the colleges and schools. Additionally, the OVCR has various compliance and administrative offices that oversee research integrity, research data and research involving human subjects, vertebrate animals, biosafety concerns, proposal development, post-doctoral student support, and a number of other institutes and centers. Collectively, the OVCR promotes excellence in research, fosters relationships with external collaborators, and invests in shared infrastructure to advance research and innovation.

The UIC's Energy Resources Center (ERC) is an interdisciplinary public service, applied research, and special projects organization that strives to provide solutions to today's energy and environmental challenges and opportunities. The ERC, based out of the UIC College of Engineering, provides expertise in the areas of bioenergy, energy efficiency, distributed generation and renewables, utility data analytics, sustainable landscapes, clean transportation and workforce development. Originally created to be a "fast response" team of experts, the ERC currently provides technical assistance, sophisticated modeling capabilities, educational outreach, and program implementation across the public and private sectors. The ERC is committed to providing the most comprehensive and up-to-date solutions to the energy and environmental problems affecting institutional, industrial, residential, and commercial sectors. The ERC is staffed by a uniquely diverse and highly experienced group of professional engineers, economists, architects, computer scientists, educators, and public policy analysts. UIC, through the ERC, has significant experience implementing both industrial energy assessments and managing energy related competitive grant applications programs. UIC has conducted more than 300 industrial assessments

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through the U.S. Department of Energy's Industrial Assessment Center (IAC).[1] UIC has managed several competitive grant application programs for the Illinois Department of Commerce and Economic Opportunity (DCEO), including the Illinois Biomass and Biogas to Energy Grant Program and the Illinois Public Sector Combined Heat and Power Pilot State Grant Program.[2,3]

We have considerable expertise in this area. Attached to this letter are the short bios and resumes of our leadership and principal staff:

- Cliff Haefke, Director, UIC-ERC – Mr. Haefke will serve as the primary representative from UIC, overseeing the overall management of the project.
- Marcello Pibiri, Senior Research Engineer, UIC-ERC – Mr. Pibiri will oversee Phase 1 of the proposed grant program, the technical assistance activities provided to the industrial facilities.
- Graeme Miller, Senior Research Specialist, UIC-ERC – Mr. Miller will oversee Phase 2 of the proposed grant program, the competitive grant program.
- Ben Campbell, Principal Research Engineer, UIC-ERC – Mr. Campbell will provide technical support throughout both phases of the proposed program.
- Jennifer Klemundt, Assistant Director of Research Services, UIC-ERC – Ms. Klemundt will provide support and connections to the relevant offices on campus for contract management.

We are enthusiastic about partnering with the Michigan Department of Environment, Great Lakes, and Energy to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Principal Investigator (PI) - Cliff Haefke, Director, Energy Resources Center, University of Illinois Chicago

Peter Nelson, PhD, Dean, College of Engineering, University of Illinois Chicago

Joanna Groden, PhD, Vice Chancellor for Research, University of Illinois Chicago

[1] https://iac.university/center/IC
[2] https://www.energy-grants.net/dceo-biogas-and-biomass-to-energy-grant-program/
[3] http://www.energy-grants.net/il-public-sector-combined-heat-and-power-pilot-state-grant-program/

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Short Bios

Cliff Haefke
Director, UIC Energy Resources Center
Cliff Haefke has over 20 years of experience in the energy industry and is the Director of the Energy Resources Center (ERC) at the University of Illinois Chicago (UIC). The ERC is an interdisciplinary public service, research, and special projects organization that strives to improve energy efficiency and the environment, providing expertise in the areas of energy efficiency, distributed generation, combined heat and power, bioenergy, sustainable transportation, utility data analytics, and sustainable landscapes. As Director of the ERC, Cliff oversees the Center's strategic direction, has overseen the securement of over $30M in new research, serves as Director of the U.S. DOE Midwest and Central Combined Heat and Power Technical Assistance Partnerships, and serves as an Assistance Director of UIC's U.S. DOE Industrial Assessment Center. Cliff also serves as President of the Midwest Cogeneration Association and on the Board of the Midwest Energy Efficiency Alliance. Cliff has a Bachelor's Degree in Mechanical Engineering from UIC and a Master's Degree in Business Administration from the UIC Liautaud Graduate School of Business.

Marcello Pibiri
Senior Research Engineer, UIC Energy Resources Center
Marcello Pibiri serves as Senior Research Engineer at the Energy Resources Center (ERC) an interdisciplinary public service, research, and special projects organization that works to advance energy sustainability and improve the environment, based out of the College of Engineering at the University of Illinois Chicago. Marcello is the Program Manager for UIC's industrial programs including the U.S. Environmental Protection Agency's Pollution Prevention (P2) grant supporting industrial manufacturers seeking pollution prevention measures. Marcello also has experience as the Outreach Coordinator for the Water/Wastewater Treatment Plant and K-12 Schools ComEd Energy Efficiency Incentive Program and the Program Manager of the Technical Education and Analysis for Community Hauling and Anaerobic Digesters (TEACH AD), a program that helps WRRFs by providing education and technical assistance to explore the increased adoption of anaerobic digestion and renewable energy biogas technologies. Marcello as a member of the ERC's Energy Efficiency team supports several technical, energy, and environmental initiatives at the ERC, conducting research and evaluating energy savings opportunities for clients. Prior to joining the Energy Resources Center, Marcello worked for several years in the project management of electrical and technological installations. Marcello holds a Master's Degree in Energy Engineering from the University of Illinois at Chicago and a Bachelor's Degree in Electrical Engineering from the Università degli Studi dell'Aquila in Italy.

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Graeme Miller
Senior Research Specialist, UIC Energy Resources Center
Graeme Miller is a Senior Research Specialist at the Energy Resources Center (ERC)— an interdisciplinary public service, research, and special projects organization that works to advance energy sustainability and improve the environment, based out of the College of Engineering at the University of Illinois Chicago. At the ERC, Mr. Miller serves as the assistant director of the US Department of Energy's Midwest Combined Heat and Power Technical Assistance Partnership where he leads technical assistance and stakeholder engagement activities. Mr. Miller focuses on identifying, quantifying, and addressing barriers to clean distributed generation technologies such as combined heat and power (CHP), waste heat to power (WHP), district energy (DE), and energy efficiency (EE) installations. In his decade plus tenure at the ERC, Mr Miller has collaborated with regulatory and utility stakeholder across the Midwest to address barriers to on-site generation. His current research is focused on modelling how Combined Heat and Power, and Waste Heat to Power technologies can promote industrial decarbonization.

Ben Campbell
Principal Research Engineer, UIC Energy Resources Center
Ben Campbell is a principal research engineer at the Energy Resources Center (ERC)--an interdisciplinary public service, research, and special projects organization that works to advance energy sustainability and improve the environment, based out of the College of Engineering at the University of Illinois Chicago. Ben has extensive experience energy efficiency, renewable energy, and distributed power generation through management of several programs for the State of Illinois, local utilities, and the Department of Energy. Ben closely follows emerging technologies, market trends, and best practices in the energy industry and pursues novel research funding opportunities. Ben is an advocate for sustainability, energy use awareness, energy efficiency, renewable fuels, high efficiency power generation, and carbon and emissions reductions. Prior to working with the Energy Resources Center, Ben has experience working in manufacturing, information technology, management, and customer service.

Jennifer Klemundt
Assistant Director of Research Operations, UIC Energy Resources Center
Jennifer Klemundt has worked at the Energy Resources Center since 2004 at the Energy Resources Center(ERC)—an interdisciplinary public service, research, and special projects organization that works to advance energy sustainability and improve the environment, based out of the College of Engineering at the University of Illinois Chicago. She started as a Project Coordinator on the IL Department of Central Management Services Utility Demand Management Billing and Auditing Program. Since 2013, Jennifer Klemundt has served as an Assistant Director of Research Operations at the Energy Resources Center (ERC) which is an interdisciplinary public service, research, and special

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UNIVERSITY OF ILLINOIS CHICAGO

projects organization that works to advance energy sustainability and improve the environment, based out of the College of Engineering at the University of Illinois Chicago. She manages and tracks all proposals, contracts, and department financials. She also manages the Utility Management/Auditing and State Utility Database programs for the Illinois Department of Central Management Services. The Utility Management program insures verification of electricity and natural gas deregulated accounts for State Agencies receiving third-party supply through the State Bulk Procurement Program. The State Utility Database program provides a repository of usage and cost data for major utility companies for all State facilities and accounts. This allows for the tracking and reporting for all State facilities by authorized users. She has also assisted the Illinois Department of Central Management Services with completing benchmarking as required by the City of Chicago ordinance since 2014.

Energy Resources Center
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CLIFFORD P. HAEFKE

Director – Energy Resources Center, University of Illinois Chicago
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ENERGY RESOURCES CENTER

The Energy Resources Center, based out of the College of Engineering at the University of Illinois Chicago, is an interdisciplinary public service, research, and special projects organization that works to advance

EDUCATION

LIAUTAUD GRADUATE SCHOOL OF BUSINESS, UNIVERSITY OF ILLINOIS CHICAGO — Chicago, IL
Master of Business Administration — 2003 – 2006

UNIVERSITY OF ILLINOIS CHICAGO — Chicago, IL
Bachelor of Science in Mechanical Engineering — *1995 – 1999*

EXPERIENCE

ENERGY RESOURCES CENTER (ERC), UNIVERSITY OF ILLINOIS CHICAGO (UIC) — Chicago, IL

Director — *2015 – Present*

- Oversees all operations and strategic direction of the ERC covering the five research areas of Energy Efficiency, Distributed Energy and Renewables, Bioenergy, Clean Transportation, Utility Data Analytics, and Sustainable Landscapes.
- Managed $35M+ of new business development research initiatives from federal government, state government, national laboratories, investor owned utilities, foundations, associations, and private sector entities.
- Supervised mentorship of 80+ student interns in the fields of energy efficiency, distributed energy, and environment.
- Serves as the Director of the US DOE's Midwest and Central CHP Technical Assistance Partnerships developing program strategies, educating stakeholders, and providing technical assistance to assist the market transformation of combined heat and power (CHP).
- Serves as the Assistant Director of UIC's US DOE Industrial Assessment Center that provides no-cost energy, productivity, and waste assessments to small and medium sized US manufacturers and providing student workforce development in the energy sector.

Academic Instructor — *2004 – Present*

- Instructor for ENER424 Industrial Energy Management and ENER420 Combined Heat & Power, Design & Management.
- Co-developed graduate level semester course curriculum and materials for Combined Heat and Power, Management and Design (for UIC Master of Energy Engineering Program).
- Serves on the Advisory Council of UIC's Master of Energy Engineering Program

Principal Research Engineer — *2011 – 2014*

- Lead senior level staff member for the ERC's Distributed Generation Research Area and key contributor to Center's planning development, strategic focus, and grant writing.
- Senior level program manager for the U.S. DOE's Midwest CHP Technical Assistance Partnership (TAP) developing program and marketing strategies, educating stakeholders, overseeing feasibility evaluations and technical assistance.
- Secured funding state energy offices to provide analytic support leading to changes in net metering, grid interconnection, standby rates, and grant and incentive programs.

Senior Energy Engineer — *2007 – 2011*

- Senior research engineer for the U.S DOE Midwest Clean Energy Application Center managing daily operations and overall project management with U.S. DOE. Developed and implemented presentations, organized workshops and conferences, completed analysis for technical papers, and oversaw the implementation of technical and economic feasibility studies.
- Program Manager for the U.S. DOE and NASEO sponsored Midwest Buildings Technology Application Center (MBTAC) program providing information, education, and technical assistance in areas of energy efficiency to commercial and intuitional markets.

Research Engineer — *2000 – 2007*

- Implemented technical and economic feasibility studies evaluating potential distributed energy, assisted development of state distributed energy roadmaps, and evaluated impacts of new natural gas R&D programs.

ADDITIONAL INFORMATION

External Leadership Roles

- President, 2012-Present, Midwest Cogeneration Association (MCA)
- Advisory Council, 2015-Present, UIC Master of Energy Engineering (UIC-MEE)
- Board Member, 2019-Present, 2015-2016, Midwest Energy Efficiency Alliance (MEEA)

Awards

- CHP Champion, awarded by the United States CHP Association (USCHPA), December 2013
- CHP Champion, awarded by the Combined Heat and Power Alliance (CHPA), September 2021

MARCELLO PIBIRI

Senior Research Engineer - Energy Resources Center, University of Illinois Chicago
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ENERGY RESOURCES CENTER

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EDUCATION

University of Illinois at Chicago — Chicago, IL
Master Degree of Energy Engineering — *December 2016*

Universita' degli studi di L'Aquila — L'Aquila, Italy
Bachelor Degree in Electrical Engineering — *December 2005*

EXPERIENCE

UNIVERSITY OF ILLINOIS AT CHICAGO – ENERGY RESOURCES CENTER — Chicago, IL

Senior Research Engineer — *August 2021 – Present*

- Outreach Coordinator for the Water/Wastewater Treatment Plant and K-12 Schools ComEd Incentive Programs. Main tasks for this position include marketing and technical outreach, acting as point of contact for clients participating in the ComEd Energy Efficiency Program, identification and technical evaluation of new energy efficiency opportunities for the client and review of eligibility for incentives, coordination of outreach activities of a team of 3 to 6 individuals, KPIs progress reporting, energy savings calculations.
- Program Manager of the new EPA funded Technical Education and Analysis for Community Hauling and Anaerobic Digesters Program. Main tasks include coordination of team's activities, technical assessments of anaerobic digestion systems, outreach and education activities including webinars and workshops, preparation of case studies documents.
- Support the U.S. DOE's Midwest CHP Technical Assistance Partnership and the U.S. DOE Industrial Assessment Center with the preparation of CHP feasibility studies and the performance of energy assessments for wastewater treatment facilities.

Energy Engineer — *June 2016 – July 2021*

- Outreach Coordinator for the Water/Wastewater Treatment Plants ComEd Incentive Programs. Main tasks for this position include marketing and technical outreach, acting as point of contact for clients participating in the ComEd Energy Efficiency Program, identification and technical evaluation of new energy efficiency opportunities for the client and review of eligibility for incentives, KPIs progress reporting, energy savings calculations.
- Management of Public Sector Boiler System Efficiency Program: the program provides incentives for the implementation of projects focused on increasing the efficiency of natural gas boiler systems. Main tasks for this position include technical assistance of potential applicants, applications review, calculation of energy savings, marketing, and outreach.
- Energy assessments for public sector facilities in Illinois that include utility bill analysis, on site walkthrough to collect information, energy modeling, and economic analysis of energy cost reduction measures.
- Management of Clean Water Incentive Program from June 2017 until December 2017. Main tasks for this position include marketing and outreach, acting as a point of contact for the client regarding submission of applications, leveraging funding opportunities, and introducing new projects through other entities such as the Industrial Center Assessment, the Environmental Protection Agency, and the Illinois Clean Energy Community Foundation.
- Development of the 2016 ASERTII National Guide to Energy Research Centers: contacted more than 200 Energy Research Centers across the nation and organized the collected data.

ADDITIONAL INFORMATION

Awards

- U.S. Department of Energy Water Resource Recovery Prize – Phase 1

Technical Skills and Competencies

- Software: Salesforce, Autocad, BTicino TSystems, Integra (electrical calculation software), eQuest, C programming language, Labview, Matlab, Office Word, Office Excel, Office PowerPoint
- Basic Practical experience in cabling electrical panels

GRAEME MILLER

Senior Research Specialist--Energy Resources Center, University of Illinois Chicago
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ENERGY RESOURCES CENTER

The Energy Resources Center, based out of the College of Engineering at the University of Illinois Chicago, is an interdisciplinary public service, research, and special projects organization that works to advance energy sustainability and improve the environment.

EDUCATION

COLLEGE OF URGAN PLANNING AND PUBLIC AFFAIRS, UNIVERSITY OF ILLINOIS CHICAGO — Chicago, IL
Master of Urban Planning and Policy — *2009 – 2011*

GRINNELL COLLEGE — Grinnell, IA
Bachelor of Arts in Music, with honors, and History — *2002 – 2006*

EXPERIENCE

ENERGY RESOURCES CENTER (ERC), UNIVERSITY OF ILLINOIS CHICAGO (UIC) — Chicago, IL

Senior Research Specialist — *2018 – Present*

- Serves as the Assistant Director of the U.S. DOE's Midwest CHP Technical Assistance Partnership (TAP) developing program and marketing strategies, educating stakeholders, overseeing feasibility evaluations and technical assistance to promote and assist in transforming the market for CHP, WHP, and district energy with CHP. Supports state led CHP initiatives, maintains relations with U.S. DOE program sponsors in Washington DC, and oversees the development of all program deliverables.
- Collaborates with trade and policy organizations such as the US CHP Alliance, National Association of State Energy Officials, Midwest Cogeneration Association, Ohio Center for Industrial Energy Efficiency, to advance policies supporting clean distributed energy generation.
- Analyzed CHP feasibility at over 20 sites in the Midwest region, including all financial modelling, prime mover performance modelling, utility tariff modelling, and environmental modelling.
- Collaborates with State Energy Offices (SEOs), local American Society for Healthcare Engineering chapters, environmental advocates, utilities, and regulators to identify opportunities and barriers for CHP in the Midwest. Through this collaboration I have developed presentation materials, organized workshops, spoke at conferences, and completed and reviewed technical analysis including detailed financial screenings, CHP qualification screenings, CHP feasibility studies and CHP technical potential studies.
- Manage junior staff and graduate student interns

Academic Instructor — *2014 – Present*

- Developed graduate level semester course curriculum and materials for Combined Heat and Power, Management and Design (for UIC Energy Engineering Masters Program).
- Instructed 200+ undergraduate / graduate students.

Energy Policy Analyst — *2011 – 2018*

- Worked with stakeholders including investor owned utilities, public service commission staff, State Energy Offices, and large energy users in Iowa, Minnesota, Indiana, Ohio and Michigan to model the financial effects of standby rates on CHP applications.
- Provided utility rate technical expertise on standby rates to MidAmerican Power (IA), Dakota Electric Association (MN), Minnesota Power (MN), Ameren Missouri, NISPCO (IN), and Alliant Power (IA)
- Program manager for the US Energy Information Administration's Illinois State Heating Oil and Propane Program (SHOPP)
- Program manager for the Illinois Energy Assurance plan and Illinois' Energy Infrastructure GIS database through the state's Department of Commerce and Economic Opportunity (DCEO).
- Coordinated the Illinois Energy Assurance Plan efforts with the Department of Transportation, Department of Central Management Services, Illinois Commerce Commission, Illinois Emergency Management Agency.
- Training and developing junior staff
- Training and developing of junior level staff.

Ben Campbell

Senior Research Engineer

(217) 417-6931 | bcampb24@uic.edu

LinkedIn Ben Campbell

ENERGY RESOURCES CENTER

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EDUCATION

UNIVERSITY OF ILLINOIS AT CHICAGO — Chicago, IL

Master of Energy Engineering — *2013 – 2014*

ILLINOIS STATE UNIVERSITY — Normal, IL

Bachelor of Science in Renewable Energy - Technology — *2009-2010*

EXPERIENCE

ENERGY RESOURCES CENTER (ERC), UNIVERSITY OF ILLINOIS CHICAGO (UIC) — Chicago, IL

Sr Research Engineer

Active Programs: *2018 – Present*

- **Department of Energy Evaluation of Economic, Ecological, and Performance Impacts of Co-Located Pollinator Plantings at Large-Scale Solar Installations (2021)** – Research lead working with Argonne National Laboratory, the National Renewable Energy Laboratory, and the University of Illinois Urbana Champaign to evaluate the impacts of pollinator plantings underneath and around solar facilities larger then 10 MW. Conducting performance research measuring evapotranspiration properties from the plants underneath photovoltaic panels. Measuring power output of the panels over the three-year period as the pollinator plantings establish. Development of tools to evaluate installation cost, annual operations and maintenance, and lifecycle costs of managing pollinator plantings at photovoltaic facilities.
- **Nicor Gas Energy Efficiency Combined Heat and Power Feasibility Study Program (2019)** – Providing Nicor Gas customers with education, resources, and feasibility analysis to promote the adoption of CHP for Nicor Gas customers. Feasibility analysis includes budgetary pricing, hourly part load modelling analysis, steam/hot water/chilled water production, electricity generated, and pro-forma cost analysis for the lifetime of the equipment. Working with industrial, commercial, and public sector facilities to size appropriate equipment for their energy needs.
- **Department of Energy Midwest and Central Combined Heat and Power Technical Assistance Program (2018)** – Lead engineer with roles including educating stakeholders in CHP technologies, and providing technical assistance in the institutional, industrial, commercial, and agricultural market sectors. Working with local utilities, as well as providing reviews of engineering studies. Develop modelling tools to evaluate the economics of installing CHP systems.
- **TEACH Anaerobic Digestion Program (2021)** – Working with the Environmental Protection Agency to provide modelling of anaerobic digestion technologies to reduce food waste and FOG sent to landfills. Analysis includes carbon reduction, landfill diversion, biogas/renewable natural gas production, and equivalent electricity generated.

Committees:

- **Illinois Technical Advisory Committee** - Developing, editing, and providing feedback on deemed savings database measures for ground source heat pumps, combined heat and power, and air source heat pumps. Work with the Illinois and Massachusetts Stakeholder Advisory Group's Technical Advisory Committee to develop version releases of the TRM.
- **Chancellors Committee on Sustainability and Energy** Assisting the development of the campus Climate Action Implementation Plan which includes a target of net zero carbon emissions by 2050. Assessment of campus' renewable energy, retrocommissioning, and energy efficiency potential to align with university carbon reduction targets. Working with UIC to develop a strategic energy management plan on campus.

Academic Instructor: *2018 – Present*

- ENER420 Combined Heat and Power course for the UIC Masters of Energy Engineering Program. CHP systems construction, operation, economics and includes a student design project. Builds on previous courses in power plants, engines, HVAC, a stress on economic and software analysis, utility rates and regulations.
- ENER422 Heating Ventilation and Air Conditioning course for the UIC Masters of Energy Engineering program. Building construction practices, sizing and design of HVAC systems, management of moisture.

JENNIFER KLEMUNDT

Assistant Director of Research Operations, Energy Resources Center
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ENERGY RESOURCES CENTER

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EDUCATION

UNIVERSITY OF ILLINOIS CHICAGO — Chicago, IL
Bachelor of Arts in Psychology — *1998 – 2004*

EXPERIENCE

ENERGY RESOURCES CENTER (ERC), UNIVERSITY OF ILLINOIS CHICAGO (UIC) — Chicago, IL

Assistant Director of Research Operations — *2014 – Present*

- Track and report on department financials to Director and project PIs.
- Approve, reconcile and analyze all financial transactions.
- Coordinate and process department human resources transactions.
- Maintain active and archive files systems for personnel, business/finance accounts and department grants and contracts.
- Manage and process all department grants and contracts from proposal to project closeout.
- Review and approve employee reimbursements.
- Coordinate and conduct utility billing auditing on electricity and natural gas accounts for multiple service territories.
- Complete annual City of Chicago Benchmarking as required for the Illinois Department of Central Management Services.
- Coordinate and oversee all annual mandatory trainings for department staff.
- Coordinate and insure compliance with University policies, federal and state regulations as well as sponsor terms.

Project Coordinator — *2004-2014*

- Assist with tracking and reporting on department financials to Director and project PIs.
- Assist with the maintenance of active and archive files systems for personnel, business/finance accounts and department grants and contracts.
- Assist with the preparation of all department grants and contracts documents for submission to University offices.
- Process employee reimbursements.
- Conduct Research including gathering legislation and utility data.
- Handle billings in excess of 40 million dollars per year for utility accounts, including account auditing, analysis and reporting, and problem resolution.
- Train and supervise student interns.
- Coordinate and conduct utility billing auditing on electricity and natural gas accounts for multiple service territories.
- Complete annual City of Chicago Benchmarking as required for the Illinois Department of Central Management Services.

MECHANICAL & INDUSTRIAL ENGINEERING, UNIVERSITY OF ILLINOIS CHICAGO (UIC) Chicago, IL

General Office Aide *2002 - 2004*

- Prepared graduate program applications for review and maintained applicant file system.
- Created and maintained databases for department.
- Organized and maintained thesis library.
- Maintain all relevant materials for Graduate Office, including all forms and application packets.
- Managed incoming and outgoing mail.
- Processed vouchers, invoices, and maintained electronic and hard copy financial records.

MINORITY ENGINEERING RECRUITMENT AND RETENTION PROGRAM, UNIVERSITY OF ILLINOIS CHICAGO (UIC) Chicago, IL

General Office Aide *1998 - 2002*

- Created and maintained information binders on scholarships and graduate school for students and visitors to the department.
- Researched and updated departmental procedures manual.
- Used word processing and other programs to maintain databases, create and manage mailing for departmental events and educational programs.
- Responsible for maintaining and preparing documents, informational packets and brochures for departmental meetings, seminars, and educational programs.
- Assisted department secretary in maintaining and updating department electronic and hard copy financial records.
- Verified and maintained contact lists for Director/Assistant Directors for various department programs and events.

UNIVERSITY OF MINNESOTA MN TAP
Minnesota Technical Assistance Program
200 Oak Street, Ste. 350-1 · Minneapolis, MN 55455-2008
612.624.1300 · www.mntap.umn.edu · mntap@umn.edu
Strengthening Minnesota businesses by maximizing efficiency and lowering costs through energy, water and waste reduction

March 15, 2024

Katrina Kessler, Commissioner
Minnesota Pollution Control Agency
520 Lafayette Road
Saint Paul, MN 55155

Subject: MnTAP Support of the State Minnesota's participation in the Climate Pollution Reduction Grant coalition proposal, Midwest Industrial Decarbonization Challenge (NOFO EPA-R-OAR-CPRGI-23-07)

Dear Commissioner Kessler,

The Minnesota Technical Assistance Program (MnTAP) affirms our partnership with the Minnesota Pollution Control Agency in its coalition with the State of Michigan in response to the Climate Pollution Reduction Grant implementation funding opportunity (EPA-R-OAR-CPRGI-23-07). We are pleased to endorse the Midwest Industrial Coalition's objective to reduce greenhouse gas (GHG) emissions from the region's top polluting, hard-to-decarbonize industries.

Through the Midwest Industrial Coalition program period, we anticipate collaborating with the MPCA to deliver incentives programs to reduce industrial GHG emissions, including but not limited to industrial energy efficiency, fuel-switching, and innovative technologies. Our commitment extends to supporting program development and implementation of industrial emission reduction strategies.

Minnesota's Climate Action Framework and Michigan's Healthy Climate Plan, both published in 2022, as well as both states' Priority Climate Action Plans align our two states with many shared goals for equitable climate action that supports a robust clean economy. This proposal connects strongly with the ambitions in those documents and of our states to be national leaders in collaborative climate action.

The proposed GHG reduction measures will achieve significant cumulative GHG reductions, provide substantial community benefits in low-income and disadvantaged communities, and complement other funding sources to maximize both GHG reductions and community benefits. The State of Michigan, through the Office of Climate and Energy (OCE), has a commendable track record of effectively utilizing state and federal grants while actively engaging with low-income and disadvantaged communities.

Given our states' shared goals and proven success in implementing equitable climate policies that support a clean economy, we have full confidence in Michigan's ability to lead the development the Midwest Industrial Decarbonization Challenge and achieve the objectives laid out in the application. These objectives include emissions reduction and mobilizing financing and private capital to address barriers to implementing clean and innovative industrial processes. Furthermore, this initiative will stimulate increased investment in clean industrial projects critical to achieving the state's climate objectives, particularly within historically underinvested communities facing longstanding challenges.

MnTAP is part of the University of Minnesota, School of Public Health, Division of Environmental Health Sciences, and funded in part by a grant from the state of Minnesota.

MnTAP is excited to collaborate in this industrial decarbonization work because it aligns with our mission: strengthening Minnesota businesses by improving efficiency while saving money through energy, water, and waste reduction. Our organization is based at the University of Minnesota in the School of Public Health. MnTAP takes pride in collaborating with others to identify practical, cost-effective solutions that help create environmentally conscious, safe, and efficient operations. We prioritize quality in our work and provide continual support through the implementation of each project.

We have provided pollution prevention technical assistance for businesses and organizations throughout Minnesota since we began in 1984. During that time, we have been involved in reducing industrial GHG emissions through activities such as site-specific energy audits, summer-long internship projects, and targeted training programs.

In addition to this work, MnTAP and MPCA have a long history of project partnerships. Following are some specific recent examples of projects that MnTAP partnered with MPCA:

- **EPA P2 Grant 2022** EPA-HQ-OPPT-2022-001 (Grant period 10/1/2022 – 9/30/2025)
  - Minnesota Performance Partnership Grant (BG-98568812)
  - "Pollution Prevention for Minnesota Food and Beverage Manufacturing Industries"
- **EPA P2 Grant 2022** EPA-I-OCSPP-OPPT-FY2022-001 (Grant period 10/1/2022 – 9/30/2025)
  - Bipartisan Infrastructure Law Grant ID 4U – 00E03258-0
  - "PFAS Pollution Prevention Best Management Practice Options and Opportunities for Minnesota Manufacturing Industries"
- **EPA P2 Grant 2020** (Grant period 10/1/2020 – 9/30/2023)
  - Minnesota Performance Partnership Grant (BG-98568811)
  - "Pollution Prevention Best Management Practices and Implementation for Minnesota Metal Fabrication Industries"
- **EPA P2 Grant 2018** (Grant period 10/1/18-9/30/21)
  - Minnesota Performance Partnership Grant (BG-98568811)
  - "Alternative Trichloroethylene (TCE) Solvent Replacements: Pollution Prevention Assistance"
- **EPA P2 Grant 2016** (Grant period 10/1/16 – 9/30/18)
  - Minnesota Performance Partnership Grant (BG-98568811)
  - "P2 Grant: Pollution Prevention Opportunities in the Minnesota Food Processing Industry"

We are excited to support this collaborative proposal because we all have a role to play in making the Midwest a national leader in industrial decarbonization and a clean economy. We are enthusiastic about partnering with the MPCA to advance our shared climate goals and the goals of the U.S. Environmental Protection Agency's ambitious and vital CPRG program.

Sincerely,

Kelsey Klucas
Director, MnTAP
200 Oak St. SE
Minneapolis, MN 55455
612-624-4619, kluc0035@umn.edu

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Mechanical Engineering Department

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March 17, 2024

Phil Roos
Director
Michigan Department of Environment, Great Lakes, and Energy
525 West Allegan Street
Lansing, MI 48933

Subject: The University of Wisconsin-Milwaukee Industrial Assessment Center (UWM-IAC) Supports the State of Michigan's CPRG Coalition Proposal for the Midwest Industrial Decarbonization Challenge (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Director Roos,

The University of Wisconsin-Milwaukee Industrial Assessment Center (UWM-IAC) affirms our commitment to work with the State of Michigan in its partnership with the states of Illinois, Minnesota, Ohio, and Wisconsin to carry out a regional effort to reduce industrial emissions in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse the Midwest Industrial Decarbonization Challenge's objective to reduce greenhouse gas (GHG) emissions from the twenty (20) region's top polluting, hard-to-decarbonize industries.

We understand the role the application contemplates we will play as a university research entity. In the event that the EPA awards the grant for the Midwest Industrial Decarbonization Challenge to the State of Michigan (EGLE) and should we enter into a contract with our partnering state agency in Wisconsin, we are ready, willing, and able to carry out the roles and responsibilities contemplated. Through the Midwest Industrial Decarbonization Challenge program period, we anticipate collaborating with the State to deliver incentive programs, including but not limited to industrial energy efficiency, fuel-switching, and innovative technologies in order to reduce industrial GHG emissions. Our commitment extends to supporting program development and implementing industrial emission reduction strategies.

The proposed GHG reduction measures will achieve significant cumulative GHG reductions, provide substantial community benefits in low-income and disadvantaged communities, and complement other funding sources to maximize both GHG reductions and community benefits. Because many industrial facilities are located in or upwind of low-income and disadvantaged communities (LIDAC), we know that improvements to the environmental performance of industrial facilities in the region will benefit LIDAC communities. We understand that the states in the coalition are committed to achieving such benefits.

We understand industrial decarbonization because we work with industrial facilities in Wisconsin to provide technical and analytical support, including assessments of measures that can be undertaken at those facilities to reduce the use of fossil fuels and otherwise reduce emissions, often saving money in the process. The role anticipated for us under the Midwest Industrial Decarbonization Challenge is a natural scaling-up of the work we are already doing.

The UWM-IAC has contributed to the Midwest regional industrial assessment program for over 20 years. The center's team comprises 14 Ph.D. candidates with Mechanical, Materials, Electrical, Energy, and Chemical engineering backgrounds. The team is directed by the PI, Prof. Ryo Amano, and four assistant directors to help manage the team. The team shares our high qualifications for providing energy assessments for manufacturers. Taking advantage of the team skills will strengthen the technical assistance provided to the industries.

UWM-IAC is the only center in Wisconsin. The center is located in Milwaukee, WI, and serves Wisconsin, Minnesota, Iowa, and northern Illinois. The food industry, foundries, and paper manufacturing are considered the major industries in the Midwest. The named industries are large GHG emitters, and the center is willing to help them reduce their emissions.

One of the center's focuses is cybersecurity. The IAC offers a professional meeting with the respective facility's IT representative and the UWM-IAC's cybersecurity specialist, assistant director, Dr. Rafat Elsharef, to provide a cybersecurity assessment recommendation to be included in the energy assessment report. The center works on workforce development in the energy field by providing training sessions and offering academic courses each academic year.

The center has built strong partnerships with several local and national entities, including industries. The center partnered with the Wisconsin Economic Development Corporation (WEDC) to promote new emerging energy technologies for industrial facilities. Another center partner is the Focus on Energy (FoE), the Wisconsin utilities' statewide energy efficiency and renewable resources program. They support our center's services by participating in energy assessments and providing incentives to clients.

We have considerable expertise in the energy area, including Ph.D. degree holders and Ph.D. candidates and members certified with CEM®, LEED, NABCEP®, CMCP™, EMIT®, etc. Other members had internships during the summer/academic period working with energy professionals conducting level 3 energy auditing. We are attaching the short CVs of our leadership and principal staff to this letter.

The center has served more than 210 industries in Wisconsin and neighboring states, including manufacturers and water and wastewater treatment plants (WWTPs). The center provided over 1,700 assessment recommendations (ARs) to save energy and optimize energy performance. The provided ARs potentially could save more than $17 million, more than 2.4 TBtu, and more than 180 thousand tons of CO2 emissions annually if implemented. The UWM-IAC program has trained over 87 graduate and undergraduate students, many of whom now work in energy-related positions and utilities in Wisconsin and nationwide. Currently, the UWM-IAC helps industries with the DOE's Implementation Incentive Grants. Our center implements approximately 20 assessments for large emitters and provides technical assistance and support services throughout the five-year grant period.

We are enthusiastic about partnering with the State of Michigan (MI EGLE) to advance the goals of the US Environmental Protection Agency through this pivotal program.

Sincerely,

Ryo S. Amano

Ryo Amano, Director of UWM-Industrial Assessment Center
Richard & Joanne Grigg Fellow Professor

RESUMES/CVS

PI: Ryo S. Amano

Richard & Joanne Grigg Fellow Professor, Dept. of Mechanical Engineering, UW-Milwaukee, Milwaukee, WI 53201

Ph: 414-229-2345; Fax: 414-229-6814 Email: amano@uwm.edu,

ASME Fellow; Royal Aeronautical Society (RAeS) Fellow; International Society for Energy, Environment, and Sustainability (ISEES) Fellow; AIAA Assoc. Fellow

Lead Project Manager, Dr. Ryo Amano, Richard & Joanne Grigg Fellow Professor, is currently the Director of the UWM-Industrial Assessment Center (UWM-IAC) and has been conducting energy assessments for industries and water/wastewater facilities in Wisconsin, Illinois, and Iowa for more than seven years. The Center has performed approximately 210 energy assessments. In research, Dr. Amano has a strong energy, power, and water engineering background and has published four books, thirty-three book chapters, and over 250 journal publications on energy-related topics. He is the recipient of the ASME George Westinghouse Gold Medal (2014) to be recognized for distinguished achievement and eminent service in the power field of mechanical engineering and outstanding contribution to turbomachines (turbines) research, the AIAA Energy Systems Award (2013) for global energy applications, and the ASME Henry R. Worthington Medal (2020) for excellent pump technology development and for outstanding achievement in the field of pumping machinery, systems, and concepts.

Education

University of California at Davis, California, Mechanical Engineering Ph.D., 1980

Appointments

Richard & Joanne Fellow Professor, University of Wisconsin-Milwaukee, 02/2022-present
Professor, Mechanical Eng. Dept., University of Wisconsin-Milwaukee, 08/1991-present
Visiting Professor, Propulsion Div., Edwards Air Force Research Lab, 05/2013-08/2013
Visiting Professor, Aircraft Propulsion, Wright-Patterson Air Force Base, 05/2012-08/2012
Visiting Professor, Turbomachinery Branch, NASA Glenn Research Center, 05/2011-08/2011

Special Appointments

2024-present	Director, Building Training and Assessment Center (BTAC), University of Wisconsin-Milwaukee
2016-present	Director, Industrial Assessment Center, University of Wisconsin-Milwaukee
2000-2002	Department Chair, Department of Mechanical Engineering, UW-Milwaukee

Editorship

2016-present	Chief Editor, Int. J. Rotating Machinery, Wiley
2023-present	Associate Editor, J. Fluids Engineering, ASME Transaction
2010-2023	Associate Editor, J. Energy Resources Technology, ASME Transaction

Publications: Published more than 700 papers, including four books, 24 book chapters, 160 journal papers, and 500 conference proceedings. About 5,700 citations; 152 i10-index; 34 h-index (Most Closely Related to the Project are listed below)

BOOKS:

1. Amano, R.S. and Sunden, B., Aerodynamics of Wind Turbine Blades--Emerging Topics, WIT Press, ISBN 978-1-78466-004-8; eISBN 978-1-78466-005-5, Pages 196, 2015, http://www.witpress.com/books/978-1-78466-004-8
2. Amano, R.S. and Sunden, B., Impingement Jet Cooling in Gas Turbines," WIT Press Book Series: Developments in Heat Transfer, 2014, Pages: 252pp, ISBN: 978-1-84564-906-7, http://www.witpress.com/books/978-1-84564-906-7
3. Amano, R.S. and Sunden, B., Computational Fluid Dynamics and Heat Transfer-Emerging Topics, WIT Press ISBN: 978-1-84564-144-3, ISSN (print): 1369-7331 Pages: 512pp, eISBN: 978-1-84564-402-4, 2010, http://www.witpress.com/books/978-1-84564-144-3
4. Amano, R.S. and Sunden, B., Thermal Engineering in Power Systems, 2008, 416pp, WIT Press ISBN: 978-1-84564-062-0, http://www.witpress.com/books/978-1-84564-062-0

BOOK CHAPTERS:

1. Selim, O., Espindola, J., and Amano, R.S., "Review of Biomass Energy Resources with Livestock Manure," Advances in Energy and Combustion, pp. 125-156, https://doi.org/10.1007/978-981-16-2648-7_6, ISBN 978-981-16-2647-0 ISBN 978-981-16-2648-7 (eBook), 2021, Springer
2. Kumar, S. and Amano, R.S., "Approach to Solve Renewable Energy Problems," Advances in Energy and Combustion, pp. 441-476, https://doi.org/10.1007/978-981-16-2648-7_20, ISBN 978-981-16-2647-0 ISBN 978-981-16-2648-7 (eBook), 2021, Springer
3. Amano, R.S., "Aerodynamic Behavior of Rear-Tubercle Horizontal Axis Wind Turbine Blade," Sustainable Development for Energy, Power, and Propulsion, ISBN 978-981-15-5666-1, pp.545-562; DOI http://doi-org-443.webvpn.fjmu.edu.cn/10.1007/978-981-15-5667-8_22, ISBN 978-981-15-5666-1 ISBN 978-981-15-5667-8 (eBook), 2021, Springer
4. Amano, R.S. and Hussein, M.S.I., "Study of Biofuel Animal Manure," Innovations in Sustainable Energy and Cleaner Environment, pp 529-539, Green Energy and Technology book series (GREEN), 2020 Springer Nature Switzerland AG, ISBN 978-981-13-9011-1 ISBN 978-981-13-9012-8 (eBook)

JOURNALS (selected papers):

- Burra, K., Selim, O., Amano, R.S., Gupta, A., "Synergy In Syngas Yield from Co-Pyrolysis of Cow and Chicken Manures," *J. Energy Resour. Technol.,* Technology (IF=3.183), 2023, 145(6): 061303 (7 pages) https://doi.org/10.1115/1.4056563
- Norin, F., Blum, B., Amano, R.S., "Exploring the Effects of Guide Vane of Gas Turbine Blade," *J. Energy Resour. Technol.,* (IF=3.183 2023, 145(5): 051702 (13 pages), https://doi.org/10.1115/1.4056334
- Saadeh, W., Amano, R.S., and Qandil, M., "Nanocomposites Vascular Self-Healing Wind Turbine Blades," *J. Energy Resour. Technol.,* (IF=3.183), 2023, 145(2): 022102 (8 pages), https://doi.org/10.1115/1.4054827
- Hasan, A., Salem, Abousabae, M.., Al Hamad, S., Amano, R.S., "Investigation of Tubercles and Winglets Horizontal Axis Wind Turbine Blade Design, *J. Energy Resour. Technol.,* (IF=3.183), 2023, 145(1): 011302 (14 pages), https://doi.org/10.1115/1.4054756
- Hasan, A., Salem, Abousabae, M.., Al Hamad, S., Amano, R.S., "Investigation of Vortex Generators and Winglets in Horizontal Axis Wind Turbine Blade Design, *J. Energy Resour. Technol.,* (IF=3.183), 2023, 145(1): 011301 (14 pages), https://doi.org/10.1115/1.4054755
- Nourin, F., Amano, R.S., "Jet Impingement Cooling for Gas Turbine Blades," *J. Energy Resour. Technol.,* (IF=3.183), 2023, 145(2): 022101 (10 pages), https://doi.org/10.1115/1.4054465
- Nourin, F.N., Blum, B., Amano, R.S., "Evaluation of Heat Transfer Enhancement on Rotational Gas Turbine Blade Internal Cooling Channel," *J. Energy Resour. Technol.,* (IF=3.183), 2022, 144(11): 112105 (12 pages), https://doi.org/10.1115/1.4054288
- Al Hamad, S., Hasan, A., Habash, O., Amano, R.S., "Effect of the J-shaped Wind Turbine Airfoil Opening Ratio and Thickness on the Performance of Symmetrical Airfoils," *J. Energy Resour. Technol.,* (IF=3.183), 2022, 144(5): 051303 (11 pages), https://doi.org/10.1115/1.4053743
- Xu, C., Amano, R.S., "Turbocharger Design Targets and Centrifugal Compressor Design," *J. Energy Resour. Technol.,* (IF=3.183), 2022, Vol. 144 / 052103-1, https://doi.org/10.1115/1.4053300
- Alkhalidi, A., Abuothman, A., Abbas, H., A-Duqqah, B., Nofal, T., Amano, R.S., "Cantilever wind turbines installation to harvest accelerated wind in dams (hybrid floating PV – Wind system," *Renewable Energy Focus,* 2021 (IF=4.082), 40(4), https://DOI:10.1016/j.ref.2021.11.005
- Hasan, A., Salem, A.R., Abdelhadi, A., Al Hamad, S., Qandil, M., Amano, R.S., "The Power Reclamation of Utilizing Micro-Hydro Turbines in the Aeration Basins of Wastewater Treatment Plants," *J. Energy Resour. Technol.,* (IF=3.183) 2021, 143(8): 081301 (7 pages), https://doi.org/10.1115/1.4048869
- Nourin, F., Amano, R.S., "Heat Transfer Enhancement with Distinct Dimpled Gas Turbine Blade," *J. Energy Resour. Technol.,* (IF=3.183), 2022, 144(7): 072101 (12 pages), https://doi.org/10.1115/1.4052035
- Nourin, F., Espindola, J., Selim, O., Amano, R.S., "Energy, Exergy, and Emission Analysis on Industrial Air Compressors," *J. Energy Resour. Technol.,* (IF=3.183), 2022, 144(4): 042104 (14 pages), https://doi.org/10.1115/1.4051682
- Burra, K.R., Hussein, M.S., Amano, R.S., and Gupta, A.K, "Syngas Evolutionary Behavior during Chicken Manure Pyrolysis and Air Gasification," Applied Energy (IF=8.5), Vol. 181, 2017, pp. 408-415, https://doi.org/10.1016/j.apenergy.2016.08.095
- Qandil, M., Abbas, A., Al Hamad, S., Saadeh, W., Amano, R.S., "Performance of Hybrid Renewable Energy Power System for a Residential Building," *J. Energy Resour. Technol.,* (IF=3.183), 2022, 144(4): 041301 (18 pages),

https://doi.org/10.1115/1.4051541

- Hasan, A., Selim, O., Abousabae, M. Amano, R.S., Otieno, W., "Economic, Exergy, and Environmental Analyses of the Energy Assessments for U.S. Industries," *J. Energy Resour. Technol.,* (IF=3.183), 2021, 143(11): 112107 (12 pages), https://doi.org/10.1115/1.4050580
- Qandil, Abbas, Salem, Abdelhadi, Hasan, Nourin, Abousabae, Selim, Espindola, R.S. Amano, "Net Zero Energy Model for Wastewater Treatment Plants," *J. Energy Resour. Technol.,* (IF=3.183), 2021, 143(12): 122101 (12 pages), https://doi.org/10.1115/1.4050082
- Selim, O., Abousabae, M., Hasan, Alaa, and Amano, R.S., "Energy Savings and CO2 Emission Reduction Contribution for Industrial Facilities In USA," *J. Energy Resour. Technol.,* (IF=3.183), 2021, 143(8): 082303 (12 pages), https://doi.org/10.1115/1.4048983
- Hussein, M.S., Burra, K.G., Amano, R.S., and Gupta, A.K., "Steam gasification of chicken manure," Fuel (IF=5.2), Vol. 189, 2017, 189, Pp 428-435, IF=3.6. https://doi.org/10.1016/j.fuel.2016.11.005
- Hussein, M.S., Burra, K.R., Amano, R.S., and Gupta, A.K, "Chicken Manure Pyrolysis and Gasification," Fuel (IF=5.2), Vol. 202, 2017, pp. 36-45. https://doi.org/10.1016/j.fuel.2017.04.017

Synergistic Activities

Editorship: (1) Chief Editor, International Journal of Rotating Machinery (2019-); (2) Associate Editor for ASME Trans. Journal of Energy Resources Technology (2014-); (3) Lead Editor for Special Issue on Industrial Compressor (2011-2012);

International Prestigious Awards: (1) ASME Henry R. Worthington Medal (2020); (2) ASME George Westinghouse Gold Medal (2014); (3) AIAA Energy Systems Award (2013); (4) AIAA Sustained Service Award (2007); (5) Three Best Paper Awards from ASME Conferences.

Patents: US Patent: Membrane for air diffuser, Ryoichi Samuel Amano and Ammar Alkhalidi, Patent Number 8888074, 11/18/2014, Pub. No.: US 2013/0099401 A1.

Research Grant Activities

Ryo Amano received more than $6 Million from NASA, NSF, DOE, US Air Force, and many industries for the research on energy systems.

Co-PI: Mohammad D. Qandil

Senior Energy Engineer, Tetra Tech, Madison, WI 53719
Assistant Director at the Industrial Assessment Center-University of Wisconsin Milwaukee

- Phone: 414-229-9371
- Email: mohammad.qandil@tetratech.com, mdqandil@uwm.edu,
- ASME Member; Association of Energy Engineers (AEE) Member; American Association of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Member.

Professional Preparation:

- University of Wisconsin-Milwaukee, Wisconsin, Mechanical Engineering Ph.D., 2021
- The Hashemite University, Zarqa, Jordan, Energy Systems, M.S., 2015
- Al-Balqa' Applied University, Amman, Jordan, Mechanical Engineering, B.S., 2012

Appointments:

Senior Energy Engineer, Tetra Tech, 11/2022 – present

- Conduct and lead impact evaluations of demand response and energy efficiency improvements to accurately calculate and verify energy and demand savings.
- Manage project teams and oversee subcontractors conducting impact evaluation activities and energy analyses to deliver against project scope on time and budget.
- Mentor new and mid-level engineering consultants through one-on-one and group training.
- Support proposals and business development related to impact evaluation.

Application Engineer, Therma-Star, 04/2021 - 11/2022

- Interact with engineers, architects, contractors, manufacturer reps, and end-users as a subject matter expert on QUEST products and their applications.
- Provide technical support to the sales organization (internal and external).
- Provide market and customer feedback to Product Management to drive the product roadmap.
- Represent Therma-stor as a technical expert.
- Assist the Marketing department.

Lead Energy Engineer (Center Lead Student), Industrial Assessment Center at UW-Milwaukee, 08/2017-04/2021

- Perform ASHRAE level I and II energy audits on industrial facilities.
- Prepare audit reports delineating the outcomes of the assessment in terms of energy savings, cost reduction in utility bills, and return on investment.
- Contact clients, arrange assessments, and manage audit teams.
- Certified by U.S. DOE's IAC program.

Research Assistant, University of Wisconsin-Milwaukee, 08/2017 - 04/2021

- Working on micro-scale Kaplan hydro-turbine along with several types of hydrofoils, to investigate and improve the performance of turbines and to investigate cavitation in hydro-turbines and hydrofoils.
- Experimental measurements and data analysis for (Hydro turbine performance, Hydrofoil cavitation characteristic) project.

Sales Engineer, PETRA Technical Projects - Oman, 06/2015 - 08/2017

- Develop and implement effective sales techniques to meet sales targets, focusing on marketing and selling HVAC equipment and expanding sales strategies.
- Visit customer sites to gather requirements and prepare proposals, conducting site surveys to identify and provide solutions for HVAC-related issues.
- Sell HVAC products to contractors and large-scale distributors, and create sales engineering reports by analyzing and summarizing sales information and engineering trends.

Technical Support Engineer, PETRA Engineering for HVAC Industries, 07/2012 -06/2015

- Study inquiries with technical specifications, schedules, and drawings to analyze and select suitable units for clients. Prepare technical and financial proposals accordingly.
- Coordinate with sales and production departments to prepare job orders for the factory, ensuring efficient communication and control of information flow.

Special Appointments:

Assistant Director/Research Associate, Industrial Assessment Center at UW-Milwaukee, 11/2022-present

- Helping the team with multiple tasks, audit report writing, recruiting facilities, and writing proposals.

Qualifications:

- Certificate of achievement for the completion of requirements mandated by the U.S. Department of Energy's Industrial Assessment Center Program at the University of Wisconsin, Milwaukee (+22 onsite energy assessments)
- Certified Energy Manager "CEM" "Oct. 2020"
- Staff Training in Engineering (Erasmus+ KA1 Program) "40 hours, Sep. 2019"
- Environmental Engineering (Climate-resilient Water Management) "50 hours, Oct. 2018"
- Assistant Project Management (AsPM) "16 hours, Jun. 2017"
- Renewable Energy "50 hours, Aug. 2016"

Publications: Published more than 25 papers, 9 journal papers, and 12 conference proceedings. (Most Closely Related to the Project are listed below) ***https://scholar.google.com/citations?user=haWeOgsAAAAJ&hl=en***

Journals (selected papers):

- **Qandil, M.**, Abbas, A., Al Hamad, S., Saadeh, W., Amano, R.S., "Performance of Hybrid Renewable Energy Power System for a Residential Building," Trans. ASME J. Energy Resources Technology (IF=3.183), Apr 2022, 144(4): 041301 (18 pages), https://doi.org/10.1115/1.4051541
- **Mohammad D. Qandil**, Ahmad I. Abbas, Abdel Rahman Salem, Ahmad I. Abdelhadi, Alaa Hasan, Farah Nazifa Nourin, Mohamed Abousabae, Osama M. Selim, Juan Espindola, Ryoichi S. Amano, "Net Zero Energy Model for Wastewater Treatment Plants," Trans. ASME J. Energy Resources Technology (IF=3.183), Dec 2021, 143(12): 122101 (12 pages), https://doi.org/10.1115/1.4050082
- **Mohammad D. Qandil**, Ahmad I. Abbas, Ahmad I. AbdelHadi, Abdel Rahman Salem, and Ryoichi S. Amano, 2020, "Energy Analysis: Ways to Save Energy and Reduce the Emissions in Wastewater Treatment Plants", International Journal of Energy for a Clean Environment, DOI: 10.1615/InterJEnerCleanEnv.2020035138
- Qandil, M. D., Abbas, A. I., Qandil, H. D., Al-Haddad, M. R., and Amano, R. S. (May 17, 2019). "A Stand-Alone Hybrid Photovoltaic, Fuel Cell, and Battery System: Case Studies in Jordan." ASME. *J. Energy Resour. Technol.* November 2019; 141(11): 111201. https://doi.org/10.1115/1.4043656
- Farah Nourin, Ahmad I. Abbas, **Mohammad D. Qandil**, and Amano, R. S. (June 23, 2020). "Analytical Study to Use the Excess Digester Gas of Wastewater Treatment Plants." ASME. J. Energy Resour. Technol. DOI: https://doi.org/10.1115/1.4047603
- Ahmad I Abbas, **Mohammad D. Qandil**, Muhannad R. Al-Haddad, Mandana S. Saravani, and Ryoichi S Amano, 2019, "Utilization of Hydroturbines in Wastewater Treatment Plants", Journal of Energy Resources Technology, Vol.141, No.6, pp. 062011 (5 pages). https://doi.org/10.1115/1.4042969
- Hasan, A., Salem, A.R., Abdelhadi, A., Al Hamad, S., **Qandil, M.**, Amano, R.S., "Optimizing Power Reclamation of Micro Hydro Turbines in Wastewater Treatment Plant, J. Energy Resour. Technol. Jan 2022, 144(1): 012109 (16 pages), https://doi.org/10.1115/1.4052539
- Abdel-Hadi, A., Salem, A. R., Abbas, A. I., **Qandil, M.**, and Amano, R. S. (September 28, 2020). "Study of Energy Saving Analysis for Different Industries." ASME. *J. Energy Resour. Technol.* May 2021; 143(5): 052101. https://doi.org/10.1115/1.4048249

Awards and Certifications:

- "The U.S. Department of Energy (DoE), Industrial Assessment Center Outstanding Student Award 2020
- Certificate for the completion of the **Certified Energy Manager® (CEM®), Certified Measurement and Verification Professional (CMVP®), and Renewable Energy Professional (REP™)** courses by the Association of Energy Engineers (AEE)
- UWM Distinguished Dissertation Fellowship (DDF) 2020-2021 Award
- UWM Graduate Student Excellence Fellowship (GSEF) 2019-2020 Award
- ME Chancellor's Awards (2018, 2020 and 2021)
- Certificate for the completion of requirements mandated by the U.S. Department of Energy's Industrial Assessment Center program at the University of Wisconsin Milwaukee

Co-PI: Ahmad I. Abdelhadi

Research Associate, Dept. of Mechanical Engineering, UW-Milwaukee, Milwaukee, WI 53201
Ph: 414-439-8213; Email: aiajr@uwm.edu, ASME Member; AEE Member; AIAA Member;

Qualifications Summary

My research interests include fluid mechanics, hydro turbines, and energy auditing.
I specialize in heat and mass transfer in turbomachinery systems, such as hydro turbines and compressors, and renewable energy concentrating on optimizing hydro turbine systems.

Professional Preparation

Al-Balqa' Applied University, Amman, Jordan, Mechanical Engineering, B.S., 2013
University of Wisconsin-Milwaukee, Wisconsin, Mechanical Engineering Ph.D., May 2023

Appointments

Research Associate/Assistant Director, Industrial Assessment Center at UW-Milwaukee, 06/2023-Present

- Managed energy engineering team in task distribution, providing guidance and training, and keeping the team up to date with innovative energy measures and solutions.
- Supervised energy auditing teams through energy inspection walkthroughs and coordinated communication with the customers.
- Measured team performance through detailed quarterly reports to the US Department of Energy (DOE) and boosted the team performance when needed.

Energy Engineer, Industrial Assessment Center at UW-Milwaukee, 08/2018-May 2023

- Completed thorough energy assessments levels 1 and 2 to analyze energy consumption and implement cost-saving efficiency measures.
- Prepare audit reports showing outcomes of the assessment in terms of energy savings, cost reduction in utility bills, and return on investment.
- Evaluate utility bills and carry out a comprehensive analysis to trace the energy usage trend.
- Conducted 52 assessments and led 7 energy audits on various industrial facilities with 9 of them being the safety officer.
- Certified by U.S. DOE's IAC program

Research Assistant, University of Wisconsin-Milwaukee, 08/2018-present

- Researched information regarding micro-scale Kaplan hydro-turbine.
- Working on a micro-scale Kaplan hydro-turbine project, studying effects of cavitation methods on hydro-turbine.
- Working on micro-hydro turbine to generate electricity from Waste Water treatment aeration system
- Working on Hydrofoil (NACA66-012) to treat cavitation
- Utilize STAR-CCM+ as a CFD tool for testing hydro-turbines performance and various design parameters. with the following experience:
- Utilize STAR-CCM+ as a CFD tool for Vertical Wind Turbine for a class project. With the following experience

Teacher Assistant, University of Wisconsin-Milwaukee, 08/2019-present

Technical Support/Sales Engineer, PETRA Engineering for HVAC Industries working for the America's sales department, 05/2013-08/2018

Publications: Published 8 papers, 5 journal papers, and 3 conference proceedings. (Most Closely Related to the Project)

- Salem, A. R., Hasan, **A., Hadi**, A. A., Al Hamad, S., Qandil, M., and Amano, R. S. (**October 13, 2021**). "Power Generation and Oxygen Transfer Analyses for Micro Hydro-Turbine Installed in Wastewater Treatment Aeration Tank." ASME. J. Energy Resour. Technol. **March 2022**; 144(3): 032102. https://doi.org/10.1115/1.4052538
- Hasan, A., Salem, A. R., **Hadi, A. A.,** Al Hamad, S., Qandil, M., and Amano, R. S. (**October 20, 2021).** "Optimizing Power Reclamation of Micro Hydro Turbines in WWTPs Aeration Basins." ASME. J. Energy Resour. Technol**. January 2022**; 144(1): 012109. https://doi.org/10.1115/1.4052539
- Qandil, M. D., Abbas, A. I., Salem, A. R**., Abdelhadi, A. I.,** Hasan, A., Nourin, F. N., Abousabae, M., Selim, O. M., Espindola, J., and Amano, R. S. (March 4, 2021). "Net Zero Energy Model for Wastewater Treatment Plants." ASME. J. Energy Resour. Technol. **December 2021**; 143(12): 122101. https://doi.org/10.1115/1.4050082
- Hasan, A., Salem, A. R., **Hadi, A. A.,** Qandil, M., Amano, R. S., and Alkhalidi, A. (November 9, 2020). "The

Power Reclamation of Utilizing Micro-Hydro Turbines in the Aeration Basins of Wastewater Treatment Plants." ASME. J. Energy Resour. Technol. **August 2021**; 143(8): 081301. https://doi.org/10.1115/1.4048869

- **Abdel-Hadi, A.,** Salem, A. R., Abbas, A. I., Qandil, M., and Amano, R. S. (September 28, 2020). "Study of Energy Saving Analysis for Different Industries." ASME. J. Energy Resour. Technol. **May 2021**; 143(5): 052101. https://doi.org/10.1115/1.4048249
- **Mohammad D. Qandil, Ahmad I. Abbas, Ahmad I. AbdelHadi, Salem, A. R., and Ryoichi S. Amano, 2020, "Energy Analysis: Ways to Save Energy and Reduce the Emissions in Wastewater Treatment Plants", International Journal of Energy for a Clean Environment. 22(1): 2021. https://doi.org/10.1615/InterJEnerCleanEnv.2020035138**
- Juan Espindola, Farah Nazifa Nourin, Mohammad D. Qandil, Ahmad I. Abdelhadi, and Ryoichi S. Amano, 2020, "Energy Saving Analysis Using Energy Intensity Usage and Specific Energy Consumption Methods", International Journal of Energy for a Clean Environment. 22(1) DOI: 10.1615/InterJEnerCleanEnv.2020034685

Awards and Certifications

- Certificate for the completion of requirements mandated by the U.S. Department of Energy's Industrial Assessment Center program at the University of Wisconsin Milwaukee.
- Award for Excellence in Applied Energy Engineering Research competition throughout the entire 31 centers in the USA by the Department of Energy "The Power Reclamation of Utilizing Micro-hydro Turbines in the Aeration Basins of Wastewater Treatment Plants." University of Wisconsin, Milwaukee – Dr. Ryo Amano (advisor) Alaa Hasan, Abdel Rahman Salem, and **Ahmad Abdel Hadi** (students)" (2020)
- Award for Excellence in Applied Energy Engineering Research competition throughout the entire 36 centers in the USA by the Department of Energy "Photovoltic cover for wastewater treatment planst." University of Wisconsin, Milwaukee – Dr. Ryo Amano (advisor) Omar Habash, and **Ahmad Abdel Hadi** (students)"(2022)

Saif M. Al Hamad

Mechanical Engineer, M.Sc., CEM®

- 1869 N Cambridge Ave, Milwaukee, WI, 53202
- Phone: +1 202 981 8770
- Email: alhamad3@uwm.edu

Education:

- Ph.D. in Mechanical Engineering
  University of Wisconsin-Milwaukee, GPA 4.00/4.00
  Jan. 2020-Present
- M.Sc. in Mechanical Engineering-Renewable Energy and Sustainable Development
  Jordan University of Science and Technology, GPA 4.12/4.3, Second Rank
  Sep. 2015-Feb. 2018
- B.Sc. in Mechanical Engineering-Thermal Power
  Jordan University of Science and Technology, GPA (77.9%)
  Sep. 2010-Mar. 2015

Work Experience:

- Energy Auditor at US DOE Industrial Assessment Center, Milwaukee, WI, USA
  Jan. 2020-Present (Center's Lead Student Aug. 2022-Present)
  Brief Description: Performing energy audits for industrial firms in cooperation with the IAC team and providing audit reports with energy-saving recommendations.
- Research and Teaching Assistant at the University of Wisconsin-Milwaukee
  Jan. 2020-Present
- Brief Description: Working as a graduate researcher in the wind tunnel laboratory to study the performance of wind turbine blades and turbines using different innovative geometries, helping in writing proposals to the Department of Energy [Industrial Assessment Centers: (FOA) Number: DE-FOA-0002452 (**Awarded**), IACs at Trade Schools, Community Colleges, and Union Training Programs; and Building Training and Assessment Centers (BTAC) Program (FOA) Number: DE-FOA-0002940 (**Awarded**), Energy Program for Innovation Clusters: (FOA) Number: DE-FOA-0002425, Research and Development for Advanced Water Resource Recovery Systems: (FOA) Number: DE-FOA-0002336, Buildings Energy Efficiency Frontiers & Innovation Technologies (BENEFIT): (FOA) Number: DE-FOA-0002196], in addition to teaching undergraduate courses (Fluid Mechanics, MATLAB, and Control Systems).
- Part Time Lecturer at Jordan University of Science and Technology, Irbid, Jordan
  Feb. 2018-Dec. 2019
  Brief description: Teaching Instrumentation and Dynamic Systems Lab, Thermo-Fluid Lab and Applied Math for Engineers.
- Teaching Assistant at Jordan University of Science and Technology, Irbid, Jordan
  Sep. 2015-Dec. 2017
  Brief description: Working on ABET accreditation, following up students' assignments and homework, supervising students in engineering labs, performing class quizzes and supervising students during exams.
- Design Engineer at Exergy Technical Alternatives LLC, Amman, Jordan
  June. 2015-Sep. 2015
  Brief description: Designing and supplying energy solutions in solar and plumbing products for the construction industry.
- Trainee engineer at DAEWOO E&C at JRTR project, Irbid, Jordan
  Jan. 2015-Mar. 2015
  Brief description: Practical training in the field of mechanical engineering to be familiar with all mechanical equipment Research and Training Reactor.

Qualifications:

- Certificate of achievement for the completion of requirements mandated by the U.S. Department of Energy's Industrial Assessment Center Program at the University of Wisconsin, Milwaukee (+40 onsite energy assessments)
- Certified Energy Manager "CEM" "Certificate ID: 99291" "Oct. 2019"

- Fire Fighting Systems workshop "15 hours, Apr. 2015"
- Solar Cooling training workshop "Aug. 28, 2014"
- Aircraft Systems and Types workshop "15 hours, Sep. 2014"
- Heating Ventilation and Air Conditioning workshop "30 hours, Sep. 2013"

Publications:

- Al Hamad, S, Abousabae, M, Hasan, A, Habash, O, & Amano, RS. "Effect of Winglet Blade on the Performance of Small-Scale Horizontal Axis Wind Turbine." Proceedings of the ASME Turbo Expo 2023: Turbomachinery Technical Conference and Exposition. Volume 14: Wind Energy. Boston, Massachusetts, USA. June 26–30, 2023. V014T37A002. ASME. https://doi.org/10.1115/GT2023-101643
- Hasan, A., Abousabae, M., Al Hamad, S., and Amano, R. S. (June 8, 2022). "Experimental and Numerical Investigation of Vortex Generators and Winglets in Horizontal Axis Wind Turbine Blade Design." ASME. *J. Energy Resour. Technol*. https://doi.org/10.1115/1.4054755
- Hasan, A., Abousabae, M., Al Hamad, S., and Amano, R. S. (June 8, 2022). "Experimental and Numerical Investigation of Tubercles and Winglets Horizontal Axis Wind Turbine Blade Design." ASME. *J. Energy Resour. Technol*. https://doi.org/10.1115/1.4054756
- Selim, O. M., Al Hamad, S., and Amano, R. S. (April 1, 2022). "Experimental and Numerical Study on the Effect of Annular Combustor Design on Thermal Uniformity Jet in Crossflow." ASME. *J. Energy Resour. Technol*. October 2022; 144(10): 102308. https://doi.org/10.1115/1.4053982
- Al Hamad, S., Habash, O., Hasan, A., and Amano, R. S. (February 21, 2022). "Effect of the J-Shaped Wind Turbine Airfoil Opening Ratio and Thickness on the Performance of Symmetrical Airfoils." ASME. *J. Energy Resour. Technol*. May 2022; 144(5): 051303. https://doi.org/10.1115/1.4053743
- Hasan, A., Salem, A. R., Hadi, A. A., Al Hamad, S., Qandil, M., and Amano, R. S. (October 20, 2021). "Optimizing Power Reclamation of Micro Hydro Turbines in WWTPs Aeration Basins." ASME. *J. Energy Resour. Technol*. January 2022; 144(1): 012109. https://doi.org/10.1115/1.4052539
- Salem, A. R., Hasan, A., Hadi, A. A., Al Hamad, S., Qandil, M., and Amano, R. S. (October 13, 2021). "Power Generation and Oxygen Transfer Analyses for Micro Hydro-Turbine Installed in Wastewater Treatment Aeration Tank." ASME. *J. Energy Resour. Technol*. March 2022; 144(3): 032102. https://doi.org/10.1115/1.4052538
- Qandil, M. D., Abbas, A. I., Al Hamad, S., Saadeh, W., and Amano, R. S. (July 12, 2021). "Performance of Hybrid Renewable Energy Power System for a Residential Building." ASME. *J. Energy Resour. Technol*. April 2022; 144(4): 041301. https://doi.org/10.1115/1.4051541
- Kiwan, S., and Al Hamad, S. (September 14, 2018). "On Analyzing the Optical Performance of Solar Central Tower Systems on Hillsides Using Biomimetic Spiral Distribution." ASME. *J. Sol. Energy Eng*. February 2019; 141(1): 011010. https://doi.org/10.1115/1.4041101

Software Skills:

- AutoCAD
- PTC Creo
- STAR CCM+
- SAM
- PVsyst
- MATLAB
- EES
- MS Office

Extracurricular Activities:

- The GLOBE program member: Participated in Oceans for Life field study "Washington, DC and California, July 30-Aug. 9, 2009"
- Association of Energy Engineers board member, JUST Chapter: Participated in AEE World Energy Conference & Expo "Washington, DC, Sep. 23-Sep. 27, 2019"
- Association of Energy Engineers board member, UW-Milwaukee Chapter: Participated in AEE World Energy Conference & Expo "Atlanta, GA, Sep. 21-Sep. 22, 2022", and "Orlando, FL, Oct. 25-Oct. 27, 2023"

Awards and Fellowships:

- Graduate Student Excellence Fellowship, Fall 2023
- Chancellor's graduate student award, Spring 2020, Spring 2021, Spring 2022, and Fall 2022, Spring 2023, and Spring 2024
- DGSF (Distinguished Graduate Student Fellowship), University of Wisconsin-Milwaukee, 2022-23

Walaa H. Saadeh

Mechanical Engineer, M.Sc., CEM®

- 3916 N Oakland Ave, Milwaukee, WI, 53211
- Phone: +1 414 326 5426
- Email: whsaadeh@uwm.edu

Education:

- Ph.D. in Mechanical Engineering
  University of Wisconsin-Milwaukee, GPA 3.93/4.00
  Jan. 2021-Present
- M.Sc. in Chemical Engineering- Polymer Nanocomposites
  Jordan University of Science and Technology, GPA (86.2%), First Rank
  Sep. 2010-Jun. 2013
- B.Sc. in Chemical Engineering
  Jordan University of Science and Technology, GPA (86.8%), Second Rank
  Sep. 2005-Jun. 2010

Work Experience:

- Energy Auditor at US DOE Industrial Assessment Center, Milwaukee, WI, USA
  Jan. 2021-Present
  Brief Description: Performing energy audits for industrial firms in cooperation with the IAC team and providing audit reports with energy-saving recommendations.
- Research Assistant at the University of Wisconsin-Milwaukee
  Jan. 2021-Present
- Teaching Assistant at the University of Wisconsin-Milwaukee
  Dec. 2021- Dec. 2022
- Brief Description: Working as a graduate researcher in the self-healing laboratory to introduce self-healing properties into fiber-reinforced epoxy composites to improve wind turbine blades performance, helping in writing proposals to the Department of Energy (Industrial Assessment Centers); Energy Program for Innovation Clusters: (FOA) Number: DE-FOA-0002425, Research and Development for Advanced Water Resource Recovery Systems: (FOA) Number: DE-FOA-0002336, Simultaneous Wastewater Treatment and Bio-Hydrogen Production: DE-FOA-0002446, in addition to teaching Fluid Mechanics course for undergraduate.
- Lecturer at Al-Balqaa Applied University, Amman, Jordan
  Sep. 2014- Nov. 2020
  Brief description: Teaching different courses in the chemical and mechanical engineering departments, such as Chemical Engineering Thermodynamics, Chemical Reaction Engineering, Heat Transfer, Material Engineering, Energy Types & Energy Transformations, Environmental Engineering, and Numerical Methods, in addition to teaching different courses for the diploma in Occupational Safety & Health program.
- Process/Project Engineer at ERG (Air Pollution Control) Ltd, Amman, Jordan
  Jun. 2014 – Sep. 2014
  Brief description: Preparing proposals - the sales document and project costing, designing air pollution control equipment and systems, and preparing hand-over documentation to implement the project post-sale.
- Teaching and Research Assistant at Jordan University of Science and Technology, Irbid, Jordan
  Dec. 2011- Dec. 2013
  Brief description: Assisting in different courses and supervising different laboratories in the chemical engineering department, in addition to working on different projects regarding polymer nanocomposites. Working on ABET accreditation, following up on students' assignments and homework, supervising students in engineering labs, performing class quizzes, and supervising students during exams.
- Trainee engineer at Jordan Petroleum Refinery Company LTD (JOPETROL), Zarqa, Jordan
  Jun. 2009- Sep. 2009
  Brief description: Practical training in the field of chemical and mechanical engineering to be familiar with

all chemical processes and mechanical equipment used in the refinery.

Qualifications:

- Certificate of achievement for the completion of requirements mandated by the U.S. Department of Energy's Industrial Assessment Center Program at the University of Wisconsin, Milwaukee (+22 onsite energy assessments)
- Certified Energy Manager "CEM" "Oct. 2020"
- Staff Training in Engineering (Erasmus+ KA1 Program) "40 hours, Sep. 2019"
- Environmental Engineering (Climate-resilient Water Management) "50 hours, Oct. 2018"
- Assistant Project Management (AsPM) "16 hours, Jun. 2017"
- Renewable Energy "50 hours, Aug. 2016"

Publications:

- Walaa Saadeh, Mohammad D. Qandil, Ryoichi S. Amano, " Imprinted Glass Fiber-Reinforced Epoxy Nanocomposites Vascular Self-Healing Wind Turbine Blades", Journal of Energy Resources Technology, July 2022, 145(2): 022102 (8 pages), https://doi.org/10.1115/1.4054827
- Mohammad D. Qandil, Ahmad I. Abbas, Saif Al Hamad, Walaa Saadeh, Ryoichi S. Amano, "Performance of Hybrid Renewable Energy Power System for a Residential Building", Journal of Energy Resources Technology, Apr 2022, Volume 144, Issue 4, pp. 1-42, https://doi.org/10.1115/1.4051541
- Omar S. Al-Ayed, Walaa H. Saadeh, "Approaches to Biomass Kinetic Modelling", Jordanian Journal of Engineering and Chemical Industries (JJECI), 2021, Volume 4, Issue 1, pp. 1-13, https://doi.org/10.48103/jjeci412021
- Walaa Saadeh, Jamil Haddad, Fadi M. Anton, "Green Drying of Tomato Slices by Modified Indirect Air Solar Heater", Jordanian Journal of Engineering and Chemical Industries (JJECI), 2020, Volume 3, Issue 3, pp 48–54, https://doi.org/10.48103/jjeci392020
- Ali Al-Shawabkeh, Ziad S. H. Abu-Hamatteh, Walaa H. Saadeh, Waid S. Omar, "Calcium Hydroxide Washing Treatment of Jordanian Phosphogypsum for Utilization as Raw Material in Cement Industry", Environmental and Earth Sciences Research Journal, Oc 2019, Volume 6, pp. 177-184. https://doi.org/10.18280/eesrj.060405
- Walaa H. Saadeh, Zaid Al-Anber, "Safety Management System", Hasib Sabbagh Foundation for Education, BAU, 2015.
- Zaid Al-Anber, Walaa H. Saadeh, "Fire Protection & Prevention", Hasib Sabbagh Foundation for Education, BAU, 2015.
- Mohammed H. Al-Saleh, Walaa H. Saadeh, Uttandaraman Sundararaj "EMI shielding effectiveness of carbon based nanostructured polymeric materials: A comparative study", August 2013, Carbon 60 , pp. 146-156, https://doi.org/10.1016/j.carbon.2013.04.008
- Mohammed H. Al-Saleh, Walaa H. Saadeh, "Hybrids of conductive polymer nanocomposites ", Materials and Design, December 2013, Volume 52, Pages 1071–1076, https://doi.org/10.1016/j.matdes.2013.06.072.

Software Skills:

- AutoCAD
- ASPEN plus
- MATLAB
- EndNote
- SAM
- Microsoft Office
- ChemCAD
- HYSYS
- Zotero
- Minitab
- Origin
- Polymath

Awards:

- "Michael Krauski Memorial Award", Student Research Poster Competition, University of Wisconsin-Milwaukee, 2023.
  "Industrial Assessment Center Outstanding Student Award 2023", U.S. Department of Energy (DoE), 2023.
- "ME Department Chancellor's Award for Outstanding Research Productivity", University of Wisconsin-Milwaukee, 2021, 2022 & 2023.
- "Fulbright Junior Faculty Development Program (JFDP) Award", Fulbright, USA, 2020.
- "Al-Balqa Applied University Honor Medal", 2019.
- "The Outstanding Student Chapter Member Award", Association of energy engineering (AEE), Washington D.C, 2019.

Areej A. Khalil
Mechanical Engineer, M.Sc
- 1869 N Cambridge Ave, Milwaukee, WI, 53202
- Phone: +1 414 534 3895
- Email: Khalilaa@uwm.edu

Education:

- Ph.D. in Mechanical Engineering
  University of Wisconsin-Milwaukee
  Jan. 2023 - Present

- M.Sc. in Engineering-Research,. Thesis topic: Optimal Building Retrofits Assessment for Zero-Energy Building Implementation
  Auckland University of Technology, New Zealand, Graduated with first-class honors (GPA 8/9)
  Jan. 2020 - Jan. 2021

- B.Sc. in Mechanical Engineering
  Al Balqa Applied University, Jordan,
  Sep. 2008 - Jan. 2013

Work Experience:

- Energy Auditor at **US DOE Industrial Assessment Center**, Milwaukee, WI, USA
  Jan. 2023-Present
  - (Fourteen - (two lead, eight safety office) onsite energy assessments).
    Brief Description: conduct level 2 energy audits for industrial companies and water/wastewater facilities. The audits result in energy assessment reports comprise of practical energy-saving suggestions, cutting-edge energy solutions, as well as new and creative energy assessment recommendations.

- Senior Mechanical Engineer at **Arabtech Jardaneh** (https://www.aj-group.com/)
  Aug. 2021- Jan/2023
  - Develop the design criteria of the mechanical services for the project's buildings.
  - Study the concept definition documents, client requirements, and compare them with the code and standards (such as CIBSE and NFPA)
  - Develop the mechanical requirements and the schematic design of the buildings.
  - Lead a team of engineers on the process of designing all mechanical services for different buildings' applications.
  - Provide a full coordinated Revit model comprise of all the mechanical services
- Mechanical project engineer at **MEPS Building Engineers** (https://meps.nz/), New Zealand
  Apr. 2021-Aug. 2021
  - Develop all the mechanical building services for varices following the local standard.
- Mechanical project engineer at **Al-Nasser + Partners** (https://alnasserpartners.com/)
  Jan. 2017-Jan. 2020
  - Develop all the mechanical building services for varices following the local standard,
  - Follow up with the site quires, review shop drawings and conduct site inspection to test the executed systems on site.
- Junior Mechanical Engineer at **Arabtech Jardaneh** (https://www.aj-group.com/)
  July. 2014- Jan/2017

Fellowships and Awards:

- The best performance award at Al-Nasser + Partners for the year 2017-2018
- The best performance award at Arabtech Jardaneh for the year 2021-2022

Certifications:

- Head of specialty – Class B by the Jordan engineering association , 2021
- Autodesk Revit Advanced Course, 2017
- Fire Fighting Systems Course , 2014
- Energy Management Training Course, 2013
- Aircraft Systems and Types workshop "15 hours, 2014
- Heating Ventilation and Air Conditioning Course, 2013
- Renewable Energy Training Course, 2013

Extracurricular Activities:

- Jordan Engineers Association (JEA)/ member
- AEE student chapter president
- ASHRAE® Associate member

Software Skills

- Excellent in Revit
- Excellent IES VE simulation software
- Excellent HAP, pipe sizing, and duct
- Excellent AutoCAD
- Excellent Elite Software (firefighting design)
- Excellent LG-lats Software

Hamza Alnawafah
Energy Engineer, M.Sc., NABCEP, LEED
- 1560 N Prospect Ave, Milwaukee, WI, 53202
- Phone: +1 4143886263
- Email: alnawaf2@uwm.edu

Education:

- Ph.D. in Mechanical Engineering
  University of Wisconsin-Milwaukee, GPA 3.89/4.00
  Aug. 2022-Present
- M.Sc. in Environmental and Renewable Energy Engineering from German Jordanian University (GJU)., GPA 89.7/100,
  Sep. 2017-Feb. 2020
- B.Sc. in Energy Engineering from German Jordanian University (GJU) and HTWK Leipzig University (Germany)., GPA (75%)
  Sep. 2012-Aug. 2017

Work Experience:

- Energy Engineer, Industrial Assessment Center at UW-Milwaukee, 08/2022 - present.
- Research Assistant, University of Wisconsin-Milwaukee, 08/2022 - present.
- Teaching Assistant, University of Wisconsin Milwaukee, 08/2022 – present.
- Photovoltaic associate instructor for the American Board of Certified Energy Practitioners. (NABCEP), 02/2022- 08/2022.
- Instructor, Al-Hussein Technical University, 02/2020-08/2022.
- Coordinator for ERUM project (Design and build electric vehicle car with smart charging). this project funded by Boeing company.
- Part of the founding team for The Energy Academy.
- Exchange teaching at Junia University in France.
- Sales & Design Engineer, Philadelphia Solar Ltd,09/2017-02/2018.
- Design Engineer, IBC SOLAR AG, Badstaffelstein , Germany, 08/2016-02/2017.
- Engineering Internship, ABB Ltd, 06/2015-07/2015.

Qualifications:

- Best paper award in IREC 2021 in session smart-grid, Zero Energy Building and Sustainable Cities (SGBC).
- Certificate of Completion LEED v4 core concepts & strategies.
- The Chancellor's Graduate Student Award (CGSA) for research productivity, University of Wisconsin-Milwaukee / winner 2021 & 2022.
- The Chancellor's Graduate Student Award (CGSA) for research productivity, University of Wisconsin-Milwaukee / winner 2022 & 2023.
- Certified by American Board of Certified Energy Practitioners (NABCEP) based on my qualifications and experience, 30.06.2021.1)

Publications:

(Hamza Alnawafah - Google Scholar)

Papers: (Total of 19 papers)

1. **Al Nawafah, H**, & Amano, RS., "A Novel Approach to Integrating Photovoltaic Technology With Wastewater Treatment Plants (WWTPs)," *Proceedings of the ASME Power*, Long Beach, California, USA. August 6–8, 2023. V001T01A005. ASME. https://doi.org/10.1115/POWER2023-108833 ,
2. **Hamza Alnawafah**, Ryo Amano. (2023). TOWARDS MICROGRIDS AND FUTURE POWER TWINS: Integrating Photovoltaic Innovation With Wastewater Treatment Plants (WWTP), ***the Association of Energy Engineers***, pp. 1-9, also, published in Expo Poster Sessions - AEE WORLD | Energy Conference & Expo.
3. **Hamza Alnawafah**, Ryo Amano, "Reshaping European Energy Relations across the Mediterranean The Case of Green Hydrogen," ***Policy paper***, pp. 1-30, DOI: 10.13140/RG.2.2.24839.37280.

4. Emad Abdelsalam, Fares Almomani, Feras Kafiah, **Hamza Alnawafah**, Adel Juaidi, Ramez Abdallah, Integrating solar chimney power plant with electrolysis station for green hydrogen production: A promising technique, *International Journal of Hydrogen Energy*, 2023, ISSN 0360-3199, https://doi.org/10.1016/j.ijhydene.2023.08.305
5. Abdelsalam, E.; **Alnawafah, H.**; Almomani, F.; Mousa, A.; Qandil, H. Enhancing the Efficiency of Bi-Facial Photovoltaic Panels: An Integration Approach. *Sustainability*, 2023, 15, 14786. https://doi.org/10.3390/su152014786
6. Almaita, E., Abdelsalam, E., **Nawafah, H.,** Alshkoor, S., & Shloul, M. (2023). Impact study of integrating solar double chimney power plant into electrical grid. Energy, 265, 126350. https://doi.org/10.1016/j.energy.2022.126350 (Q1 , 8.857 Impact Factor, 13.4 CiteScore).
7. **Alnawafah, Hamza** and Sarrias-Mena, Raúl and Harb, Ahmad and Fernández-Ramírez, Luis M. and Llorens-Iborra, Francisco, Evaluating the Inertia of the Jordanian Power Grid. Available at *The Social Science Research Network (SSRN)*, Elsevier https://ssrn.com/abstract=4377377 or http://dx.doi.org/10.2139/ssrn.4377377
8. **H. Alnawafah** and A. Harb, "Modeling and Control for Hybrid Renewable Energy System in Smart Grid Scenario - A Case Study Part of Jordan Grid," 2021 12th International Renewable Energy Congress (IREC), 2021, pp. 1-6.
9. D. Habash, E. Abdelsalam, **H. Alnawafah**, F. Almomani, T. Salameh and A. Al Makky, "Green Hydrogen: A Novel Hybrid Solar Chimney Power Plant Integrated with Electrolysis Station," *2023 Advances in Science and Engineering Technology International Conferences (ASET)*, Dubai, United Arab Emirates, 2023, pp. 1-6, doi: 10.1109/ASET56582.2023.10180725
10. Alkasrawi, Malek, Emad Abdelsalam, **Hamza Alnawafah**, Fares Almomani, Muhammad Tawalbeh, and Aya Mousa. 2021, "Integration of Solar Chimney Power Plant with Photovoltaic for Co-Cooling, Power Production, and Water Desalination" *Processes*, 9, no. 12
11. Almaita, E., Abdelsalam, E., **Al Nawafah, H.**, AlShkoor, S., & Almomani, F. (2022). Analysis and feasibility of integrating a new and novel hybrid solar chimney power plant with a traditional electrical grid. *International Journal Of Energy Research*, pp. 1-23 **https://doi.org/10.1002/er.7795.**
12. Abdelsalam, E., Almomani, F., **Alnawafah, H.** et al. Triple-renewable energy system for electricity production and water desalination. *Environmental Science and Pollution Research*, Springer, 30, 98895–98906 (2023). https://doi.org/10.1007/s11356-022-22547-2
13. A. Azzam, E. Abdelsalam, F. Almomani**, H. Nawafah**, M. Alkasrawi and T. Salameh, "Solar Chimney Power Plant Integrated with Water Desalination Plant for Gray Hydrogen Production," *2023 Advances in Science and Engineering Technology International Conferences (ASET)*, Dubai, United Arab Emirates, 2023, pp. 1-4, doi: 10.1109/ASET56582.2023.10180777.
14. Emad Abdelsalam, Fares Almomani, **Hamza Alnawafah**, Dareen Habash, Mohammad Jamjoum, Sustainable production of green hydrogen, electricity, and desalinated water via a Hybrid Solar Chimney Power Plant (HSCPP) water-splitting process, *International Journal of Hydrogen Energy*, 2023, ISSN 0360-3199, https://doi.org/10.1016/j.ijhydene.2023.06.165.
15. Abdelsalam, E.; **Alnawafah, H.**; Almomani, F.; Mousa, A.; Jamjoum, M.; Alkasrawi, M. Efficiency Improvement of Photovoltaic Panels: A Novel Integration Approach with Cooling Tower. *Energies*, **2023**, *16*, 1070. https://doi.org/10.3390/en16031070
16. **Alnawafah, H.;** Abdelsalam, E.; Almomani, F. Towards Implementing a Smart Grid in Jordan: Designing and Assessing the Potential for A Microgrid in King Hussein Business Park. International Conference On Energy, Environment And Storage Of Energy Conference. pp. 1-9
17. A. Harb, **H. Alnawafah** and O. Alalwan, "A Case Study of Jordanian Power Grid Stability and Sustainability with and Without an External Grid Tie Line," *2022 13th International Renewable Energy Congress (IREC)*, Hammamet, Tunisia, 2022, pp. 1-5, doi: 10.1109/IREC56325.2022.10001973.
18. **H. Alnawafah**, A. Harb, R. S. Mena, F. L. Iborra and L. M. F. Ramírez, "Modeling and Validation of Jordanian Power Grid in DIgSILENT PowerFactory Toward Implementing a Smart Grid Scenario," 2022 13th International Renewable Energy Congress (IREC), Hammamet, Tunisia, 2022, pp. 1-6, doi: 10.1109/IREC56325.2022.10001996.
19. Sunna, Jad; Abdelsalam, Emad; **Nawafah, Hamza** ; Alkasrawi, Malek; Muheidat, Ali. A Hybrid Solar Chimney Power Plant For Electricity Generation Al Ain Case Study. International Conference on Applied Energy (2022). https://doi.org/10.46855/energy-proceedings-10287.

Software Skills:

- Digsilent Power Factory expertise
- AutoCAD expertise
- MATLAB expertise
- Helios for 3D design expertise
- Pvsyst program expertise
- SAM

Professional Organizations Memberships:

- Association of Energy Engineers (AEE) Member, Student Member.
- Member of a MERG research team.

Asma Khasawneh, EMIT®
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Email: khasawn2@uwm.edu | Phone: +1 (414) 394-5483
LinkedIn: https://www.linkedin.com/in/asma-khasawneh-12052b202/

EDUCATION

University of Wisconsin-Milwaukee (UWM) ***Milwaukee, WI, United States***
PhD Student, Mechanical Engineering. *September 2023 – Present*

Al-Hussein Technical University (HTU)*Amman, Jordan*
B.Sc., Energy Engineering. Cumulative GPA: 3.79/4. *October 2018 – February 2023*
Thesis: *"The Development of Energy Efficiency Service Companies (ESCOs): An Economic, Policy, and Technical Analysis"*

CERTIFICATES

Energy Manager in Training (EMIT®) Certification
By the Association of Energy Engineers (AEE), issued in September 2021. | Credential ID 93747

EXPERIENCE

Energy Efficiency Engineer ***Milwaukee, WI, United States*** U.S. Department of Energy's Industrial Assessment Center (USDOE-IAC) at UWM
August 2023- Present

- Conduct ASHRAE level I and II energy audits for small and medium-sized industrial facilities.
- Analyze equipment, systems, and processes to enhance energy efficiency and productivity.
- Evaluate utility bills to identify optimization opportunities and trends.
- Prepare detailed audit reports showcasing potential energy savings, cost reductions, and return on investment.
- Communicate findings to clients and facilitate effective implementation of recommendations through client engagement.

Graduate Research Assistant ***Milwaukee, WI, United States*** University of Wisconsin-Milwaukee (UWM)
August 2023- Present

- Research Area: Investigating *Hydro Turbine Performance for Efficient Production, Green Hydrogen Production*
- Utilizing STAR-CCM+ as a Computational Fluid Dynamics (CFD) tool to assess hydro-turbine performance and optimize design parameters. (learning in progress).
- Advanced techniques, including 3D printing, high-speed cameras, and high-performance computing (HPC) clusters, will be employed to support research objectives. (learning in progress).

Energy Efficiency Advisor Intern ***Amman, Jordan***
German Agency for International Cooperation (GIZ) *March 2023- July 2023*
Internship – **Project**: "Advice on and support of bilateral energy partnerships with developing countries" / Jordanian-German Energy Partnership. Specialized in the activity: Jordan's Third National Energy Efficiency Action Plan (III NEEAP).

- Assist the project team in all aspects related to the project's implementation.
- Assist specifically in advising the partner ministry with developing the National Energy Efficiency Action Plan (NEEAP) for Jordan.
- Conduct data research and analysis for the reporting on the energy intensity for Jordan's NEEAP.
- Support in the communication between the German consultants dena (German Energy Agency) and the partner ministry.
- Support for the data analysis for MEPS (Minimum Performance Energy Standards)
- Support the presentations and explanations of complex technical measures to the stakeholders.

- Support the project monitoring and updating information regularly.

Energy Efficiency Technical Support Apprentice ***Amman, Jordan***
Jordan Renewable Energy & Energy Efficiency Fund (JREEEF) *July 2022- February 2023*
Apprenticeship in "Industrial Sector Energy Efficiency Program (ISEEP)" – Technical Support Department

- Conducted research to identify areas in the Jordanian energy market for implementing solutions and governmental incentives to enhance efficiency.
- Proposed climate mitigation and adaptation project ideas for international calls of proposals to capitalize on green investment opportunities.
- Provided technical assistance and support for energy efficiency and renewable energy projects.
- Participated in the tendering process by assisting in designing requirements and technical specifications, conducting technical evaluations, and selecting the best bid.
- Coordinated with contractors, international organizations, voluntary groups, and end-users.
- Assisted in revising project framework measurement matrices, focusing on performance indicators, and economic, social, and environmental impacts.
- Supported the project progress reporting system and annual reviews.
- Assisted in developing data collection forms for new and ongoing projects to maintain the measurement and evaluation database and analyze findings.
- Reviewed the quality of existing data in project subject areas to ensure good baseline statistics for impact evaluation.

Engineering & Business Development Intern ***Amman, Jordan***
Algebra Intelligence *January 2022- March 2022*
Student-Startup Internship

- Executed dashboard functional testing and generated data analysis reports to drive informed decision-making.
- Conducted site visits for the installation of smart meters and data loggers in commercial facilities, ensuring seamless hardware implementation.
- Conducted comprehensive market research to support the company's business development strategy and conducted competitor analysis within the energy sector.
- Played a key role in pitch development, including preparing and designing pitch presentations, user manuals, and hardware implementation guides.

Freelance Research Assistant ***Amman, Jordan***
Short-Term Contract *August 2022- October 2022*

- Conducted regional benchmarking for Minimum Energy Performance Standards (MEPs) in the industrial sector.
- Analyzed the suitability of Jordan's trade partner countries to develop incentive measures for MEPs in Jordan's industry.
- Produced comprehensive reports outlining findings and recommendations for policy development in energy efficiency within Jordan's industrial sector.

Undergraduate Researcher ***Bradford, United Kingdom***
Faculty of Engineering & Informatics, University of Bradford (UoB) *September 2021- December 2021Erasmus+ Student Exchange Program*

- Investigated the effects of various X-ray radiation dosages on cellular behavior in the laboratory, employing

techniques such as Cell Culture, DNA Damage, and the Comet Assay.

- Conducted a comprehensive literature review to inform experimental design and analysis.
- Documented experiment procedures and summarized findings for potential publication.

Undergraduate Researcher ***Amman, Jordan***
Energy Engineering Department, HTU *July 2020-February 2023*

- Actively participated as a member of the Multidisciplinary Engineering Research Group (MERG) (http://merg.live/).
- Conducted research in the following areas:
  - Enhancing the performance and technology of solar chimney power plants (SCPP) and cooling towers (CT).
  - Green hydrogen production.
- Contributed to co-authoring research papers, validating results, and visualizing data.
- Supervised and mentored new research students joining the MERG team.

PUBLICATIONS & PRESENTATIONS

Journal Publications:

- Abdelsalam, E.; Almomani, F.; Kafiah, F.; Almeida, E.; Tawalbeh, M.; **Khasawneh, A.**; Habash, D.; Omar, A.; Alkasrawi, M. A New Sustainable, and Novel Hybrid Solar Chimney Power Plant Design for Power Generation and Seawater Desalination. **Sustainability 2021**, 13, 12100. https://doi.org/10.3390/su132112100
- Abdelsalam, E.; Kafiah, F.; Almomani, F.; Tawalbeh, M.; Kiswani, S.; **Khasawneh, A.;** Ibrahim, D.; Alkasrawi, M. An Innovative Design of a Solar Double-Chimney Power Plant for Electricity Generation. **Energies 2021**, 14, 6235. https://doi.org/10.3390/en14196235

Conference Publications:

- **Asma Khasawneh**, Emad Abdelsalam, Ahmad Azzam, Fares Almomani. Green Hydrogen: A Cooling Tower Integrated with Electrolysis Station. 15th International Conference on Sustainable Energy & Environmental Protection **(SEEP).**
- Owais Ogdeh, Aya Mousa, **Asma Khasawneh**, and Dareen Habash. Municipality Waste Management Energy Conservation Measures Economic, Environmental, Social impact: Case Study. **2022 AEE World Energy Conference and Expo**, 21-23September 2022, Atlanta, GA.
- **A. Khasawneh**, D. Habash, E. Abdelsalam, H. Nawafah, and F. Almomani. Green Hydrogen: A Novel Solar Chimney Powerplant Integrated with an Electrolysis Station. The 2nd International Conference on Energy, Environment, and Storage of Energy **(ICEESEN2022)**, 1-3 September 2022, Kayseri-Turkiye.
- **A. Khasawneh,** S. Ibrahim, E. Abdelsalam, H. Nawafah, and F. Almomani. A Novel Design of a Hybrid Solar Double- Chimney Power Plant for Generating Electricity. The 2nd International Conference on Energy, Environment, and Storage of Energy **(ICEESEN2022)**, 1-3 September 2022, Kayseri-Turkiye.
- Emad Abdelsalam, Fadwa Kassem, Shadwa Ibrahim, **Asma Khasawneh**, Fares Almomani. Analysis and Feasibility of Employing a New and Novel Hybrid Solar Chimney Power Plant (HSCPP) – KSA Case Study. 13th International Exergy, Energy and Environment Symposium **(IEEES-13)**, November 15-18, 2021, Makkah, Saudi Arabia

PROFESSIONAL TRAINING

- The National Science Foundation's (NSF) Innovation Corps (I-Corps) program – Milwaukee, WI, February 2024 - Present
- Renewable Power to X Training by the International PtX Hub – Amman, Jordan, March 2023
- Green Climate Fund (GCF) Accreditation Capacity Building, provided by Global Green Growth Institute (GGGI) - Amman,Jordan, October 2022.
- LEED v4 Core Concepts and Strategies Training by the Green Building Council. – Amman, Jordan, May 2021.
- Certified Energy Manager (CEM®) training course by the Association of Energy Engineers (AEE). – Amman, Jordan, March 2021.
- Entrepreneurship Bootcamp associated with HTU Center of Innovation and Entrepreneurial Excellence.

Amman, Jordan, March 2021- June 2021.

VOLUNTEERING

The Association of Energy Engineers (AEE) UWM Chapter
Committee Student Member *August 2023 -Present*
Engineers Without Boarders (EWB) in UWM
Committee Student Member *August 2023 -Present*
The Association of Energy Engineers (AEE) HTU Chapter
Vice President *January 2022 -February 2023*
Committee Student Member *September 2019 -February 2023*

AWARDS

- UWM Chancellor's Graduate Student Award - Fall semester of the 2023-24 Academic Year
- Boeing Student Project Grant – "Solar Chimney Power Plant" Project - May 2021.
- First Place Winner in Irex Global Solutions Sustainability Challenge 2021 - April 2021

Technical Skills

- Research and development (R&D)
- Proposal writing
- Energy auditing
- Policy Research and Analysis
- Report and technical writing
- Data analysis
- Data visualization and validation
- Project management
- Pitch development
- Monitoring and evaluation

Soft Skills

- Adaptability
- Teamwork
- Public speaking
- Relationship building
- Strategic planning
- Market analysis
- Networking
- Communication (Written and verbal)
- Presentations
- Adaptability
- Leadership
- Collaboration

Software

- **Coding**: MATLAB.
- **Drawing**: AutoCAD, Sketchup
- **Simulation & Modeling**: PVsyst, Carrier HAP, Simulink, SAM
- **Assessment Tools:** MEASUR, EDGE App
- **Productivity tools:** Camunda BPM

Co-PI:Rafat R. Elsharef

8906 S. Pond View Dr
Oak Creek, WI 53154
Cell Phone: 414-324-1877
Work Phone: 414-571-4759
E-mail: elsharer@matc.edu, elsharef@uwm.edu

Objectives

Work / Teach in the field of Networking and Cyber Security.

Education

- **University of Wisconsin Milwaukee – PhD–Industrial Engineering - minor in computer science - May 2021**
  - Specialized in Cyber Security for Industrial Control Systems (ICS).
  - Interest in Cyber Security for OT, IOT, and IIOT.
- **Master of Science, August 2002**
  - **Cardinal Stritch University** www.stritch.edu
- **Bachelor of Science in Electrical Engineering, December 1987**
  - **University of Wisconsin- Milwaukee** www.uwm.edu

Leadership Roles:

- Co-PI National Science Foundation (NSF) :
  - Award Number: 2201667, Award Amount: $649,740.00, Date: 7/01/2022
  - https://www.nsf.gov/awardsearch/simpleSearchResult?queryText=2201667&ActiveAwards=true
- Speaker/Panelist in many technical conferences on IT and OT Security
- Assistant Director of UW-Milwaukee Industrial Assessment Center (IAC) - https://sites.uwm.edu/ceas-iac/
- Member of the IT Security Advisory committee for Wisconsin Section of American Water Works Association - https://www.wiawwa.org/
- MATC - Information Security Club Advisor
- MATC - National Collegiate Cyber Defense Competition (CCDC) Coach
- MATC - National Cyber League (NCL) Coach
- MATC - Digital Diploma creator and Lead Instructor
- VBNS Grant
  - (Very high-performance Backbone Network service) for the University of Wisconsin-Madison sponsored by the National Science Foundation (NFS).
  - Served as a Technical design contact for vBNS proposal at UW-Madison. www.vbns.net
- Zayed University:
  - Part of a consulting team that visited Zayed University coming from University of Wisconsin-Madison to evaluate the Network and computer systems used at the time.

Certifications

- Amazon Cloud Practitioner – AWS-CP
- Cisco CyberOps
- CCAI (Cisco Certified Academy Instructor). http://Cisco.netacad.net
- CCNA (Cisco Certified Network Associate). http://Cisco.netacad.net
- NET+ (Network Plus Certified). www.comptia.com
- Palo Alto firewall
- Security+
- Mobility+
- Access Data Certified Examiner (ACE)
- Access Data Certified Mobile Examiner (ME)
- Many trainings and certifications from Idaho National Labs on OT Security.
- Fortinet – In progress – Finished NSE 1,2, and 3.
- CISSP – In progress

Teaching Experience

- **UW- Milwaukee Lecturer / TA (Computer Science department) – Part Time 2005 – present**
  Teaching the following courses:

- Computer Network – CompSci-520
- Computer Security- CompSci-469
- Cyber Security lab- CompSci-658
- Network Lab- CompSci-530
- Connected Systems - Business school – BUS ADM 533/817 - Using Microsoft Cloud – Azure and Amazon AWS

Teaching Experience

Faculty of IT-Networking and Security – Full Time January 02 – Present

Milwaukee Area Technical College – MATC www.matc.edu

- **Developing the following courses**:
  - Risk Management
  - Ethical Hacking
  - Penetration Testing
  - Wireless Security
  - Wireshark
  - Computer Forensics
  - Mobile Forensics
  - Advanced Forensics
  - Advanced Linux.
  - Network Security. www.matc.edu/infosec

Technical Experience

Information Security Specialist March 2001 – September 2001

Metavante Corporation www.metavante.com

- Member of the information Security Architecture team at Metavante Corporations.
- Evaluate and recommend security architecture solutions for Metavante as needed.
- Recommended Security Architecture for Server design (e-commerce).
- Recommended Security Architecture for Firewall design.
- Recommended security Architecture for Network Intrusion Detection (IDS) design.
- Evaluated Host-Based Intrusion Detection (HIDS) to protect E-Commerce server farm.
- Evaluated and recommended Cisco Secure to be implemented at Metavante.
- Worked with other network and server administrators to insure their compliance with information security guidelines and policies.

Senior Network Engineer September 99 – March 2001

M&I Data Services www.midata.com

- Core Network support team

Senior Network Engineer February 99 – September 99

WiscNet www.wiscnet.net

- Support the educational backbone of Wisconsin www.wiscnet.net

Network Engineer November 96 – February 99

University of Wisconsin-Madison www.wisc.edu ; **Division of Information Technology- DoIT** www.doit.wisc.edu

- Support the educational backbone of Wisconsin.

Network Specialist/MIS manager June 95 – November 96

University of Wisconsin – Madison www.wisc.edu

Network Specialist September 93 – June 95

University of Wisconsin – Whitewater www.uww.edu

- Designed campus backbone using fiber optics.

Network Manager August 91 – September 93

University of Wisconsin – Milwaukee www.uwm.edu

- Managed and administered several MS LAN Manager and Novell servers.

Other interests:

- Software Defend Radio (SDR)
- Amateur Radio (Ham):
  - Call sign N9TLE.

Mohamed I. Youssef
Current Address: 2350 W Good Hope Rd, Glendale, WI - 53209
Cell Phone: +1 (414)-338-4936 **E-mail:** m.i.youssef@outlook.com

Education

Aug.2023-Present **PhD Candidate in Mechanical Engineering**
(Milwaukee, WI – USA) o Mechanical Engineering Department, University of Wisconsin Milwaukee
Aug.2012-Dec 2013 **Masters of Science in Engineering Management**
(Melbourne, FL – USA) o Engineering Systems Department, Florida Institute of Technology
Sept.2005-Jul.2010 **BSc. BSc in Mechanical Power Engineering**
(Cairo – Egypt) o Mechanical Power Engineering Department, Ain Shams University

Professional Certificates

- o Certified Energy Manager – CEM (AEE)
- o Project Management Professional- PMP (PMI)
- o Certified Maintenance & Reliability Professional - CMRP (SMRP)
- o Risk Management Professional- RMP (PMI)
- o Certified KPI Professional CKPI – P (KPI Institute)

Skills

Software:

o AutoCAD 2D	o Sketch UP	o SPSS – IBM	o Energy Plus V.5.0	o Photoshop CS 6	o Microsoft Projects	
o Solid Works	o Revit 2020	o Primavera P6	o Arena 14.5	o Visual PROMETHEE	o Microsoft Office	

Professional Experience

Aug.2023- Present *Energy Audit Engineer* **UWM-Industrial Assessment Center**, (Milwaukee – WI, USA)

- o Planning energy audits for the off-site and on-site energy assessment plans
- o Evaluating building envelope and systems analysis (HVAC, water, electrical and industrial operations)
- o Investigating current energy consumption and recommending energy conservation and efficiency measures
- o Identifying issues that have impact on energy usage
- o Providing energy reports to clients with cost estimations for the implementation plans and payback periods
- o Reviewing the final report for the DOE for conclusive approval

Aug.2015- Present *Senior Mechanical Engineer* **Institute of Public Administration**, (Jeddah - KSA)

- o Member of various technical and engineering committees
- o Reviewing and approving material submittals and project invoices (MEP)
- o Site supervision, project control and performing project review reports of a net worth of 375 million USD projects

Jul.2014- Jan. 2015 *Projects Coordinator* **MRI Inc.,**
(Melbourne-FL, USA)

- o Gathering requirements and Stakeholders management
- o Overseeing the project budget, schedule and cost estimation
- o Performing status reports, performance reviews & Project Documentation

Aug.2013- Dec.2013 *Graduate Research Assistant* **Florida Institute of Technology**, (Melbourne-FL, USA)

- o Supervised and assisted with grading of student assignments
- o Supported research activities and projects
- o Conducted research, surveys and data collection for thesis purposes

Apr.2011-Apr.2012 *Projects Engineer* **Total Solutions (Petroleum Integrated Services)**, (Cairo - Egypt)

- o Managed the New WSV Laboratory in Kattamia project for Schlumberger Logelco Inc.-Egypt. (250K USD)

- Supervised the West Delta Deep Marine Phase 8/A project for Technip.
- Supervised the execution of Tank No.8 demolishing-Musturod Farm Exxon Mobil-Egypt Branch. (100K USD)

Aug.2010-Mar.2011 *Technical and Sales Engineer* **MAS Trading Co. (YORK-SHIPLEY)**, (Cairo - Egypt)

- Delegated with maintenance and sales of York-Shipley Fire tube Boilers
- Provided pre-sales technical assistance and after-sales support services

Volunteering Positions

Jun.2014-Jul.2014 *HVAC Engineer Assistant* Brevard Board of County Commissioners (Viera -FL, USA)

Apr.2014-May2014 *Planning Engineer* Brevard Board of County Commissioners (Viera -FL, USA)

Publications

26th Jan. 2022 A Multi-Criteria Decision Making Approach to the New Product Development Process in Industry

ISSN: 2683-5894 DOI: https://doi.org/10.31181/rme2001260122y (**Reports In Mechanical Engineering**)

Awards

Jan.2013 ME Graduate Students Research Achievement (MEGSRA) **(University of Wisconsin Milwaukee**)

clean energy economy mn

cleanenergyeconomymn.org

March 22, 2024

Katrina Kessler, Commissioner
Minnesota Pollution Control Agency
520 Lafayette Road
Saint Paul, MN 55155

Subject: Clean Energy Economy MN support of the State of Minnesota's CPRG Coalition Proposal for the following 3 programs; Equitable Residential Decarbonization (Award Number EPA-R-OAR-CPRGI-23-07); Single Entity Proposal for Climate-Smart Food Systems (Award Number EPA-R-OAR-CPRGI-23-07); as well as Midwest Industrial Decarbonization Challenge (NOFO EPA-R-OAR-CPRGI-23-07)

Dear Commissioner Kessler,

On behalf of Clean Energy Economy MN (CEEM), we write today in support of all three proposals led by the Minnesota Pollution Control Agency (MPCA) in which the agency is applying for funding under the Climate Pollution Reduction Grant program to implement projects and programs that reduce greenhouse gas emissions (GHGs).

CEEM is an industry-led, nonpartisan, non-profit organization representing the business voice of energy efficiency and clean energy in Minnesota. We are focused on educating Minnesotans about the economic benefits of transitioning to a clean energy economy. Our business membership is comprised of over 60 clean energy companies ranging from start-up businesses to Fortune 100 and 500 corporations that employ tens of thousands of Minnesotans across the state. CEEM stands committed to delivering a 100% clean energy future where all Minnesota businesses and citizens will thrive.

CEEM is pleased to see an emphasis on equitable residential decarbonization work because of the critical role it plays in reducing GHGs from our built environment, as well as the business opportunity it presents many of CEEM's member businesses. Our organization has worked extensively to support the Energy Conservation and Optimization bill in 2021, and the current ECO upgrades being proposed this legislative session. This overarching state efficiency policy is one of the reasons the American Council for an Energy Efficiency America consistently ranks Minnesota as having the strongest energy efficiency policy in the Midwest.

We also support MPCA's grant proposal to rescue emissions across the food system. CEEM is pleased to support this collaborative proposal because we all have a role to play in making Minnesota a national leader in climate-smart approaches to our food system. Our organizations coming together allows us to take a systems approach and capture multiple benefits while achieving significant greenhouse gas emissions reductions and carbon sequestration across all aspects of our food system.

Finally, CEEM affirms our partnership with the MPCA in its coalition with the State of Michigan in response to the Climate Pollution Reduction Grant implementation funding opportunity. We are pleased to endorse the Midwest Industrial Coalition's objective to reduce greenhouse gas (GHG) emissions from the region's top polluting, hard-to-decarbonize industries.

clean energy economy mn

cleanenergyeconomymn.org

Minnesota's Climate Action Framework and Michigan's Healthy Climate Plan, both published in 2022, as well as both states' Priority Climate Action Plans align our two states with many shared goals for equitable climate action that supports a robust clean economy. This proposal connects strongly with the ambitions in those documents and of our states to be national leaders in collaborative climate action.

Minnesota has all the ingredients to lead on innovation, and foster new ideas that will allow us to decarbonize difficult-to-decarbonize sectors such as agriculture, heavy-industry and buildings. In fact, CEEM, in collaboration with Grid Catalyst, recently launched Minnesota Energy Alley, a public-private partnership made possible by a grant from the Minnesota Department of Commerce and is part of a larger focus on driving innovation to secure the state's energy and economic development future.

Our organization is proud of Minnesota's leading work to secure a clean energy future, and our net-zero economy goal by 2050. We are enthusiastic about partnering with the MPCA to advance our shared climate goals and the goals of the U.S. Environmental Protection Agency's ambitious and vital CPRG program.

Sincerely,

Gregg Mast
Executive Director
gmast@cleanenergyeconomymn.org

March 15th, 2024

Katrina Kessler, Commissioner
Minnesota Pollution Control Agency
520 Lafayette Road
Saint Paul, MN 55155

Subject: Axaule Sultanova's Support of the State Minnesota's participation in the Climate Pollution Reduction Grant coalition proposal, Midwest Industrial Decarbonization Challenge (NOFO EPA-R-OAR-CPRGI-23-07)

Dear Commissioner Kessler,

I, Axaule Sultanova, Minnesota Climate Innovation Finance Authority Board Member with Expertise in Sustainable Development and Energy Conservation and an experienced energy & decarbonization professional, support the Minnesota Pollution Control Agency in its coalition with the State of Michigan in response to the Climate Pollution Reduction Grant implementation funding opportunity (EPA-R-OAR-CPRGI-23-07). I endorse the Midwest Industrial Coalition's objective to reduce greenhouse gas (GHG) emissions from the region's top polluting, hard-to-decarbonize industries, as an individual and a professional, not on behalf of the entire MnCIFA board.

Through the Midwest Industrial Coalition program period, I anticipate collaborating with the MPCA to deliver incentives programs to reduce industrial GHG emissions, including but not limited to industrial energy efficiency, fuel-switching, and innovative technologies. My commitment extends to supporting program development and implementation of industrial emission reduction strategies.

Minnesota's Climate Action Framework and Michigan's Healthy Climate Plan, both published in 2022, as well as both states' Priority Climate Action Plans align our two states with many shared goals for equitable climate action that supports a robust clean economy. This proposal connects strongly with the ambitions in those documents and of our states to be national leaders in collaborative climate action.

The proposed GHG reduction measures will achieve significant cumulative GHG reductions, provide substantial community benefits in low-income and disadvantaged communities, and complement other funding sources to maximize both GHG reductions and community benefits. The State of Michigan, through the Office of Climate and Energy (OCE), has a commendable track record of effectively utilizing state and federal grants while actively engaging with low-income and disadvantaged communities.

Given our states' shared goals and proven success in implementing equitable climate policies that support a clean economy, we have full confidence in Michigan's ability to lead the development the Midwest Industrial Decarbonization Challenge and achieve the objectives laid out in the application. These objectives include emissions reduction and mobilizing financing and private capital to address barriers to implementing clean and innovative industrial processes. Furthermore, this initiative will

stimulate increased investment in clean industrial projects critical to achieving the state's climate objectives, particularly within historically underinvested communities facing longstanding challenges.

I am excited to support this collaborative proposal because we all have a role to play in making the Midwest a national leader in industrial decarbonization and a clean economy. I am enthusiastic about partnering with the MPCA to advance our shared climate goals and the goals of the U.S. Environmental Protection Agency's ambitious and vital CPRG program.

Sincerely,

Axaule Sultanova, PE
643 36 ½ Ave NE
Minneapolis, MN 55418
720-386-0830
aksaule@gmail.com

accelera
by Cummins

March 14th, 2024

Katrina Kessler, Commissioner
Minnesota Pollution Control Agency
520 Lafayette Road
Saint Paul, MN 55155

Subject: **Cummins'** Support of the State Minnesota's participation in the Climate Pollution Reduction Grant coalition proposal, Midwest Industrial Decarbonization Challenge (NOFO EPA-R-OAR-CPRGI-23-07)

Dear Commissioner Kessler,

We, Cummins, affirm our partnership with the Minnesota Pollution Control Agency in its coalition with the State of Michigan in response to the Climate Pollution Reduction Grant implementation funding opportunity (EPA-R-OAR-CPRGI-23-07). We are pleased to endorse the Midwest Industrial Coalition's objective to reduce greenhouse gas (GHG) emissions from the region's top polluting, hard-to-decarbonize industries.

Through the Midwest Industrial Coalition program period, we anticipate collaborating with the MPCA to deliver incentives programs to reduce industrial GHG emissions, including but not limited to industrial energy efficiency, fuel-switching, and innovative technologies. Our commitment extends to supporting program development and implementation of industrial emission reduction strategies.

Minnesota's Climate Action Framework and Michigan's Healthy Climate Plan, both published in 2022, as well as both states' Priority Climate Action Plans align our two states with many shared goals for equitable climate action that supports a robust clean economy. This proposal connects strongly with the ambitions in those documents and of our states to be national leaders in collaborative climate action.

The proposed GHG reduction measures will achieve significant cumulative GHG reductions, provide substantial community benefits in low-income and disadvantaged communities, and complement other funding sources to maximize both GHG reductions and community benefits. The State of Michigan, through the Office of Climate and Energy (OCE), has a commendable track record of effectively utilizing state and federal grants while actively engaging with low-income and disadvantaged communities.

Given our states' shared goals and proven success in implementing equitable climate policies that support a clean economy, we have full confidence in Michigan's ability to lead the development the Midwest Industrial Decarbonization Challenge and achieve the objectives laid out in the application.

3850 Victoria Street North
Shoreview, MN 55126

accelera
by Cummins

These objectives include emissions reduction and mobilizing financing and private capital to address barriers to implementing clean and innovative industrial processes. Furthermore, this initiative will stimulate increased investment in clean industrial projects critical to achieving the state's climate objectives, particularly within historically underinvested communities facing longstanding challenges.

Cummins is excited to partner in this industrial decarbonization work because it aligns with our mission. Our mission is making people's lives better by powering a more prosperous world. We understand that our products and facilities have environmental impacts, and we are working to reduce them through our Planet 2050 initiative, which has three pillars:

- Reducing greenhouse gas and air emissions in line with experts' recommendations.
- Using natural resources in the most sustainable way possible.
- Helping communities address their major environmental challenges.

In Minnesota we are actively implementing these measures at our large manufacturing facility in Fridley, and at our Sales and Service and office locations throughout the state. You can read more about this work at https://www.cummins.com/company/esg/environment/planet-2050.

Cummins is also working to decarbonize our products and work towards zero emissions solutions through our Destination Zero strategy. Destination Zero is the road we've paved to a zero emissions future where we continue to provide the power that our world needs. Internal combustion engine (ICE) technologies are an important transitory step for the trucking industry. We are focused on a combination of advancing zero and improving engine-based products today. This includes diesel, natural gas, hydrogen internal combustion in addition to battery electric and hydrogen fuel cell, and electrolyzers.

We strive to be a strong partner with the State of Minnesota. We are excited to support this collaborative proposal because we all have a role to play in making the Midwest a national leader in industrial decarbonization and a clean economy. We are enthusiastic about partnering with the MPCA to advance our shared climate goals and the goals of the U.S. Environmental Protection Agency's ambitious and vital CPRG program.

Sincerely,

Alex Savelli
Managing Director – Hydrogen for the Americas
+1 612 430 3794
alex.savelli@cummins.com

3850 Victoria Street North
Shoreview, MN 55126

STATE OF MINNESOTA

Office of Governor Tim Walz
Lt. Governor Peggy Flanagan

130 State Capitol ♦ 75 Rev. Dr. Martin Luther King Jr. Blvd. ♦ Saint Paul, MN 55155-1611

March 18, 2024

The Honorable Michael Regan
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, DC 20004

Re: Governor support for Midwest Industrial Decarbonization Challenge (NOFO EPA-R-OAR-CPRGI-23-07)

Dear Administrator Regan:

I write to you to express my enthusiastic support for the participation of the Minnesota Pollution Control Agency (MPCA) in the State of Michigan's coalition application entitled "Midwest Industrial Decarbonization Challenge" in response to EPA's Notice of Funding Opportunity (NOFO) No. EPA-R-OAR-CPRGI-23-07. I am pleased to endorse the Midwest Industrial Coalition's objective to reduce greenhouse gas (GHG) emissions from the region's top polluting, hard-to-decarbonize industries.

Minnesota has long led the way for climate action in the Midwest. Minnesota's Climate Action Framework, published in 2022, establishes a vision for climate action that will make Minnesota carbon-neutral, resilient, and equitable. These three co-equal pillars of Minnesota's Framework guide our collaborative climate work. Our Priority Climate Action Plan was built off of that foundation. Michigan similarly published its Healthy Climate Plan in 2022. Our plans align our two states with many shared goals for equitable climate action that supports a robust clean economy. This proposal connects strongly with the ambitions in those documents to be national leaders in collaborative climate action.

The Midwest Industrial Decarbonization Challenge will support Minnesota's ongoing work towards our equitable clean economy future by supporting a climate-smart industrial sector, reducing GHGs and other harmful air pollution, and expanding job opportunities.

Given our shared goals and proven success in implementing equitable climate policies, we have full confidence in Michigan's ability to lead the development the Midwest Industrial Decarbonization Challenge and achieve the objectives laid out in the application. These objectives include emissions reduction and mobilizing financing and private capital to address barriers to implementing clean and innovative industrial processes. Furthermore, this initiative will stimulate increased investment in clean industrial projects critical to achieving the state's climate objectives, particularly within historically underinvested communities facing longstanding challenges.

Michigan's proposal will strengthen regional collaboration to address climate change and further develop the Midwest's clean economy leadership. We are excited about the opportunity to significantly reduce GHG emissions and demonstrate new technology while also prioritizing the reduction of co-pollutants and supporting healthy communities in Minnesota and beyond.

We are pleased to join Michigan and our other regional partners in this coalition application and thank you for your consideration.

Sincerely,

Tim Walz
Governor

March 4, 2024

Hon. Michael Regan
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, DC 20004

Subject: WI Sustainable Business Council Support the State of Michigan's CPRG Coalition Proposal for the Midwest Industrial Decarbonization Challenge, (Award Number EPA-R-OAR-CPRGI-23-07)

Dear Administrator Regan,

The Wisconsin Sustainable Business Council (owned by WMEP Manufacturing Solutions) supports the State of Michigan in its partnership with the State of Wisconsin in response to EPA-R-OAR-CPRGI-23-07. We are pleased to endorse the Midwest Industrial Coalition's objective to reduce greenhouse gas (GHG) emissions from the region's top polluting, hard-to-decarbonize industries.

Through the Midwest Industrial Coalition program period, we anticipate collaborating with the State of WI and beyond to deliver programs to reduce industrial GHG emissions, including but not limited to industrial energy efficiency, behavior training and innovative technologies. **Our expertise is in supporting companies develop sustainability metrics and systems for tracking their metrics, developing supporting programs and implementation of industrial emission reduction strategies.**

The proposed GHG reduction measures will achieve significant cumulative GHG reductions, provide substantial community benefits, and complement other funding sources to maximize both GHG reductions and community impacts. Both the State of Wisconsin, through the Office of Sustainability and Clean Energy(OSCE) and the State of Michigan through the Office of Climate and Energy has a commendable track record of effectively utilizing state and federal grants while actively engaging communities. Under the leadership of Governors Tony Evers and Gretchen Whitmer, both states have demonstrated a strong commitment to clean energy and achieving carbon neutrality.

Given the both State's proven success in implementing equitable climate policies, we have confidence in their ability to develop the Midwest Industrial Decarbonization Challenge and achieve the objectives laid out in the application. These objectives include emissions reduction and mobilizing financing and private capital to address barriers to implementing clean and innovative industrial processes. Furthermore, this initiative will stimulate increased investment in clean industrial projects critical to achieving the state's climate objectives, particularly within historically underinvested communities facing longstanding challenges.

At the Wisconsin Sustainable Business Council (WSBC), we believe that sustainability is good business and good business is sustainable. WSBC supports businesses in advancing sustainable principles and practices, offering a professional network where businesses, big and small, unite to share insights,

experiences, and best practices to advance their sustainability initiatives, learning and growing together as a community.

We have a long history of working with the manufacturing sector in WI to support their sustainability efforts and have been educating businesses on ways to reduce GHG emissions for over a decade. Our assessment process takes a

We have successfully been involved in the states previous E3 program which showcase how we have and are able to partner with the State in future programs. Additionally, we also have had long with standing relationships and prior collaboration with the State of Wisconsin through education, outreach and engagement around connecting the business community on climate action across WI.

We are enthusiastic about partnering with the State of Michigan to advance the goals of the U.S. Environmental Protection Agency through this pivotal program.

Sincerely,

Jessy Servi Ortiz

Jessy Servi Ortiz
Managing Director
Wisconsin Sustainable Business Council

March 1, 2024

Mr. Cory Connelly
Michigan Department of Energy, Great Lakes, and the Environment
525 W. Allegan Street,
Lansing, MI 48933

Re: Letter of Support for the Midwest Governors Decarbonization Challenge

Dear Mr. Connolly,

Holcim U.S. has been built on continued innovation to lower our environmental impact. We applaud efforts that focus on protecting our environment while continuing to allow businesses to innovate. The Midwest Governors Decarbonization Challenge (MGDC), we feel, supports innovation within many industry sectors, including the one in which we operate. We ask for your continued support in Michigan's efforts to provide innovation while decarbonizing the industry.

Holcim U.S. is pleased to see that Michigan's Department of Energy, Great Lakes, and the Environment (EGLE), along with its coalition partners in Wisconsin, Minnesota, Ohio, and Illinois, is prioritizing projects that develop and encourage the adoption of new and innovative decarbonization technologies through the MGDC. This approach will help increase market transparency, encourage innovation, and lead to the most significant reductions in GHG emissions, all while supporting low-emissions industrial production in the United States.

If the coalition receives funding for its MGDC through the U.S. Environmental Protection Agency's Climate Pollution Reduction Grants (CPRG), Holcim U.S. intends to submit a project proposal for consideration where we have facilities in Illinois, Michigan, and Ohio. We have a long-standing tradition of innovation at our facilities in the region. The MGDC will allow us to continue and, more importantly, speed up that innovation.

Obtaining funding through the Midwest Governors Decarbonization Challenge is critical to the success of our decarbonization efforts, and Holcim U.S. fully supports the coalition's CPRG application.

Sincerely,

Jeffrey Scott
Plant Manager

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

EPA Project Control Number

CERTIFICATION REGARDING LOBBYING

CERTIFICATION FOR CONTRACTS, GRANTS, **LOANS AND COOPERATIVE AGREEMENTS**

The undersigned certifies, to the best of his or her knowledge and belief, that:

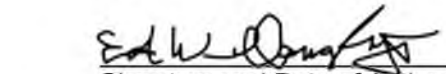
(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including sub-contracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31 U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Ed Willoughby, Federal Aid Coordinator
Typed Name & Title of Authorized Representative



2/1/2023
Signature and Date of Authorized Representative

NOTE: USE OF THIS EXAMPLE COVER PAGE IS OPTIONAL. IF THIS INFORMATION IS PROVIDED IN A DIFFERENT FORMAT, EPA WILL NOT REVIEW AN APPLICATION UNFAVORABLY.

CPRG IMPLEMENTATION GRANTS COMPETITION
COVER PAGE FOR APPLICATION

APPLICANT INFORMATION

Organization	Michigan Department of Environment, Great Lakes, and Energy/Office of Climate and Energy
Primary Contact Name	Cory Connolly; Paul McDonald
Phone Number	517-881-8972; 517-284-5003
Email Address	ConnollyC3@Michigan.gov; McDonaldP@Michigan.gov

TYPE OF APPLICATION ☐ Individual Applicant ☑ Lead Applicant for a Coalition

If lead applicant for a coalition, provide a list of the coalition members below.

(1) Michigan Department of Environment, Great Lakes, and Energy (Coalition Lead)
(2) Illinois Environmental Protection Agency
(3) Minnesota Pollution Control Agency
(4) Ohio Environmental Protection Agency

FUNDING REQUESTED: *Provide total EPA CPRG Implementation Grant funding requested.*

$ 500,000,000

APPLICATION TITLE: *Provide the title of your proposed project.*

MIDWEST INDUSTRIAL DECARBONIZATION CHALLENGE COALITION

BRIEF DESCRIPTION OF GHG MEASURES: *Describe each GHG reduction measure contained in the application (1-2 sentences each).*

The Michigan Department of Environment, Great Lakes, and Energy, as coalition lead, Illinois Environmental Protection Agency, Minnesota Pollution Control Agency, Ohio Environmental Protection Agency, and Wisconsin Office of Sustainability and Clean Energy propose to carry out an industrial decarbonization competition that consists of two components: (1) a predevelopment program providing support to large industrial facilities for carrying out technical assessments and planning, to be handled by each coalition member in their state; and (2) a competitive grant program to support decarbonization projects at large industrial facilities located in Coalition states resulting in no less than 40% reduction in greenhouse gas emissions from each participating facility.

SECTORS: *Identify the sector(s) associated with the GHG reduction measures included in the application.*

- [x] Industry
- [ ] Electricity Generation
- [ ] Transportation
- [ ] Other (please describe)
- [ ] Commercial and Residential Buildings
- [ ] Agriculture/Natural and Working Lands
- [ ] Waste and Materials Management

EXPECTED TOTAL CUMULATIVE GHG EMISSION REDUCTIONS

For all proposed measures combined, provide the estimated cumulative GHG reductions:

Estimated cumulative GHG reductions for 2025-2030 (in metric tons)

8,792,795

Estimated cumulative GHG reductions from 2025-2050 (in metric tons)

47,155,383

LOCATIONS: *List the primary location(s) where the proposed measures will be implemented*

City

State; Territory; Federally recognized Tribe At industrial facilities that receive technical assistance and/or apply and receive grant

APPLICABLE PRIORITY CLIMATE ACTION PLAN(S) (PCAP) ON WHICH MEASURES ARE BASED

PCAP Lead Organization(s): State of Michigan

PCAP Title(s): State of Illinois Priority Climate Action Plan, Michigan Priority Climate

PCAP Website link(s) (if applicable): Illinois: https://www.epa.gov/system/files/documents/2024-0

List of GHG reduction measures and PCAP page reference for each measure:

Industrial decarbonization GHG reduction measures are included in each state's PCAP:
State of Illinois Priority Climate Action Plan, at page 64.
Michigan Priority Climate Action Plan, at page 80

Midwest Industrial Decarbonization Challenge

A CPRG Coalition of States

Illinois, Michigan, Minnesota, Ohio, Wisconsin

April 1, 2024

WORK PLAN NARRATIVE

1. OVERALL PROJECT SUMMARY AND APPROACH

The Michigan Department of Environment, Great Lakes, and Energy (EGLE), as coalition lead (Coalition Lead), Illinois Environmental Protection Agency, Minnesota Pollution Control Agency, Ohio Environmental Protection Agency, and Wisconsin Office of Sustainability and Clean Energy (together, the "Coalition") propose to carry out an industrial decarbonization competition that consists of two components: (1) a predevelopment program providing support to large industrial facilities for carrying out technical assessments and planning, to be handled by each Coalition member in their state; and (2) a competitive grant program to support decarbonization projects at large industrial facilities located in Coalition states, to be administered by the Energy Resources Center of the University of Illinois Chicago ("UIC") in collaboration with Coalition members. Roles and responsibilities of each Coalition member are described in Table 1.

The states participating in this Coalition have long been the industrial heartland of the United States. Together, the Coalition states were responsible for 12 percent of U.S. industrial emissions in 2022.[1] Ohio and Illinois are the 5th and 6th largest industrial emitting states, respectively. Michigan and Minnesota are also top-20 industrial emitting states at 12th and 16th, respectively. Wisconsin ranks 32nd among industrial emitters. The table below shows the breakdown by industrial sub sector for the Coalition states.

Industrial Subsector	Total Emissions	Share of Emissions in 5-state Region
Refining	20,227,262	30%
Iron & Steel	13,543,198	20%
Cement & Lime	7,515,764	11%
Agricultural Processing	7,251,405	11%
Agricultural Chemicals & Fertilizer	4,746,475	7%
Paper Products	3,808,542	6%
Coke	2,229,780	3%
Chemicals	1,899,221	3%
Coal Mining	1,689,808	2%
Waste	1,581,403	2%
Industrial Gasses	1,216,872	2%
Natural Gas Systems	976,153	1%
University	812,130	1%
Carbon Removal	557,212	1%
Glass	407,772	1%

[1] Emissions information comes from the U.S. Environmental Protection Agency's (EPA) Greenhouse Gas Reporting Program, 2022.

a. Description of Industrial Decarbonization Predevelopment and Challenge Grant Program

The predevelopment program and challenge grant components of the Midwest Industrial Decarbonization Challenge are described below.

The Predevelopment Program

Each Coalition state will receive funding totaling $10.3 million per state for the predevelopment portion of the Climate Pollution Reduction Grant(CPRG) implementation grant (first two years), after providing for lead state administrative costs and the costs of funding the non-profit convener and technical assistance provider, to fund the following activities:

i. *Add Staff Capacity.* Each Coalition state will create an industrial decarbonization program by adding 3.0 full-time employee equivalents (FTE) – a director, a specialist, and an analyst – or equivalent contracting capacity to staff and manage the state's participation in both the predevelopment and competitive regionwide grant program components.

ii. *Provide Predevelopment Assistance to Large Industrial Facilities.* Each Coalition state will provide technical assistance to large industrial facilities to identify and develop decarbonization opportunities and to prepare for implementation of decarbonization projects, including the challenge grant funded under this proposal. Projects must achieve a minimum of 40 percent reduction in combined scope 1 and scope 2 greenhouse gas (GHG) emissions, maximize local air pollution reductions in low-income and disadvantaged communities (LIDAC), and demonstrate efforts to maximize private sector investments and federal tax credit uptake. States will have discretion to support the predevelopment efforts that are needed at their large industrial facilities, and those efforts may include American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Level II assessments and support for engineering studies necessary for planning projects. Each Coalition member will work with their respective state university that currently manages a U.S. Department of Energy (DOE) Industrial Assessment Center (or equivalent) to provide this predevelopment assistance.[2] Coalition member states may also administer an application process for large industrial facilities to access up to $6 million in additional funding for predevelopment assistance.

iii. *Coordinate with Other Coalition Members.* Each Coalition state will coordinate with other states in the coalition to share best practices, provide updates on progress and collaborate with the coalition lead, the non-profit convener and technical assistance providers, the UIC, and the respective state university with industrial assessment expertise in each state. With the assistance of a non-profit convener, the Coalition Lead will regularly convene the Coalition states to carry out this coordination.

iv. *Advance Statewide Industrial Decarbonization.* Each Coalition state will advance industrial decarbonization by executing a stakeholder engagement process, modeling and analysis, and LIDAC engagement to identify barriers and policy and program recommendations to

[2] In Illinois, the University of Illinois Chicago Industrial Assessment Center; in Michigan, Michigan State University Industrial Assessment Center; in Ohio, the University of Dayton Industrial Assessment Center; in Minnesota, the University of Minnesota Technical Assistance Program; and in Wisconsin, University of Wisconsin, Milwaukee Industrial Assessment Center. Whenever reference is made to "IAC" in this application, it references the University that has the industrial assessment expertise and staffs the IACs.

decarbonize the state's industrial sector, and work to implement those recommendations. Each Coalition state will also host an annual statewide Industrial Decarbonization Conference or similar convening to identify and address barriers to industrial decarbonization, build a shared understanding of established and emerging solutions, and highlight resources and programs available from the federal government, state government, and other sources.

Each Coalition state brings contributions to this project in the form of existing capacity and experience working with industrial and manufacturing facilities in their states. In addition, some members will leverage available state funding, while others will engage their existing state economic development teams to assist in the effort to support innovation and investment at existing industrial facilities in participating states in ways complementary to this proposed predevelopment component.

The Competitive Challenge Grant Program

The Coalition will work with the UIC to administer a $416 million dollar challenge grant program open to the large industrial emitters across the participating states. In addition, each coalition state will receive approximately $5 million, after providing for lead state administrative costs and the costs of funding the non-profit convener and technical assistance provider, to fund ongoing staff capacity and participation in the challenge portion of the program. During the challenge portion, facilities will compete for grants against other facilities in the Coalition states, as follows:

v. *Challenge Grant Amounts.* It is expected that between 15 and 40 grants will be awarded in amounts of up to $50 million in size. At least three grants will be awarded in each Coalition state.

vi. *Eligible Facilities.*[3] Industrial facilities from each member state are eligible to compete for challenge grants. These facilities will be encouraged by each coalition member to participate in the challenge grant program.

vii. *Eligible measures.* The following measures are eligible for challenge grant funding:

- Electrification, heat pump installation, thermal storage, and use of other low- and zero-carbon sources of industrial heat;
- Lighting and heating, ventilation, and air conditioning (HVAC) improvements;
- Heat recovery;
- Facility maintenance and system upgrades;
- Carbon capture technologies;
- Recycling and waste management upgrades;
- Fuel-switching to low-carbon fuels, such as hydrogen made from renewable energy or nuclear energy; and

[3] The Coalition states acknowledge EPA's intention to not fund the same measure in the same location with CPRG funds. The Coalition states commit to ensuring projects do not receive funding from more than one CPRG implementation grant award. No facility will be eligible for funding under this Midwest Industrial Decarbonization Challenge if it has received other CPRG funding.

- Equipment replacement and upgrades to improve system efficiency.

viii. *Minimum Challenge Grant Requirements.* All projects receiving funding under the grant challenge will be required to, at a minimum, leverage private capital at a minimum ratio of 4 to 1; result in a minimum emissions reduction of 40 percent of combined scope 1 and scope 2 GHG emissions; demonstrate a substantial reduction in co-pollutants; and develop a comprehensive community benefits plan.

ix. *Competitive Criteria.* Projects that meet the minimum requirements will compete based on how well they satisfy the following grant criteria above and beyond the minimum requirements:

- Reductions in direct scope 1 and indirect scope 2 GHG emissions;
- Local air pollution benefits;
- LIDAC benefits;
- Private sector funding leverage;
- Use of relevant tax credits and other federal incentives, loans, or grants; and
- Overall impact on scope 3 GHG emissions.

Coalition states, in partnership with the UIC, will develop the challenge grant program after CPRG grant funds are awarded and additional competitive criteria may be added at that time to ensure the best, most impactful projects are selected in the region. The UIC will administer the challenge grant program under the direction of the Coalition Lead and with the input of Coalition member states. The UIC will establish a program web portal; outreach materials for coalition members to use; a standard application; conduct one or more Q&A sessions for potential applicants; provide for the technical review of the challenge grant applications and recommend scoring to the regional application evaluation committee board (described in the following paragraph). The evaluation committee will apply the criteria in a manner that ensures at least three projects will be carried out in each Coalition state.

A challenge grant application evaluation committee consisting of representatives from all Coalition states, as well as additional expert members selected by the Coalition, will make the final decisions on grant recipients. Applications will be scored based on objective criteria decided before the challenge grant program begins Each Coalition state will appoint one member to the committee. The UIC will provide technical input to the committee and a non-profit convener will convene the evaluation committee.

Table 1 Coalition Roles and Responsibilities

Entity	Roles and Responsibilities
Coalition Lead: Michigan Department of Environment, Great Lakes, and Energy	• Submit to EPA a fully executed Memorandum of Agreement (MOA) signed by all coalition members by July 1, 2024 • Issue subawards to coalition partners for the predevelopment, technical and planning assistance component of the program, in accordance with EPA's Subaward Policy • Issue a subaward to the UIC to enable the UIC to function as program administrator for the competitive grant program, in accordance with the EPA's Subaward Policy • Issue a subaward to a non-profit convener to assist the Coalition Lead in convening the coalition members from time to

	time and provide for collaboration by the coalition members, in accordance with the EPA's Subaward Policy • Overseeing subrecipients, and/or contractors and vendors • Tracking and reporting on project progress on expenditures and purchases • Tracking, measuring, and reporting accomplishments on proposed timelines and milestones • Submitting semi-annual progress reports on grant implementation and planned activities to the EPA • Submitting detailed final report to the EPA within 120 calendar days of the completion of the period of performance • Community and stakeholder outreach and education within Michigan for both the predevelopment and challenge grant components of the program • Carry out the predevelopment component of the program in Michigan, working closely with the Industrial Assessment Center at Michigan State University (MSU) • Identify and/or make available additional incentives for industrial decarbonization projects within the state to complement the challenge
Coalition Members: • Illinois Environmental Protection Agency; • Minnesota Pollution Control Agency; • Ohio Environmental Protection Agency; and • Wisconsin Office of Sustainability and Clean Energy.	• Enter into an MOA with all Coalition states so that the Coalition Lead can submit to EPA no later than July 1, 2024 • Carry out the predevelopment, technical, and planning assistance component of the program with the assistance of the state's Industrial Assessment Center or equivalent entity,[4] in compliance with the subrecipient requirements of EPA's Subaward Policy • Participate in regional convenings to share best practices, generally support industrial facilities in the state to prepare for participation in the program, and appoint a member to the regional challenge grant application evaluation committee • Tracking and reporting to Coalition Lead on project progress on expenditures and purchases within each Coalition state's jurisdiction • Tracking, measuring, and reporting to Coalition Lead on accomplishments and proposed timelines and milestones within each Coalition state's jurisdiction • Community and stakeholder outreach and education within each Coalition state's jurisdiction • Identify and/or make available additional incentives for industrial decarbonization projects within their respective states to complement the challenge

[4] See footnote 1 for a list of the DOE-supported centers that will serve as industrial assessment centers for this grant program.

Table 2 details tasks and milestones for implementation of the proposed industrial grant challenge program. The period of performance is December 2024 to December 2029. Table 3 details anticipated risks associated with measure implementation and mitigation strategies for each risk.

Table 2 Tasks and Milestones

Task #	Task Description	Anticipated Milestone Dates[5]	Assumptions
EPA	Notification of Funding Selection	July 2024	
1	Develop program materials for the predevelopment component of the program (incl. program guide, website, application, outreach materials)	October 2024	Coalition states work together with assistance of non-profit convener, technical assistance provider the UIC and state industrial assessment centers.
EPA	Anticipated Award	October 2024	
2	Distribute state shares of predevelopment funding to state partners for predevelopment, technical and planning assistance	November 2024	Coalition Lead distributes funds received from EPA
3	Contract with non-profit convener and technical assistance provider (the UIC) to support the predevelopment component of the program; States contract with in-state IACs.	November 2024	
4	Stand up/go live with predevelopment component and commence industry outreach around program	December 2024	Coalition states conduct outreach, non-profit convener and the UIC assist
5	Community engagement around program design specifics	November 2024 – December 2025	Concurrent with standing up program components
6	Preparation of materials for $416 million challenge grant program (program guide, application, and promotional materials and community engagement around these materials)	November 2024 – December 2025	Coalition states work together with assistance of non-profit convener and technical assistance provider, the UIC
7	Stand up challenge grant program; Educate stakeholders and communities about program guide and solicit applications for projects	January 2026 – December 2026	Three months following completion and publication of the program guide and promotional materials
8	Accept application for challenge grants	January to February 2027	Provides large emitters with 2 years to prepare for challenge grant competition

[5] These dates may be revised based on stakeholder and community input.

9	Review applications, select projects, and enter into agreements with project sponsors	March 2027 – May 2027	One month to evaluate and select successful applications and two months to enter into agreements with project sponsors
10	Disburse funds to project sponsors	May 2027	As established in the agreements with project sponsors
11	Semi-annual review of progress on grant projects	December 2027 and every 6 months	Coalition states work together with assistance of non-profit convener and technical assistance (the UIC)

Table 3 Risks and Mitigation Strategies

Risk	Effect on GHG emission reductions	Mitigation Strategy
Program undersubscribed and the $416 million is not spent in one round of challenge grants	Delays may reduce cumulative GHG emission reductions in the near-term (2025 – 2030)	Carry out a second round of competitive applications with potential adjustments to competitive criteria (excluding GHG emissions impact)
A Coalition state drops out of the program	The program is not carried out in that state	MOA will provide that the funds will be returned to Coalition Lead and will be added to the $416 million challenge grant pool

Table 4 demonstrates how this proposed measure relates to GHG reduction measures in Coalition member PCAPs. This measure was selected as a priority because industrial innovation to reduce emissions is an imperative across all of the Coalition member states. While industry represents a significant portion of each state's GHG emissions inventory, it is a sector that has often received the least attention among sectors. The CPRG funding offers an opportunity to address industrial emissions through a voluntary, incentive-based approach that emphasizes innovation and investment.

Table 4 Alignment with Coalition Member PCAPs

Coalition Member	**PCAP References to Measure to be Implemented**
Illinois	State of Illinois Priority Climate Action Plan, at page 64, available here.
Michigan	Michigan's Priority Climate Action Plan, at page 90, available here.
Minnesota	MN Priority Climate Action Plan, at page 42, available here.
Ohio	OH Priority Resiliency Plan, at pages 46, 56-57, available here.
Wisconsin	Wisconsin Emissions Reduction Roadmap, at page 18, available here.

This proposed Midwest Industrial Decarbonization Challenge will advance EPA's CPRG goals as follows:

1. ***Ambitious Program that will Achieve Significant Emissions Reductions.*** The challenge grant program proposed in this application brings together a diverse set of states in America's industrial heartland to support innovation in the industrial and manufacturing sector – a sector that has often received the

least attention when it comes to government support of emissions reductions projects. The predevelopment component of the program will help large industrial facilities identify innovative measures to lower costs, while reducing emissions. Some of the measures identified will be possible without additional government assistance. Others will become the focus of challenge grant applications. The challenge grant criteria will ensure that facilities receiving challenge grants achieve significant emissions reductions.

2. ***The Program will Achieve Substantial Community Benefits.*** The program will result in additional private investment at existing industrial and manufacturing facilities in the region, making the facilities more competitive and supporting the continuation of the jobs and community benefits they provide. The challenge grant criteria will ensure that the projects awarded grants will provide robust community benefits reflected in a comprehensive community benefits plan. The program will pursue measures that will achieve substantial community benefits (such as reduction of criteria air pollutants (CAPs) and hazardous air pollutants (HAPs)), particularly in LIDACs. The community benefits plan will also provide benefits in addition to the reductions in localized pollution that will result from the projects funded.

3. ***The Program will Complement Other Funding Sources.*** It is well understood that existing programs to support industrial innovation and decarbonization at the federal and state levels are necessary but not sufficient on their own to meet the full need such facilities have. As such, the predevelopment component will help industrial facilities identify additional federal funding sources to implement their projects, while the grant challenge program proposed will complement the other available funding sources to maximize GHG reductions and community benefits. A review of some other funding sources is provided in Table 5. Additionally, participating states will identify additional resources and leverage existing economic development tools to support industrial decarbonization. For example, Michigan intends to leverage its $337 million "Make it in Michigan Competitiveness Fund" to bolster the program in that state.

4. ***The Program is Replicable and Scalable***. The proposed program is both replicable and scalable in other states and regions. The predevelopment component will help industrial facilities identify worthwhile projects at their facilities. Some of the projects identified will already be cost effective without additional government support or through other available federal funding programs, yielding investments at industrial sites that other states could easily support. For those measures that require additional government support, the challenge grant program will demonstrate a way for other states and regions to lift up the promising ideas for funding, ensuring that investments go to the very best projects.

b. Demonstration of Funding Need

CPRG implementation funding is necessary to carry out the proposed industrial decarbonization challenge grant program and achieve the emissions reductions and other benefits of the program. Table 5 lists federal funding sources that coalition members have taken into account as the proposed grant program was developed. Industrial decarbonization presents a special challenge because industry faces international competition that is less present in other domestic economic sectors, such as the power, buildings, and transportation sectors. Incentive-based programs such as the proposed grant program are needed to lift up the best projects and encourage low-carbon investments in domestic industry and American manufacturing.

Table 5 Funding Sources Examined in Connection with the Proposed Industrial Decarbonization Challenge Grant Program

Funding Source	Funding Status	Need for CPRG funding
48C Tax Credit Program	DOE accepted applications for the current round in December 2023; awards are expected in spring 2024.	The $4 billion in federal funding is expected to be oversubscribed nationwide. This competitive challenge grant program would only apply to projects that do not receive 48C tax credits.
45Q Tax Credit	Facilities can receive up to $85 per ton of CO_2 sequestered.	Facilities would be required to take into account the 45Q tax credit and demonstrate need from the challenge grant program above and beyond the tax credit.
45V Tax Credit	Hydrogen production that meets U.S. Treasury guidelines gets funding through tax credit.	Facilities would be required to take into account the 45V tax credit and demonstrate need from the challenge grant program above and beyond the tax credit.
DOE IEDO Fiscal Year 2024 Cross-Sector Technologies	$38 million nationwide to advance the strategies identified in the DOE's Industrial Decarbonization Roadmap and support the goals of the Industrial Heat Shot™ through a focus on cross-sector approaches for industrial decarbonization.	Facilities would be required to take into account any support they receive from this federal program and demonstrate need from the challenge grant program above and beyond the program.
DOE FY24 Energy and Emissions Intensive Industries	$83 million nationwide to support applied research, development, and demonstration (RD&D) for the highest GHG-emitting industrial subsectors, specifically: chemicals and fuels; iron and steel; food and beverage; building and infrastructure materials (including cement and concrete, asphalt pavements, and glass); and forest products.	Facilities would be required to take into account any support they receive from this federal program and demonstrate need from the challenge grant program above and beyond the program.
DOE Clean Energy and Manufacturing Workforce Training and Technical Assistance Awards (IAC Program) Section 40521	$24 million nationwide to establish new industrial training and assessment centers, as part of the Industrial Assessment Centers (IAC) network, across the United States to train students and incumbent workers for high-quality careers in clean energy, energy efficiency, and advanced manufacturing, and to help small and mid sized manufacturers (SMMs) save money, reduce energy waste, and improve productivity.	Facilities would be required to take into account any support they receive from this federal program and demonstrate need from the challenge grant program above and beyond the program.

DOE Carbon Capture Demonstration Projects Program Front End Engineering Design Studies for Integrated Carbon Capture, Transport and Storage Systems	Funding opportunity has closed. $189 million nationwide to support Carbon Capture Demonstration Projects Program to de-risk integrated carbon capture and sequestration (CCS) demonstrations and catalyze significant follow-on investments from the private sector for commercial-scale, integrated CCS demonstrations on carbon emissions sources across industries in the U.S.	Facilities would be required to take into account any support they receive from this federal program and demonstrate need from the challenge grant program above and beyond the program.
DOE Clean Energy Manufacturing Innovation Institute for Industrial Decarbonization through Electrification of Process Heating	Funding opportunity closed. $70 million nationwide for the development of a new institute that will conduct research, development, and demonstration (RD&D) focused on developing and scaling electrified processes that reduce emissions, improve flexibility, and enhance energy efficiency of industrial process heating.	Facilities would be required to take into account any support they receive from this federal program and demonstrate need from the challenge grant program above and beyond the program.
DOE Clean Hydrogen Electrolysis, Manufacturing, and Recycling	$500 million for the development of manufacturing and recycling of clean hydrogen technologies, and $1 billion for electrolyzer development for the five.	Facilities would be required to take into account any support they receive from this federal program and demonstrate need from the challenge grant program above and beyond the program.
DOE Industrial Decarbonization and Emissions Reduction Demonstration-to-Deployment	Funding opportunity has closed. $6 billion in federal funds for projects that will validate low-GHG emitting industrial facilities capable of manufacturing products and materials with low-carbon footprints. DOE aims to fund projects in the highest emitting, hardest-to-abate industries where rapidly deployed decarbonization technologies can have the greatest impact: iron, steel, steel mill products, aluminum, cement, concrete, glass, pulp, paper, industrial ceramics, chemicals, and other energy intensive industrial processes.	Facilities would be required to take into account any support they receive from this federal program and demonstrate need from the challenge grant program above and beyond the program.
State of Michigan State Energy Program investments in industrial decarbonization	Michigan's remaining American Recovery and Reinvestment Act (ARRA) funds will provide $2.5 million to support industrial energy efficiency initiatives. Centrepolis Accelerator at Lawrence Technological University hosts the Industrial Decarbonization Innovation Challenge	Facilities would be required to take into account any support they receive from this state program and demonstrate need from the challenge grant program above and beyond the program.

	with up to $250,000 available for the best industrial decarbonization solutions.	

c. Transformative Impact

The Midwest Industrial Decarbonization Challenge is expected to be transformative for the region and for industrial decarbonization generally. The five states participating in this coalition represent a significant proportion of industrial facilities in the Midwest, some of which compete with one another and some of which are owned by the same company. Catalyzing action at sites in each state via the regional industrial predevelopment and challenge grant program has the potential for truly transformative impacts above and beyond the direct benefits brought about by the grants themselves.

This program will:

i. Bring together a diverse, bipartisan group of states in America's industrial heartland. The cooperation and collaboration of the states in this coalition will demonstrate common ground in the effort to advance American industry and manufacturing, supporting innovation and investment that will benefit states and communities within states while contributing to solutions that reduce environmental impacts.

ii. Demonstrate positive outcomes in the industrial sector that can be scaled and replicated elsewhere. The predevelopment portion of the program will provide assistance to industry in identifying the most promising measures they can take to innovate and advance decarbonization at their facilities. This is an approach other states and regions can readily adopt with minimal investment. The larger challenge grants, in turn, will lift up the most innovative, impactful ideas from across a five-state region and demonstrate success stories for others within the coalition states and in other states and regions.

iii. Concentrate state efforts toward industrial decarbonization, encouraging states to leverage economic development tools, other state and federal funding programs, and the convening power of the state to drive rapid industrial emissions reductions. For example, Michigan will leverage the tools of the Michigan Economic Development Corporation, the $337 million "Make it in Michigan Competitiveness Fund," and $2.75 million from its State Energy Program. Michigan will also prominently promote the competition and leverage its relationships and convening power through the state's Michigan Infrastructure Office, Community and Worker Economic Transition Office within Michigan's Department of Labor and Economic Opportunity, Michigan's Council on Climate Solutions, the planning and stakeholder engagement activities of the CPRG program, and other state efforts to support Michigan's industrial facilities pursuing the challenge grant program. Other Coalition states will leverage their existing programs and resources in a similar fashion.

2. IMPACT OF GHG REDUCTION MEASURES

Table 6 provides estimates of the cumulative emission reductions in metric tons of carbon dioxide equivalent ($mtCO_2e$) anticipated from implementation of both program components for two time

periods: 2025 to 2030 and 2025 to 2050. Further details on quantification methods, relevant assumptions, annual emission reduction estimates, and any uncertainties associated with the estimates are provided in the Technical Appendix to this application.

Table 6 Cumulative GHG Emission Reductions Anticipated from Implementation of Proposed Measures

	Cumulative GHG emission reductions (mt CO_2e)	
	2025–2030	**2025–2050**
Predevelopment Program (Technical Assessments and Planning)	**1,553,323**	**11,099,869**
Challenge Grant Program Total	**7,402,783**	**36,055,514**
Total	**8,792,795**	**47,155,383**

According to our conservative estimates, this program will generate over eight million metric tons of GHG savings by 2030 and over 47 million by 2050. Since it is not possible to know at this time the possible sources of facility matching funds, we have conservatively estimated the GHG reductions represented only by the portion of the project funded directly by the CPRG funding requested in this application. The total emission reduction estimated from this program and its required private capital leverage is over 39 million metric tons by 2030 and over 191 million metric tons by 2050 and could be attributed to CPRG funds if no additional state or federal funding is applied to the projects.

The implementation of the proposal is highly cost-effective. The cost-effectiveness of the proposal, inclusive of all measures in this application, is $56.87 per ton of CO_2e reduced by 2030 and $11.86 per ton of CO_2e reduced by 2050.

3. ENVIRONMENTAL RESULTS – OUTPUTS, OUTCOMES, AND PERFORMANCE MEASURES

The Midwest Industrial Decarbonization Challenge will directly support the EPA's No. 1 strategic goal: tackle the climate crisis. As described in the previous section, the program will significantly reduce industrial GHG emissions in a key industrial region of the country, and do so cost effectively. The program is designed to select projects that bring the best environmental results by drawing industrial facilities into a competitive challenge grant program in which only the best, most impactful projects will win funding to implement decarbonization projects at industrial facilities in the region. As described above, the competitive grant criteria will emphasize the project's direct scope 1 emissions reductions and benefits to LIDAC communities.

a. Expected Outputs and Outcomes

Outputs from this proposal include:

i. Added capacity at Coalition state environmental agencies to work closely with industrial facilities in the state to encourage innovation and investment consistent with a low-carbon economy. Each Coalition state is expected to add three FTEs or equivalent capacity for the 5-year performance period of the grant and the Coalition Lead will add four FTEs.

ii. Added capacity for technical assistance to industrial facilities in the Coalition states through the DOE industrial Technical Assistance Partnerships in the Midwest region at the University of Illinois Chicago and the University of Minnesota.
iii. Added capacity for technical assistance at industrial facilities in coalition member states through the DOE IACs at the University of Dayton, Ohio; Michigan State University; University of Wisconsin, Milwaukee; and the University of Illinois Chicago.
iv. An estimated 20 new industrial ASHRAE Level II assessments at industrial facilities in each of the five coalition member states. These assessments will identify cost-effective measures that make sense to implement even if the facility does not receive funding under the challenge grant portion of the program. The assessments also identify other measures facility owners and operators can plan for over time to modernize the facilities.
v. Between 15 and 40 challenge grants awarded to the very best projects proposed at industrial facilities in the region. The precise features of these projects is not known in advance but the competitive nature of the challenge grant program ensures the very best projects will be identified for support.
vi. Semi-annual progress reports.[6]
vii. Detailed final report.

Outcomes from this proposal include:

i. Reduction in cumulative metric tons of GHG emissions are estimated to be:
    - 2025 – 2030: 8,792,795metric tons CO_2e
    - 2025 – 2050: 47,155,383metric tons CO_2e
    - While the precise emissions reductions will depend on the projects selected for funding under the competitive challenge grant program, the design of the program ensures that only the very best, most-impactful projects will be funded. As such, the emissions reduction estimates are likely to be conservative estimates.
ii. Associated reductions in annual CAP and HAP emissions. Because projects will be selected in part based on the benefits they bring to local communities, the final mix of projects funded under this application are ensured to have strong environmental co-benefits.
iii. Implementation of projects identified in the technical assistance assessments will reduce energy consumption at the facilities, lower costs, and make the facilities more competitive.
iv. Lower energy consumption at industrial facilities will reduce overall energy demand, likely reducing energy costs for commercial and residential customers, including low-income residential customers.

b. Performance Measures and Plan

The Coalition has established the following performance measures to track progress concerning successful processes and output and outcome strategies.

i. Number of industrial facilities in each coalition state that participate in the predevelopment component of the program. "Participation" is defined as receiving technical advice and/or

[6] Beginning with the second semi-annual report, reporting will include detailed quantified benefits to low-income and disadvantaged communities, including changes in co-pollutant emissions, and provide updates on ongoing and planned community engagement.

assistance from a coalition member, the UIC, the state's IAC, or an affiliated technical assistance provider in the coalition state.

ii. Number of facilities that plan projects to modernize and innovate at their facilities because those projects were identified in assessments provided by the program.
iii. Number of industrial facilities in each coalition state that compete in the industrial challenge grant program.
iv. Number of challenge grants awarded meeting the minimum emissions reduction and community benefit requirements of the program.
v. Number of projects carried out at industrial facilities with the help of challenge grants.
vi. Amount of private capital leveraged by the program to carry out innovative investments at industrial and manufacturing facilities in member states.
vii. Benefits to LIDAC communities.
viii. Other community benefits, including environmental, health, educational, job and economic benefits, resulting from projects supported by the program.
ix. Emissions reductions, both GHG and co-pollutant reductions, achieved by projects identified and/or funded in part by the program.

Coalition states and subaward recipients will track progress for each performance measure within their jurisdiction and report progress to Coalition Lead. The Coalition Lead will provide a status update with respect to each performance measure to the EPA in the semi-annual reports and final report.

c. Authorities, Implementation Timeline, and Milestones

All Coalition states have the legal authority to carry out their roles and responsibilities under this coalition proposal. The roles and responsibilities of each coalition member are detailed in Section 1 of this proposal. A detailed implementation timeline – including tasks, key milestones, and key actions needed to meet goals and objectives by the end of the grant period – is provided in Section 1.a of this proposal.

4. LOW-INCOME AND DISADVANTAGED COMMUNITIES

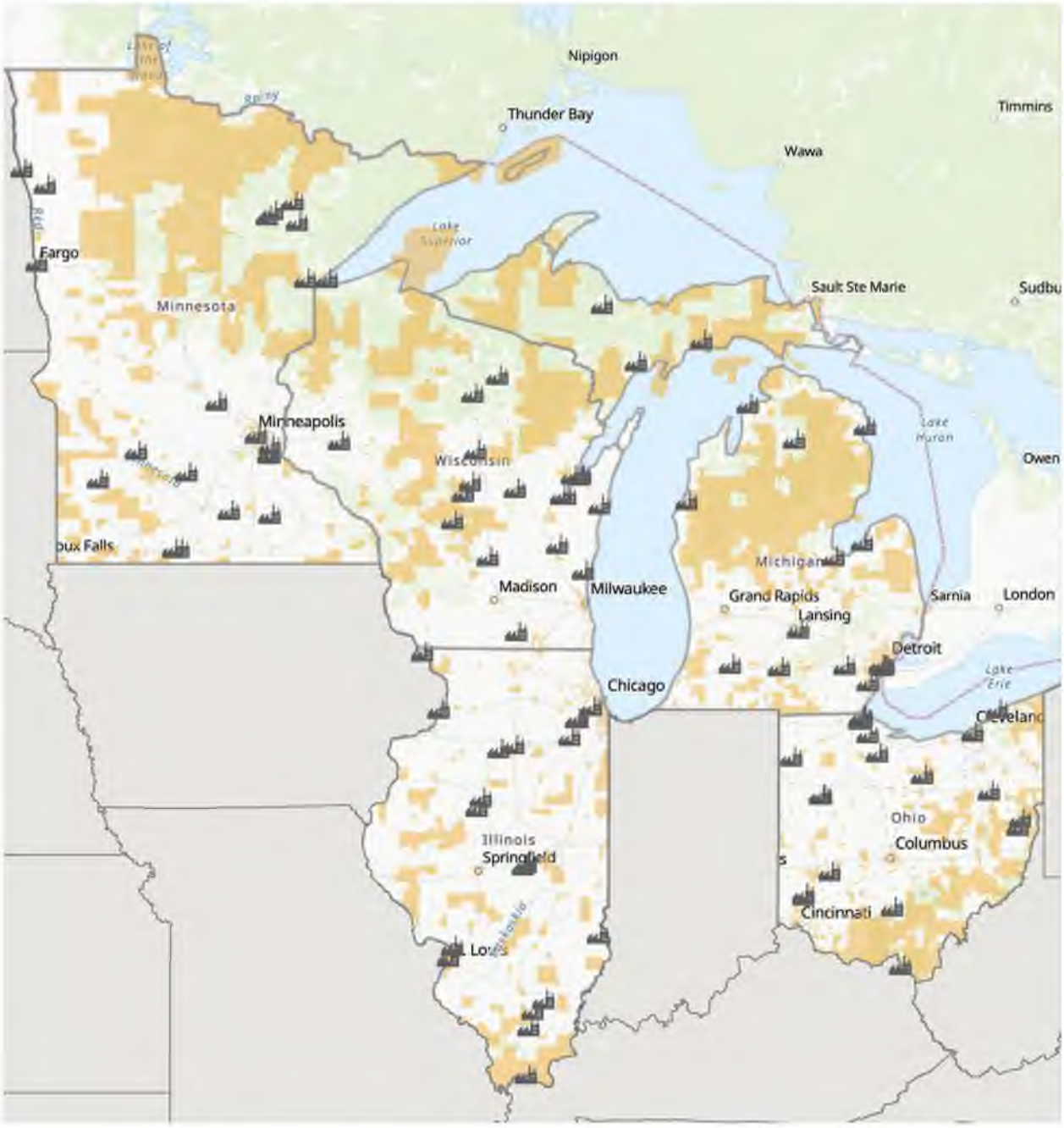
a. Community Benefits

The implementation of the Midwest Industrial Decarbonization Challenge coalition is expected to provide significant benefits to LIDAC communities in the coalition states. As described above, projects that receive technical assistance under the predevelopment component and/or grant funds for projects under the challenge grant component will reduce GHG emissions as well as emissions of co-pollutants. Lowering emissions in the communities where the facilities are located will bring the health and environmental benefits of cleaner air to these communities. At the same time, investments in the facilities will preserve and create good quality, family-sustaining jobs for members of the communities.

Because it is not known precisely which facilities will take advantage of the predevelopment assistance offering and/or apply for and receive challenge grant funding, the map below shows where the top-20 industrial emitters are located in each Coalition state relative to the LIDAC communities using the White House Council on Environmental Quality's Climate and Economic Justice Screening Tool. The majority of

the large industrial emitters in the Coalition states are located in or near LIDAC communities.

A list of all LIDAC census tracts affected by this proposal is included as an attachment to this application. Full-page maps of each individual Coalition state and their top-20 industrial emitters is also provided in the attachment.



The Coalition states will assess, quantify, and report a more thorough analysis of associated community benefits based on actual data collected during implementation. The Coalition states will track the deployment of innovative industrial measures in and near identified LIDAC census tracts to quantify

reduction in GHG emissions and co-pollutant emissions and other community benefits. The Coalition partners will include results of these assessments in semi-annual reports to the EPA and make the information publicly available.

b. Community Engagement to Date and Looking Forward

Past Engagement efforts

Each Coalition state performed extensive community outreach, including to LIDACs, during development of their PCAPs that, in turn, resulted in this coalition application. Over the course of the last several months, coalition members have intentionally and meaningfully engaged a wide swath of communities across their respective states, with a specific focus on centering the voices and experiences of LIDAC community members.

These outreach efforts included:

i. Hosting multiple stakeholder meetings, including virtual and in-person presentations and workshops to elevate the perspectives and lived experiences of LIDAC community members. Several of the in-person meetings held across the coalition states were focused on areas that would be easily accessible to LIDAC community members. Information was presented in an accessible manner to enhance opportunities for engagement. These meetings helped to:
   - Provide greater insight into the barriers LIDAC communities face in accessing and benefiting from climate and clean energy strategies.
   - Inform the development and selection of priority reduction measures.
   - Educate, inform, and excite communities about the opportunities available through CPRG funding.
   - Form and strengthen relationships with nongovernmental organizations (NGOs) and community-based organizations serving LIDAC residents across each state.
   - Center benefits for LIDAC communities as a key desired outcome for any measure incorporated into the CPRG application.

ii. Developing and distributing community surveys to allow expanded access for commentary and feedback.
   - Information gathered from these public surveys helped to directly inform the development of the respective state's CPRG application.

iii. Creating online platforms for individuals from various communities to easily and accessibly provide feedback that could then be used to inform the development of the application. Links to the online platform were distributed to key stakeholders proximate to LIDAC community members.

iv. Partnering directly with municipalities, NGOs and other community-based organizations where relationships already existed to enhance awareness of engagement opportunities.

v. Intentionally engaging Tribal Nations and other communities historically excluded from key decision-making conversations.
   - Multiple states consulted and strengthened key partnerships with leaders and officials from federally recognized Tribal Nations across their respective states.

Specific details of each coalition member's community engagement leading up to this application is contained in their respective PCAP plans referenced in Table 4 above.

Future Engagement efforts

Each coalition member will allocate time and staff resources to continue meaningful engagement efforts with community members and other stakeholders leading up to and during the program, leveraging existing channels of stakeholder engagement. These engagement efforts will be aimed at increasing education about the program, gathering and incorporating input from LIDAC communities and other stakeholders into the program, and ensuring community engagement efforts become common practice.

The Coalition states will engage communities:

vi. **Ahead of the launch of the program:**

- State agency officials across the coalition will work with community members, leaders, and organizations in their respective states to host in-person and virtual town hall meetings prior to launching the program to help inform residents of the program, its potential benefits, and the opportunities that exist for ongoing collaboration. Locations and timing for these meetings will intentionally take accessibility for LIDAC community members into account. Officials will work to incorporate feedback from these meetings into the final details of the program.
- Coalition members will proactively partner with tribal officials, municipalities and NGOs to deepen engagement across the state, with a particular focus on LIDAC communities.
- States will work collaboratively to develop eligibility criteria for prospective grantees that intentionally incorporates community outreach as a key component for a successful grant application, helping to ensure sites applying for funds proactively engage their surrounding community.

vii. **During the program:**

- Each state will provide annual, public-facing updates in various, accessible formats to share progress from the prior year. These updates will include information about selected projects, siting locations, projected energy and emissions reductions, and anticipated benefits for the surrounding community.
- States will host an annual series of (virtual/in-person) town hall meetings with participating grantees to allow community members to ask questions, gain understanding and provide additional insight and feedback to help further refine programming implementation for the following year.
- Coalition states will convene regularly to assess outreach efforts, compare strategies, and strengthen meaningful engagement practices to enhance accessibility and incorporate various linguistic, cultural, institutional, and geographic perspectives.

In addition to these outreach efforts, the program itself is designed to maximize benefits to LIDAC communities through a challenge grant criterion that will give extra points for projects proposed in LIDAC communities.

5. JOB QUALITY

The Midwest Industrial Decarbonization Challenge will support good quality, family-sustaining jobs, including union jobs, at existing industrial facilities in Illinois, Michigan, Minnesota, Ohio, and Wisconsin by bringing new investment at these facilities that will make these facilities more efficient and therefore more competitive. As the world moves to decarbonize across the economy, the challenge grant program will motivate industrial partners to take steps to future-proof their facilities, positioning these facilities

to compete in a low-carbon economy, thereby preserving quality jobs for workers in Coalition states. Because Davis-Bacon applies to CPRG funded projects, all projects under the challenge grant component must meet or exceed the prevailing wage requirements of Davis-Bacon. As such, the Midwest Industrial Decarbonization Challenge is wholly consistent with the Biden Administration's Roadmap to Support Good Jobs.

As part of the Administration's Roadmap to Support Jobs, DOE expanded its support of the Industrial Assessment Centers, which according to the White House,

> [increase] pathways for workers into high-quality clean energy jobs and [support] small and medium-sized American manufacturers. The IAC Program will form new partnerships with community colleges, trade schools, and union training programs, offering hands-on experience for engineers-in-training while helping manufacturers save energy, reduce costs, increase productivity, and boost competitiveness.[7]

The Midwest Industrial Decarbonization Challenge will likewise bring additional support to IACs in the region focused on projects to decarbonize and innovate at the region's larger industrial and manufacturing facilities, providing a place for workers coming through these important pipelines to work. The IACs are located at universities and employ students who assist in carrying out IAC work, giving them important experience that the students bring with them to jobs at facilities in the region. The proposal will therefore boost the training efforts of the IACs as they in turn help manufacturers "save energy, reduce costs, increase productivity and boost competitiveness."

6. PROGRAMMATIC CAPABILITY AND PAST PERFORMANCE

a. Programmatic Capability of Coalition Lead, Members, and Partners

The Coalition Lead, EGLE, is the principal environmental agency and energy agency of the State of Michigan with decades of experience working with industry in the state to reduce the environmental impacts associated with industrial operations. The proposed Midwest Industrial Decarbonization Challenge fits squarely in EGLE's expert competencies. EGLE has established expertise in key areas relevant to carrying out the responsibilities of this grant application, including with: (1) the measurement, monitoring and use of emissions information from industrial facilities; (2) selection and installation of pollution abatement equipment and fuel switching and other changes to industrial processes to reduce pollution; (3) inspection and verification of environmental results at industrial facilities; and (4) the administration of grant programs to achieve environmental goals. Each of the other member agencies in the Coalition are similarly established to carry out the environmental regulatory goals of their states and have significant experience working closely with industry in their states to improve environmental performance and measuring and tracking environmental performance at industrial facilities.

In addition to the extensive experience Coalition members bring working with industrial facilities in their states, the Midwest Industrial Decarbonization Challenge will enlist the partnership of the UIC's Energy Resources Center (ERC) to provide technical assistance and to work with Coalition members to

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[7] See *Biden-Harris Administration Roadmap to Support Good Jobs,* May 16, 2023, available at https://www.whitehouse.gov/briefing-room/statements-releases/2023/05/16/biden-harris-administration-roadmap-to-support-good-jobs/.

administer the challenge grant component of the program. The UIC's ERC already serves as the Technical Assistance Program (TAP) for the DOE's industrial onsite technical assistance program for the Midwest and Central regions of the country.[8] In this role, the UIC's ERC interacts with industrial partners in the region to evaluate measures that can improve efficiency and lower costs. This experience lines up directly with the UIC's role helping to carry out both the predevelopment and challenge grant components of the Midwest Industrial Decarbonization Challenge. Working closely with the UIC will be the IACs in each member state.

Technical assistance for the program will also come from the DOE Industrial Assessment Centers (IACs) through the region. The IACs at the University of Dayton, Ohio; Michigan State University; University of Illinois, Chicago; and the University of Wisconsin, Milwaukee. Each of the IACs is already working to provide a limited number of industrial assessments in their states under DOE's IAC program.

b. **Past Performance under EPA Grants**

Michigan and all of the Coalition member states have successfully implemented other federal grants within their jurisdictions. Federally funded assistance agreements that the Coalition Lead is performing or has performed within the last three years include:

Leaking Underground Storage Tank Trust Fund (LUST)

i. Program Assistance Agreement Number: (Cooperative Agreement #) LS-97534216
ii. Funding Agency: EPA
iii. Assistance Listing Number (e.g., CFDA number): 66.805
iv. Description: The LUST grant is an ongoing, 2-year grant from the EPA that supports EGLE's administration of the LUST program. It provides funds to ensure the appropriate investigation and cleanup of petroleum release sites from leaking underground storage tanks for the protection of human health and the environment.
v. Funding Agency Contact: Ethel Crisp, 312-353-1442, crisp.ethel@epa.gov
vi. Status: The LUST grant is a two-year grant to fund EGLE's implementation of the LUST program. EGLE uses the funds for personnel and some contractual expenses and reports to the EPA biannually on various program metrics.
vii. Reporting History: EGLE's Remediation and Redevelopment Division (RRD) biannual reports to the EPA about progress toward achieving the expected outputs and outcomes, challenges to meeting expected outputs and outcomes during the reporting period, and strategies to address such challenges.

Section 106 Monitoring Initiative

i. Program Assistance Agreement Number: 01E01479-0
ii. Funding Agency: EPA
iii. Assistance Listing Number: 66.419
iv. Description: This grant included a project titled, "Climate Change Monitoring Plan," which was intended to outline objectives and a potential sampling plan for the Great Lakes Watersheds Assessment, Restoration, and Management Section (GLWARMS) to measure impacts to biological stream communities from climate change.
v. Funding Agency Contact: Ed Hammer, hammer.edward@epa.gov, 312-886-3019

[8] The Midwest region covers all coalition member states Illinois, Michigan, Minnesota, Ohio, and Wisconsin. See https://betterbuildingssolutioncenter.energy.gov/onsite-energy.

vi. Status: Complete. This project deliverable is complete and has led to GLWARMS developing a Quality Assurance Project Plan (QAPP) with a project start date of summer 2024. GLWARMS staff successfully performed site reconnaissance in March 2024 and plan to begin sampling when the QAPP is complete and permits are in place to install monitoring equipment (e.g., flow and temperature gages) on public property.
vii. Reporting History: The EGLE's Water Resources Division (WRD) submitted annual reports to the EPA about progress toward achieving the expected outputs and outcomes, challenges to meeting expected outputs and outcomes during the reporting period, and strategies to address such challenges.

Wetland Program Development Grant - Shorelines and Shallows

i. Program Assistance Agreement Number: CD00E02070
ii. Funding Agency: EPA
iii. Assistance Listing Number: 66.461
iv. Description: Developing Tools to Protect and Restore Wetland Shorelines and Shallows
v. Funding Agency Contact: Kristen Faulhaber, Faulhaber.kristen@epa.gov, 312-353-4378
vi. Status: Complete. This project has significantly advanced Michigan's ability to address the challenges and improve protection of riparian wetlands on inland lakes statewide. This project has also led to improved understanding of the importance of these resources by landowners, shoreline professionals, and regulatory staff. Annual reports to EPA Region 5 included funded activities and explained progress towards achieving the expected environmental outputs and outcomes. The final report was submitted in April 2022.
vii. Reporting History: EGLE's Water Resources Division (WRD) submitted annual reports to the EPA about progress toward achieving the expected outputs and outcomes, challenges to meeting expected outputs and outcomes during the reporting period, and strategies to address such challenges.

State Clean Diesel Grant Program

i. Program Assistance Agreement Number: 00E66606
ii. Funding Agency: EPA
iii. Assistance Listing Number: 66.04
iv. Description: Michigan Diesel Emission Reduction Strategy
v. Funding Agency Contact: Julia Frusciante, frusciante.julia@epa.gov, 312-886-1478
vi. Status: Complete.
vii. Reporting History: EGLE's Materials Management Division (MMD) submitted annual reports to the EPA about progress toward achieving the expected outputs and outcomes, challenges to meeting expected outputs and outcomes during the reporting period, and strategies to address such challenges.

Superfund Management Assistance Cooperative Agreement

i. Program Assistance Agreement Number: (Cooperative Agreement #) V-07E00776
ii. Funding Agency: EPA
iii. Assistance Listing Number: 66.802
iv. Description: Superfund Management Assistance annual grant funding which is used to provide technical and community relations support for Federal lead projects in Michigan. Eligible activities under the grant include technical assistance, community relations assistance, legal support, and project coordination and review.
v. Funding Agency Contact: Lindaa Ross, ross.lindaa@epa.gov, 312-353-6626

vi. Status: Ongoing. The Superfund Management Assistance Grant is an annual funding allocation received from the EPA. The Management Assistance grant is awarded on a yearly basis and has a performance period of April 1 to March 31.

vii. Reporting History: EGLE's RRD submits bi-annual progress reports to the EPA about state involved site progress and expenditures during a six-month reporting period.

BUDGET NARRATIVE FOR THE MIDWEST INDUSTRIAL DECARBONIZATION CHALLENGE

This budget narrative provides an explanation of costs associated with each of the predevelopment and the challenge grant components of the program, followed by a consolidated budget. Additional details are included in the attached optional budget spreadsheet. The spreadsheet includes three tabs: a consolidated budget; the lead agency budget; and a sample budget for the non-lead coalition states. Each budget tab includes funding across all five years of the program, with predevelopment component costs covered in years 1 and 2, and challenge component costs covered in years 3-5.

1. Predevelopment Component (Years 1 & 2)

The predevelopment component of the project will provide technical assessments to industrial facilities in the Coalition states and advance statewide industrial decarbonization efforts. Itemized costs associated with each budget category are provided in the Budget Table included with this proposal under the "Predevelopment Component (Years 1 & 2)" in each spreadsheet tab.

a. Personnel and Fringe

The lead agency personnel listed in the budget table will provide the following in support of the predevelopment component of the program. Notably, these have been split into two categories – services the lead agency will provide to the project overall, and services that the lead agency will provide for itself, similar to what other states will do for themselves with their subawards under the predevelopment component of the program.

- Services the lead agency will provide for the coalition:
  - Establish contract with a non-profit convener with a history of working with diverse states across the region to regularly convene the coalition partners in support of predevelopment activities.
  - Distribute state shares of predevelopment funding to state partners and technical assistance provider for predevelopment, technical, and planning assistance.
  - Gather and ensure proper submission of all reporting requirements and deliverables across the Coalition.
- Services the lead agency will provide for itself (and that each coalition member will also do with its subaward funds):
  - Work collaboratively with a non-profit convener, technical assistance provider, and other states to develop program materials for the predevelopment component of program (including program guide, website, application, outreach materials)
  - Establish contract with the university that operates their in-state Industrial Assessment Center (IAC) or equivalent to provide at least 20 assessments to industrial facilities.
  - Commence outreach following stand up/go live of predevelopment phase.
  - As part of outreach, conduct community engagement around program design specifics.
  - Support all other predevelopment component activities as described in this proposal.

Fringe calculation: official retirement and insurance rates are unknown for future years, so the state of Michigan will use a conservative estimate based on current conditions that provides 40% of total payroll for fringe expenses for senior staff positions and 60% for more junior staff positions, as staff with lower classification levels typically have a smaller salary, but benefits comprise a higher percentage of their total payroll. Benefit estimates include costs for pension, FICA (social security), dental, health, and vision

insurance, leave balance payouts when employees separate from state service, and other post-employment retirement costs like retirement health care plans.

b. Travel

Lead agency staff will conduct travel statewide as part of their outreach activities. We anticipate they will make approximately 36 trips per year to varying locations across the state. We estimate these trips will on average be 500 miles round-trip (some will be longer– driving from Lansing to Houghton is 1,000 miles round trip), paid at the federal mileage reimbursement rate of $0.67 per mile. Some of these trips will require lodging, estimated at one, one-night hotel stay per month for two staff members, using an average hotel cost of $250 per room per night. We also anticipate each staff member attending one out of state conference per year, including flight and lodging. These travel reimbursement rates are used for estimating the total travel budget amount. Each participating state will determine the exact rates in accordance with their respective state travel guidelines.

c. Equipment

The predevelopment component of the project is not expected to incur investments in equipment that has a cost of $5,000 or more per unit.

d. Supplies

Not applicable.

e. Contractual

Non-profit Convener: The lead agency will contract with a third-party neutral nonprofit convener that will regularly convene the Coalition members to refine and implement the predevelopment phase of the program. This is needed to ensure that the program is designed to meet the needs of all Coalition members, to support collaboration among the members, and to effectively resolve any disputes that may arise during program development and implementation. Responsibilities of the nonprofit convener will include the following:

- Regularly convene the coalition members throughout the predevelopment phase to develop program rules and materials, support outreach, share best practices, provide updates on progress, and navigate any unforeseen challenges or disputes that may arise.
- Work with coalition members and technical assistance providers to develop program materials for the predevelopment component of the program (including program guide, website, application, outreach materials).
- Assist states with implementing their outreach activities to ensure that all states are providing high-quality outreach to their industrial emitters.

IAC: The lead agency will issue a contract to its respective IAC to provide assessments to large industrial emitters. Particularly large emitters are expected to require more in-depth assessments that go beyond the current capacity of IACs. For these facilities, the lead agency may expand a partnership with their respective IAC or run a separate intra-state application process for accessing a pool of $6 million in funding to support predevelopment activities. Each Coalition member state will also do this with their in-state IAC or equivalent as part of their subaward.

The lead agency will hire a third-party neutral convener to convene an in-state stakeholder engagement process to identify barriers and policy and program recommendations to decarbonize the state's industrial sector, and work to implement those recommendations. This will be complemented by the following components:

- Modeling and analysis to inform the discussion and recommendations.
- LIDAC specific engagement to inform the recommendations.
- Following the engagement process, the contractor will work with industry, government, and others to advance the recommendations. This work will continue through the challenge component of the project because advancing policy and program recommendations may require a multi-year effort. Each Coalition state will also do each of the above as part of their subaward.

f. Other

Other costs for lead agency that also apply to the Coalition member state budgets as noted below:

- Laptops, cell phones, VPNs, and other supplies are calculated at 5% of total wages and fringe. This captures costs for information technology equipment, maintenance, and support for industrial decarbonization staff.
- Conference registration for industrial decarbonization staff.
- Employee training funds for industrial decarbonization staff.
- Host an annual Industrial Decarbonization Conference to identify and address barriers to industrial decarbonization, build a shared understanding of established and emerging solutions, and highlight resources and programs available from the federal government, state government, and other sources.
- Provide support to the state's top 40 emitters with conducting assessments and/or implementing other predevelopment activities:
  - Establish a contract with in-state (IAC to provide at least 20 assessments to industrial facilities.
  - Top 20 emitters– the lead agency will run an intra-state application process for accessing a pool of $6 million to support predevelopment activities.

Technical assistance provider: The lead agency will provide a subaward to the University of Chicago's (UIC) Energy Resources Center (ERC) to serve as the lead technical assistance provider. The UIC will provide the following services for predevelopment component:

- Assist with developing program materials for the predevelopment component of the program (including program guide, website, application, outreach materials).
- Assist with stand up/go live of predevelopment component, including industry outreach around program.
- Assist with technical guidance and criteria for predevelopment assessments that qualify for applications to the challenge grant funding and coordinate with IACs across all coalition states as necessary.
- Assist with establishing conventions for metrics tracking and reporting across states.
- Work collaboratively with the Coalition member states and the nonprofit convener on overall program development and coordination.

Coalition States: The lead agency will provide subawards to each of the other four Coalition members to carry out the following activities as part of the predevelopment component of the program. A sample budget for these activities is included in the attached optional budget spreadsheet in the tab labeled "Non-Lead Agency Budget." Each state will refine their own budget based on their respective contexts

and strategies for driving industrial emissions reductions. These predevelopment component costs are covered in years 1-2 of the five-year budget.

- Create an industrial decarbonization program and hire adequate staffing or contractual support to support the predevelopment component activities, work with industry across the state, and coordinate with other states on decarbonization efforts. It is anticipated each state will hire three FTEs (a director, a specialist, and an analyst) or add the equivalent contractual support.
- Other staffing and contractual costs necessary to fulfill the Coalition members' roles and responsibilities under this proposal.
- Work collaboratively with the non-profit convener, technical assistance provider, and other states to develop program materials for the predevelopment component of program (including program guide, website, application, outreach materials).
- Commence outreach following stand up/go live of predevelopment phase. As part of outreach, conduct community engagement around program design specifics.
- Planning and implementation meetings, workshops, and convenings necessary to perform community and stakeholder outreach and education within each Coalition member's jurisdiction.
- Modeling and analytical costs, including purchase or licensing of software, data, or tools.
- Studies, assessments, data collection, etc., needed to track, measure, and report actual accomplishments related to this measure.
- Evaluation and metrics-tracking activities.
- Training and staff capacity-building costs.
- Supplies (e.g., office supplies, software, printing, etc.).
- Incidental costs related to the above activities, including, without limitation: travel, membership fees, and indirect costs.
- Other activities as agreed upon by the Coalition.
- Other allowable activities as necessary to fulfill the Coalition members' roles and responsibilities under this proposal.
- Hire a contractor to convene a stakeholder engagement process to identify barriers and policy and program recommendations to decarbonize the state's industrial sector, and work to implement those recommendations.
  - As part of that engagement process, conduct modeling and analysis to inform the discussion and recommendations.
  - Conduct LIDAC/EJ community specific engagement to inform the recommendations.
  - Following the engagement process, work with industry, government, and others to advance the recommendations.
- Provide support to the state's top 40 emitters with conducting assessments and/or implementing other predevelopment activities:
  - Establish a contract with in-state IAC or equivalent entity to provide at least 20 assessments to industrial facilities.
  - Top 20 emitters – states will run an intra-state application process for accessing a pool of $6 million to support predevelopment activities.
- Host an annual Industrial Decarbonization Conference or similar convening to identify and address barriers to industrial decarbonization, build a shared understanding of established and emerging solutions, and highlight resources and programs available from the federal government, state government, and other sources.

g. Indirect Costs

The negotiated 2024 indirect rate for EGLE is 16.65%. This has been applied to salary and fringe for State of Michigan staff, or contractual equivalent, that will be hired to manage the program.

2. Industrial Challenge Grant Component

The industrial challenge grant component of the project will provide competitive grants to industrial facilities who apply and win in the Coalition states. Itemized costs associated with each budget category are provided in the Budget Table included with this proposal under the "Challenge Grant Component (Years 3-5)" in each spreadsheet tab.

a. Personnel and Fringe

The lead agency personnel listed in the budget table will provide the following in support of the industrial challenge grant component. Notably these have been split into two categories – services the lead agency will provide to the project overall, and services that the lead agency will provide for itself, similar to what other states will do for themselves with their subawards under the industrial challenge grant component.

- Services the lead agency will provide for the coalition:
  - Establish contract with a non-profit convener with a history of working across the Great Lakes states to regularly convene the coalition partners in support of industrial challenge grant activities.
  - Distribute state shares of challenge funding to state partners and technical assistance provider for challenge phase activities.
- Services the lead agency will provide (and that each Coalition member will also do with its subaward funds):
  - Work collaboratively with assistance of non-profit convener and technical assistance provider to prepare materials for $416 million challenge grant program (program guide, application, and promotional materials and community engagement around these materials).
  - Educate stakeholders and communities about challenge grant program guide and solicit applications for projects.
  - Participate in the project review and selection process.

Fringe calculation: official retirement and insurance rates are unknown for future years, so the state of Michigan will use a conservative estimate based on current conditions that provides 40% of total payroll for fringe expenses for senior staff positions and 60% for more junior staff positions, as staff with lower classification levels typically have a smaller salary, but benefits comprise a higher percentage of their total payroll. Benefit estimates include costs for pension, FICA (social security), dental, health, and vision insurance, leave balance payouts when employees separate from state service, and other post-employment retirement costs like retirement health care plans.

b. Travel

Lead agency staff will conduct travel statewide as part of their outreach activities for the challenge grant component. We anticipate they will make approximately 36 trips per year to varying locations across the state. We estimate these trips will on average be 500 miles round-trip (some will be longer – driving from Lansing to Houghton is 1,000 miles round trip), paid at the federal mileage reimbursement rate of $0.67 per mile. Some of these trips will require lodging, estimated at one, one-night hotel stay per

month for two staff members, using an average hotel cost of $250 per room per night. We also anticipate each staff member attending one out of state conference per year, including flight and lodging. These travel reimbursement rates are used for estimating the total travel budget amount. Each participating state will determine the exact rates in accordance with their respective state travel guidelines.

c. Equipment

This phase of the project is not expected to incur investments in equipment that has a cost of $5,000 or more per unit.

d. Supplies

Not applicable.

e. Contractual

Nonprofit Convener: The lead agency will contract with a third-party neutral nonprofit convener that will regularly convene the coalition members to refine and implement the challenge grant component of the program. This is needed to ensure that the program is designed to meet the needs of all coalition members, to support collaboration among the members, and to effectively resolve any disputes that may arise during program development and implementation. Responsibilities of the nonprofit convener will include the following:

- Regularly convene the coalition members throughout the challenge phase to develop program rules and materials, support outreach to solicit challenge grant applications, review challenge grant applications, maintain established timelines, provide updates on challenge grant progress, and navigate any unforeseen challenges or disputes that may arise.
- Work with coalition members and technical assistance providers to develop materials for $400 million challenge grant program (program guide, application, and promotional materials and community engagement around these materials).
- Assist states with implementing their outreach activities to ensure that all states are providing high-quality outreach to their industrial emitters and to solicit high quality challenge grant applications.
- Convene a review and selection committee that will make recommendations for awarding challenge grants.
- Support the semi-annual review of progress on grant projects.

Industrial Assessment Center: The lead agency will issue a contract to Michigan State University, the home of Michigan's IAC, to support industries with developing challenge grant applications. Each coalition member state will also do this as part of their subaward.

f. Other

Other costs for lead agency that also apply to the coalition member state budgets as noted below:

- Laptops, cell phones, VPNs, and other supplies are calculated at 5% of total wages and fringe. This captures costs for information technology equipment, maintenance, and support for industrial decarbonization staff.
- Conference registration for industrial decarbonization staff.
- Employee training funds for industrial decarbonization staff.

- Host an annual Industrial Decarbonization Conference to identify and address barriers to industrial decarbonization, build a shared understanding of established and emerging solutions, and highlight resources and programs available from the federal government, state government, and other sources.
- Establish a contract with in-state IAC to assist industries with developing challenge grant applications.

Technical assistance provider: The lead agency will provide a subaward to the UIC's ERC to serve as the lead technical assistance provider. The UIC will provide the following services for the challenge grant component:

- Manage and disburse the $416 million challenge grant funding to grant recipients.
- Coordinate and oversee the administrative issuance of the grant funding, including all necessary legal and compliance requirements.
- Assist with developing program materials for challenge component of program (including program guidelines and rules, technical guidance and criteria, and application review process).
- Assist with stand up/go live of challenge component, including industry outreach around program.
- Lead the technical review process for the challenge grant applications, in service to the selection committee.
- Assist with establishing conventions for metrics tracking and reporting across states.
- Work collaboratively with the coalition member states and nonprofit convener on overall program development and coordination.

Coalition states: The lead agency will provide subawards to each of the other four coalition members to carry out the following activities during the challenge component (years 3-5):

- Continue to operate an Industrial Decarbonization Office or program with adequate staffing to support the challenge phase, work with industry across the state, and coordinate with other states on decarbonization efforts.
- Work collaboratively with assistance of non-profit convener and technical assistance provider to prepare materials for $416 million challenge grant program (program guide, application, and promotional materials and community engagement around these materials).
- Participate in the application review and selection process.
- Other staffing and contractual costs necessary to fulfill the coalition members roles and responsibilities under this proposal.
- Work collaboratively with non-profit convener, technical assistance provider, and other states to develop program materials for challenge component of program (including program guide, website, application, outreach materials).
- Conduct outreach to support applications to the challenge grants.
- Planning and implementation meetings, workshops, and convenings necessary to perform community and stakeholder outreach and education within the coalition member's jurisdiction.
- Modeling and analytical costs, including purchase or licensing of software, data, or tools.
- Studies, assessments, data collection, etc. needed to track, measure, and report actual accomplishments related to this measure.
- Evaluation and metrics-tracking activities.
- Training and staff capacity-building costs.
- Supplies (e.g., office supplies, software, printing, etc.).
- Incidental costs related to the above activities, including without limitation: travel, membership fees, and indirect costs.

- Other activities as agreed upon by the coalition.
- Other allowable activities as necessary to fulfill the Coalition members' roles and responsibilities under this proposal.
- Establish a contract with in-state IAC or equivalent to assist industries with developing challenge grant applications.
- Host an annual Industrial Decarbonization Conference to identify and address barriers to industrial decarbonization, build a shared understanding of established and emerging solutions, and highlight resources and programs available from the federal government, state government, and other sources.

g. Indirect Costs

The negotiated FY24 indirect rate for EGLE is 16.65%. This has been applied to salary and fringes for State of Michigan staff, or contractual equivalent, that will be hired to manage the program.

3. Consolidated Budget by Year

BUDGET BY YEAR		Predevelopment Component		Challenge Component			
COST-TYPE	CATEGORY	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
Direct Costs	TOTAL PERSONNEL	*$469,000*	*$499,954*	*$532,951*	*$568,126*	*$605,622*	*$2,675,653*
	TOTAL FRINGE BENEFITS	*$220,400*	*$199,982*	*$213,180*	*$227,250*	*$242,249*	*$1,103,061*
	TOTAL TRAVEL	*$22,110*	*$22,110*	*$22,110*	*$22,110*	*$22,110*	*$110,550*
	TOTAL EQUIPMENT	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	TOTAL SUPPLIES	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	TOTAL CONTRACTUAL	*$1,375,000*	*$1,375,000*	*$800,000*	*$800,000*	*$800,000*	*$5,150,000*
	TOTAL OTHER	*$24,826,611*	*$24,921,338*	*$146,656,615*	*$146,856,806*	*$147,070,210*	*$490,331,580*
	TOTAL DIRECT	*$26,913,121*	*$27,018,384*	*$148,224,857*	*$148,474,292*	*$148,740,190*	*$499,370,844*
	TOTAL INDIRECT	$114,785	$116,539	$124,231	$132,430	$141,170	$629,156
TOTAL FUNDING		**$27,027,906**	**$27,134,923**	**$148,349,088**	**$148,606,722**	**$148,881,361**	**$500,000,000**

4. Consolidated Budget by Project

BUDGET BY PROJECT			
Project Number	Project Name	Total Cost	% of Total
1	*Predevelopment Component: Years 1-2*	*$54,162,829*	*11%*
2	*Challenge Component: Years 3-5*	*$445,837,171*	*89%*
Total		*$500,000,000*	*100%*

5. Expenditure of Awarded Funds

The State of Michigan will expend and account for awarded funds in accordance with state laws and procedures for expending and accounting for the state's own funds. The financial management system for Coalition Lead complies with the requirements of 2 CFR 200.302(b). As noted in the application, the Coalition Lead has extensive experience administering EPA grants with great success.

The State of Michigan will enter into a subaward agreement with each coalition member prior to disbursement of subaward funds. These agreements will include all applicable pass-through

requirements for subrecipients in accordance with EPA's Subaward Policy and EPA's General Terms and Conditions for Subawards.

The semi-annual reports and final report will include a breakdown of expenditures associated with implementation of this proposal.

6. Reasonableness of costs

The costs outlined in the budget are reasonable and consistent with costs deemed reasonable by the EPA in previous and existing EPA grants to Coalition Lead.

Introduction:

This Excel Spreadsheet is provided to aid Climate Pollution Reduction Grant implementation grant applicants in developing the required budget table(s) within the budget narrative. Applicants may submit a budget spreadsheet (no page limit) with their application.

The individual worksheets are formatted for 1 page width of 8.5" x 11" landscape orientation.

Instructions:

The template contains 5 tabs (titled "Measure 1 Budget" through "Measure 5 Budget") where applicants can create budgets for up to 5 discrete GHG measures contained in their application. Applicants should leave excess tabs blank (ie, if an application is for a single GHG measure, only Tab 1 should contain any numerical entries.) The Consolidated Budget tab will automatically sum budget totals across all GHG measure Tabs. If an application includes more than 5 GHG measures, users may add duplicate tabs, but will need to manually update the formulas contained on the Consolidated Budget tab.

Measure Tab Instructions:

Below is a description of the steps an applicant should complete to finish each measure tab of the template.

- **In column C,** provide itemized costs descriptions in each cost category. Insert or delete rows as needed.

- **In columns D through H,** fill in the cost for the line item per year - personnel, fringe benefits, travel, equipment, installation, or labor supplies, contractual costs, and other direct costs (i.e., subawards, participant support costs), and indirect costs for each applicable year. Subtotals will calculate automatically.

- **Column J** will automatically calculate the total cost for the line item for the entire measure, including subtotals for each budget category - personnel, fringe benefits, travel, equipment, installation, or labor supplies, contractual costs, and other direct costs (i.e., subawards, participant support costs), and indirect costs.

Please check all formulas and calculations before finalizing your budget tables.

Consolidated Budget Instructions:

This table will update automatically based on the budget detail entered in the tabs for measures 1-5. If your application includes more than 5 individual measures, you will need to add additional tabs, update the formulas below, and add additional lines to the "Budget by Project" table to include the additional measures.

Consolidated Budget Table

This table will update automatically based on the budget detail entered in the tabs for measures 1-5. If your application includes more than 5 individual measures, you will need to add additional tabs, update the formulas below, and add additional lines to the "Budget by Project" table to include the additional measures.

BUDGET BY YEAR		Predevelopment Component		Challenge Component			
COST-TYPE	**CATEGORY**	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**	**TOTAL**
Direct Costs	TOTAL PERSONNEL	*$469,000*	*$499,954*	*$532,951*	*$568,126*	*$605,622*	*$2,675,653*
	TOTAL FRINGE BENEFITS	*$220,400*	*$199,982*	*$213,180*	*$227,250*	*$242,249*	*$1,103,061*
	TOTAL TRAVEL	*$22,110*	*$22,110*	*$22,110*	*$22,110*	*$22,110*	*$110,550*
	TOTAL EQUIPMENT	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	TOTAL SUPPLIES	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	TOTAL CONTRACTUAL	*$1,375,000*	*$1,375,000*	*$800,000*	*$800,000*	*$800,000*	*$5,150,000*
	TOTAL OTHER	*$24,826,611*	*$24,921,338*	*$146,656,615*	*$146,856,806*	*$147,070,210*	*$490,331,580*
	TOTAL DIRECT	*$26,913,121*	*$27,018,384*	*$148,224,857*	*$148,474,292*	*$148,740,190*	*$499,370,844*
	TOTAL INDIRECT	$114,785	$116,539	$124,231	$132,430	$141,170	$629,156
TOTAL FUNDING		**$27,027,906**	**$27,134,923**	**$148,349,088**	**$148,606,722**	**$148,881,361**	**$500,000,000**

BUDGET BY PROJECT			
Project Number	**Project Name**	**Total Cost**	**% of Total**
1	*Predevelopment Component: Years 1-2*	*$54,162,829*	*11%*
2	*Challenge Component: Years 3-5*	*$445,837,171*	*89%*
Total		*$500,000,000*	*100%*

Detailed Budget Table

This Excel Workbook is provided to aid applicants in developing the required budget table(s) within the budget narrative.
Items highlighted in yellow are included in budget for all member states; items in white are unique to Michigan as lead agency

BUDGET BY YEAR

		Predevelopment Component		Challenge Component				
COST-TYPE	**CATEGORY**	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**		**TOTAL**
Direct Costs	**Personnel**							
	Industrial Decarbonization Program Director or equiavlent capacity (support all state activities under predevelopment and challenge phases)	*$165,000*	*$175,890*	*$187,499*	*$199,874*	*$213,065*		*$941,328*
	Industrial Decarbonization Program Specialist or equiavlent capacity (support all state activities under predevelopment and challenge phases)	*$140,000*	*$149,240*	*$159,090*	*$169,590*	*$180,783*		*$798,702*
	Industrial Decarbonization Program Analyst 1 or equiavlent capacity (support all state activities under predevelopment and challenge phases)	*$82,000*	*$87,412*	*$93,181*	*$99,331*	*$105,887*		*$467,811*
	Industrial Decarbonization Program Adminstrator (support the lead agency with adminstering the overall program, including overseeing subawards and contracts)	*$82,000*	*$87,412*	*$93,181*	*$99,331*	*$105,887*		*$467,811*
	TOTAL PERSONNEL	*$469,000*	*$499,954*	*$532,951*	*$568,126*	*$605,622*	#	*$2,675,653*
	Fringe Benefits							
	Industrial Decarbonization Program Director	*$66,000*	*$70,356*	*$74,999*	*$79,949*	*$85,226*		*$376,531*
	Industrial Decarbonization Program Specialist	*$56,000*	*$59,696*	*$63,636*	*$67,836*	*$72,313*		*$319,481*
	Industrial Decarbonization Program Analyst	*$49,200*	*$34,965*	*$37,272*	*$39,732*	*$42,355*		*$203,525*
	Industrial Decarbonization Program Adminstrator	*$49,200*	*$34,965*	*$37,272*	*$39,732*	*$42,355*		*$203,525*
	TOTAL FRINGE BENEFITS	*$220,400*	*$199,982*	*$213,180*	*$227,250*	*$242,249*	#	*$1,103,061*
	Travel							
	Outreach travel for meetings with industry, communities, and program collaborators (36 trips per year @ 500 miles per trip avg, $.67 per mile)	*$12,060*	*$12,060*	*$12,060*	*$12,060*	*$12,060*		*$60,300*
	Outreach travel lodging (12 1-night hotel stays @$250/night for 2 staff per year)	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$6,000*		*$30,000*
	Conference attendance (3 flights per year @$850/flight)	*$2,550*	*$2,550*	*$2,550*	*$2,550*	*$2,550*		*$12,750*
	Conference attendance lodging (1 hotel stay of 2 nights @$250/night for 3 employees, annually)	*$1,500*	*$1,500*	*$1,500*	*$1,500*	*$1,500*		*$7,500*
	TOTAL TRAVEL	*$22,110*	*$22,110*	*$22,110*	*$22,110*	*$22,110*	#	*$110,550*
	Equipment							
								$0
	TOTAL EQUIPMENT	*$0*	*$0*	*$0*	*$0*	*$0*		*$0*
	Supplies							
	TOTAL SUPPLIES	*$0*	*$0*	*$0*	*$0*	*$0*	#	*$0*

1.066 Annual Salary increase

0.4 Fringe rate Director and Specialist

0.6 Fringe rate analyst and administrator

0.05 Supplies rate on personnel and fringe

Contractual						
Capacity building for state Industrial Assessment Center for predevelopment technical assistance and other support (predevelopment assessments, assistance with challenge applications, and other activities as requested by state)	*$750,000*	*$750,000*	*$500,000*	*$500,000*	*$500,000*	*$3,000,000*
Contract for stakeholder engagement process to identify barriers and recommendations to decarbonize industry in Michigan, and work to implement those recommendations	*$150,000*	*$150,000*	*$100,000*	*$100,000*	*$100,000*	*$600,000*
Contract for modeling and analysis to inform industrial decarbonization stakeholder engagement process	*$150,000*	*$150,000*				*$300,000*
Contract for LIDAC outreach and engagement as part of stakeholder engagement process	*$125,000*	*$125,000*				*$250,000*
Nonprofit Convener contract for overall convenings and general support	*$200,000*	*$200,000*	*$200,000*	*$200,000*	*$200,000*	*$1,000,000*
TOTAL CONTRACTUAL	*$1,375,000*	*$1,375,000*	*$800,000*	*$800,000*	*$800,000*	# *$5,150,000*
OTHER						
Industrial Decarbonization Program Director (Laptops, cell phones, VPNs, and other supplies calculated at 5% of total wages and fringe)	*$11,550*	*$12,312*	*$13,125*	*$13,991*	*$14,915*	*$65,893*
Industrial Decarbonization Program Specialist (Laptops, cell phones, VPNs, and other supplies calculated at 5% of total wages and fringe)	*$9,800*	*$10,447*	*$11,136*	*$11,871*	*$12,655*	*$55,909*
Industrial Decarbonization Program Analyst (Laptops, cell phones, VPNs, and other supplies calculated at 5% of total wages and fringe)	*$6,560*	*$6,119*	*$6,523*	*$6,953*	*$7,412*	*$33,567*
Conference registration ($875/person for 4 employees once per year)	*$3,500*	*$3,500*	*$3,500*	*$3,500*	*$3,500*	*$17,500*
Employee training ($1,000 per year per employee)	*$4,000*	*$4,000*	*$4,000*	*$4,000*	*$4,000*	*$20,000*
Funding to host annual statewide Industrial Decarbonization Conference (including planning, venue, food, facilitation, and staffing capacity in addition to personnel listed above)	*$250,000*	*$250,000*	*$250,000*	*$250,000*	*$250,000*	*$1,250,000*
Predevelopment support for top 20 emitters, in addition to and in concert with support from state IAC, to be deployed at discretion of state	*$3,000,000*	*$3,000,000*				*$6,000,000*
Industrial Decarbonization Program Adminstrator (Laptops, cell phones, VPNs, and other supplies calculated at 5% of total wages and fringe)	*$6,560*	*$6,119*	*$6,523*	*$6,953*	*$7,412*	*$33,567*

	University of Illinois Chicago contract for overall technical assistance and administrative support (predevelopment assessment criteria and coordination, challenge rules development, reviewing challenge applications, admistration of challenge grants and associated reporting)	*$1,000,000*	*$1,000,000*	*$1,000,000*	*$1,000,000*	*$1,000,000*	*$5,000,000*
	Illinois Environmental Protection Agency subaward for participation in all program activities (see "Non-Lead Agency Budget" tab for sample budget)	*$5,133,660*	*$5,157,210*	*$1,628,582*	*$1,678,014*	*$1,730,709*	*$15,328,175*
	Minnesota Pollution Control Agency subaward (see "Non-Lead Agency Budget" tab for sample budget)	*$5,133,660*	*$5,157,210*	*$1,628,582*	*$1,678,014*	*$1,730,709*	*$15,328,175*
	Ohio Environmental Protection Agency subaward (see "Non-Lead Agency Budget" tab for sample budget)	*$5,133,660*	*$5,157,210*	*$1,628,582*	*$1,678,014*	*$1,730,709*	*$15,328,175*
	Wisconsin Office of Sustainability and Clean Energy subaward (see "Non-Lead Agency Budget" tab for sample budget)	*$5,133,660*	*$5,157,210*	*$1,628,582*	*$1,678,014*	*$1,730,709*	*$15,328,175*
	Challenge Grant Funding for all states (number and size of grants to be determined by review committee , likely 20-40).			*$138,847,481*	*$138,847,481*	*$138,847,481*	*$416,542,444*
	TOTAL OTHER	*$24,826,611*	*$24,921,338*	*$146,656,615*	*$146,856,806*	*$147,070,210*	*$490,331,580*
	TOTAL DIRECT	*$26,913,121*	*$27,018,384*	*$148,224,857*	*$148,474,292*	*$148,740,190*	*$499,370,844*
Indirect Costs	**Indirect Costs**						
	Industrial Decarbonization Program Director	*$38,462*	*$41,000*	*$43,706*	*$46,591*	*$49,666*	*$219,423*
	Industrial Decarbonization Program Specialist	*$32,634*	*$34,788*	*$37,084*	*$39,531*	*$42,140*	*$186,178*
	Industrial Decarbonization Program Analyst	*$21,845*	*$20,376*	*$21,721*	*$23,154*	*$24,682*	*$111,777*
	Industrial Decarbonization Program Administrator	*$21,845*	*$20,376*	*$21,721*	*$23,154*	*$24,682*	*$111,777*
	TOTAL INDIRECT	*$114,785*	*$116,539*	*$124,231*	*$132,430*	*$141,170* #	*$629,156*
TOTAL FUNDING		***$27,027,906***	***$27,134,923***	***$148,349,088***	***$148,606,722***	***$148,881,361***	***$500,000,000***

1207125

0.1665 Indirect rate on salary and fringe

Detailed Budget Table

This Excel Workbook is provided to aid applicants in developing the required budget table(s) within the budget narrative.

BUDGET BY YEAR								
		Predevelopment Component		Challenge Component				
COST-TYPE	CATEGORY	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5		TOTAL
Direct Costs	**Personnel**							
	Industrial Decarbonization Program Director or equiavlent capacity (support all state activities under predevelopment and challenge phases)	*$165,000*	*$175,890*	*$187,499*	*$199,874*	*$213,065*		*$941,328*
	Industrial Decarbonization Program Specialist or equiavlent capacity (support all state activities under predevelopment and challenge phases)	*$140,000*	*$149,240*	*$159,090*	*$169,590*	*$180,783*		*$798,702*
	Industrial Decarbonization Program Analyst 1 or equiavlent capacity (support all state activities under predevelopment and challenge phases)	*$82,000*	*$87,412*	*$93,181*	*$99,331*	*$105,887*		*$467,811*
	TOTAL PERSONNEL	*$387,000*	*$412,542*	*$439,770*	*$468,795*	*$499,735*	#	*$2,207,841*
	Fringe Benefits							
	Industrial Decarbonization Program Director	*$66,000*	*$70,356*	*$74,999*	*$79,949*	*$85,226*		*$376,531*
	Industrial Decarbonization Program Specialist	*$56,000*	*$59,696*	*$63,636*	*$67,836*	*$72,313*		*$319,481*
	Industrial Decarbonization Program Analyst	*$49,200*	*$34,965*	*$37,272*	*$39,732*	*$42,355*		*$203,525*
	TOTAL FRINGE BENEFITS	*$171,200*	*$165,017*	*$175,908*	*$187,518*	*$199,894*	#	*$899,537*
	Travel							
	Outreach travel for meetings with industry, communities, and program collaborators (36 trips per year @ 500 miles per trip avg, $.67 per mile)	*$12,060*	*$12,060*	*$12,060*	*$12,060*	*$12,060*		*$60,300*
	Outreach travel lodging (12 1-night hotel stays @$250/night for 2 staff per year)	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$6,000*		*$30,000*
	Conference attendance (3 flights per year @$850/flight)	*$2,550*	*$2,550*	*$2,550*	*$2,550*	*$2,550*		*$12,750*
	Conference attendance lodging (1 hotel stay of 2 nights @$250/night for 3 employees, annually)	*$1,500*	*$1,500*	*$1,500*	*$1,500*	*$1,500*		*$7,500*
	TOTAL TRAVEL	*$22,110*	*$22,110*	*$22,110*	*$22,110*	*$22,110*	#	*$110,550*
	Equipment							
								$0
	TOTAL EQUIPMENT	*$0*	*$0*	*$0*	*$0*	*$0*		*$0*
	Supplies							
								$0
	TOTAL SUPPLIES		*$0*	*$0*	*$0*	*$0*	#	*$0*

1.066 Annual Salary increase

0.4 Fringe rate Director and Specialist

0.6 Fringe rate analyst

	Contractual						
	Capacity building for state Industrial Assessment Center for predevelopment technical assistance and other support (predevelopment assessments, assistance with challenge applications, and other activities as requested by state)	*$750,000*	*$750,000*	*$500,000*	*$500,000*	*$500,000*	*$3,000,000*
	Contract for stakeholder engagement process to identify barriers and recommendations to decarbonize industry in Michigan, and work to implement those recommendations	*$150,000*	*$150,000*	*$100,000*	*$100,000*	*$100,000*	*$600,000*
	Contract for modeling and analysis to inform industrial decarbonization stakeholder engagement process	*$150,000*	*$150,000*				*$300,000*
	Contract for LIDAC outreach and engagement as part of stakeholder engagement process	*$125,000*	*$125,000*				*$250,000*
	TOTAL CONTRACTUAL	*$1,175,000*	*$1,175,000*	*$600,000*	*$600,000*	*$600,000*	# *$4,150,000*
	OTHER						
	Industrial Decarbonization Program Director (Laptops, cell phones, VPNs, and other supplies calculated at 5% of total wages and fringe)	*$11,550*	*$12,312*	*$13,125*	*$13,991*	*$14,915*	*$65,893*
	Industrial Decarbonization Program Specialist (Laptops, cell phones, VPNs, and other supplies calculated at 5% of total wages and fringe)	*$9,800*	*$10,447*	*$11,136*	*$11,871*	*$12,655*	*$55,909*
	Industrial Decarbonization Program Analyst (Laptops, cell phones, VPNs, and other supplies calculated at 5% of total wages and fringe)	*$6,560*	*$6,119*	*$6,523*	*$6,953*	*$7,412*	*$33,567*
	Conference registration ($875/person for 4 employees once per year)	*$3,500*	*$3,500*	*$3,500*	*$3,500*	*$3,500*	*$17,500*
	Employee training ($1,000 per year per employee)	*$4,000*	*$4,000*	*$4,000*	*$4,000*	*$4,000*	*$20,000*
	Funding to host annual statewide Industrial Decarbonization Conference (including planning, venue, food, facilitation, and staffing capacity in addition to personnel listed above)	*$250,000*	*$250,000*	*$250,000*	*$250,000*	*$250,000*	*$1,250,000*
	Predevelopment support for top 20 emitters, in addition to and in concert with support from state IAC, to be deployed at discretion of state	*$ 3,000,000.00*	*$ 3,000,000.00*				*$6,000,000*
	TOTAL OTHER	*$3,285,410*	*$3,286,378*	*$288,284*	*$290,316*	*$292,481*	*$7,442,869*
	TOTAL DIRECT	*$5,040,720*	*$5,061,047*	*$1,526,072*	*$1,568,738*	*$1,614,220*	*$14,810,797*
Indirect Costs	**Indirect Costs**						
	Industrial Decarbonization Program Director	*$38,461.50*	*$40,999.96*	*$43,705.96*	*$46,590.55*	*$49,665.53*	*$219,423*

0.05 DTMB cost rate

0.1665 Indirect rate on salary and fringe

	Industrial Decarbonization Program Specialist	*$32,634.00*	*$34,787.84*	*$37,083.84*	*$39,531.38*	*$42,140.45*	*$186,178*
	Industrial Decarbonization Program Analyst	*$21,844.80*	*$20,375.74*	*$21,720.54*	*$23,154.09*	*$24,682.26*	*$111,777*
	TOTAL INDIRECT	*$92,940*	*$96,164*	*$102,510*	*$109,276*	*$116,488*	*$517,378*
TOTAL FUNDING		***$5,133,660***	***$5,157,210***	***$1,628,582***	***$1,678,014***	***$1,730,709***	***$15,328,175***

IMPLEMENTATION GRANT APPLICATION TECHNICAL APPENDIX

This technical appendix explains the methodology and assumptions used for developing the estimated greenhouse gas (GHG) emissions reduced for each component of the proposal. The "GHG Emission Reduction Calculation Spreadsheet" included with this application provides the specific GHG emission reduction calculations for each measure.

1. **Predevelopment Program ($100 million)**
    a. Emission Reductions Estimate Method:

There are multiple components within the $100 million pre-development phase, only one of which was analyzed for emissions reduction potential: the Predevelopment Assistance to Large Industrial Facilities. Our analysis identified the top 40 industrial sector, non-power plant emitters in each state. By partnering with state technical assistance providers, this program will offer up to 20 detailed audits per state to these facilities. While these audits will help identify transformative projects for which recipients may apply for competitive grant funding, they will also undoubtedly identify measures likely to be self-implemented by facilities due to their acceptable paybacks. It was assumed that the top 20% of emitters would have already implemented these measures and therefore they were not included in this savings analysis. Further, it was assumed that a set of facilities would self-fund their own energy audit or contract a third party to provide the analysis. Therefore, the technical assistance network in the Midwest is not expected to provide all analyses. However, since the completion of such a study is a requisite to participation in the competitive grant, the energy and GHG savings from implemented measures even from self-funded or third-party studies were included in this estimation analysis.

To calculate the amount of savings from implemented measures, we first identified the top 40 emitters in each state using the U.S. Environmental Protection Agency (EPA) Flight Tool. Each of these facilities was assigned a three-digit North American Industry Classification System (NAICS) code, if it was not provided through the Facility Level Information on Greenhouse gases Tool (FLIGHT).[1] For such facilities, NAICS codes were assigned individually based upon market sector characteristics of the facility. This analysis removed a number of market sectors as ineligible for program participation. See the table below for a list of removed sectors.

Table 1: Eliminated Market Sectors

Industrial Landfills	Underground Natural Gas Storage
LNG Storage	Natural Gas Pipelines - All
Municipal Landfills	Injection of Carbon Dioxide
Natural Gas Distribution	Natural Gas Processing
Natural Gas Liquids Fractionation	Solid Waste Combustion

[1] https://ghgdata.epa.gov/ghgp

Sometimes the listed sectors in FLIGHT differed from the chosen NAICS designation. One such example is the McKinley Paper Company in Combined Locks, Wisconsin. According to FLIGHT, this facility is designated an industrial landfill (NAICS 562); however, while there is a landfill present at the facility, its emissions and energy use characteristics more closely match a paper mill. Therefore, it was assigned NAICS code 322. See the tables below.

Individually Assigned Sectors

Other Combustion
Other Manufacturing
Industrial Landfills - Specific Sector

Identified NAICS Codes for Top State Emitters

212	324	331
311	325	336
322	327	611

We then converted each facility's scope 1 GHG emissions into component parts (natural gas, petroleum, coal, etc.). This was accomplished by averaging the emissions breakdown into All Fuel Combustion components and Process Emissions categories for state level three-digit NAICS code. These averages were converted into percentages and then applied to each facility's scope 1 emissions to estimate input fuel emissions by type. This analysis then converted natural gas derived emissions into natural gas quantities in MMBtu at the rate of 14.43 kg CO2/MMBtu. See the table below for a list of NAICS codes and emissions breakdowns.

Scope 1&2 Emissions Breakdown by NAICS and State - Using EPA PILOT & DOE EEIO

NAICS Code	State Code	Natural Gas	Coal	Petroleum	Biofuels	Non Energy Emissions	Scope 1 Emissions % of Whole	Scope 2 Emissions % of Whole	Scope 2 Biogenic Portion %
212	212WI	9.16%	0.64%	15.59%	0.00%	74.60%	0%	0%	0.0%
311	311WI	35.16%	58.65%	0.20%	0.15%	5.84%	8%	7%	2.8%
322	322WI	82.02%	13.44%	0.13%	0.36%	4.04%	74%	11%	2.8%
324	324WI	81.58%	0.00%	17.82%	0.00%	0.60%	52%	6%	3.0%
325	325WI	99.99%	0.00%	0.01%	0.00%	0.00%	62%	17%	2.7%
327	327WI	20.12%	27.87%	1.53%	0.00%	50.37%	69%	12%	2.8%
331	331WI	38.67%	51.96%	0.19%	0.00%	9.18%	52%	26%	2.7%
336	336WI	97.50%	0.00%	1.25%	1.25%	0.00%	4%	12%	2.9%
212	212OH	9.16%	0.64%	15.59%	0.00%	74.60%	0%	0%	0.0%
311	311OH	30.45%	0.00%	0.01%	27.09%	42.45%	8%	7%	2.8%
322	322OH	91.44%	0.00%	0.99%	3.27%	4.30%	74%	11%	2.8%
324	324OH	7.85%	0.00%	0.03%	41.25%	50.87%	52%	6%	3.0%
325	325OH	53.26%	0.00%	0.54%	1.17%	45.02%	62%	17%	2.7%
327	327OH	21.79%	12.10%	8.93%	0.00%	57.18%	69%	12%	2.8%
331	331OH	28.73%	0.69%	0.01%	31.28%	39.30%	52%	26%	2.7%
336	336OH	97.50%	0.00%	1.25%	1.25%	0.00%	4%	12%	2.9%
611	611OH	99.47%	0.00%	0.53%	0.00%	0.00%	50%	50%	10.0%
212	212MI	9.16%	0.64%	15.59%	0.00%	74.60%	0%	0%	0.0%
311	311MI	32.90%	48.74%	0.16%	3.62%	14.57%	8%	7%	2.8%
322	322MI	76.90%	8.50%	0.00%	0.83%	13.77%	74%	11%	2.8%
324	324MI	5.72%	0.00%	0.00%	55.54%	38.74%	52%	6%	3.0%
325	325MI	63.35%	0.00%	0.21%	0.00%	36.44%	62%	17%	2.7%
327	327MI	7.90%	6.38%	0.50%	0.00%	85.22%	69%	12%	2.8%
331	331MI	23.96%	6.01%	0.13%	46.55%	23.37%	52%	26%	2.7%
336	336MI	97.50%	0.00%	1.25%	1.25%	0.00%	4%	12%	2.9%
611	611MI	99.95%	0.00%	0.04%	0.01%	0.00%	50%	50%	10.0%
212	212IL	9.16%	0.64%	15.59%	0.00%	74.60%	0%	0%	0.0%
311	311IL	20.65%	53.63%	0.13%	8.53%	17.06%	8%	7%	2.8%
322	322IL	99.97%	0.00%	0.03%	0.00%	0.00%	74%	11%	2.8%
324	324IL	2.62%	0.00%	0.46%	52.05%	44.88%	52%	6%	3.0%
325	325IL	63.01%	0.00%	0.03%	5.01%	31.95%	62%	17%	2.7%
327	327IL	24.18%	0.00%	0.00%	0.00%	75.82%	69%	12%	2.8%
331	331IL	26.62%	1.10%	0.02%	36.16%	36.11%	52%	26%	2.7%
336	336IL	97.50%	0.00%	1.25%	1.25%	0.00%	4%	12%	2.9%
611	611IL	86.79%	12.51%	0.13%	0.01%	0.56%	50%	50%	10.0%
212	212MN	9.16%	0.64%	15.59%	0.00%	74.60%	0%	0%	0.0%
311	311MN	43.04%	42.29%	0.94%	0.00%	13.73%	8%	7%	2.8%
322	322MN	77.29%	0.00%	0.52%	1.37%	20.82%	74%	11%	2.8%
324	324MN	12.98%	0.00%	0.02%	33.62%	53.36%	52%	6%	3.0%
325	325MN	99.58%	0.00%	0.32%	0.00%	0.11%	62%	17%	2.7%
327	327MN	68.96%	16.63%	0.00%	0.00%	14.41%	69%	12%	2.8%
331	331MN	19.53%	3.41%	0.12%	0.00%	76.94%	52%	26%	2.7%
336	336MN	97.50%	0.00%	1.25%	1.25%	0.00%	4%	12%	2.9%
611	611MN	99.89%	0.00%	0.11%	0.00%	0.00%	50%	50%	10.0%

To calculate the estimated electric consumption per facility, this analysis used the U.S. Department of Energy's (DOE) Environmentally Extended Input Output for Industrial Decarbonization Analysis (EEIO-IDA) subsector emissions summaries.[2] This document provides average facility emissions breakdown for the above NAICS codes with one exception; NAICS code 611 covering universities is not present in this dataset. This analysis assumed that scope 1 GHG emissions comprise 50% of total GHG emissions, and scope GHG 2 emissions comprise the other 50%. It was assumed that universities have minimal scope 3 GHG emissions. Using the breakdowns, we could make an estimation for annual electric emissions consumption at each facility. This analysis omitted biogenic electric emissions from these calculations.

[2] https://www.energy.gov/sites/default/files/2023-09/EEIO-IDA%20Overview%20and%20All%20Subsector%20Emissions%20Summary.pdf

To convert these electric emissions into electricity consumed (MWh) this analysis used the average state emissions rate from the EPA's eGrid 2024 dataset. See table below.

It should be noted that state average emission rates are incredibly coarse, especially in states, like Illinois, that span two regional transmission operators (MISO and PJM) with widely differing average emissions rates. However, using the more accurate eGrid subregion geography proved too difficult, as many facilities exist in the gray area between region, requiring the model operator to individually select each facility's eGrid region.

To calculate savings from implemented measures, this analysis used the DOE's Office of Manufacturing and Energy Supply Chain's (MESC) Industrial Assessment Center (IAC) database.[3] This database contains statistics from all of the IAC energy audits nationwide on identified and implemented measures for natural gas and electricity. Using the three-digit NAICS codes, we can see the average implemented savings as a percentage of gas and electric consumption. While IAC assessments are provided for small- to medium-size industrial clients, we felt that this dataset is applicable to larger clients as well. However, we omitted the largest 20% of emitters in the five-state region under the assumption that these largest facilities would have already implemented most of these measures on their own.

EPA eGrid 2024 (2022 data)	
State	**eGrid 2024 Avg Emissions Rate CO2e (lbs/MWh)**
IL	592.394
MI	1,015.727
MN	773.811
OH	1,162.128
WI	1,178.408

NAICS	Electric Savings (%)	Gas Savings (%)
212	1.3%	14.9%
311	3.4%	2.3%
322	1.6%	2.2%
324	1.1%	2.6%
325	2.8%	2.5%
327	2.5%	0.6%
331	2.3%	1.6%
336	4.1%	2.1%
611	7.0%	2.1%

Multiplying each facility's estimated annual natural gas and electric consumption by the IAC average implemented savings by NAICS yielded an amount of MMBtu and MWh savings achieved through facilities' self-implementation. Due to the heterogenous nature of these industrial sites and their consumption of energy, it is not possible to provide a list of specific measures that we expect to be implemented. However, the underlying assumption that these site audits will identify cost-effective measures able to be self-funded is rooted in the experience of the IAC program, the UIC, and the Coalition's experience working in the industrial sector. To calculate cumulative scope 1 emissions from natural gas saving measures, this analysis multiplied year 1 savings by 5 to arrive at 2030 cumulative savings and by 25 to arrive at 2050 cumulative savings for each facility.

This process is decidedly more complicated when calculating scope 2 emissions savings due to the evolving nature of the electric grid.

[3] https://iac.university/statistics

To calculate scope 2 emissions savings from measures identified in the audits and self-implemented by facilities it was necessary to model the emission rates of the grid. To calculate the emissions savings from these measures, this analysis used National Renewable Energy Laboratory's (NREL) Cambium model, specifically the Short Run Marginal Emissions Rate (SRMER) and the Long Run Marginal Emissions Rate (LRMER). When assessing the emissions savings from an efficiency measure it is appropriate to use the grid's marginal emissions rate instead of the average grid emissions rate. While the EPA's Avoided Emissions and Generation Tool (AVERT) provides marginal emissions rates for energy efficiency measures, its geographies are too large and timeframes too short for use in this analysis.

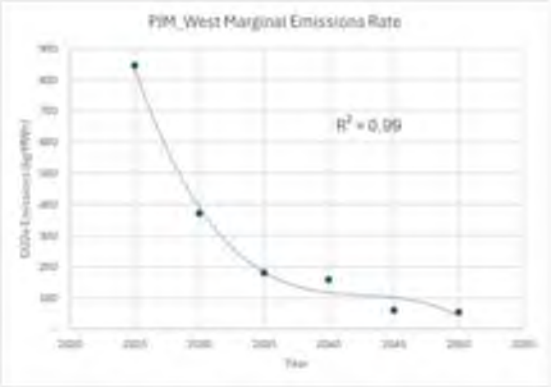
Therefore, this analysis used NREL's Cambium model to calculate the SRMER and LRMER by Generation and Emission Assessment (GEA) regions.[4] See the map for GEA Regions used in Cambium. Cambium lists GEA regions by zip code, thereby making it possible to search for each facility's specific region.

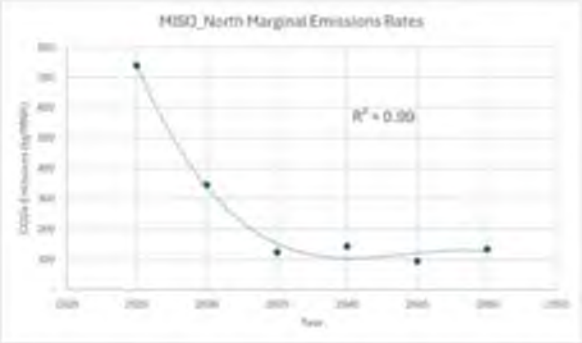
To capture the full effect of implemented measures on emissions, this analysis blended SRMER and LRMER rates in the near term. See table below for weighting of each emissions rate by year.

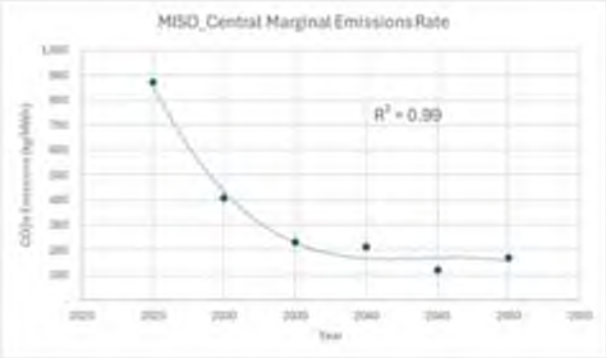
	LRMER and SRMER Weighted Averages					
	2025	2030	2035	2040	2045	2050
LRMER	0%	30%	80%	100%	100%	100%
SRMER	100%	70%	20%	0%	0%	0%
	Blended SRMER & LRMER Combined CO2e (kg/MWh)					
	2025	2030	2035	2040	2045	2050
MISO_Central	873.00	408.17	231.85	212.70	119.87	169.31
MISO_North	738.80	346.08	124.64	144.40	93.70	132.73
PJM_East	861.60	482.91	304.33	261.18	209.79	262.40
PJM_West	845.80	371.92	181.35	159.37	60.87	54.05

Once the blended emission rates were calculated using the weightings shared in the table above, this analysis used a regression analysis to estimate the year-by-year marginal emission rate for each GEA region. See graphs in the table below.

[4] https://www.nrel.gov/analysis/cambium.html







The implemented electric savings in MWh was multiplied by the marginal emission rate by year and corresponding GEA region to calculate the cumulative emissions savings.

Lastly, we should note that while most energy efficiency programs in the United States assume a maximum lifetime for each implemented measure, this analysis did not. This is for two primary reasons. The first is that it is our assumption that measures self-funded and implemented because of the CPRG-funded site audits will be replaced by a similar or more efficient measure at the end of its life. Therefore, the savings identified and implemented will persist even after the initial measure reaches the end of its lifetime. And since the initial measure was induced as a direct result of CPRG funding, it is proper to account for savings beyond its life. Second, measure lifetimes are necessary for energy efficiency programs in order to pass a cost/benefit analysis. All EE programs require a cost/benefit analysis to decide which measure they will fund. However, our assumption is that the savings identified in phase one are implemented by each facility with no additional CPRG funding since the measures are assumed to have an attractive payback. A cost/benefit approach is not relevant to this analysis.

b. Models/Tools Used:

- EPA Facility Level Information on Greenhouse Gases Tool
- National Renewable Energy Laboratory Cambium Model
- EPA 2024 eGrid Dataset
- DOE Environmentally Extended Input Output for Industrial Decarbonization Analysis
- Industrial Assessment Center Statistics

c. Measure Implementation Assumptions:

- 20 studies per state provided by the technical assistance network
- Additional studies provided or acquired by sites themselves
- Top 20% of emitters excluded on the assumption that they have already accomplished any identified measure

d. Emission Reduction Estimate Assumptions:

- Estimated scope 2 emissions using the DOE EEIO tool by three-digit NAICS code.
- Converted facility level scope 2 emissions to MWh using 2023 eGrid state average CO2e emissions rate.
- Estimated self-implemented electric and natural gas savings using the Industrial Assessment Center's national statistics by three-digit NAICS code.
- Did not analyze or estimate any other GHG source reduction.

e. Reference Case Scenario:

BAU Cumulative Emissions by 2030 (Metric Tons)

	Gas	Electric	Total	
Illinois	122,964,927	1,501,971	124,466,897	
Minnesota	59,669,600	301,795	59,971,394	
Michigan	57,093,860	519,207	57,613,066	
Ohio	104,526,854	681,115	105,207,969	
Wisconsin	27,107,185	51,843	27,159,028	
Total	371,362,425	3,055,930	**Grand Total**	**374,418,355**

BAU Cumulative Emissions by 2050 (Metric Tons)

	Gas	Electric	Total	
Illinois	614,824,633	3,921,757	618,746,389	
Minnesota	298,347,998	617,885	298,965,883	
Michigan	285,469,298	1,341,641	286,810,939	
Ohio	522,634,270	2,338,961	524,973,231	
Wisconsin	135,535,925	106,141	135,642,066	
Total	1,856,812,123	8,326,385	**Grand Total**	**1,865,138,507**

f. Measure-Specific Activity Data and Implementation Tracking Metrics:

Measure-specific activity data and implementation will be tracked and measured based on the metrics outlined in the "Performance Measures and Plan" in the workplan and other relevant data to be determined during the first year of the project and on a case-by-case basis as projects are awarded funding. The implementation tracking process will include at least one year of monitoring and verification for each project awarded funds.

g. GHG Emissions Reduced:

Phase 1 Cumulative Savings by 2030 (Metric Tons)

	Gas	Electric	Total	
Illinois	233,498	53,563	287,061	
Minnesota	341,277	17,310	358,587	
Michigan	255,250	43,605	298,855	
Ohio	224,487	19,753	244,241	
Wisconsin	361,469	3,111	364,580	
Total	1,415,981	137,342	**Grand Total**	**1,553,323**

Phase 1 Cumulative Savings by 2050 (Metric Tons)

	Gas	Electric	Total	
Illinois	1,167,488	120,072	1,287,560	
Minnesota	1,706,384	38,394	1,744,778	
Michigan	1,276,249	103,190	1,379,439	
Ohio	1,122,437	54,324	1,176,761	
Wisconsin	1,807,345	6,900	1,814,245	
Total	7,079,904	322,880	**Grand Total**	**7,402,783**

2. Challenge Grant Program ($400 million)

a. Emission Reductions Estimate Method:

Due to the nature of the phase 2 competitive grant, it is difficult to predict which projects or facilities will be funded. The only methodologically sound approach to estimating emissions savings from such a competitive grant program is to calculate the minimum achievable savings.

In order to access grant funded a project must meet two criteria. First, a project must provide a minimum 40% combined scope 1 & 2 GHG reduction in year 1; and second, a project must have a private/grant leverage of at least 4-1.

For the purposes of this analysis, it was assumed that this program would provide 40 grants and that these grants would be divided between states based on the weighted average facility emissions from sites in each state. Each grant would provide a minimum 40% emissions reduction to each state's average facility emissions. The attributable savings would be the 20% funded directly through the CPRG, and not inclusive of private leverage. It was estimated that phase 2 first-year savings to be 7,238,472 metric tons of CO2e, 1,447,694 metric tons of which is directly allocable to the CPRG funding. See the table below.

Phase 2 - Year 1 GHG Savings (Minimum)

States	Avg. Facility GHG Emissions	Weighted %	Grants per State	Avg. Savings by Site (Metric Tons CO2e)	Total State Savings (Metric Tons CO2e)	Attributable to CPRG (Metric Tons CO2e)
IL	614,825	33%	13	245,930	3,257,276	651,455
MN	298,348	16%	6	119,339	767,005	153,401
MI	285,469	15%	6	114,188	702,216	140,443
OH	522,634	28%	11	209,054	2,353,682	470,736
WI	135,536	7%	3	54,214	158,293	31,659
				Total	**7,238,472**	**1,447,694**

b. Models/Tools Used:

Without knowing which projects or facilities will receive grant funding, it was largely impossible to model the emission reduction affects of implemented projects.

c. Measure Implementation Assumptions:

While we are not able to know which facilities or projects might be funded through this program, based on the identified NAICS codes of the top 40 emitters in each state, we understand the processes responsible for a significant portion of total emissions. Thermal energy plays a significant role in generating emissions from the industrial sector.

d. Emission Reduction Estimate Assumptions:

It was assumed that the average project will be implemented in 2026 and provide emissions savings through 2050.

e. Reference Case Scenario:

BAU Cumulative Emissions by 2030 (Metric Tons)

	Gas	Electric	Total	
Illinois	122,964,927	1,501,971	124,466,897	
Minnesota	59,669,600	301,795	59,971,394	
Michigan	57,093,860	519,207	57,613,066	
Ohio	104,526,854	681,115	105,207,969	
Wisconsin	27,107,185	51,843	27,159,028	
Total	371,362,425	3,055,930	**Grand Total**	**374,418,355**

BAU Cumulative Emissions by 2050 (Metric Tons)

	Gas	Electric	Total	
Illinois	614,824,633	3,921,757	618,746,389	
Minnesota	298,347,998	617,885	298,965,883	
Michigan	285,469,298	1,341,641	286,810,939	
Ohio	522,634,270	2,338,961	524,973,231	
Wisconsin	135,535,925	106,141	135,642,066	
Total	1,856,812,123	8,326,385	**Grand Total**	**1,865,138,507**

f. Measure-Specific Activity Data and Implementation Tracking Metrics:

Measure-specific activity data and implementation will be tracked and measured based on the metrics outlined in the "Performance Measures and Plan" in the workplan and other relevant data to be determined during the first year of the project and on a case-by-case basis as projects are awarded funding. The implementation tracking process will include at least one year of monitoring and verification for each project awarded funds.

g. GHG <and Co-pollutant> Emissions Reduced:

	Cumulative Total Savings by 2030 (Metric Tons CO2e)	Cumulative CPRG Savings by 2030 (Metric Tons CO2e)	Cumulative Total Savings by 2050 (Metric Tons CO2e)	Cumulative CPRG Savings by 2050 (Metric Tons CO2e)
IL	16,286,379	3,257,276	78,174,620.08	15,634,924.02
MN	3,835,026	767,005	18,408,123.36	3,681,624.67
MI	3,511,081	702,216	16,853,188.34	3,370,637.67
OH	11,768,410	2,353,682	56,488,368.16	11,297,673.63
WI	791,463	158,293	3,799,024.63	759,804.93
Total	**36,192,359**	**7,238,472**	**173,723,325**	**34,744,665**

	Phase 1 Cumulative Savings (Metric Tons CO2e)	Phase 2 CPRG Responsible Cumulative Savings (Metric Tons)	Total CPRG Responsible GHG Savings (Metric Tons)	Cost of Emissions Reduction ($/metric ton)
2030	1,553,323	7,238,472	8,791,795	$56.87
2050	7,402,783	34,744,665	42,147,448	$11.86