# COMPREHENSIVE CLIMATE ACTION PLAN FOR GREATER CHICAGO

Appendices

# Appendix A: Engagement summary

This appendix documents how stakeholder and community input informed the development of the plan. It summarizes who was engaged, how engagement was structured, what participants shared, and how those perspectives shaped the plan's priorities and strategies. Engagement occurred throughout the planning process and included a formal steering committee, working groups, interviews, and community engagement activities.

## Stakeholder engagement

The project team sought guidance and expertise from a wide range of stakeholders through the creation of project-specific committees and working groups, leveraging existing committees and regional bodies, and conducting interviews.

### Steering Committee

The Steering Committee included regional implementers, subject matter experts, and leaders from impacted communities across Greater Chicago. Over the course of four meetings, its role was to guide the planning process — providing input on plan principles, emissions reduction targets, messaging, overall strategy, and draft recommendations — as well as build support for plan implementation. Several members also served on CMAP's Climate Committee, NIRPC's Environment Committee, and the NIRPC Climate Planning Work Group, helping to bridge discussions across topics and foster collaboration among partners.

### Steering Committee member organizations

Chicago Environmental Justice Network
Chicago Metropolitan Agency for Planning
City of Chicago Department of Environment
City of Gary
City of Rolling Meadows
Climate Jobs Illinois
ComEd
Cook County Department of Environment and Sustainability
Cook County Department of Transportation and Highways
Discovery Partners Institute
DuPage County Environment and Sustainability
Earth Charter Indiana
Elevate
Illinois Department of Transportation
Illinois Environmental Council
Illinois Environmental Protection Agency
Illinois International Port District
Lake County, IL Division of Transportation
Loyola University Chicago
Metropolitan Mayors Caucus
Northwestern Indiana Regional Planning Commission
P33
Regional Transportation Authority
Steel Manufacturing Simulation and Visualization Consortium
Urban Land Institute
Will County
World Business Chicago

## Community Working Group

This working group was tasked with ensuring both the plan and planning process reflected the priorities of low-income and disinvested communities. The group shaped the community engagement activities used to identify priorities by providing feedback on the topics and methods. Members included community-based organizations, institutions, and advocacy groups with experience advancing goals related to air quality, public health, clean energy, environmental protection, and workforce development. This group met four times, with several participants also serving on the Steering Committee and other working groups to represent community needs in all discussions.

### Community Working Group member organizations

Calumet Collaborative
Chicago Environmental Justice Network
Citizens Utility Board
Clean Power Lake County
Climate Jobs Illinois
Earth Charter Indiana
Farmworker and Landscaper Advocacy Project
Little Village Environmental Justic Organization
Southeast Environmental Task Force
University of Illinois Chicago School of Public Health

## Buildings, industry, and transportation working groups

Comprised of public and private implementers, subject matter experts, and community representatives, these groups reviewed and proposed sector-specific strategies, goals, and targets over three meetings per group. They reviewed modeling results, shared data and resources, and refined messaging to ensure each sector's recommendations were practical, ambitious, and aligned with regional priorities.

### Buildings Working Group member organizations

Building Owners and Managers Association of Chicago
City of Aurora
City of Chicago Department of Buildings
City of Kenosha
Climate Jobs Illinois
ComEd
Cook County Bureau of Economic Development
Elevate
IFF
Illinois Green Alliance
Illinois C-PACE
Illinois Housing Development Authority
Kane County
Lake County, IL
Metropolitan Planning Council
Urban Land Institute
Will County

## Industry Working Group member organizations

Calumet Collaborative
Civic Committee of the Commercial Club of Chicago
Cook County Bureau of Economic Development
Cook County Department of Environment and Sustainability
Current
Earth Charter Indiana
Ecolab
Illinois Manufacturing Excellence Center
MacArthur Foundation
Northwest Indiana Forum
P33
Southeast Environmental Task Force
Steel Manufacturing Simulation and Visualization Consortium
Zareen Khan (self-employed)

## Transportation Working Group member organizations

City of Chicago Department of Transportation
ComEd
Cook County Department of Transportation and Highways
Chicago Transit Authority
Drive Clean Indiana
DuPage County Division of Transportation
Elevated Chicago
Faith in Place
Gary Public Transit Corporation
Illinois Department of Transportation
Illinois Environmental Council
Illinois International Port District
Illinois Tollway
Lake County, IL Division of Transportation
Little Village Environmental Justice Organization
Martin Brower
McHenry County Division of Transportation
Metra
Pace Suburban Bus
Regional Transportation Authority
Respiratory Health Association

## CMAP Climate Committee and other regional bodies

This standing committee supplemented the Steering Committee and working groups by providing broad oversight and expertise across topics over the course of seven meetings. In addition to guiding overall plan development, the committee focused on waste, water and wastewater, agriculture, and natural carbon sequestration.

In addition to these formal working groups, the project team engaged other regional bodies, including the NIRPC Environment Committee, Metropolitan Mayors Caucus Environment Committee, and the CARE cohort of community-based organizations in the CMAP region, to share progress, gather input, and strengthen alignment across the region's climate and sustainability efforts.

## Workforce planning

To help inform the workforce planning analysis, the project team held interviews with leaders across the greater Chicago region — representing unions, government agencies, apprenticeship providers, business associations, and educational institutions. These conversations highlighted the deep interconnections within the workforce system, from early education through long-term career support, and identified key challenges to overcome to support workforce development and climate goals.

# Community engagement

Community engagement focused on identifying community priorities, raising awareness of the benefits of GHG emission reductions, and building capacity for continued collaboration in climate action. Engagement activities explored the effects of climate change, barriers and opportunities to reduce emissions, and ways reduction strategies can deliver additional benefits to communities.

Recognizing the impacts of climate change and pollution are not experienced equally; engagement efforts prioritized input from low-income and disinvested communities. These communities often face greater exposure to climate risks and air pollution, and may have fewer resources to adopt clean energy solutions or access the benefits of the clean energy transition. Gathering this perspective helped craft plan strategies that minimize potential burdens and maximize community benefits. The team also reviewed recent regional planning initiatives to learn from input related to emissions reduction.

Opportunities for community input took place over the summer and fall of 2025 and included an online questionnaire (in English and Spanish) and workshops facilitated by community-based organizations. Plan partners, steering committee members, and working group members were invited to share social media posts and graphics promoting the questionnaire and workshop engagement opportunities to spread awareness of the plan.

## Key themes

Across all engagement activities, several key themes emerged:

- **Alignment with community priorities:** Residents emphasized that decarbonization efforts should advance existing local goals, such as improving air quality, expanding transportation options, and increasing trees and green space.
- **Balancing immediate needs:** Many participants noted that day-to-day challenges, such as affording rent and accessing fresh food, take precedence over climate concerns.
- **Rising climate impacts:** Increasing flooding, heat, and poor air quality incidents are growing concerns for communities' public health and safety.
- **Transportation access:** Limited transit, walking, and biking options constrain residents' ability to participate in emissions-reducing activities.
- **Utility costs:** Many respondents reported difficulty paying for gas, electricity, and water bills.
- **Access to fresh and healthy food:** Many participants noted a lack of fresh and healthy food options in their communities and a desire for more affordable produce in grocery stores and community gardens.
- **Financial barriers:** Upfront costs limit residents' ability to shift to electric appliances and vehicles.
- **Expand education and outreach:** Community outreach and education are needed to improve understanding of local issues, communicate the benefits decarbonization efforts, share resources on assistance programs, and build trust between local community members.

## Co-benefits of climate action

Actions to reduce GHG emissions provide many additional benefits. Understanding desired co-benefits prioritized by the region's residents can improve strategy design and build broad support for action.

During the planning process, community members shared which co-benefits matter most. Across all engagement activities, the following benefits were identified as priorities to inform plan strategies and recommendations.

### Clean air and improved public health

Residents across the region emphasized clean air and public health concerns as their top priorities, especially those living near manufacturing facilities and freight corridors. Many described the toll of constant exposure to harmful air pollutants, with entire families affected by asthma and other chronic health conditions. Others noted that people often move to live near these businesses because they depend on them for jobs, and may be unaware of potential health impacts; this underscores the need to balance economic opportunity with health protection.

Residents also raised growing concerns about worsening air quality from wildfire smoke, which increasingly forces people indoors during summer months, and about poor indoor air quality in older industrial buildings and homes damaged by flooding and mold. Together, these experiences highlight how closely air quality, health, and economic well-being are intertwined across Greater Chicago.

### Safe and accessible bike and pedestrian infrastructure

Many residents noted a lack of safe sidewalks and trails, forcing people to bike or walk in the street alongside car traffic — which deters residents from these forms of transportation. Complete networks of accessible sidewalks, bike paths, and trails can reduce vehicle miles traveled, lower emissions, and promote healthier, more active lifestyles that many communities desire.

### Safe, reliable, and accessible public transit

Community members reported limited transportation options, particularly for low-income families who rely on public transit. Issues include long waits, unsafe stops, and long commute times. Reliable, frequent, and safe transit reduces dependence on personal vehicles and expands mobility options — a higher priority for many residents than owning electric vehicles.

### More trees and green spaces

Access to trees and natural areas is limited in many low-income communities, contributing to urban heat islands and poorer public health. Expanding and preserving green spaces can store carbon, improve air quality, lower local temperatures, support pollinators and wildlife, and provide spaces for urban farming and recreation. Maintenance support is critical to ensure these benefits endure, as community members noted a lack of capacity to maintain trees and natural spaces after they are planted.

### Lower energy and water bills

Rising utility costs burden families, especially during extreme temperatures. Air conditioning is often considered a luxury, and many low-income or older residents cannot afford to use it or pay their utility bills. Residents are also concerned about how large increases in energy demand, like from data centers, could increase costs for all ratepayers. While energy-efficient appliances and home upgrades reduce electricity and water use and lower bills, the upfront installation costs are out of reach for many people. Financial assistance, incentives and safeguards — such as protections against rent increases and utility rate hikes for both electricity and natural gas — are essential to ensure equal access to these benefits.

### Reduced extreme weather risk

Residents highlighted the growing impacts of extreme heat and flooding, particularly in low-income neighborhoods with more impervious surfaces, less vegetation, and few places to escape conditions. Heatwaves and floods also threaten farms and community gardens and reduce yields. After storms, some residents feel their neighborhoods are the last to have power restored or receive clean up services, and note the high costs that their municipalities encounter to recover from events. Investments in natural areas and green infrastructure will not only sequester carbon but can also protect homes, livelihoods, and infrastructure while reducing community vulnerability.

### Workforce opportunities

Community members noted the tension around the clean energy transition, often a critical community objective, and the current dependency on existing jobs in fossil fuel industries, protected by some labor organizations. Decarbonization and electrification present new employment opportunities, but community members stressed the need to connect training programs with actual jobs. By pairing workforce development with education and outreach, communities overburdened by pollution can benefit from cleaner air while accessing good jobs.

## Community workshops

Community-based organizations engaged in the Steering Committee and working groups were invited to host and facilitate local workshops, bringing the planning process directly into areas experiencing some of the highest levels of air pollution and climate impacts in the region. These workshops created space for residents to share their experiences, discuss local climate change impacts, and identify priorities for the plan.

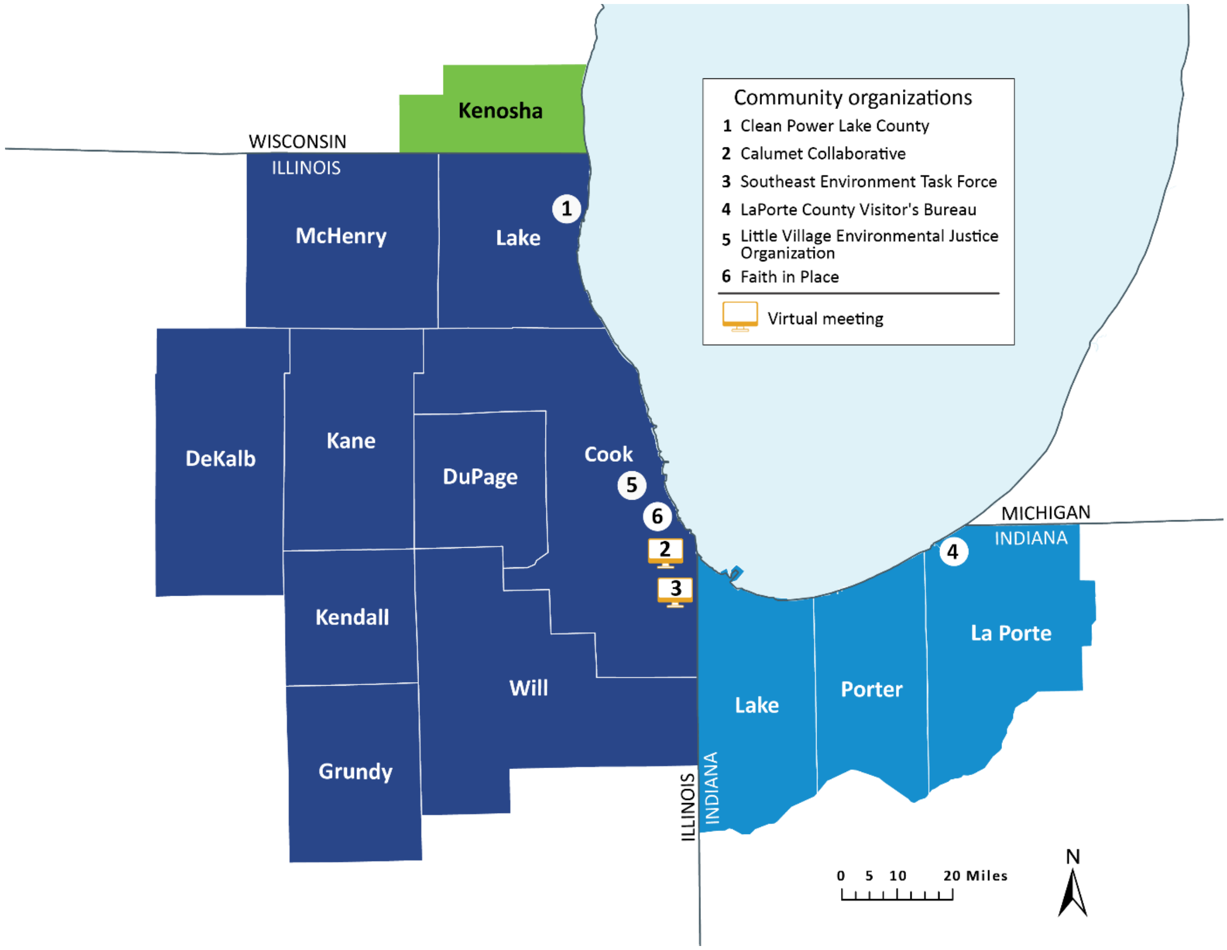
The project team created a workshop in a box for organization to take to their communities (Figure A-1). Workshop materials were written in English and Spanish. Host organizations participated in an orientation session and received a stipend for their time and effort. After the orientation, some host partners mentioned that the assumptions on the prioritization sheet might not resonate with their community. The project team encouraged challenges to the assumptions and allowed partners to modify the script to better resonate with their community members. This approach ensured that engagement was community-led, accessible, and grounded in local context.

The following organizations hosted workshops:

- Clean Power Lake County – July 15, 2025
- Calumet Collaborative – July 30, 2025
- Little Village Environmental Justice Organization (LVEJO) – July 31 through August 3, 2025*
- La Porte County Visitor’s Bureau – August 14, 2025
- Southeast Environmental Task Force – August 14, 2025
- Faith in Place – October 21, 2025

*LVEJO hosted workshop materials at Fiesta del Sol and collected prioritization feedback at the event.

**Figure A-1. Map of community workshop locations**



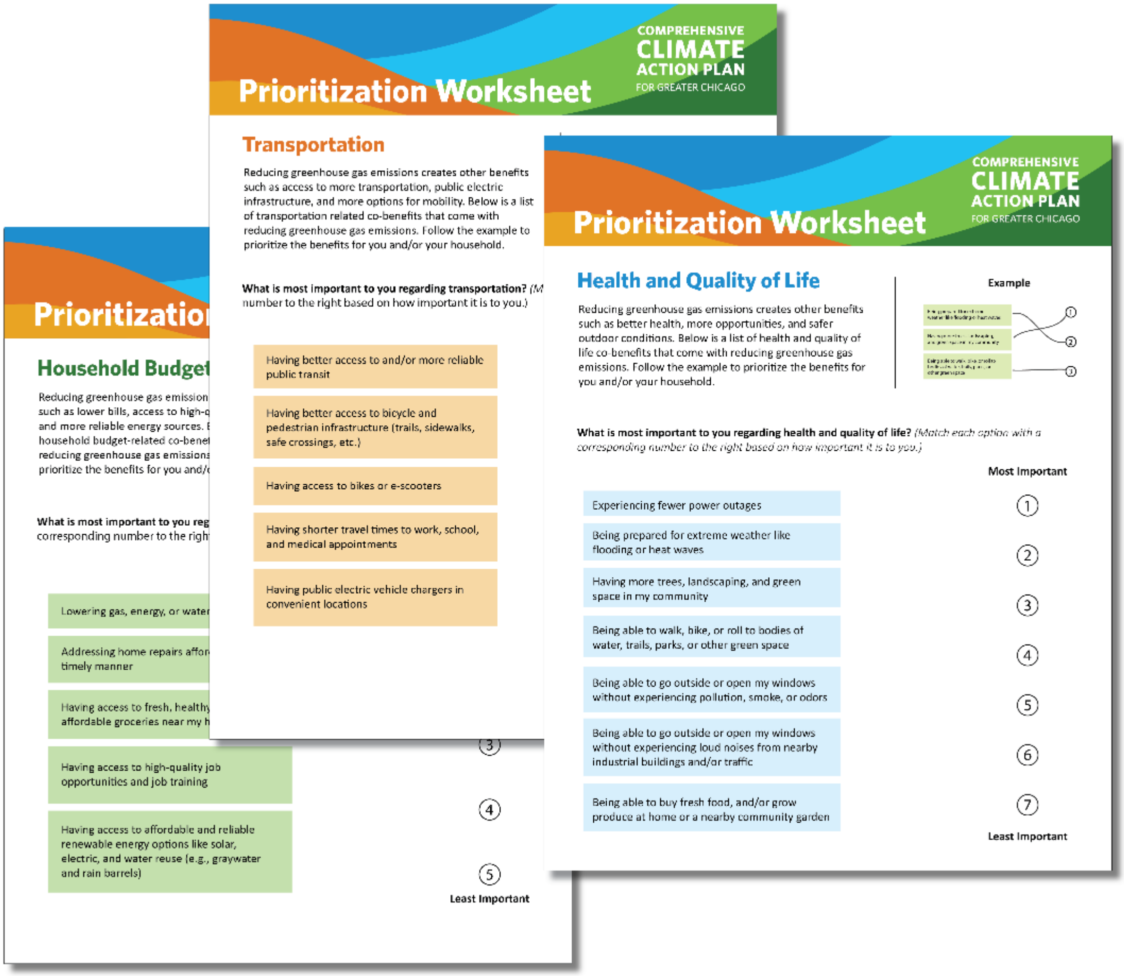

Source: CMAP and MUSE, 2025.

During the workshops, community-based organizations provided a brief background of the project's goals and summary data, followed by discussion about how climate change appears in the community. Discussion questions allowed participants to talk about the effects of climate change, impacts on their lives, and opportunities and barriers to action. Participants were then asked to complete a worksheet to rank the importance of different co-benefits for their households (Figure A-2). The worksheet presented 17 co-benefits that were categorized into three themes. The top two priorities from each of three themes were combined to identify workshop participants' top six priorities. These top priorities are noted in **bold** below.

- Theme 1: Health and quality of life
    - **Being able to go outside or open my windows without experiencing pollution, smoke, or odors**
    - **Being prepared for extreme weather like flooding or heat waves**
    - Having more trees, landscaping, and green space in my community

  - Being able to walk, bike, or roll to bodies of water, trails, parks, or other green space
  - Experiencing fewer power outages
  - Being able to go outside or open my windows without experiencing loud noises from nearby industrial buildings and/or traffic
- Theme 2: Household budget
  - **Lowering gas, energy, or water bills**
  - **Having access to fresh, healthy, and affordable groceries near my home**
  - Addressing home repairs affordably and in a timely manner
  - Having access to high-quality job opportunities and job training
  - Having access to affordable and reliable renewable energy options like solar, electric, and water reuse (e.g., graywater and rain barrels)
- Theme 3: Transportation
  - **Having better access to bicycle and pedestrian infrastructure (trails, sidewalks, safe crossings, etc.)**
  - **Having shorter travel times to work, school, and medical appointments**
  - Having better access to and/or more reliable public transit
  - Having access to bikes or e-scooters
  - Having public electric vehicle chargers in convenient locations

**Figure A-2. Workshop prioritization worksheet**

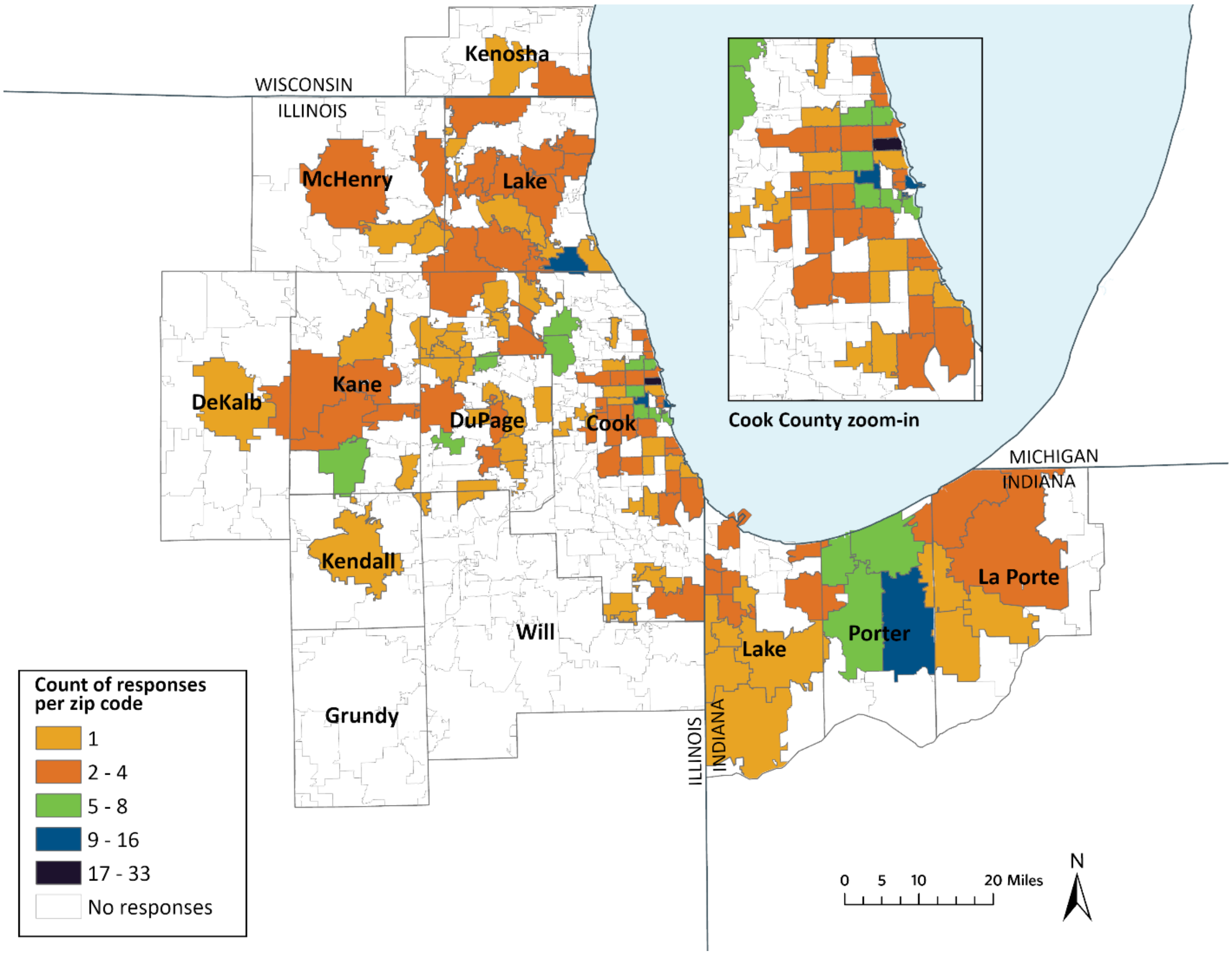



Source: CMAP and MUSE, 2025.

## Questionnaire summary

As a supplement to the workshops, an online questionnaire was distributed to residents across the region. Available in English and Spanish, the questionnaire mirrored the workshop questions to capture perspectives on climate impacts and community priorities throughout Greater Chicago. It remained open for six weeks and received 413 responses (Figure A-3). Participants who completed the questionnaire were entered in a drawing to win one of twenty $20 general-use gift cards.[1]

**Figure A-3. Map of questionnaire responses by zip code**

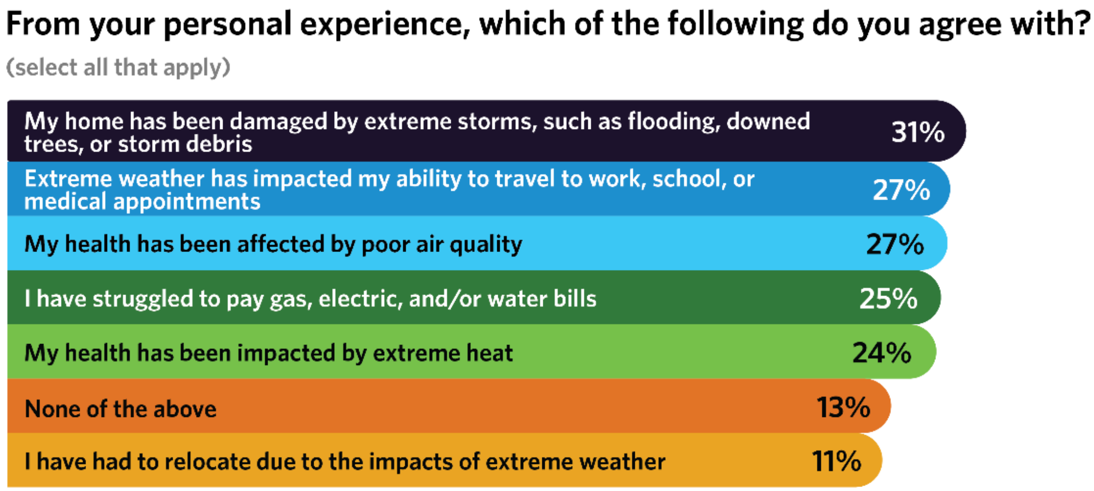



Source: CMAP and MUSE, 2025.

## Impacts of climate change

The first section of the questionnaire asked about challenges respondents and their families face with climate change (Figure A-4). Some challenges included extreme heat, poor air quality, and flooding. More than half of all respondents said extreme weather (storms, heat, flooding, etc.) has impacted their lives, either through damaging their homes (31 percent) or impacting their ability to travel to work, school, or medical appointments (27 percent). At least one quarter of respondents indicated they face negative health impacts due to poor air quality and/or extreme heat and that they struggle to pay utility bills.

**Figure A-4. Response distribution for questionnaire question #2**

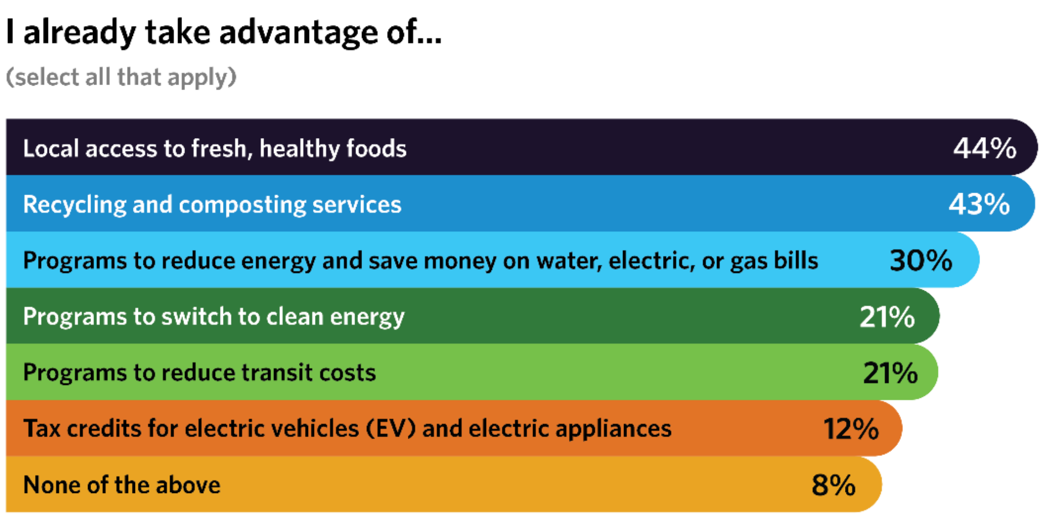



Source: CMAP and MUSE, 2025.

## Acting against climate change

The second section of the questionnaire asked how respondents act against climate change in their daily lives (Figure A-5). Nearly half of respondents take advantage of access to fresh, healthy local foods available in their communities (44 percent) and/or recycling and composting services (43 percent). Meanwhile, only 12 percent report using tax credits for electric appliances and electric vehicles.

**Figure A-5. Response distribution for questionnaire question #4**

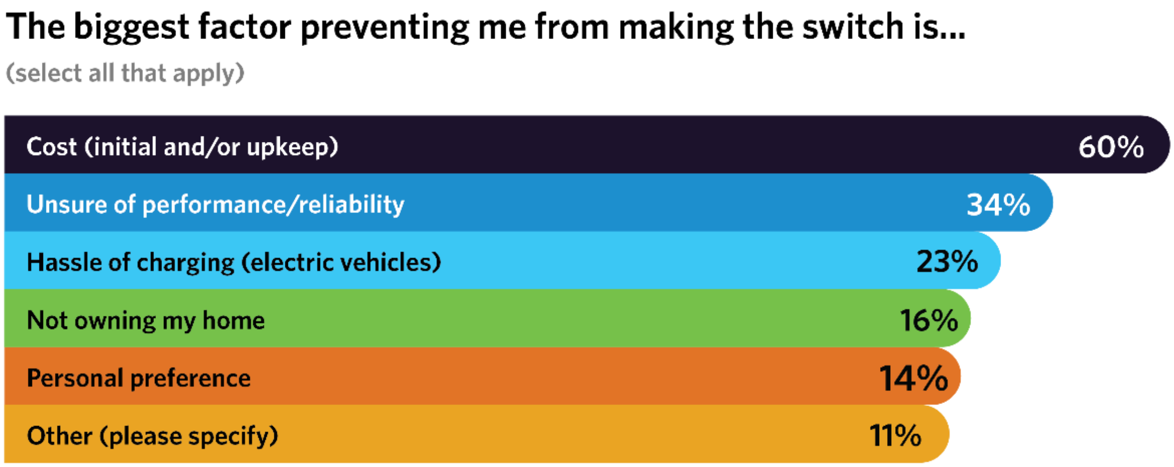



Source: CMAP and MUSE, 2025.

## Examining barriers to action

The questionnaire also asked about barriers to action, such as cost and performance reliability (Figure A-6). More than half (60 percent) of respondents indicated that cost is the biggest factor preventing them from switching to electric appliances and/or vehicles. Other deterrents or barriers to electric adoption include concern about the performance and reliability of electric appliances and vehicles (34 percent) and the inability as a renter to make such a decision (16 percent).

**Figure A-6. Response distribution for questionnaire question #6**




Source: CMAP and MUSE, 2025.

## Prioritizing co-benefits

Finally, the questionnaire asked about co-benefits of reducing greenhouse gas emissions. The questions were divided into three themes: health and quality of life, transportation, and household budget. Participants ranked co-benefits in each theme from most to least important to their families. While all the benefits would improve lives in the region, the ranking exercise helped identify which policy opportunities would have the greatest impact for residents.

Across the three themes, respondents' top six co-benefits were:

1. **Clean air:** Being able to go outside/open windows without experiencing pollution, smoke, or odors
2. **Quiet neighborhoods:** Being able to go outside or open my windows without experiencing loud noises from nearby industrial buildings and/or traffic
3. **Access to open space:** Being able to walk, bike, or roll to bodies of water, trails, parks, or other green space
4. **Access to fresh food:** Being able to buy fresh food, and/or grow produce at home or a nearby community garden
5. **Access to transit:** Having better access to and/or more reliable public transit
6. **Lower bills:** Lowering gas, energy, or water bills

# Appendix B: GHG inventory methodology

This appendix outlines the methodology used in the development of the following *Comprehensive Climate Action Plan* activities:

- Development of the 2020 GHG inventory for Greater Chicago
- Development of the 2005 GHG inventory for Greater Chicago
- Process and results of the quality assurance project plan

The greater Chicago region covers 13 counties: 9 in Illinois (Cook, DeKalb, DuPage, Grundy, Kane, Kendall, Lake, McHenry, and Will), 3 in Indiana (Lake, La Porte, and Porter), and 1 in Wisconsin (Kenosha).

## 2020 GHG inventory methodology

The 2020 Greater Chicago GHG inventory includes 2020 county-level emissions data for three major GHGs: carbon dioxide, methane, and nitrous oxide. The project team chose the year 2020 because it was the most recent year available across the region.[2] The project team also reviewed past inventories for northeastern Illinois (2019) and northwestern Indiana (2017).

The 2020 GHG inventory covers emissions from eight sectors: commercial and residential buildings, industry, transportation, waste, water and wastewater, agriculture and land management, and natural carbon sequestration or carbon sinks. Waste emissions related to materials management are not included in the inventory due to limited data availability.

### Underlying data

To create the 2020 GHG inventory, the project team used USEPA's Local Greenhouse Gas Inventory Tool (LGGIT).[3] LGGIT is a free, interactive spreadsheet tool that calculates GHG emissions for many sectors. Table B-1 provides a summary of the data source and quality for each sector. The full LGGIT created as part of this inventory is available upon request.[4]

**Table B-1. 2020 inventory data sources and quality for each GHG emissions sector**

| Sector | Emissions data source | Data quality |
|---|---|---|
| Buildings (commercial): Electricity* | U.S. Department of Energy (USDOE)/ National Renewable Energy Laboratory (NREL) State and Local Planning for Energy (SLOPE) Data Viewer[5] | High |
| Buildings (commercial): Natural gas* | USDOE/NREL SLOPE Data Viewer | High |
| Buildings (residential): Electricity* | USDOE/NREL SLOPE Data Viewer | High |
| Buildings (residential): Natural gas* | USDOE/NREL SLOPE Data Viewer | High |
| Industry: Electricity* | USDOE/NREL SLOPE Data Viewer | High |
| Industry: Natural gas* | USDOE/NREL SLOPE Data Viewer | High |
| Industry: Processes | USEPA Greenhouse Gas Reporting Program (GHGRP)[6] | High |
| Transportation | National Emissions Inventory[7] | High |
| Transportation (aviation) | Federal Aviation Administration Air Traffic Activity System;[8] Re-Evaluation of the 2015 O'Hare Modernization Environmental Impact Study[9] | High |
| Waste** | USEPA Facility Level Information on GreenHouse gases Tool (FLIGHT)/GHGRP | High |
| Wastewater | Local reported data from Metropolitan Water Reclamation District scaled with population data from the U.S. Census Bureau[10] | Medium |
| Water | CMAP Regional Water Demand Forecast for Northeastern Illinois, 2020-2050[11] | High |

| | | |
|---|---|---|
| Agriculture and land management | USEPA State Inventory Tool (SIT)[12] scaled with U.S. Dept. of Agriculture (USDA) cropland acreage;[13] USDA National Agricultural Statistics Service[14] | High |
| Natural carbon sequestration | Tree canopy data from USDA i-Tree Landscape tool;[15] land use data from Replica;[16] and sequestration from various land uses in USEPA SIT. | Medium/High |

* Stationary energy data.
** Emissions related to materials management are not included in the inventory due to limited data availability.

Source: CMAP, 2025.

## Process

The following sections document the process for calculating GHG emissions from each data source. This inventory relies on global warming potential values from the Intergovernmental Panel on Climate Change Fifth Assessment Report, also written as GWP5.[17]

### Stationary energy

The State and Local Planning for Energy (SLOPE) Data Viewer was selected because it provides a consistent and comparable dataset across multiple states and counties, which is essential for a regional inventory that spans Illinois, Indiana, and Wisconsin. The Emissions and Generation Resource Integrated (eGRID) database was used because it is the most authoritative and widely accepted source for U.S. electricity emissions factors, reflecting the actual generation mix and emissions intensity of the grid.

Stationary energy includes emissions from natural gas and electricity consumed within residential, commercial and institutional, and industrial buildings.

Data for these sources were collected, refined, and entered into LGGIT using the steps below:

1. Retrieve energy consumption data (electricity and natural gas) from SLOPE, which provides U.S. county-level data disaggregated by economic sector (residential, commercial, and industrial).
2. Filter data for the inventory analysis year, 2020.
3. Filter the data to include only the 13 counties of Greater Chicago.
4. Convert SLOPE outputs in millions of British thermal units (MMBtu) to the required unit for entry into LGGIT, using the conversion factors shown in Table B-2.
5. Calculate emissions from electricity consumption by multiplying state-level activity by the corresponding state-level emission factors from the eGRID database (Table B-3).

6. Subtract emissions associated with natural gas used for industrial processes from stationary energy totals. These emissions are entered separately in LGGIT under the stationary-energy category.
7. Enter the final electricity and natural gas values into LGGIT by county and sector, as documented on the Stationary-Data tab.

**Table B-2. Conversion factors to convert SLOPE energy outputs from millions of British thermal units (MMBtu) to metric cubic feet (mcf) for natural gas consumption and kilowatt hours (kWh) for electricity consumption**

| Energy source | SLOPE units | Community module units | Conversion factor |
|---|---|---|---|
| Natural gas consumption | MMBtu | mcf | 0.9643 mcf/1 MMBtu |
| Electricity consumption | MMBtu | kWh | 293.07 kWh/1 MMBtu |

Source: CMAP, 2025.

**Table B-3. Conversion factors to convert SLOPE electricity outputs into emissions**

| State | eGRID state emission factor ($CO_2$) | eGRID state emission factor (CH4) | eGRID state emission factor (N2O) |
|---|---|---|---|
| Illinois | 553.201 | 0.048 | 0.007 |
| Indiana | 1539.922 | 0.141 | 0.02 |
| Wisconsin | 1184.878 | 0.106 | 0.015 |

Source: USEPA eGRID database, 2025.

## Industrial processes

Industrial process emissions were obtained from the USEPA's Greenhouse Gas Reporting Program (GHGRP) because it provides the most accurate, facility-level emissions data available in the U.S. facilities that emit 25,000 metric tons $CO_2e$ or more per year must report annually to GHGRP, including emissions associated with specific industrial activities (e.g., steelmaking and petrochemical production). This allows emissions to be assigned to the correct county and subsector rather than relying on modeled estimates.

Industrial process emissions include greenhouse gases released during manufacturing and production activities that are not associated with fuel combustion.

Data for these sources were collected, refined, and entered into LGGIT using the steps below:

1. Download industrial process emissions data reported to the USEPA through the GHGRP. Two datasets are required: (1) sector summary information, with emissions grouped by reporting sectors, and (2) subpart information summary, with emissions grouped by the regulatory subpart under which the facility reports.

a. Download sector summary information.
    i. Choose a Subject Area: Sector Summary Information
    ii. Choose a Table: V_GHG_Emitter_Sector
    iii. Select Fields: Select All
    iv. Add Search Criteria:
        1. State Abbreviations: IL, IN, WI
        2. Reporting Year: 2020
    v. Export to CSV
b. Download subpart information summary.
    i. Choose a Subject Area: Subpart Information
    ii. Select Fields: Select All
    iii. Add Search Criteria:
        1. State Abbreviations: IL, IN, WI
        2. Reporting Year: 2020
    iv. Export to CSV.

2. Filter both datasets to retain data for the 13 counties.
3. Assign facilities to industrial subsectors using the sector mapping crosswalk developed for the 2019 CMAP GHG Inventory (CMAP_Sector_Lookup tab of the Chicago_MSA_GHGRP_Data.xlsx). Due to the larger geography of this inventory, several new subsectors were added to the crosswalk.
4. Summarize emissions by County for the following industrial subsectors:
    a. Petroleum Refining
    b. Petroleum and Natural Gas Systems
    c. Hydrogen Production
    d. Ethanol Production
    e. Iron and Steel Production
    f. Petrochemical Production
    g. Lime Production
    h. Glass Production
    i. Zinc Production
    j. Food Processing
    k. Other Chemicals Manufacturing Industries & Construction
    l. Other Metals (not including Iron and Steel)
    m. Other Minerals
    n. Pulp and Paper Production
5. Enter summarized emissions into the GHG Inventory tool as $CO_2e$. To avoid double counting, natural gas emissions associated with industrial processes were subtracted from stationary national gas totals (Stationary-Energy category).

## Transportation: Excluding aviation

Transportation emissions were estimated using USEPA's National Emissions Inventory (NEI) 2020, which provides the most comprehensive and consistent dataset of transportation-related greenhouse gas emissions across all U.S. counties. The NEI includes emissions from on-road, non-road, rail, and marine transportation sources and reports methane (CH4), nitrous oxide (N2O), and carbon dioxide ($CO_2$), allowing direct calculation of $CO_2$e. The NEI was selected because it provides county-level emissions for the three states in the planning region, enabling consistent treatment across jurisdictional boundaries and eliminating the need to reconcile separate state inventories or modeling tools.

Transportation emissions include on-road vehicles, non-road equipment, locomotives, and commercial marine vessels. Due to limitations in LGGIT, the NEI results were entered into the Additional Emission Sources tab instead of the mobile entry tab within the tool.

The following steps detail how the data was collected, refined, and entered into LGGIT:

1. Access the 2020 NEI data retrieval tool.
2. Apply geographic filters:
    a. States: The states selected include the three states of Greater Chicago.
    b. Counties: The counties selected include the 13 counties of Greater Chicago.
3. Select GHG pollutants: Carbon Dioxide ($CO_2$), Methane (CH4), and Nitrous Oxide (N2O).
4. Filter to include only transportation-related emissions by selecting the following sectors:
    a. Mobile – Commercial Marine Vessels
    b. Mobile – Locomotives
    c. Mobile – Non-Road Equipment – Diesel
    d. Mobile – Non-Road Equipment – Gasoline
    e. Mobile – Non-Road Equipment – Other
    f. Mobile – On-Road Diesel Heavy Duty Vehicles
    g. Mobile – On-Road Diesel Light Duty Vehicles
    h. Mobile – On-Road non-Diesel Heavy Duty Vehicles
    i. Mobile – On-Road non-Diesel Light Duty Vehicles
5. Export the selected data.
6. Convert emissions from short tons to metric tons (MT) using the following conversion factor:
    a. 1 short ton x 0.907185 = 1 MT
7. Convert emissions to $CO_2$e using global warming potentials for $CO_2$, CH4, and N2O (Table B-4).
8. Separate NEI results by subsector (on-road, non-road, etc.)
9. Enter the $CO_2$e values into LGGIT under the Additional Emission Sources tab.

**Table B-4. Conversion factors for three GHG pollutants to $CO_2e$**

| GHG conversion | Global warming potential fifth assessment conversion factor |
|---|---|
| Carbon dioxide to $CO_2e$ | 1 |
| Methane to $CO_2e$ | 28 |
| Nitrous oxide to $CO_2e$ | 265 |

Source: Greenhouse Gas Protocol, 2016.

## Transportation: Aviation

Aviation emissions were quantified using operations data reported through the Federal Aviation Administration Air Traffic Activity System (ATADS) because it provides the most accurate and complete dataset of aircraft activity at individual commercial and general-aviation airports. Fuel consumption per operation was calculated using a standardized landing and takeoff fuel rate from the O'Hare 2015 Environmental Impact Study, which is consistent with prior regional emissions work and avoids requiring confidential carrier-level fuel data. Emission factors from the USEPA GHG Emission Factors Hub were used to convert fuel volume to $CO_2e$, ensuring consistency with federal GHG accounting methods.

The following steps detail how aviation data was collected, refined, and entered into LGGIT:

1. Quantify aircraft landing and takeoff operations for aviation trips that occur within the 13 counties using operation data from the ATADS. Due to COVID-19 pandemic anomalies in 2020, 2019 ATADS data was used as a proxy for a typical operating year.
2. Calculate annual fuel consumption using a standard fuel burn rate of 142.758505 gallons of jet fuel per landing and takeoff cycle, as documented in the O'Hare study.
3. Assign each airport to a county and summarize total fuel consumption by county.
4. Convert fuel consumption (gallons) to metric tons of $CO_2e$ using aviation fuel emission factors from USEPA's GHG Emission Factors Hub.[18]

## Waste

Solid waste emissions were obtained from USEPA's Facility Level Information on GreenHouse gases Tool (FLIGHT) database because it provides facility-level GHG emissions reported directly by landfills under the GHGRP. FLIGHT includes methane (CH4), carbon dioxide ($CO_2$), and nitrous oxide (N2O) emissions from landfill operations and gas collection systems, allowing emissions to be assigned to specific facilities and counties within the region. FLIGHT also provides transparent and auditable emissions data using standardized USEPA methodologies, which ensures consistency with the stationary and industrial sectors that also use GHGRP data.

The following steps detail how solid waste data was collected, refined, and entered into LGGIT:

1. Create a comprehensive list of landfills within the region using the USEPA FLIGHT tool. The following filters were applied to the tool to identify landfills within the region:
    a. Data Year: 2020

    b. State: Illinois, Indiana, Wisconsin
    c. Counties: Select all counties within the region
    d. Sector: Waste (deselect Wastewater Treatment)
2. Export FLIGHT data and confirm that only landfills located within the planning region are included.
3. For each landfill, extract emissions values for CH4, $CO_2$, and NO2 emissions.
    a. FLIGHT reports these emissions in $CO_2$e using global warming potential fourth assessment (GWP4) rates. Because the 2020 Greater Chicago inventory uses GWP5 values, emissions were first converted back to raw pollutant emissions using GWP4, then reconverted to $CO_2$e using GWP5 (Table B-5).
4. Convert raw emissions to $CO_2$e emissions using GWP5 values for consistency with other sectors in the inventory.
5. Summarize landfill emissions by county and enter values into the spreadsheet tool in the solid waste entry tab of LGGIT.

**Table B-5. Conversion factors for three GHG pollutants to $CO_2$e**

| Pollutant | Global warming potential fourth assessment factors | Global warming potential fifth assessment factors |
|---|---|---|
| Carbon dioxide ($CO_2$) | 1 | 1 |
| Methane (CH4) | 28 | 25 |
| Nitrous oxide (N2O) | 265 | 298 |

Source: Greenhouse Gas Protocol, 2016.

## Wastewater

Wastewater emissions were estimated using data from the 2019 CMAP GHG Inventory, which included methane and nitrous oxide emissions directly provided by the Metropolitan Water Reclamation District of Greater Chicago (MWRD). The MWRD is the primary wastewater treatment agency serving the majority of Cook County and maintains direct measurements of biogas generation and combustion at its facilities. Using MWRD data ensures consistency with prior CMAP inventories and supports an emissions calculation method that reflects actual operations rather than relying solely on population-based wastewater modeling. For counties outside the MWRD service area, emissions were estimated using population-normalized emission rates derived from the 2019 inventory to maintain methodological consistency across the full 13-county region. Only process emissions from wastewater treatment (biogas handling and treatment processes) are included here; energy used at wastewater facilities is accounted for under the stationary energy sector.

The following steps detail how wastewater data was collected, refined, and entered into LGGIT:

1. For each of the seven CMAP counties, use wastewater emissions in the CMAP 2019 GHG Inventory.[19]
2. For the remaining six counties of the region, use MWRD emissions data that informed the CMAP 2019 GHG inventory to fill geographic gaps.
    a. Calculate a per-capita emissions rate (emissions per million gallons of wastewater treated per person) and apply this rate to county-level populations for the six counties.
3. Convert wastewater emissions to MT $CO_2e$ and enter them into LGGIT under the Additional Emission Sources tab.

## Agriculture and land management: Fertilizer

Fertilizer application estimates were developed using USEPA's State Inventory Tool (SIT) Agriculture Module, because it provides standardized, state-level nitrogen fertilizer consumption data that aligns with U.S. GHG inventory methods and reporting frameworks. SIT incorporates fertilizer industry sales data and state reporting to the USDA, making it the most consistent and comparable source across Illinois, Indiana, and Wisconsin. State totals were downscaled to counties using USDA cropland acreage from Quick Stats, ensuring that fertilizer emissions reflect the share of agricultural activity occurring in each county.[20] This approach avoids relying on modeled emissions factors and ties fertilizer emissions directly to fertilizer use patterns in the region.

The following steps detail how data fertilizer consumption data was collected, refined, and entered into LGGIT:

1. Obtain state-level fertilizer data from SIT, Agriculture Module for Illinois, Indiana, and Wisconsin. The Fertilizer Data tab provides total nitrogen consumption in metric tons by state.
2. Convert fertilizer-year data to calendar-year values. Per Tennessee Valley Authority guidance, nitrogen consumption is distributed 35% from July to December and 65% from January to June.
    a. $Fertilizer_{total}$ = (Year 1 Fertilizer $t_m$ * 35%) + (Year 2 Fertilizer $t_m$ * 65%)
    b. Where:
        i. $Fertilizer_{total}$: total amount of fertilizer applied during the calendar year
        ii. Year 1 Fertilizer $t_m$: total amount of fertilizer applied during Year 1 fertilizer year
        iii. Year 2 Fertilizer $t_m$: total amount of fertilizer applied during Year 2 fertilizer year
        iv. $t_m$: metric tons
    c. Note, for 2019 and 2020, fertilizer-year values were the same, so this correction did not change totals for this specific inventory year. For example, the calculation for Illinois: 937,962 = (937,962 * 35%) + (937,962 * 65%)
3. Convert metric tons to short tons.

a. $Fertilizer_{total}$ = Fertilizer $t_m$ / 0.907185
b. Where:
    i. $Fertilizer_{total}$: total amount of fertilizer applied, from all sources
    ii. $t_m$: metric tons
    iii. 0.9072: the conversion factor for metric tons to short tons

4. Disaggregate total fertilizer into fertilizer types. Fertilizer totals were allocated into four categories using SIT default nitrogen fertilizer composition percentages.
    a. Synthetic nitrogen fertilizer (short tons): $Fertilizer_{synthetic}$ = Fertilizer $t_s$ * 99.75%
        i. Where:
            1. $Fertilizer_{synthetic}$ : amount of synthetic fertilizer applied, from total fertilizer (short tons)
            2. $t_s$: short tons
            3. 99.75%: percentage of synthetic nitrogen fertilizer in total fertilizer
    b. Manure-based fertilizer (short tons): $Fertilizer_{manure}$ = Fertilizer $t_s$ * 0.01%
        i. Where:
            1. $Fertilizer_{manure}$: amount of manure applied, from total fertilizer
            2. $t_s$: short tons
            3. 0.01%: Percentage dried manure fertilizer in total fertilizer
    c. Activated sewage sludge (organic fertilizer) (short tons): $Fertilizer_{organic}$ = Fertilizer $t_s$ * 0.15%
        i. Where:
            1. $Fertilizer_{organic}$: amount of activated sewage sludge fertilizer applied, from total fertilizer
            2. $t_s$: short tons0.15%: percentage of (organic) sewage sludge in fertilizer
    d. Other organic fertilizer (short tons): $Fertilizer_{other}$ = Fertilizer $t_s$ * 0.09%
        i. Where:
            1. $Fertilizer_{other}$: amount of other fertilizer applied (e.g., compost), from total fertilizer
            2. $t_s$: short tons
            3. 0.09%: percentage of other fertilizer
5. Downscale state-level data to the county level. County fertilizer values were estimated based on each county's proportion of state cropland acreage, with cropland acres for each county and state obtained from Quick Stats (Table B-6).
    a. $Fertilizer_{county}$ = (Cropland $acres_{county}$ / Cropland $acres_{state}$) * $Fertilizer_{state}$
        i. Where:
            1. Cropland $acres_{county}$: total cropland acreage per selected county, from Quick Stats
            2. Cropland $acres_{state}$: total cropland acreage per selected state, from Quick Stats
6. Enter fertilizer consumption data (in short tons) into LGGIT.

**Table B-6. Estimated short tons of fertilizer by county**

| County, state | Cropland $acres_{county}$ | Cropland $acres_{state}$ | Short tons $fertilizer_{state}$ | Short tons $fertilizer_{county}$ |
|---|---|---|---|---|
| Cook, IL | 10,763 | 24,003,086 | 1,033,909 | 464 |
| DeKalb, IL | 362,602 | 24,003,086 | 1,033,909 | 15,619 |
| DuPage, IL | 1,643 | 24,003,086 | 1,033,909 | 71 |
| Grundy, IL | 224,916 | 24,003,086 | 1,033,909 | 9,688 |
| Kane, IL | 161,894 | 24,003,086 | 1,033,909 | 6,973 |
| Kendall, IL | 133,626 | 24,003,086 | 1,033,909 | 5,756 |
| Lake, IL | 23,883 | 24,003,086 | 1,033,909 | 1,029 |
| McHenry, IL | 189,679 | 24,003,086 | 1,033,909 | 8,170 |
| Will, IL | 208,158 | 24,003,086 | 1,033,909 | 8,966 |
| Lake, IN | 106,022 | 12,909,673 | 507,128 | 4,165 |
| La Porte, IL | 229,986 | 12,909,673 | 507,128 | 9,034 |
| Porter, IL | 114,702 | 12,909,673 | 507,128 | 4,506 |
| Kenosha, WI | 65,214 | 10,085,021 | 354,273 | 2,291 |
| TOTAL | -- | -- | -- | 76,731 |

Source: USDA, 2024.

## Agriculture and land management: Non-$CO_2$ emissions associated with soil management

Non-$CO_2$ emissions from soil management (e.g., liming, field burning of agricultural residues) were estimated using SIT because it provides state-level GHG emissions for agricultural soil management activities using methodologies aligned with the U.S. national inventory. These data are not available at the county level from USEPA or USDA, so emissions were downscaled using USDA cropland acreage proportions from Quick Stats for each county. This approach allocates emissions based on the share of agricultural activity occurring in each county while maintaining consistency with national and state GHG accounting protocols.

The following steps detail how emissions data was collected, refined, and entered into LGGIT:

1. Scale two subsectors — liming and field burning — from SIT for all three states in the region. Calculate the proportion of agricultural land within the region for all three states and apply these rates to the state totals for each respective emission type. The state proportion of cropland, state totals for liming and field burning emissions (shown in MMT $CO_2e$), and the calculated county totals are shown in Table B-7.
2. Within LGGIT, enter emissions under the Agriculture Soil Management category.

**Table B-7. Estimated liming and field burning emissions by county**

| County, state | Cropland $acres_{county}$ | Cropland $acres_{state}$ | Liming emissions (MMT $CO_2e)_{state}$ | Liming emissions (MMT $CO_2e)_{county}$ | Field burning emissions (MMT $CO_2e)_{state}$ | Field burning emissions (MMT $CO_2e)_{county}$ |
|---|---|---|---|---|---|---|
| Cook, IL | 10,763 | 24,003,086 | 2.372 | 0.001 | 0.059 | 0.00003 |
| DeKalb, IL | 362,602 | 24,003,086 | 2.372 | 0.036 | 0.059 | 0.00089 |
| DuPage, IL | 1,643 | 24,003,086 | 2.372 | 0.000 | 0.059 | 0.00000 |
| Grundy, IL | 224,916 | 24,003,086 | 2.372 | 0.0222 | 0.059 | 0.00055 |
| Kane, IL | 161,894 | 24,003,086 | 2.372 | 0.016 | 0.059 | 0.00040 |
| Kendall, IL | 133,626 | 24,003,086 | 2.372 | 0.013 | 0.059 | 0.00033 |
| Lake, IL | 23,883 | 24,003,086 | 2.372 | 0.002 | 0.059 | 0.00006 |
| McHenry, IL | 189,679 | 24,003,086 | 2.372 | 0.019 | 0.059 | 0.00046 |
| Will, IL | 208,158 | 24,003,086 | 2.372 | 0.021 | 0.059 | 0.00051 |
| Lake, IN | 106,022 | 12,909,673 | 0.142 | 0.001 | 0.011 | 0.00009 |
| La Porte, IN | 229,986 | 12,909,673 | 0.142 | 0.001 | 0.011 | 0.00009 |
| Porter, IN | 114,702 | 12,909,673 | 0.142 | 0.003 | 0.011 | 0.00019 |
| Kenosha, WI | 65,214 | 10,085,021 | 0 | 0 | 0.010 | 0.00006 |

Source: USEPA, 2024.

## Agriculture and land management: Enteric fermentation

Enteric fermentation emissions were estimated using livestock population data from the USDA National Agricultural Statistics Service and methane emissions from the USEPA SIT. SIT provides state-level emissions using nationally accepted GHG inventory methodologies and emission factors used in the national inventory. County-level livestock data are available from the USDA, making it possible to allocate state emissions proportionally to counties based on cattle populations. This approach ensures consistency with federal agriculture emissions accounting while reflecting the geographic distribution of livestock production within the 13-county region.

The following steps detail how enteric fermentation data was collected, refined, and entered into LGGIT:

1. Determine livestock populations. Obtain statewide and county cattle counts from the USDA National Agriculture Statistical Service Quick Stats database for Illinois, Indiana, and Wisconsin.
2. Obtain state-level methane emissions from enteric fermentation. Use the USEPA's SIT to pull enteric fermentation emissions (methane) for the three states. The county proportion of cattle and calculated county totals are shown in Table B-8.
    a. Downscale state emissions to the county level based on the proportion of statewide cattle within each county in the region. $Emissions_{county} = (Cattle_{county} / Cattle_{state}) * Emissions_{state}$
3. Within LGGIT, enter enteric fermentation emissions under Agriculture: Livestock Enteric Fermentation.

**Table B-8. Estimated cattle count by county**

| County, state | $Cattle_{county}$ | $Cattle_{state}$ | Enteric fermentation emissions (MMT $CO_2e$) $_{state}$ | Enteric fermentation emissions (MMT $CO_2e$) $_{county}$ |
|---|---|---|---|---|
| Cook, IL | 0* | 1,090,000 | 2.372 | 0.000 |
| DeKalb, IL | 17,900 | 1,090,000 | 2.372 | 0.039 |
| DuPage, IL | 0* | 1,090,000 | 2.372 | 0.000 |
| Grundy, IL | 1,700 | 1,090,000 | 2.372 | 0.004 |
| Kane, IL | 4,500 | 1,090,000 | 2.372 | 0.010 |
| Kendall, IL | 3,700 | 1,090,000 | 2.372 | 0.008 |
| Lake, IL | 1,700 | 1,090,000 | 2.372 | 0.004 |
| McHenry, IL | 17,200 | 1,090,000 | 2.372 | 0.037 |
| Will, IL | 2,500 | 1,090,000 | 2.372 | 0.005 |
| Lake, IN | 1,600 | 840,000 | 1.962 | 0.004 |
| La Porte, IN | 13,600 | 840,000 | 1.962 | 0.032 |
| Porter, IN | 4,100 | 840,000 | 1.962 | 0.010 |
| Kenosha, WI | 9,700 | 3,450,000 | 8.185 | 0.023 |

*Cattle numbers for Cook and DuPage counties were not reported to USDA due to small size. While the number is higher than 0, it was deemed to be insignificant for purposes of calculating emissions from enteric fermentation.

Source USDA, 2024.

## Natural carbon sequestration: Forests, grasslands, and wetlands

Natural carbon sequestration estimates were developed using multiple federal datasets to reflect different types of natural carbon sinks.

- **Forests (tree canopy):** County-level tree canopy coverage was obtained through i-Tree Landscape, a peer-reviewed U.S. Forest Service tool that combines LiDAR, satellite imagery, and field inventory data. i-Tree is the most widely used dataset for local and regional carbon estimation and aligns with U.S. Forest Service carbon accounting methods.

- **Land area (land use allocation):** Land area by use type was obtained from Replica, which provides spatially explicit land use data that can be allocated across inventory sectors (residential and commercial buildings, industry, and energy generation).
- **Wetlands and grasslands:** Carbon sequestration from wetlands and other non-forest vegetated lands was estimated using USEPA's SIT, which provides state-level sequestration values based on the national greenhouse gas inventory. These values were scaled to counties using land area proportions.

The following steps detail how data on natural carbon sequestration sources (forests, grasslands, and wetlands) were collected, refined, and entered into LGGIT:

1. Obtain tree canopy coverage using i-Tree.
    a. Select the 13 counties of Greater Chicago.
    b. Generate report using:
        i. Report Type: Executive Summary
        ii. Report Element: Canopy and Impervious
    c. The resulting report provides county-level tree canopy coverage.
2. Obtain land use data by county from Replica.
    a. Download land use area (sq ft) for all 15 land use categories.
3. Assign Replica land use categories to the four LGGIT GHG inventory sectors (residential, commercial/institutional, industrial, and energy generation) using the crosswalk in Table B-9.
4. Allocate canopy coverage to inventory sectors.
    a. Calculate percentage of land in each inventory sectors for each county.
    b. Calculate percentage of area in each county with tree canopy coverage (Table B-10).
    c. Use these percentages to determine the total tree canopy coverage area (in sqft) for each county.
5. Convert canopy area to required LGGIT units.
    a. Convert sq ft to km2 using: 1 km2 = 10,763,900 sq ft.
6. Obtain wetland and grassland sequestration totals from SIT for Illinois, Indiana, and Wisconsin.
    a. Scale state sequestration to counties using the proportion of land area classified as wetlands/grasslands within each county.
    b. $\text{Sequestration}_{\text{county}} = (\text{area}_{\text{county}}/\text{area}_{\text{state}}) * \text{Sequestration}_{\text{state}}$
        i. Where:
            1. $\text{Sequestration}_{\text{county}}$: total sequestration for each county
            2. $\text{Area}_{\text{state}}$: total wetland and grassland acreage for each state
            3. $\text{Area}_{\text{county}}$: total wetland and grassland acreage for each county
            4. $\text{Sequestration}_{\text{state}}$: total sequestration for each state, from SIT
7. Enter sequestration values into LGGIT:

a. Tree canopy coverage data by sector (km2).
b. Wetlands and grasslands sequestration entered by county.

**Table B-9. Land use category crosswalk**

| Replica land use category | 2020 Greater Chicago inventory sector |
|---|---|
| Single-family | Residential |
| Multi-family | Residential |
| Retail | Commercial/institutional |
| Office | Commercial/institutional |
| Non-retail attraction | Commercial/institutional |
| Mixed use | Residential |
| Industrial | Industrial |
| Civic/institutional | Commercial/institutional |
| Education | Commercial/institutional |
| Healthcare | Commercial/institutional |
| Utilities | Energy generation |
| Open space | Split* |
| Agriculture | Industrial |
| Other | Split* |
| Unknown | Split* |

*Land use categories with no clear connection to an existing inventory sector were split evenly among the existing sectors.

Source: CMAP, 2025.

**Table B-10. Estimates of tree canopy coverage by county**

| County, State | Canopy coverage % | Residential area share | Commercial/ institutional area share | Industrial area share | Energy generation share |
|---|---|---|---|---|---|
| McHenry, IL | 18.6% | 45.2% | 4.8% | 49.1% | 0.9% |
| Kane, IL | 15.7% | 43.0% | 11.0% | 43.3% | 2.7% |
| La Porte, IN | 12.4% | 27.3% | 1.6% | 69.7% | 1.4% |
| Cook, IL | 16.7% | 55.1% | 22.3% | 14.0% | 8.6% |
| DeKalb, IL | 2.5% | 25.2% | 2.0% | 72.0% | 0.8% |

| | | | | | |
|---|---|---|---|---|---|
| Kendall, IL | 8.1% | 40.0% | 2.8% | 56.6% | 0.5% |
| Porter, IN | 18.1% | 50.0% | 5.7% | 42.1% | 2.3% |
| DuPage, IL | 26.3% | 58.6% | 23.9% | 10.7% | 6.9% |
| Lake, IL | 10.3% | 59.4% | 19.1% | 18.2% | 3.3% |
| Kenosha, WI | 5.1% | 54.0% | 11.2% | 32.5% | 2.3% |
| Lake, IN | 14.0% | 36.8% | 10.1% | 47.8% | 5.3% |
| Grundy, IL | 6.3% | 22.7% | 2.2% | 74.4% | 0.7% |
| Will, IL | 14.0% | 43.1% | 8.8% | 45.4% | 2.6% |

Source: CMAP, 2025.

## Natural carbon sequestration: Croplands

Cropland carbon sequestration was estimated using USEPA's SIT and spatial land use data from Replica. SIT provides state-level sequestration estimates that are consistent with the national GHG inventory and based on accepted carbon accounting models for agricultural soils. Because USEPA does not provide sequestration values at the county scale, cropland area proportions from Replica were used to downscale state values to the county level. This method ensures sequestration totals reflect the actual distribution of cropland within the 13-county region.

The following steps detail how data on croplands was collected, refined, and entered into LGGIT:

1. Obtain state-level cropland sequestration estimates.
    a. Download cropland carbon sequestration values from SIT for Illinois, Indiana, and Wisconsin.
2. Determine cropland area by state and by county.
    a. Use Replica land use data to identify total cropland acreage for each state and each county.
3. Downscale state sequestration to counties.
    a. Allocate state-level sequestration emissions to counties based on the proportion of statewide cropland located in each county.
    b. $Sequestration_{county} = (area_{county}/area_{state}) * Sequestration_{state}$
        ii. Where:
            1. $Sequestration_{county}$: total sequestration for each county
            2. $Area_{county}$: total cropland acreage for each county
            3. $Area_{state}$: total cropland acreage for each state
            4. $Sequestration_{state}$: total sequestration for each state, from SIT tool
4. Enter sequestration values into LGGIT.

# 2005 GHG inventory methodology

## Underlying data

A detailed activity-based GHG inventory could not be developed for 2005 due to data limitations. Utility, fuel consumption, industrial process, land use, and transportation datasets that exist today either did not exist in 2005 or are not available at a county level. To produce a defensible 2005 regional baseline that is comparable to the 2020 inventory, the project team used a scaling approach based on:

- **USEPA State Inventory Tool (SIT):** Provides state-level historical emissions for all sectors using the same methodology applied in the national GHG inventory.
- **2020 Greater Chicago GHG inventory:** Provides county-level emissions for the greater Chicago region using detailed activity data.
- **Proportional allocation:** The share of each state's 2020 emissions occurring within the 13 counties was calculated and applied to 2005 state emissions to estimate 2005 regional emissions.

This approach ensures that:

- 2005 and 2020 results are methodologically consistent
- Scaling reflects actual regional industrial, agricultural, and land-use distribution
- No back-casting assumptions are made about historical activity data that did not exist

To develop the 2005 GHG inventory, the project team used USEPA's Annual Inventory of U.S. Greenhouse Gas Emissions and Sinks and the 2020 GHG inventory described above. Table B-10 provides a summary of the data source and quality for each sector.

**Table B-11. 2005 inventory data sources and quality for each GHG emission sector**

| Sector | Emissions data source | Data quality |
|---|---|---|
| Transportation | USEPA SIT | High |
| Residential: Natural gas* | USEPA SIT, U.S. Energy Information Administration (EIA) energy consumption | High |
| Residential: Electricity* | USEPA SIT, EIA energy consumption, eGRID | High |
| Commercial: Natural gas* | USEPA SIT, EIA energy consumption | High |
| Commercial: Electricity* | USEPA SIT, EIA energy consumption, eGRID | High |
| Industry: Natural gas* | USEPA SIT, EIA energy consumption | High |

| | | |
|---|---|---|
| Industry: Electricity* | USEPA SIT, EIA energy consumption, eGRID | High |
| Industry: Processes | USEPA SIT/GHGRP | High |
| Transportation | USEPA SIT | High |
| Agriculture and land management | USEPA SIT | High |
| Waste** | USEPA SIT | High |
| Wastewater*** | USEPA SIT | N/A |
| Carbon sinks | USEPA SIT | High |

* Stationary energy data.
** Emissions related to materials management are not included in the inventory due to limited data availability.
*** Water emissions are included within the buildings sector due to limited data availability for these sources. Wastewater emissions are captured in the waste sector within the EPA State Inventory. These emissions are still captured, but they were not broken out into a separate sector like they were treated in the 2020 inventory.

Source: CMAP, 2025.

## Process

Because detailed activity data were not available for 2005, the project team used a scaling approach based on state emissions.

- Extract 2005 and 2020 state-level GHG emissions for Illinois, Indiana, and Wisconsin from SIT.
- Use the 2020 county-level CMAP inventory to determine what percentage of each state's emissions occurred within the region.
- Apply that percentage to the 2005 state totals to generate 2005 emissions for the region.
- Apply sector-specific scaling methods where needed for specific sectors.

The following sections detail the scaling process for each emissions sector.

### Stationary energy

Emissions from natural gas and electricity emission from commercial, residential, and industrial buildings were estimated by scaling state-level energy use data from NREL SLOPE and the U.S. Energy Information Administration (EIA). The EIA provides annual energy use by energy type at the state level.

Emissions from natural gas were ultimately scaled from SLOPE at the state level (Table C-13). The project team selected SLOPE values for consistency with the 2020 Greater Chicago GHG inventory and because they were comparable to the EIA natural gas consumption estimates. A similar approach was used for electricity, using EIA State Energy Data System (SEDS) to pull electricity usage by state and sector (Table B-11).[21]

Next, energy usage from the 2020 Greater Chicago GHG inventory was used to determine the proportion of energy use from each county of Illinois, Indiana, and Wisconsin within the region. This exercise was completed separately for both natural gas and electricity usage. The results of this exercise are shown in Table B-11 and Table B-12, respectively.

Finally, these 2020 proportions (from SLOPE and EIA) were applied to the 2005 state-level energy use from EIA (for electricity) and SLOPE (for natural gas) to estimate the portion of 2005 consumption attributable to the planning area across the three states in the region. This resulted in 2005 natural gas and electricity usage for the portions of each state within the region.

Electricity data was translated from trillion BTu's into million metric tons of $CO_2e$ (MMT $CO_2e$). Electricity output emission rates were collected via eGRID's 2005 database (Table B-13). These rates were used to translate energy usage data into emissions data, which was the same process used for the 2020 GHG inventory.

Natural gas usage data also needed to be translated into emissions data. The EIA provides 2005 usage data in trillion Btu of natural gas consumption, which was translated into metric cubic feet (mcf) and then into MMT $CO_2e$ by converting energy use into emissions for the following GHG pollutants: carbon dioxide, nitrous oxide, and methane (Table B-14).

**Table B-12. Scaled building-related natural gas emissions by state and sector**

| State and sector | 2020 proportion of emissions (%) | 2005 state emissions (trillion Btu) | 2005 CCAP proportion of emissions (trillion Btu) |
|---|---|---|---|
| Illinois residential | 68.7% | 444.0 | 304.9 |
| Illinois commercial | 84.4% | 204.8 | 172.9 |
| Illinois industrial | 36.8% | 264.4 | 97.2 |
| Indiana residential | 19.8% | 151.3 | 29.9 |
| Indiana commercial | 10.3% | 77.6 | 8.0 |
| Indiana industrial | 31.3% | 268.9 | 84.0 |
| Wisconsin residential | 3.8% | 133.0 | 5.1 |
| Wisconsin commercial | 3.9% | 87.2 | 3.4 |
| Wisconsin industrial | 1.0% | 132.3 | 1.3 |

Source: CMAP, 2025.

**Table B-13. Scaled building-related electricity emissions by state and sector**

| State and sector | 2020 proportion of emissions (%) | 2005 state emissions (trillion Btu) | 2005 CCAP proportion of emissions (trillion Btu) |
|---|---|---|---|
| Illinois residential | 58.3% | 165.8 | 96.6 |
| Illinois commercial | 75.3% | 170.5 | 128.5 |
| Illinois industrial | 44.2% | 156.6 | 69.3 |
| Indiana residential | 8.6% | 114.7 | 9.8 |
| Indiana commercial | 9.5% | 81.7 | 7.7 |
| Indiana industrial | 15.8% | 167.0 | 26.3 |
| Wisconsin residential | 2.8% | 76.6 | 2.1 |
| Wisconsin commercial | 5.0% | 76.8 | 3.8 |
| Wisconsin industrial | 1.1% | 86.6 | 1.0 |

Source: CMAP, 2025.

**Table B-14. 2005 eGRID emission factors used to translate electricity usage into MMT $CO_2e$**

| State | State annual $CO_2$ output emission rates (lb/MWh) | State annual CH4 output emission rates (lb/MWh) | State annual N2O output emission rates (lb/MWh) |
|---|---|---|---|
| Illinois | 1125.9968 | 0.0131 | 0.0185 |
| Indiana | 2087.7522 | 0.0245 | 0.0348 |
| Wisconsin | 1720.1284 | 0.0255 | 0.0283 |

Source: eGRID 2005.

**Table B-15. Conversion factors for three GHG pollutants to $CO_2e$**

| GHG conversion | Global warming potential fifth assessment conversion factor |
|---|---|
| Carbon dioxide to $CO_2e$ | 1 |
| Methane to $CO_2e$ | 28 |
| Nitrous oxide to $CO_2e$ | 265 |

Source: Greenhouse Gas Protocol, 2016.

## Industry: Processes

Industrial process emissions were gathered by subsector from the USEPA SIT for Illinois, Indiana, and Wisconsin. Since industrial emissions can fluctuate significantly due to a single facility opening, closing, or changing operations, USEPA GHGRP data were also reviewed to identify major changes in facilities going back to 2011, when that database was first created. While this data source does not provide data for 2005, it was used as a quality control check in the Quality Assurance Project Plan.

The state inventory rates were found to be an accurate estimate of regional industrial process emissions going back to 2011 and were used to estimate 2005 emissions. Industrial process emissions are broken into the following subsectors:

- Product uses as substitutes for ozone depleting substances
- Chemical industry
- Mineral industry
- Metal industry
- Other product manufacture and use
- Carbon dioxide consumption
- Electronics industry

A crosswalk was created to translate the industrial process subsectors used in the 2020 Greater Chicago GHG inventory into categories that could be scaled using SIT (Table B-15). Each of these subsectors was scaled based on the percentage change in state-level emissions between 2005 and 2020 and the totals were aggregated to determine the 2005 industrial process emissions.

**Table B-16. Crosswalk of industrial process subsectors used in 2020 Greater Chicago GHG inventory and USEPA's SIT**

| 2020 Greater Chicago GHG inventory subsectors | USEPA SIT subsectors |
|---|---|
| Chemicals | Chemical industry |
| Food processing | Other product manufacture and use |
| Iron and steel | Metal industry |
| Other primary metal production | Metal industry |
| Manufacturing industries and construction | Other product manufacture and use |
| Cement and lime | Product uses as substitutes for ozone depleting substances |
| Glass | Product uses as substitutes for ozone depleting substances |
| Other nonmetallic minerals | Mineral industry |
| Pulp and paper | Other product manufacture and use |
| Petroleum refineries | Product uses as substitutes for ozone depleting substances |

Source: CMAP, 2025.

## Transportation

Transportation emissions for 2005 and 2020 were compiled from the SIT for Illinois, Indiana, and Wisconsin. For 2020, the proportion of emissions coming from each county was calculated and applied to the 2005 state totals, resulting in the region's proportion of transportation emissions in each state. These percentages were then scaled to the county level based on the 2020 counties proportion of emissions (Table B-16).

**Table B-17. Scaled transportation emissions by state**

| State | 2020 proportion of transportation emissions | 2005 transportation state emissions (MMT) | 2005 CCAP emissions (MMT $CO_2e$) |
|---|---|---|---|
| Illinois | 61.9% | 77.92 | 48.26 |
| Indiana | 14.4% | 47.60 | 6.85 |
| Wisconsin | 2.9% | 32.55 | 0.93 |

Source: CMAP, 2025.

## Waste and wastewater

While waste and wastewater emissions are captured separately in the 2020 Greater Chicago GHG inventory, data was not available to split these emissions going back to 2005. The SIT considers these emissions as one sector and are grouped together within USEPA's state inventories. As such, waste and wastewater emissions were scaled by determining the proportion of 2020 state emissions that occurred within the region and applying the proportion to statewide emissions from the 2005 SIT for Illinois, Indiana, and Wisconsin (Table B-17).

**Table B-18. Waste and wastewater emissions scaling rates**

| State | 2020 proportion of emissions (%) | 2005 statewide emissions (MMT $CO_2e$) | 2005 CCAP emissions (MMT $CO_2e$) |
|---|---|---|---|
| Illinois | 15.0% | 8.26 | 1.00 |
| Indiana | 5.1% | 4.81 | 0.20 |
| Wisconsin | 1.2% | 5.54 | 0.06 |

Source: CMAP, 2025.

## Agriculture

Agriculture emissions were scaled by determining the proportion of 2020 statewide emissions that occurred within the region, and then applying the proportion to statewide emissions from the 2005 SIT for Illinois, Indiana, and Wisconsin for each subsector. Because the 2020 Greater Chicago GHG inventory used the SIT as a source, the subsectors were already aligned. The proportional rates and resulting scaled emissions for each of the agricultural subsectors are provided in Table B-18.

**Table B-19. Agriculture 2005 scaled emissions by subsector**

| State | 2020 proportion of emissions (%) | 2005 statewide emissions (MMT $CO_2e$) | 2005 CCAP emissions (MMT $CO_2e$) |
|---|---|---|---|
| Enteric fermentation | | | |
| Illinois | 4.5% | 2.63 | 0.12 |
| Indiana | 2.3% | 1.86 | 0.04 |
| Wisconsin | 2.8% | 6.92 | 0.02 |
| Agricultural soil management | | | |
| Illinois | 5.5% | 14,93 | 0.82 |
| Indiana | 4.0% | 8.61 | 0.35 |
| Wisconsin | 0.6% | 7.46 | 0.05 |
| Manure management | | | |
| Illinois | 16.6% | 1.86 | 0.31 |
| Indiana | 5.5% | 1.63 | 0.09 |
| Wisconsin | 0.3% | 3.21 | 0.01 |
| Field burning | | | |
| Illinois | 0.6% | 0.06 | <0.01 |
| Indiana | 3.5% | 0.00 | 0.00 |
| Wisconsin | 0.6% | 0.01 | <0.01 |
| Liming | | | |
| Illinois | 22.4% | 1.43 | 0.32 |
| Indiana | 0.8% | 0.90 | 0.01 |
| Wisconsin | 0.0% | 0.00 | 0.00 |

Source: CMAP, 2025.

## Natural carbon sequestration

Emissions sequestered by natural carbon sequestration sources were scaled by determining the proportion of 2020 statewide emissions that occurred within the region and applying the proportion to statewide emissions from the 2005 SIT for Illinois, Indiana, and Wisconsin for each subsector (Table B-19).

**Table B-20. Natural carbon sequestration emissions scaling rates**

| State | 2020 proportion of emissions (%) | 2005 statewide emissions (MMT $CO_2e$) | 2005 CCAP emissions (MMT $CO_2e$) |
|---|---|---|---|
| Illinois | 15.0% | 8.26 | 1.00 |
| Indiana | 5.1% | 4.81 | 0.20 |
| Wisconsin | 1.2% | 5.54 | 0.06 |

Source: CMAP, 2025.

# Quality assurance project plan process and results

## Process and results

As required, the project team developed a quality assurance project plan (QAPP) that outlined the process for reviewing the development of the GHG inventory for quality assurance purposes. The following section outlines the process for performing the QAPP and provides the results by sector/emission source.

### 2020 GHG inventory

#### Mobile sources

As described above, mobile sources in this inventory were collected from the U.S. National Emissions Inventory. This dataset is considered of the highest quality rank in terms of data quality. The methodology used to gather this data and enter it into the inventory tool also followed USEPA guidance.

Data was collected twice, once when it was entered into the inventory tool and then a second time, following the instructions noted in the mobile sources section above, to ensure that no errors were made in collecting, cleaning, and entering the data into the inventory tool. This analysis resulted in an exact match to the inventory entry.

Mobile emissions were also compared to CMAP's 2019 GHG inventory and a variance between the two inventories for the overlapping areas (Table B-20). Only the seven counties covered in the CMAP inventory were compared.

**Table B-21. Comparison between mobile GHG emissions in the CCAP 2020 GHG inventory for the counties in CMAP's 2019 GHG inventory**

| Subsector | CCAP GHG inventory (MT $CO_2e$) for CMAP counties | CMAP 2019 GHG Inventory (MT $CO_2e$) | Variance |
|---|---|---|---|
| On-road Mobile emissions | 25,825,978 | 29,506,123 | -12.5% |
| Non-road mobile emissions | 3,936,888 | 3,626,269 | 8.6% |
| All other mobile emissions* | 566,668 | 912,269 | -37.9% |

*All other mobile emissions included emissions from locomotives and marine vessels.

Source: CMAP, 2025.

All these subsectors were within the stated variance within the QAPP. It is important to note that while all three of these subsectors fall within the stated variance goals in the QAPP, emissions from locomotives and marine vessels are larger than other comparisons. This is primarily tied to additional emissions from marine vessels within the CMAP 2019 GHG inventory. These differences should be noted and considered for future analysis.

### Electric power consumption

As described above, electric power consumption in this inventory was derived from the USEPA SLOPE tool, which provides power consumption estimates by county. Data for this section was collected twice, once when it was entered into the inventory tool and then a second time, following the instructions noted in the stationary energy section above, to ensure that no errors were made in collecting, cleaning, and entering the data into the inventory tool. This analysis resulted in an exact match to the inventory entry.

Electricity consumption emissions were compared to CMAP's 2019 GHG inventory and a variance between the two inventories for the overlapping areas (Table B-21). This was only done for the seven CCAP counties included in the 2019 inventory.

**Table B-22. Comparison between electric power GHG emissions in the CCAP 2020 GHG inventory for the counties in CMAP's 2019 GHG inventory**

| Subsector | CCAP2020 GHG inventory (MT $CO_2$e) for CMAP counties | CMAP 2019 GHG inventory (MT $CO_2$e) | Variance |
|---|---|---|---|
| Residential electricity | 10,317,241 | 9,837,890 | 4.9% |
| Commercial electricity | 20,744,914 | 20,367,940 | 1.9% |
| Industrial electricity | 8,734,420 | 7,907,887 | 10.5% |

Source: CMAP, 2025.

## Natural gas consumption

As described above, natural gas emissions in this inventory were derived from the USEPA SLOPE tool, which provides power consumption estimates by county.

Data for this section was collected twice, once when it was entered into the inventory tool and then a second time, following the instructions noted in the stationary energy section above, to ensure that no errors were made in collecting, cleaning, and entering the data into the inventory tool. This analysis resulted in an exact match to the inventory entry.

Natural gas consumption emissions were compared to CMAP's 2019 GHG inventory and a variance between the two inventories for the overlapping areas (Table B-22). Only the seven planning area counties covered in the CMAP inventory were compared.

**Table B-23. Comparison between natural gas GHG emissions in the CCAP 2020 GHG inventory for the counties in CMAP's 2019 GHG inventory**

| Subsector | CCAP GHG inventory (MT $CO_2$e) for CMAP counties | CMAP 2019 GHG inventory (MT $CO_2$e) | Variance |
|---|---|---|---|
| Residential natural gas | 16,267,367 | 17,265,623 | -5.8% |
| Commercial natural gas | 13,008,443 | 11,951,341 | 8.8% |
| Industrial natural gas | 5,046,982 | 5,127,403 | -1.6% |

Source: CMAP, 2025.

### Solid waste

As described above, solid waste emissions in this inventory were derived from USEPA's FLIGHT tool, which provides emissions information for large point sources, such as landfills.

Data for this section was collected twice, once when it was entered into the inventory tool and then a second time, following the instructions noted in the solid waste section above, to ensure that no errors were made in collecting, cleaning, and entering the data into the inventory tool. This analysis resulted in an exact match to the inventory entry.

Solid waste emissions were compared to the CMAP 2019 GHG inventory and a variance between the two inventories for the overlapping areas (Table B-23). Only the seven counties covered in CMAP's 2019 GHG Inventory were compared.

**Table B-24. Comparison between solid waste GHG emissions in the CCAP 2020 GHG inventory for the counties in CMAP's 2019 GHG inventory**

| Subsector | CCAP GHG inventory (MT $CO_2e$) for CMAP counties | CMAP 2019 GHG inventory (MT $CO_2e$) | Variance |
|---|---|---|---|
| Solid waste | 525,115 | 461,051 | 12.2% |

Source: CMAP, 2025.

### Wastewater

As described above, wastewater emissions in this inventory were derived from CMAP's 2019 GHG Inventory. This is the same inventory that was used to determine the variance for the quality assurance/quality control process. As a result, the variance for this sector is 0 percent.

Data for this section was collected twice, once when it was entered into the inventory tool and then a second time, following the instructions noted in the solid waste section above, to ensure that no errors were made in collecting, cleaning, and entering the data into the inventory tool. This analysis resulted in an exact match to the inventory entry (Table B-24). Only the seven CCAP planning area counties in the CMAP inventory were compared.

**Table B-25. Comparison between wastewater GHG emissions in the CCAP 2020 GHG inventory for the counties in CMAP's 2019 GHG inventory**

| Subsector | CCAP GHG inventory (MT $CO_2e$) | CMAP 2019 GHG inventory (MT $CO_2e$) | Variance |
|---|---|---|---|
| Wastewater and water conveyance | 1,492,768 | 1,492,768 | 0% |

Source: CMAP, 2025.

### Agriculture and land management

As described above, agriculture and land management emissions in this inventory were derived from scaled state inventory data.

Data for this section was collected twice, once when it was entered into the inventory tool and then a second time, following the instructions noted in the solid waste section above, to ensure that no errors were made in collecting, cleaning, and entering the data into the inventory tool. This analysis resulted in an exact match to the inventory entry (Table B-25).

**Table B-26. Comparison between agriculture and land management GHG emissions in the CCAP 2020 GHG inventory and the CCAP planning area GHG quality control (QC) inventory**

| Subsector | CCAP GHG inventory (MT $CO_2e$) | CCAP GHG inventory QC entry | Variance |
|---|---|---|---|
| Agriculture and land management | 852,181 | 852,181 | 0% |

Source: CMAP, 2025.

### Industrial processes

As described above, industrial process emissions in this inventory were derived from the GHG reporting program.

Data for this section was collected twice, once when it was entered into the inventory tool and then a second time, following the instructions noted in the industrial process section above, to ensure that no errors were made in collecting, cleaning, and entering the data into the inventory tool. This analysis resulted in an exact match to the inventory entry (Table B-26). Only the seven CCAP covered in the CMAP 2019 GHG inventory were compared.

**Table B-27. Comparison between industrial processes GHG emissions in the CCAP 2020 GHG inventory for the counties in CMAP's 2019 GHG inventory**

| Subsector | CCAP GHG inventory (MT $CO_2e$) for CMAP counties | CMAP 2019 GHG inventory (MT $CO_2e$) | Variance |
|---|---|---|---|
| Fugitive emissions and energy industry emissions | 5,436,478 | 4,988,738 | 8.2% |

Source: CMAP, 2025.

Both the fugitive emissions and industry subsectors were within the stated variance within the QAPP. It is important to note that while all three of these subsectors fall within the stated variance goals within the QAPP, there are still significant differences between the two inventories, despite similar sources and methodologies. Specific facilities were examined and compared as part of the quality assurance process to determine if specific plants were responsible for the increase in emissions from the CMAP 2019 GHG inventory to the CCAP 2020 GHG inventory. Several facilities, such as the Lemont Refinery in Will County, Illinois, were identified as having significantly higher emissions in 2020 than 2019, as reported to the GHGRP.

Emissions from other industrial processes, such as metal and glass production were not included in the 2019 CMAP GHG inventory and thus, cannot be used for quality control. These emissions were compared to the independently gathered information from the same source and resulted in an exact match of the industrial process emissions reported in the CCAP 2020 GHG inventory.

It was difficult to find 2005 GHG inventory secondary datasets needed to fully compare the 2005 inventory, as many of the commonly used and readily available datasets do not contain 2005 emissions at the county level. As such, this inventory was recreated using the methodology noted previously in this document, which was compared to the results. The findings from this analysis are provided in Table B-27.

**Table B-28. Comparison between the 2005 inventory and the QAPP 2005 inventory results**

| Subsector | CCAP GHG Inventory (MMT $CO_2$e) for CMAP counties | CMAP 2019 GHG Inventory (MMT $CO_2$e) | Variance |
|---|---|---|---|
| Transportation | 56,052,344 | 56,052,344 | 0% |
| Residential buildings | 35,077,805 | 35,077,805 | 0% |
| Commercial buildings | 31,563,033 | 31,563,033 | 0% |
| Industry | 65,153,025 | 65,153,025 | 0% |
| Agriculture | 2,128,063 | 2,128,063 | 0% |
| Waste | 2,950,625 | 2,950,625 | 0% |
| Natural carbon sinks | -3,573,566 | -3,573,566 | 0% |

Source: CMAP, 2025.

# Appendix C: GHG reduction quantification and benefit analysis methodology

This appendix outlines the methodology used to quantify GHG emissions reductions and the co-pollutant benefits of those reductions. The methodology was developed to address all requirements of the plan, including the following:

- GHG reduction targets
- GHG emission projections
- Quantified GHG reduction strategies
- Benefits analysis

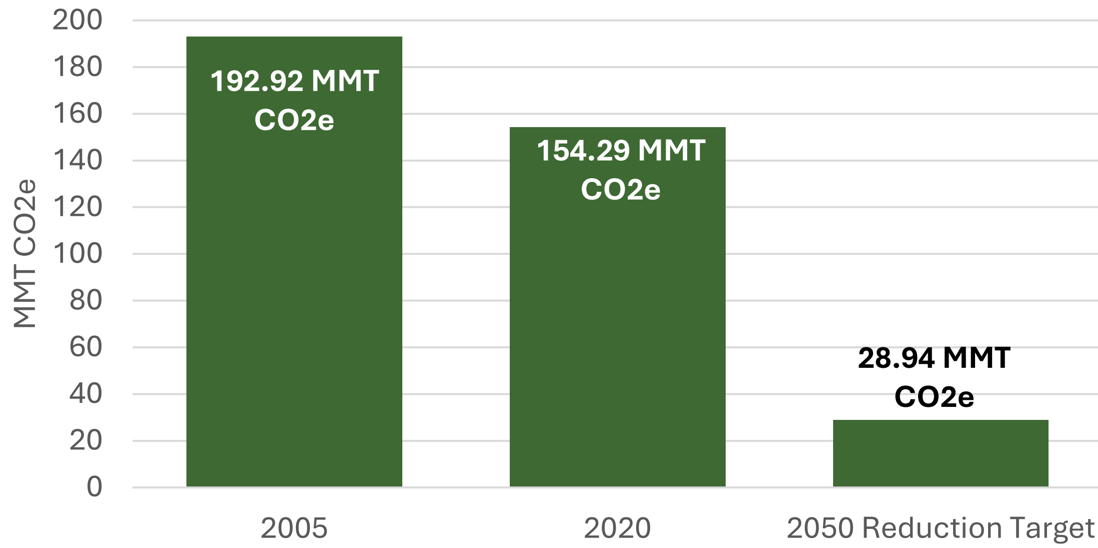
## GHG reduction targets

One of the first tasks of the planning process was to identify and define regional climate action targets that are consistent with the United States' near- and long-term commitments. The USEPA Climate Pollution Reduction Grant program requires that grantees include economywide near-term targets (2030-2035) and long-term targets (2050) in their plans. While the USEPA does not require a specific reduction target for each recipient jurisdiction, the plans "should not be inconsistent with the United States' formal commitments to reduce emissions 50-52 percent relative to 2005 levels by 2030 and to reach net-zero emissions by 2050."[22]

In October 2024, the Steering Committee set a target to achieve an economywide gross GHG reduction of 80 to 85 percent below 2005 levels by 2050. This target provides the overall context for the plan and requires strategies that address all emissions produced within the 13-county region.

To translate the reduction target into actionable amounts, the project team developed a 2005 baseline emissions inventory using USEPA's State Inventory Tool.[23] Using this baseline, an 85 percent reduction by 2050 will require emissions to decrease by 125.35 MMT $CO_2e$ between 2020 and 2050. This equates to a reduction of 4.18 MMT $CO_2e$ per year. This analysis also provides an important perspective on recent progress. Between 2005 and 2020, annual GHG emissions in the region declined by 20 percent, resulting in a total reduction of nearly 39 MMT $CO_2e$ in 2020 alone (Figure C-1).

**Figure C-1. Greenhouse gas emissions in Greater Chicago: 2005, 2020, and 2050 target**




Source: CMAP, 2025.

The Steering Committee also confirmed the approach to set sector targets. To do this, the project team calculated sectoral targets as an output of the economywide modeling rather than establishing them as an input. This approach recognizes that not all sectors will be able to decarbonize at the same rate and that some sectors will have to achieve greater reductions than others. Tables C-1 to C-3 provide the sectoral targets for both the plan implementation and state and local implementation scenarios.

**Table C-1. Sector reduction targets to achieve plan implementation**

| Sector | Emissions (MMT $CO_2e$) | | | | Reduction needed (from 2005) | |
|---|---|---|---|---|---|---|
| | 2005 | 2020 | 2035 | 2050 | 2035 | 2050 |
| Buildings | 66.64 | 53.99 | 36.54 | 3.35 | -45% | -95% |
| Transportation | 56.05 | 39.57 | 21.77 | 4.89 | -61% | -91% |
| Industry | 65.15 | 55.95 | 39.36 | 15.14 | -40% | -77% |
| Waste | 1.54 | 0.96 | 0.66 | 0.70 | -57% | -56% |
| Water and wastewater | - | 1.70 | 1.10 | 0.57 | - | - |
| Agriculture | 2.13 | 2.14 | 1.56 | 1.56 | -27% | -27% |
| *Gross emissions* | 192.92 | 154.27 | 100.48 | 26.23 | -48% | -86% |

Note: Water and wastewater emissions are included within the buildings and waste sectors in 2005 due to limited data availability for these sources.

Source: CMAP and E3, 2025.

**Table C-2. State and local sector reduction targets**

| Sector | Emissions (MMT $CO_2e$) | | | | Reduction needed | |
|---|---|---|---|---|---|---|
| | 2005 | 2020 | 2035 | 2050 | 2035 | 2050 |
| Buildings | 66.64 | 53.99 | 42.45 | 14.79 | -36% | -78% |
| Transportation | 56.05 | 39.57 | 26.59 | 20.27 | -53% | -64% |
| Industry | 65.15 | 55.95 | 49.68 | 43.96 | -24% | -33% |
| Waste | 1.54 | 0.96 | 0.66 | 0.70 | -57% | -56% |
| Water and wastewater | - | 1.70 | 1.17 | 0.70 | - | - |
| Agriculture | 2.13 | 2.14 | 1.56 | 1.56 | -27% | -27% |
| *Gross emissions* | 192.92 | 154.27 | 121.53 | 81.88 | -37% | -58% |

Note: Water and wastewater emissions are included within the buildings and waste sectors in 2005 due to limited data availability for these sources.

Source: CMAP and E3, 2025.

**Table C-3. State and local scenario emission offsets by natural carbon sequestration**

| Sector | Emissions captured (MMT $CO_2e$) | | | | Increase in emissions offset | |
|---|---|---|---|---|---|---|
| | 2005 | 2020 | 2035 | 2050 | 2035 | 2050 |
| Natural carbon sequestration | 3.57 | 2.74 | 4.15 | 6.25 | 16% | 75% |

Source: CMAP and E3, 2025.

## Considerations for GHG target setting

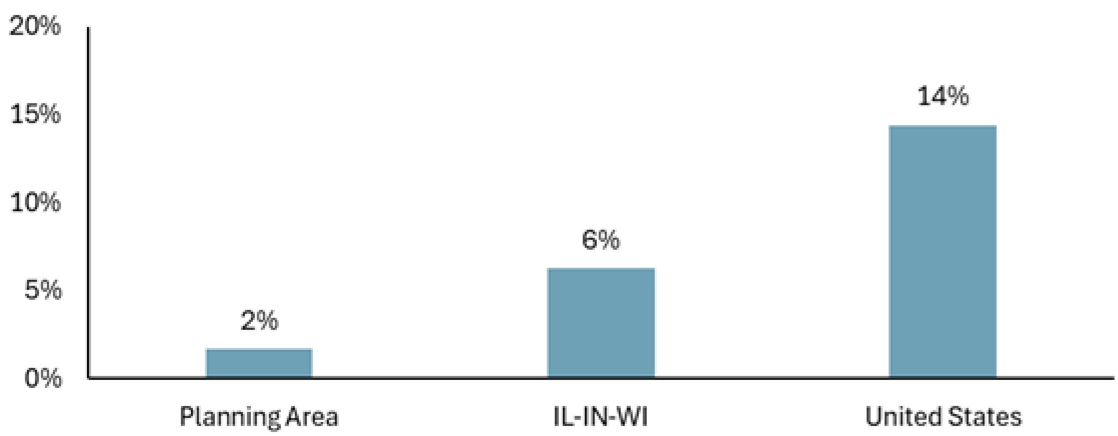
There are many factors to consider when determining if a GHG target for Greater Chicago is consistent with the U.S. reaching its economywide emissions targets.

- **All modeled scenarios where the U.S. achieves net-zero by 2050 require negative emissions to offset residual emissions that cannot be fully abated in the next 25 years, most of which come from non-fuel combustion activities.** [24] Natural carbon sinks are a critical source of negative emissions in all scenarios, and some scenarios also include geologic sequestration of captured carbon dioxide.
- **Existing natural carbon sinks are much smaller proportionally in Greater Chicago than they are in both the surrounding states and in the U.S.** (Figure C-2). According to the 2020 GHG Inventory, natural carbon sinks in the planning area offset around 2 percent of

gross GHG emissions (i.e., all GHG emissions produced within the territory, excluding negative emissions). For the three-state region (Illinois, Indiana, Wisconsin), this value is 6 percent.[25] For the U.S., natural carbon sinks offset 14 percent of gross GHG emissions in 2021.[26]

- **The potential for future negative emissions from increased natural carbon sinks or geologic carbon dioxide sequestration is low within the greater Chicago area and higher in other parts of Illinois, Indiana, and Wisconsin.** Because the planning area is mostly comprised of densely populated urban or suburban counties, there is relatively low potential for increased sequestration from natural carbon sinks like reforestation, agroforestry, or cropland carbon storage, compared to more rural counties. This is confirmed by the Naturebase database, which maps carbon dioxide sequestration potential from natural climate solutions at the county level for the entire U.S.[27] In addition, while there is significant technical potential for geologic carbon dioxide sequestration across much of Illinois and Indiana, any sequestration sites are more likely to be in more rural areas with higher land availability and lower operational costs.

**Figure C-4. Share of gross GHG emissions offset by natural carbon sinks (2020-2021)**




Sources: Data for the planning area is from CMAP, 2020 GHG Inventory, 2024. Data for state and national data is from USEPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks by State, 2022.

## Assessment and recommendation

**The project team recommended that the plan adopt an economywide target of a gross GHG reduction of 80 to 85 percent by 2050.** This means that the plan will demonstrate pathways for reducing all GHG emissions produced within the planning area, excluding negative emissions, by 80 to 85 percent as part of achieving net-zero emissions. This approach is recommended for the following reasons:

- **This target reflects the reality that a densely populated metro area is unlikely to achieve net-zero emissions within its own boundaries** and thus requires assistance from the larger national effort.

- **This target is consistent with not only CMAP and the City of Chicago's 2050 target of an 80 percent reduction, but also GHG targets for other major cities in states with ambitious climate goals.** For example, New York City has an 80 percent reduction target while the state has a net-zero target.[28]
- **This target is consistent with emissions modeling used to inform national GHG targets**. In those scenarios, gross GHG emissions for the entire U.S. are reduced between 75 to 85 percent by 2050 with the remaining 15 to25 percent of emissions reduced through carbon sequestration in other states.[29]
- After developing an economywide scenario that achieves this target for Greater Chicago, **we will be able to calculate the resulting emissions reductions targets for each sector.** strongly recommended including sectoral targets, which the Steering Committee supported. The project team proposed calculating these as an output of the economywide modeling rather than establishing them as an input. This meant that the modeling effort would inform the percent reduction for each sector as well as interim targets (e.g., the reduction the region should achieve in the next five years for the buildings sector to be on track).

# GHG emission projections

The following section details the methodology to develop GHG emissions projections, including modeling tool selection and scenario design.

## Modeling tool

Reliable technical analysis for this plan required a modeling platform capable of generating consistent, economywide GHG projections and capturing interactions across sectors. After reviewing 59 modeling tools, the project team selected the E3 Pathways model due to its ability to incorporate the GHG inventory developed for this plan, customize reduction measures to regional conditions, and model all sectors together — reducing inconsistencies that can occur when multiple tools are combined.

Developed in 2008, Pathways uses an economywide representation of technology, energy use, efficiency, and emissions to analyze decarbonization scenarios and associated costs against long-term GHG reduction targets. It has been widely applied in jurisdictions across the U.S. for long-term energy and climate planning.

A key strength of Pathways is that it is a stock rollover model, meaning it accounts for the real-world timing of equipment turnover — including sales, adoption, total stock growth, and end-of-life retirements for appliances, vehicles, buildings, and other infrastructure. This approach enables realistic projections of how quickly cleaner technologies can replace existing systems. It also captures interactions between sectors, such as how electrification of buildings and vehicles affects electricity generation needs and the role of low-carbon fuels.

It is important to note that Pathways is a scenario analysis tool, not an optimization tool. It evaluates the implications of predefined scenarios rather than identifying least-cost pathways.

Pathways produced annual outputs including device sales and stocks, capital and fuel costs, final energy demand by fuel type, and GHG emissions. These results informed downstream analyses, such as air quality modeling, public health impacts, and workforce projections.

Table C-5 provides a detailed description of modeling approaches used for each sector.

**Table C-5. Sectoral modeling in Pathways**

<table>
<tr><th>Sector</th><th>Primary subsector types</th><th>Modeling details</th><th>Default data sources</th></tr>
<tr><td>Transportation</td><td rowspan="3">Stock rollover</td><td rowspan="3">Calculates the changes in equipment stock due to the adoption of new equipment and the retirement of old equipment each year. This process accounts for the overall growth of the total stock driven by population and economic growth. The annual stock is categorized by equipment type, fuel type, equipment capital cost, efficiency level, and energy demand.<br><br>Next, the annual stock and its associated attributes are used to determine the annual energy demand by fuel type and capital costs for equipment purchases.<br><br>Finally, the energy demands are used to calculate annual emissions and fuel costs. Note: In the transportation sector, aviation and other non-road vehicles are categorized as “energy only.”</td><td>Federal Highway Administration (FHWA), Census Bureau Vehicle Inventory Use Survey (VIUS)</td></tr>
<tr><td>Residential</td><td>National Renewable Energy Laboratory (NREL) ResStock, Energy Information Agency (EIA) Residential Energy Consumption Survey (RECS), EIA National Energy Modeling System (NEMS)</td></tr>
<tr><td>Commercial</td><td>NREL ComStock, EIA Commercial Building Energy Consumption Survey (CBECS), EIA NEMS</td></tr>
<tr><td>Industrial</td><td>Energy only</td><td>Annual energy demand by fuel type and industrial subsector is calculated for the base year, with economic growth rates determining change in baseline energy demand for future years.<br><br>User can specify how much energy by fuel type and subsector is electrified, converted to hydrogen, replaced with a renewable drop-in fuel, saved through energy efficiency,</td><td>EPA Greenhouse Gas Reporting Program (GHGRP), EIA Manufacturing Energy Consumption Survey (MECS)</td></tr>
</table>

| | | | |
|---|---|---|---|
| | | or used in conjunction with carbon capture and sequestration | |
| Waste | Emissions only | Each sector accounts for emissions from non-combustion related sources such as agriculture, waste, industrial processes, and fossil fuel extraction and processing, in addition to natural carbon sinks. Emissions are tracked by source and GHG type (e.g., manure management, methane) in each sector. Pathways currently tracks four pollutant types: carbon dioxide, methane, nitrous oxide, and $CO_2e$ ($CO_2e$ used mostly for hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs)).<br><br>First, Pathways calculates the baseline emission level for each GHG type, which is then applied with a growth rate to project business-as-usual growth before applying any mitigation measures.<br><br>Next, the user can specify a percent reduction below the business-as-usual trend for each source and GHG type, along with an input for the capital costs of mitigation on a $/t$CO_2e$ basis. | EPA State-Level Non-$CO_2$ Projection and Mitigation Report |
| Wastewater | | | |
| Agriculture | | | |
| Electricity generation | Emissions only | While electricity generation is not a native component of PATHWAYS, for this analysis the project team will pair the loads from PATHWAYS with regional electricity emissions factors from the NREL 2023 Standard Scenarios to show electricity sector emissions under a range of loads and electric sector policies. | NREL 2024 Standard Scenarios |

Source: E3, 2024.

## Scenario design

To demonstrate how the region can achieve the GHG reduction targets for 2035 and 2050, the plan evaluates three complementary scenarios.

### Current policy

The current policy scenario, or business-as-usual projection, reflects state-level policies in place as of August 2025. This scenario reflects the impact of existing state-level policies, primarily Illinois' Climate and Energy Jobs Act (CEJA), and identifies the remaining emissions gap the plan needs to address. It accounts for recent federal policy changes. Based on feedback from stakeholders, several federal policies and programs — such as fuel economy and emissions standards for vehicles, federal appliance efficiency standards, and the Inflation Reduction Act — were not included given changing federal priorities.

The current policy scenario also does not capture the full extent of existing state and local programs. For example, municipal scale policies, such as benchmarking ordinances or the adoption of stretch codes enabling higher energy performance, are important to reduce local emissions but have not been modeled as part of the current policy scenario. Modeled strategies included in this scenario are detailed in Table C-5.

**Table C-6. Strategies modeled in the current policy scenario**

| Modeled strategy | Description | GHG emissions reduced, MMT $CO_2e$ (% of sector emissions) | |
|---|---|---|---|
| | | 2035 | 2050 |
| Implement the Illinois Climate and Equitable Jobs Act | Require the State of Illinois to eliminate emissions from electricity generation facilities by 2045, raise the state renewable portfolio standard to 50% by 2040, and require 100% clean energy by 2050. | 5.1 (18%) | 22.8 (79%) |
| Replace/update Imhoff tanks at Metropolitan Water Reclamation District of Greater Chicago (MWRD) facilities | Replace MWRD's Imhoff tanks with primary settling tanks and new aerated grit facilities by 2025.<br><br>The Pathways model assumes a 52% reduction in non-$CO_2$ emissions from wastewater treatment processes. | 0.3 (52%) | 0.3 (52%) |

Source: CMAP and E3, 2025.

## Implementation scenarios

This plan contains two implementation scenarios.

The **plan implementation scenario** builds on the current policy scenario to demonstrate how the region can achieve the economywide emissions reduction targets through more than 30 quantified strategies across 7 emission sectors. While natural carbon sequestration strategies were modeled, emissions reductions from carbon sinks do not count toward the 85 percent target. This scenario includes actions at the federal, state, and local levels.

The **state and local implementation scenario** models a subset of strategies from the plan implementation scenario, focusing on measures that can be led by state and local governments. These strategies draw from existing policies and programs already either established in the region or adopted in other U.S. jurisdictions. In some cases, assumptions differ slightly from those used in the plan implementation scenario, typically reflecting less aggressive implementation rates or slower timelines.

## Quantified GHG reduction strategies

The USEPA requires the plan to quantify the GHG emissions reductions associated with each implementation measure (referred to as reduction strategies or modeled strategies). The project team's approach to model GHG reduction strategies involved a combination of research, best practice, and stakeholder input to inform two runs using E3's Pathways model. The first model run occurred in spring 2025 with the final occurring in summer 2025.

All modeled strategies were evaluated both individually and as part of the combined implementation scenarios. Because many strategies interact or overlap — such as passenger EV adoption and reduced vehicle miles traveled, which both lower gasoline consumption — their individual effects can be difficult to fully isolate within a single model run. Modeling strategies independently provides directional insight into their standalone influence on emissions, while modeling them in aggregate illustrates how their impacts compound or interact when implemented together. This dual approach allowed the project team to better understand both the isolated and combined effects of each modeled strategy, even though the exact contribution of each measure within an integrated scenario cannot be cleanly separated.

To inform the model, the team first drafted a suite of decarbonization objectives and strategies for each sector. In late 2024, these objectives and strategies were vetted and refined by the building, industry, and transportation working groups and the CMAP Climate Committee for water and wastewater, waste, agriculture, and natural carbon sequestration. Using the refined list, the project team identified strategies which could both be quantified with E3's Pathways model and presented the greatest potential for reductions. When feasible, existing policy both inside and outside of the region were used to inform the modeling assumptions used for this plan. This allows the plan to be based on realistic, yet ambitious assumptions around implementation rates and timelines. The refined list of strategies informed the first model run.

In June and July of 2025, the project team convened the third and final meetings of the working groups and CMAP's Climate Committee to solicit reactions to the first model run and refine the strategies. Among the feedback received were discussions around critical strategy implementation steps, known barriers, and key actors necessary for strategy success. With this input, improved scenarios were incorporated into the second and final model run.

Appendix D has a full list of modeled strategies as well as references to the existing policy or study that was used to inform the strategies assumptions.

### Cost estimate methodology

Given the interdependencies among the plan's various reduction measures, estimating their individual costs presents significant challenges. Because transitioning the region's stock of appliances, vehicles, and equipment requires multiple, overlapping policy tools — and because many strategies interact with and are dependent upon one another — it is difficult to reliably isolate cost impacts by specific a measure. These challenges are further compounded by two additional factors. First, the costs of implementation depend on specific program designs, staffing needs, and administrative structures which are not detailed (and therefore cannot be quantified) at the current planning phase. Second, the costs of implementation vary significantly by implementing entity, and consistent reference data is not available.

Given these limitations, the plan focuses on estimating the net societal costs and benefits of the suite of measures in the state and local implementation and plan implementation scenarios relative to the current policy scenario. Pathways captured the upfront and maintenance costs of energy-consuming devices (such as space heaters and vehicles), fuel and electricity prices, and the costs of mitigating non-energy emissions. Input cost data were drawn primarily from federal and academic sources: fuel and electricity prices from the EIA Annual Energy Outlook and NREL Annual Technology Baseline; device costs from the EIA National Energy Modeling System and International Council on Clean Transportation; and non-energy mitigation costs from the USEPA State-Level Non-$CO_2$ GHG Mitigation Report.

The International Council on Clean Transportation's long-term vehicle cost projections indicate that electric vehicles are expected to reach upfront price parity with internal combustion engine vehicles in the late 2020s. When combined with lower lifetime maintenance costs, these projections contribute to modeled cost savings in the transportation sector. While EVs currently carry a price premium, the model reflects these longer-term cost declines.

The Pathways cost framework did not track internal transfers, such as state-funded incentives or administrative costs, but it did reflect the societal cost of energy and energy-consuming devices across the economy. It also did not fully account for the cost of system-level investments needed to enable certain strategies, such as expanded transit service required to support reductions in vehicle miles traveled. As these investments could be funded through separate policy mechanisms, such as road usage charges or other transportation revenue strategies, they fell outside the scope of the model.

Air quality and climate benefits were estimated using the USEPA Co-Benefits Risk Assessment (COBRA) tool (see benefits analysis section below) and the USEPA's *Report on the Social Cost of Greenhouse Gases: Incorporating Recent Scientific Advances*, respectively. In 2024, the social cost of greenhouse gases was updated to be $190 per metric ton, which provides a monetary estimate of the harm avoided for each ton of emissions reduced.

Costs and benefits were presented by sector in the Pathways results. This approach incorporated both the direct costs of implementation and the broader benefits of global climate action and improved air quality, providing a comprehensive view of net societal impacts. Full results are provided in Appendix D.

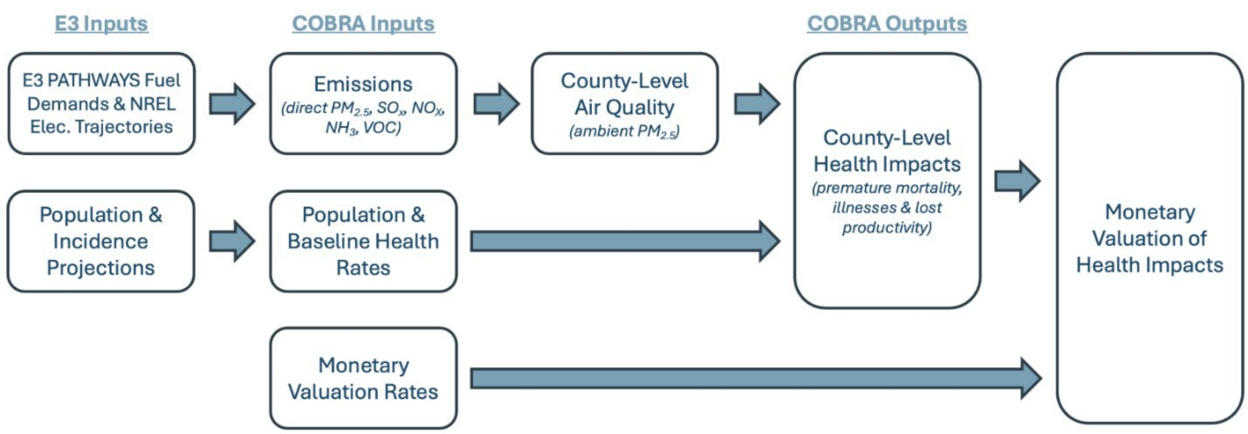
## Benefits analysis

Following the scenario and strategy-specific modeling, the project team conducted an analysis of air quality and associated public health impacts through changes in the following co-pollutants:

- Fine particulate matter (PM2.5)
- Sulfur dioxide: (SO2)
- Nitrogen oxides: (NOx)
- Ammonia: (NH3)
- Volatile organic compounds: (VOCs)

Using USEPA's COBRA screening model, the analysis estimated changes in air quality resulting from shifts in technology adoption and fuel use across sectors.[30] Key drivers influencing air pollutant levels included increased electric vehicles adoption, improvements in EV battery technologies that enable longer driving ranges and faster charging, and reductions in the emissions intensity of fuels. Figure C-7 illustrates the workflow used to translate these technology and fuel changes into estimated co-pollutant and health impacts.

**Figure C-7. Co-pollutant health impact methodology workflow**




Source: E3, 2024.

The project team used Pathways to estimate future changes in emissions of pollutants that COBRA uses to model health impacts. COBRA ultimately estimated changes in PM2.5 concentrations, but it required inputs for multiple pollutants: directly emitted (primary) PM2.5 as well as precursors that form secondary PM2.5 in the atmosphere (sulfur dioxide, nitrogen oxides, ammonia, and volatile organic compounds). COBRA provided a 2023 baseline emissions dataset at the county and emissions-category level, which the project team modified to reflect modeled scenarios before running the analysis.

For non-electricity fuel combustion emissions, the project team mapped COBRA emissions categories to Pathways' sector-fuel demands and scaled 2023 COBRA emissions using the ratio of Pathways fuel consumption in each future year relative to 2023. For electricity-sector emissions, given the absence of detailed electric-sector modeling in this project, the project team applied reductions using the National Renewable Energy Laboratory's (NREL) Standard Scenarios, which provide annual state-level forecasts for emissions coal, gas, and oil generation.[31]

Emissions from non-combustion sources were held constant at 2023 levels due to insufficient information to adjust them in future years. These include industrial processes and manufacturing, solvent utilization, waste disposal and recycling, agriculture and forestry, and dust and fires.

Using these adjusted emissions forecasts, the project team ran COBRA for each scenario to estimate county-level changes in PM2.5 concentrations and population exposure, associated changes in premature mortality and other health outcomes, and the monetarized value of those impacts. In addition to premature mortality, COBRA estimates included outcomes such as respiratory hospital admissions, emergency room visits, respiratory impacts, non-fatal heart attacks, and lost workdays, among others.[32]

## Air quality benefits

The strategies outlined in this plan would reduce pollutants and improve air quality across Greater Chicago. In the current policy scenario, reductions in PM2.5, nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), ammonia ($NH_3$), and volatile organic compounds (VOCs) by 2050 are modest, ranging from 0.5 percent to 4 percent (Table C-8), continuing the slow progress we have seen in recent years.

**Table C-8. Business as usual scenario criteria air pollutant reductions by year**

| Pollutant | 2035 | 2050 |
|---|---|---|
| Fine particulate matter (PM2.5) | -1% | -2% |
| Sulfur dioxide (SO2) | 0% | 0% |
| Nitrogen oxides (NOx) | -1% | -3% |
| Volatile organic compounds (VOCs) | -3% | -4% |

Source: CMAP and E3, 2025.

In the plan implementation scenario, reductions become more significant as major emissions sources fully transition to clean energy (Table C-9). In 2035, the region sees 5.9 to nearly 20 percent reductions in all modeled pollutants. By 2050, regional nitrogen dioxide, sulfur dioxide, and ammonia see the largest decreases, ranging from 34 percent to 58.7 percent, and PM2.5 and VOCs decrease by 16.5 and 14.2 percent respectively.

**Table C-9. Plan implementation scenario criteria air pollutant reductions by year**

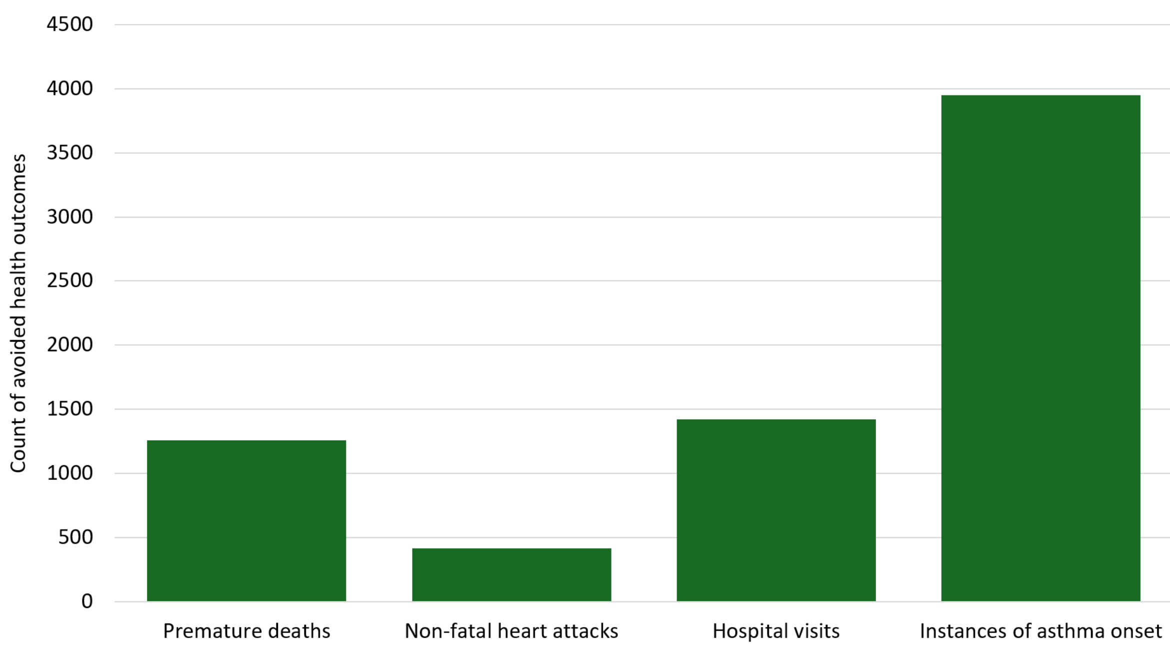
| Pollutant | 2035 | 2050 |
|---|---|---|
| Fine particulate matter (PM2.5) | -6% | -17% |
| Sulfur dioxide (SO2) | -17% | -59% |
| Nitrogen oxides (NOx) | -19% | -48% |
| Volatile organic compounds (VOCs) | -8% | -14% |

Source: CMAP and E3, 2025.

## Public health benefits

Implementing the strategies in this plan would significantly improve regional air quality, public health, and economic wellbeing (Figure C-10). Under the plan implementation scenario, the region could avoid on average 1,250 premature deaths each year from PM2.5 and ozone exposure, saving an estimated $2.3 to $3.6 billion annually in health care costs and lost productivity (Table C-11). Nearly 4,000 new asthma cases, more than 400 non-fatal heart attacks, and 1,500 pollution-related emergency room visits could also be prevented each year. Altogether, the plan could avert over one million pollution-related health events across Greater Chicago each year. Additional public health benefits, such as those from increased active transportation, could occur but are not included in the model. Improved air quality, safer outdoor environments, and greater access to green and natural spaces can also reduce stress and anxiety, support mental well-being, and strengthen community health.

**Figure C-10. Annual avoided health outcomes in 2050 under the plan implementation scenario**




Source: CMAP and E3, 2025.

**Table C-11. Public health benefits gained under plan implementation relative to current policy (billions of dollars)**

| Scenario | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|
| State and local | $0.02 | $0.67 | $1.22 | $1.66 | $2.04 | $2.33 |
| Plan implementation | $0.02 | $0.69 | $1.54 | $2.31 | $3.01 | $3.62 |

Source: CMAP and E3, 2025.

# Appendix D: Modeled strategies

This appendix summarizes information required for the full suite of implementation measures that have been identified to meet the plan's GHG reduction targets. Referred to as modeled strategies, these measures address the main GHG emission sectors: energy generation, industry, commercial and residential buildings, transportation, waste, water and wastewater, agriculture, and natural carbon sequestration.

Table D-1 provides information to satisfy the requirements of the CPRG program. These requirements include:

- Quantifiable GHG emissions reductions (or enhancement of carbon sinks)
- Key implementing agency or agencies
- Implementation schedule and milestones
- Expected geographic location, if applicable
- Milestones for obtaining implementation authority, as appropriate
- Identification of funding sources, if relevant
- Metrics for tracking progress

Many of these components are subject to change, especially funding opportunities; this summary reflects best available information as of November 2025.

## Cost estimates

The plan provides a clear picture of the overall net societal costs and benefits associated with both the plan implementation and state and local implementation scenarios relative to the current policy scenario. This high-level assessment captures how the full package of modeled strategies influences energy use, equipment and infrastructure investments, and the broad health and climate benefits expected across the region. These results offer a meaningful understanding of the economic implications of plan implementation.

Many strategies overlap or interact, and future program designs, staffing needs, and administrative structures remain undefined. As a result, the plan reports combined economywide and sector impacts rather than isolating costs for specific modeled strategies. For more details on the methodology, see Appendix C.

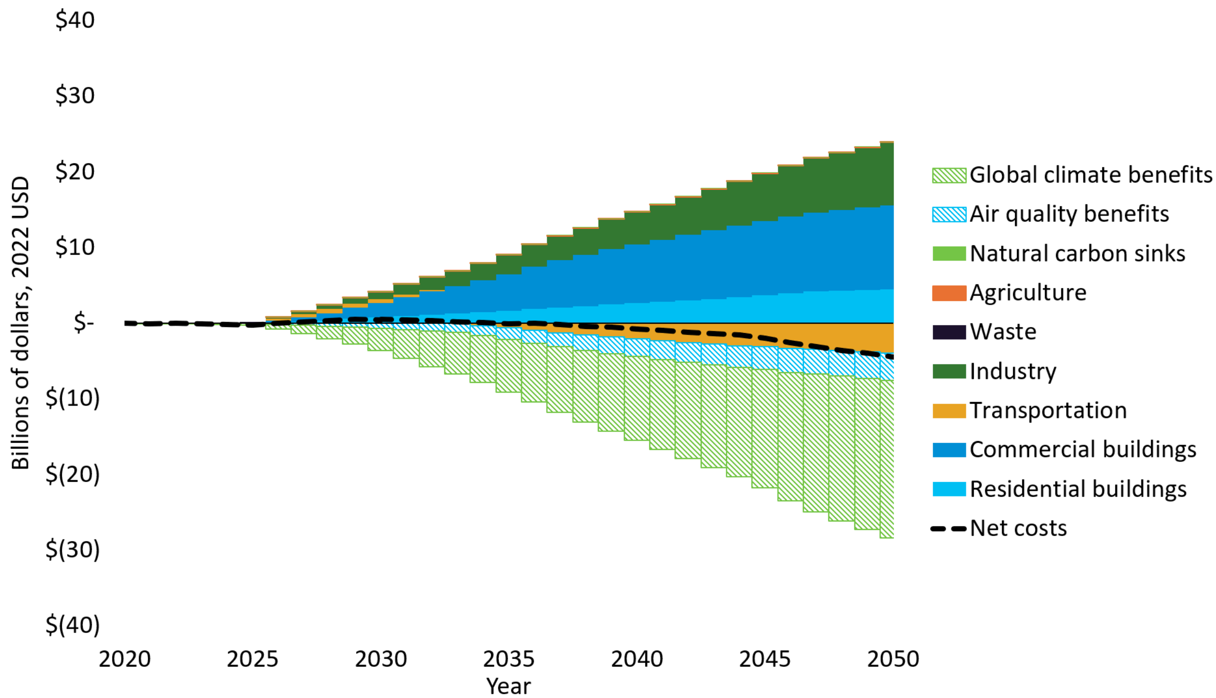
In the plan implementation scenario, significant investments are needed to transition to a clean energy future. Figure D-1 estimates a total investment of $24 billion needed by 2050, with the largest needs in commercial and residential buildings and industrial facilities. Transportation actions, by contrast, could generate cost savings; however, due to modeling limitations, the full investment needed to achieve reductions in vehicle miles traveled is not fully captured in the model results. A portion of these transportation-related savings reflect long-term projections that electric vehicles will reach upfront cost parity with gasoline vehicles in the late 2020s, combined with lower lifetime maintenance costs, consistent with forecasts from the International Council on Clean Transportation.

When these investment needs are combined with the plan's public health and air quality benefits (approximately $4 billion) and the larger climate benefits (approximately $21 billion), the overall net costs of plan implementation is a net savings of $4 billion by 2050. The climate benefits represent the avoided global damages from reducing greenhouse gas emissions, including avoided property losses, agricultural impacts, ecosystem damages, and other climate-related costs. These values are calculated using the federal Social Cost of Greenhouse Gases, updated in 2024 to $190 per metric ton, which provides a monetary estimate of the harm avoided for each ton of emissions reduced.

In the state and local implementation scenario, significant investments are needed to transition to a clean energy future. Figure D-2 estimates a total investment of $13 billion needed by 2050, with the largest needs in commercial and residential buildings. Transportation actions, as in the plan implementation scenario, appear as a net savings; however, the model does not fully capture the investments required to support VMT reductions. These savings are again influenced by long-term EV cost projections that show electric vehicles becoming less expensive to purchase and maintain than gasoline vehicles over the coming decades**.**

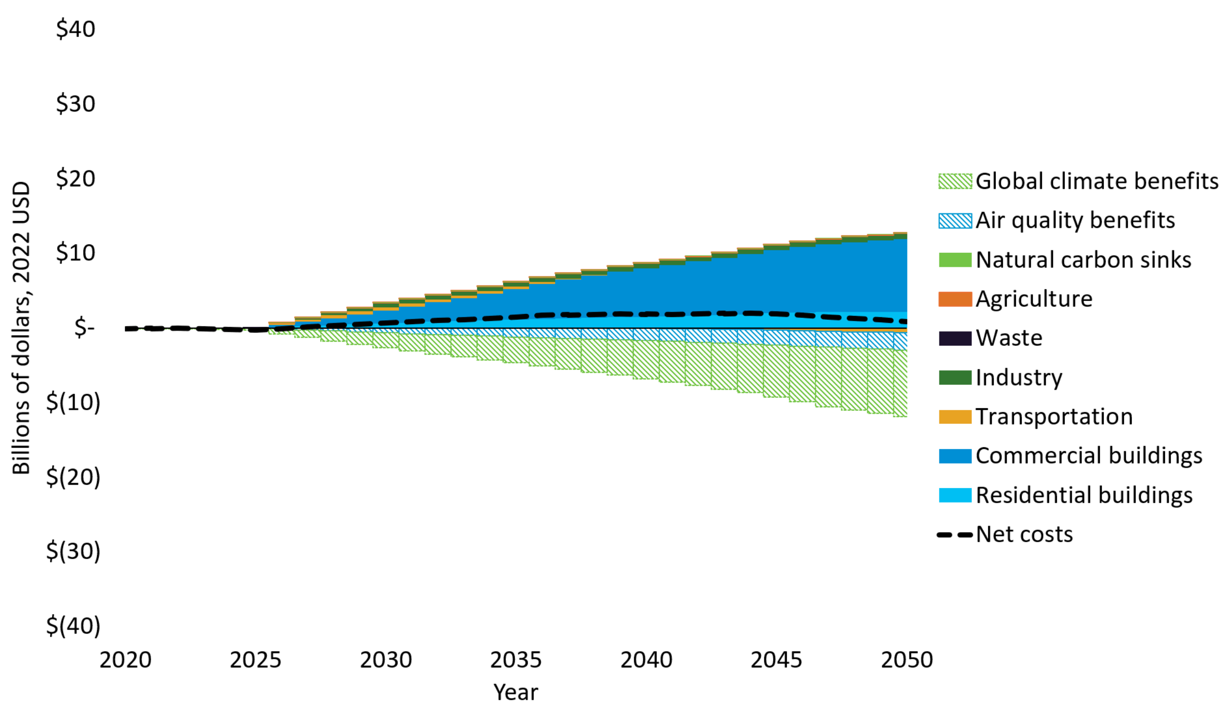
Unlike the full plan implementation scenario, however, the state and local implementation scenario includes only the strategies that state and local governments can advance without new federal policy. As a result, fewer emissions are reduced and fewer benefits are realized, while many of the same building and infrastructure investments are still required. This leaves the region with a modest net cost—about $1 billion—representing the net societal cost of implementing only state and local actions. When these investment needs are combined with the plan's public health and air quality benefits (approximately $2 billion) and the global climate benefits (approximately $9 billion), the overall net costs of state and local implementation is $1 billion by 2050.

**Figure D-1. Societal costs and benefits of the plan implementation scenario relative to the current policy scenario, (billions of dollars, 2022 USD)**




Source: CMAP and E3, 2025.

**Figure D-2. Societal costs and benefits of the state and local implementation scenario relative to the current policy scenario, (billions of dollars, 2022 USD)**




Source: CMAP and E3, 2025.

**Table D-1. Modeled strategies by sector and emissions reductions scenarios**

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><td colspan="5">Energy generation</td></tr>
<tr><td rowspan="11">Adopt clean electricity standards</td><td rowspan="11">Adopt standards that reduce electricity generation emissions in IN and WI until they reach 95% below 2005 levels, approximately achieving a 98% clean electricity standard by 2050.<br><br>The Pathways model assumes clean electricity aligns with clean energy, referring to both renewable and nuclear energy sources.</td><td colspan="2">Scenario</td><td>Plan implementation</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Indiana and Wisconsin</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 6.1 MMT $CO_2e$</td></tr>
<tr><td>2050: 5.8 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>National Renewable Energy Laboratory (NREL) 2024 Standard Scenarios</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: Clean Electricity Production Tax Credit, Clean Electricity Investment Tax Credit<br><u>States of IN and WI</u>: Utility ratepayer funds, state financing</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>State of WI</td></tr>
<tr><td>Authority needed</td><td>State of IN</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>Passage of state legislation authorizing Indiana Dept. of Environmental Management and the Environmental Rules Board to put more stringent limits on emissions from electricity generation than federal requirements; passage of state legislation authorizing Indiana Utility Regulatory Commission to establish a clean energy portfolio standard program</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Annual electricity generation GHG emissions reductions overtime; share of clean electricity generated as a percentage of total energy generation</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Energy generation (continued)</th></tr>
<tr><td rowspan="11">Adopt a clean heat standard</td><td rowspan="11">Adopt a clean heat standard that requires gas utilities to reduce natural gas emissions by 22% by 2035.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 5.5 MMT $CO_2e$</td></tr>
<tr><td>2050: 12.0 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>Colorado’s clean heat standards program (SB 21-264)</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: Clean Electricity Production Tax Credit, Clean Electricity Investment Tax Credit<br><u>States</u>: Utility ratepayer investments</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States of IL and WI</td></tr>
<tr><td>Authority needed</td><td>State of IN</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>Passage of state legislation authorizing Indiana Utility Regulatory Commission or Indiana Dept. of Environmental Management to adopt and enforce emission reduction requirements on natural gas utilities; completion of the rulemaking process (including public hearing, commission adoption; approval by the attorney general and governor)</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Annual reductions in natural gas emissions; number of clean heat plans approved; number of clean heat programs and/or related installations (e.g., heat pumps, weatherization improvements, geothermal systems)</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Energy generation (continued)</th></tr>
<tr><td rowspan="11">Adopt renewable natural gas (RNG) for industry use</td><td rowspan="11">Limit the region's use renewable natural gas from waste feedstocks in industrial facilities to 45 Tbtu annually (trillion British thermal units) by 2050.</td><td colspan="2">Scenario</td><td>Plan implementation</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 0.6 MMT $CO_2e$</td></tr>
<tr><td>2050: 2.4 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>2022 Illinois Decarbonization Study (prepared by E3)</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: Renewable Fuel Standard, which creates a market through use of tradeable renewable identification numbers; U.S. Department of Energy State Energy Program; Clean Electricity Investment Tax Credit<br><u>States</u>: None (market-based)</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States of IL and WI</td></tr>
<tr><td>Authority needed</td><td>State of IN</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>Passage of state legislation authorizing Indiana Dept. of Environmental Management to regulate the use of RNG; issuance of new regulations; creation of the caps/limits on RNG; adjustment of air quality permitting rules</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Annual RNG consumed in Tbtu; total RNG product in Tbtu; share of RNG to region's total gas supply</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><td colspan="5">Industry</td></tr>
<tr><td rowspan="10">Establish facility emissions standards</td><td rowspan="10">Establish statewide facility-level emissions standards for manufacturing facilities, requiring energy-intensive, “trade-exposed” industries (e.g., cement, iron, steel) to reduce emissions by 5% by 2030 and other manufacturing facilities reduce emissions by 20% by 2030. The Pathways model assumes standards are achieved through the implementation of technologically feasible and cost-effective reduction measures on-site.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 3.3 MMT $CO_2e$</td></tr>
<tr><td>2050: 3.5 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>Colorado Greenhouse Gas Emissions and Energy Management for Manufacturing program</td></tr>
<tr><td colspan="2">Funding sources</td><td>N/A</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States of IL and WI</td></tr>
<tr><td>Authority needed</td><td>State of IN</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>Revocation of Indiana Governor Executive Order 25-38 or adoption of overriding legislation; granting Indiana Dept. of Environmental Management (IDEM) the authority to establish and enforce emissions standards; IDEM establishment of facility emissions regulations; integration of regulation into the state's State Implementation Plan (SIP); review and approval of SIP by U.S. Environmental Protection Agency (USEPA)</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Facility emissions reductions; air pollutant reductions (NOx and SO2) share of facilities using low-zero emissions technologies; number of approved GHG reduction plans</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Industry (continued)</th></tr>
<tr><td rowspan="10">Increase manufacturing energy efficiency</td><td rowspan="10">Invest in manufacturing energy efficiency standards, supported by technical assistance, R&D, risk sharing, and incentives, to cut manufacturing energy demand by 15% by 2050.</td><td colspan="2">Scenario</td><td>Plan implementation</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 4.27 MMT $CO_2$e</td></tr>
<tr><td>2050: 4.32 MMT $CO_2$e</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>2019 American Council for an Energy-Efficient Economy report, Halfway There: Energy Efficiency Can Cut Energy Use and Greenhouse Gas Emissions in Half by 2050</td></tr>
<tr><td colspan="2">Funding sources</td><td>Federal: U.S. Dept. of Energy Industrial Training and Assessment Centers Implementation Grant and Office of Energy Efficiency and Renewable Energy competitive funding opportunities; USEPA Greenhouse Gas Reduction Fund; National Science Foundation Advanced Manufacturing Seed Fund, Clean Energy Tax credits; U.S. Dept. of Agriculture Rural Energy for America Program.<br>Illinois: ComEd Energy Efficiency Program, ComEd and Nicor Gas on-bill financing, Illinois Municipal Electric Agency; Illinois Finance Authority Energy Efficiency Revolving Loan Fund; IEPA Climate Pollution Reduction Grant (CPRG) Clean Industry concierge; IEPA CPRG Fluorinated Gas Reduction program; Illinois Manufacturing Excellence Center (IMEC) Made in Illinois Grant Program<br>Indiana: NIPSCO Retro-Commissioning Incentives; Indiana Energy Efficiency Fund; Indiana Energy Independence Fund financing<br>Wisconsin: Wisconsin Economic Development Corporation Green Innovation Fund; Public Service Commission (PSC) Energy Innovation Grant Program</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>U.S. federal government</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Shifts in manufacturing energy demand; number of facilities receiving technical assistance through a strategic energy management program; number of facilities receiving technical assistance, research and development assistance, and/or incentives from the federal government</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Industry (continued)</th></tr>
<tr><td rowspan="10">Require net-zero iron and steel production</td><td rowspan="10">Require all iron and steel production to be net-zero emissions by 2050 by replacing blast furnace-basic oxygen furnaces with hydrogen-based direct reduced iron technology with electric arc furnaces (H2-DRI-EAF).<br><br>While other technologies could potentially be used to decarbonize iron and steel production (e.g., carbon capture and sequestration), H2-DRI was chosen due to the significant air quality and health benefits it provides.</td><td colspan="2">Scenario</td><td>Plan implementation</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 6.4 MMT $CO_2e$</td></tr>
<tr><td>2050: 23.3 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>U.S. Steel and Cleveland-Cliffs 2050 net-zero GHG emissions targets</td></tr>
<tr><td colspan="2">Funding sources</td><td>Federal: Section 45V Clean Hydrogen Production tax credit<br>Illinois: "Zero-carbon" hydrogen tax credit for 2026 and 2027; Illinois Reimagining Energy and Vehicles tax credit<br>Other: Climate Policy Initiative's Financing Steel Decarbonization Financing Facility and Steel Decarbonization Initiative</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>Iron and steel manufacturing entities</td></tr>
<tr><td>Authority needed</td><td>U.S. federal government</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>Passage of federal legislation authorizing the establishment of GHG emissions performance standards for iron and steel manufacturing, or mandate the transition to net-zero by 2050; followed by rulemaking, codification, implementation and enforcement</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Emissions intensity of manufacture steel; share of hydrogen-based direct reduced iron (H2-DRI) produced</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Industry (continued)</th></tr>
<tr><td rowspan="11">Establish State Buy Clean Programs for cement and steel</td><td rowspan="11">Establish state Buy Clean program to set emissions intensity requirements for cement and steel used in publicly funded construction projects.<br><br>The Pathways model uses a national estimate of steel and cement materials in public procurements to estimate the share of local production of these materials going into public projects. The model also assumes steel emissions reductions will reach 7% and cement reductions will reach 23% by 2050.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 0.8 MMT $CO_2e$</td></tr>
<tr><td>2050: 1.9 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>Council on Environmental Quality Net-zero emissions procurement by 2050</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: Section 45Q Tax Credit for Carbon Sequestration; Low Carbon Transportation Materials Program (available until September 30, 2026)<br><u>Illinois</u>: None<br><u>Indiana</u>: None<br><u>Wisconsin</u>: None</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States (IL, WI, IN)</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Emissions intensity benchmarks; share of budget allocated to "buy clean" material in state procurement budget</td></tr>
</table>

| Modeled strategy | Description | | | |
|---|---|---|---|---|
| **Industry (continued)** | | | | |
| Require net-zero cement production | Require net-zero cement production by 2050, achieved using low-carbon cement alternatives, shifts in the fuel used in production, and/or carbon capture and storage. | Scenario | | Plan implementation |
| | | Expected geographic location | | Full planning area |
| | | GHG emissions reduction from current policy scenario | | 2035: 0.1 MMT $CO_2e$ |
| | | | | 2050: 0.3 MMT $CO_2e$ |
| | | Reference policy/program | | California SB 596 |
| | | Funding sources | | Federal: Section 45Q Tax Credit for Carbon Sequestration; Low Carbon Transportation Materials Program (available until September 30, 2026)<br>Illinois: Illinois Reimagining Energy and Vehicles tax credit<br>Indiana: None<br>Wisconsin: Wisconsin Economic Development Corporation (WEDC) Technology Development Loans |
| | | Key implementing agency | Existing authority | States (IL, WI, IN) |
| | | | Authority needed | N/A |
| | | Milestones for obtaining implementation authority | | N/A |
| | | Metrics for tracking progress | | Emissions intensity benchmarks for cement; GHG emissions from cement used; volume of low-carbon/alternative cements use; technology (e.g., retrofits, alternative fuels, CCS use) deployment metrics; procurement metrics; air quality and community health metrics |

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Industry (continued)</th></tr>
<tr><td rowspan="11">Electrify low-temperature processes</td><td rowspan="11">Electrify low-temperature processes (i.e., existing process heating, boilers, and combined heat and power generation using natural gas to produce heat below 140 degrees Celsius) by 2050 using equipment emissions standards, technical assistance, and financial incentives; model assumes all thermal energy used to produce heat below 140 degrees Celsius is electrified by 2050.</td><td colspan="2">Scenario</td><td>Plan implementation</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 2.6 MMT $CO_2e$</td></tr>
<tr><td>2050: 5.6 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>National Renewable Energy Lab manufacturing thermal energy use data</td></tr>
<tr><td colspan="2">Funding sources</td><td>Federal: 179D Energy Efficient Commercial Buildings Tax Deduction (expiring June 30, 2026)<br>Illinois: IL Advancing Innovative Manufacturing (AIM) tax credit; IMEC Made in Illinois Grant Program; IEPA Climate Pollution Reduction Grant Clean Industry concierge; Commercial Property Assessed Clean Energy (C-PACE) financing<br>Indiana: NIPSCO Prescriptive Incentive Program; Indiana Energy Efficiency Fund; Indiana Energy Independence Fund financing<br>Wisconsin: WEDC Green Innovation Fund; Public Service Commission (PSC) Energy Innovation Grant Program</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>U.S. federal government; IL; manufacturers</td></tr>
<tr><td>Authority needed</td><td>States (IL, WI, IN)</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>For equipment emission standards: Passage of state legislation granting agency/entity authority to set requirements; definition of industries, processes, temperature ranges to be electrified; starting the rulemaking processes; gathering public input; completing an economic impact analysis; establishing compliance pathways</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Sales share of new electric equipment; number of facilities accepting technical assistance; annual total amount of incentives provided; total number of facilities in compliance with equipment standards; number incentives received/spent on low-temperature equipment electrification</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Industry (continued)</th></tr>
<tr><td rowspan="10">OPTIONAL - Implement Carbon capture and storage (CCS) for cement and petroleum refineries</td><td rowspan="10">Apply CCS technologies to industries (e.g., cement and petroleum refineries) that would continue to have significant process emissions remaining by 2050, resulting in a 40% reduction in emissions from refineries and a 100% reduction in emissions from cement production by 2050.<br><br>Model assumes CSS is applied to 100% of remaining cement emissions and 30% of remaining petroleum refining emissions.</td><td colspan="2">Scenario</td><td>Plan implementation</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 1.0 MMT $CO_2$e</td></tr>
<tr><td>2050: 2.6 MMT $CO_2$e</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>California SB 596; U.S. Department of Energy Pathways to Commercial Liftoff: Decarbonizing Chemicals and Refining report</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: Section 45Q Tax Credit for Carbon Sequestration<br><u>Illinois</u>: CCS operator fees (per the IL Safe CCS Act)<br><u>Indiana</u>: None<br><u>Wisconsin</u>: None</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>U.S. federal government; states (IL, WI, IN)</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Reductions in cement emissions; reduction in petroleum refining emissions; total $CO_2$e captured</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><td colspan="5">Commercial and residential buildings</td></tr>
<tr><td rowspan="10">Build denser homes to reduce energy demand</td><td rowspan="10">Expand investments, incentives, and policies supporting smaller, denser development patterns, increasing the share of new multi-family and attached single-family (townhouses) from 47% (current levels) to 71% starting in 2026.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 0.3 MMT $CO_2e$</td></tr>
<tr><td>2050: 0.5 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>Socioeconomic forecasting in the greater Chicago region</td></tr>
<tr><td colspan="2">Funding sources</td><td>Federal: U.S. Dept. of Housing and Urban Development (HUD) Community Development Block Grant (CDBG); HUD HOME Investment Partnerships Program<br>Illinois: Illinois Dept. of Commerce and Economic Opportunity Rebuild Illinois Programs; Illinois Low Income Housing Tax Credit; Illinois Property Tax Incentive for Affordable Rental Housing incentive; Chicago Metropolitan Agency for Planning Technical Assistance Program<br>Indiana: Indiana Regional Acceleration and Development Initiative Program; Residential Infrastructure Fund; Indiana Affordable Housing and Community Development Fund; Indiana Owner Occupied Rehabilitation Grant Program<br>Wisconsin: Wisconsin Economic Development Corporation Community Development Investment Grant Program; Wisconsin CDBG – Small Cities Housing Program</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>Local government entities (e.g., municipalities, counties, plan commissions)</td></tr>
<tr><td>Authority needed</td><td>States (for statewide land use policies)</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>Passage of legislated land use changes at state level; establishing the implementing body and administrative rules; ensuring conformance at local level; engagement in enforcement and monitoring; amendments as needed</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Annual share of multifamily and attached single-family homes; dwelling units per acre/hectare (as net/gross density)</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Commercial and residential buildings (continued)</th></tr>
<tr><td rowspan="11">Adopt all-electric new construction requirements</td><td rowspan="11">Require that all new construction homes are all-electric starting in 2027. The Pathways model assumes all heat pumps installed are to be all-electric cold climate air source heat pumps.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 1.3 MMT $CO_2e$</td></tr>
<tr><td>2050: 4.0 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>N/A</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: 45L Tax Credit for builders of new energy-efficient homes (expiring June 30, 2026); Fannie Mae Green Financing Loans<br><u>Illinois</u>: Commercial Property Assessed Clean Energy (C-PACE) financing (only available for multifamily buildings (5+ units)); IEPA Climate Pollution Reduction Grant stretch code adoption technical assistance; Clean and Reliable Grid Act (CRGA) geothermal funding<br><u>Indiana</u>: NIPSCO's Small Business Direct Install Program<br><u>Wisconsin</u>: PACE Wisconsin program (only available for multifamily buildings (5+ units)); Focus on Energy residential rebates and incentives (New Home Certification program)</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>Municipalities in IL and WI; states (IL, WI, IN)</td></tr>
<tr><td>Authority needed</td><td>Municipalities in IN</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>Passage of Indiana state legislation that repeals statewide preemption law banning local fuel mandates and allows local jurisdictions to adopt building codes that are more stringent than the adopted state codes</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Share of planning area's municipalities and/or states adopting standards; number of buildings passing inspections under new requirements</td></tr>
</table>

| Modeled strategy | Description | | | |
|---|---|---|---|---|
| **Commercial and residential buildings (continued)** | | | | |
| Adopt building performance standards | Require existing commercial and residential multi-family buildings over 50,000 square feet (approximately 120,500 units) to reduce emissions by 20% by 2035, and buildings larger than 25,000 square feet (approximately 361,000 units) to reduce emissions by 80% by 2050. | Scenario | | State and local |
| | | Expected geographic location | | Full planning area |
| | | GHG emissions reduction from current policy scenario | | 2035: 4.8 MMT $CO_2e$ |
| | | | | 2050: 16.1 MMT $CO_2e$ |
| | | Reference policy/program | | Colorado Building Performance Colorado program |
| | | Funding sources | | Federal: None<br>Illinois: Commercial Property Assessed Clean Energy (C-PACE) financing; Green bank financing (e.g., Coalition for Green Capital (CGC)); Power Purchase Agreements (PPAs); Energy Services Agreements (ESAs); program implementation funds (e.g., fees for non-compliance); Illinois Climate Bank Energy Efficiency Revolving Loan Fund; IEPA Energy Efficiency Trust Fund Grant Program; IEPA Climate Pollution Reduction Grant stretch code adoption technical assistance; CRGA geothermal funding<br>Indiana: Indiana Home Appliance Rebate program; NIPSCO Custom Incentives Program; Indiana Energy Efficiency Fund; Green bank financing (e.g., CGC); PPAs; ESAs; program implementation funds (e.g., fees for non-compliance)<br>Wisconsin: PACE financing; Green bank financing (e.g., CGC); PPAs; ESAs; program implementation funds (e.g., fees for non-compliance); Focus on Energy residential and business rebates and incentives |
| | | Key implementing agency | Existing authority | Municipalities in IL and WI; states (IL, WI, IN) |
| | | | Authority needed | Municipalities in IN |
| | | Milestones for obtaining implementation authority | | Passage of Indiana state legislation that allows local governments to adopt building codes that are more stringent than the adopted state codes |
| | | Metrics for tracking progress | | Reduction in buildings emissions; share of eligible buildings meeting performance standards; average change of energy use intensity of covered buildings |

| Modeled strategy | Description | | | |
|---|---|---|---|---|
| **Commercial and residential buildings (continued)** | | | | |
| Fully electrify buildings | Establish energy efficiency standards, accelerating the sales of all-electric appliances for space heating, water heating, cooking, and clothes drying, until they reach 100% by 2035.<br><br>Sales shares for heat pumps and other electric technologies (e.g., electric cooktops and clothes dryers) are aligned with the state and local portion through 2027, then interpolated to 100% by 2035 based on assumptions outlined in the referenced reports. | Scenario | | Plan implementation |
| | | Expected geographic location | | Full planning area |
| | | GHG emissions reduction from current policy scenario | | 2035: 10.1 MMT $CO_2e$ |
| | | | | 2050: 32.4 MMT $CO_2e$ |
| | | Reference policy/program | | 2024 University of Maryland U.S. Climate Pathways for 2035 with Strong Non-Federal Leadership report; 2022 E3 Illinois Decarbonization Study: residential and commercial electrification rates |
| | | Funding sources | | Federal: Energy-Efficient New Homes Tax Credit for Home Builders (expiring June 30, 2026);<br>Illinois: Illinois Climate Bank Energy Efficiency Revolving Loan Fund; Illinois Environmental Protection Agency (IEPA), Energy Efficiency Trust Fund Grant Program, IEPA CPRG Whole-Building Electrification incentives, low-cost equitable bridge loans, large building owner technical assistance; C-PACE financing (only available for commercial, industrial, and multifamily buildings (5+ units)); IEPA CPRG stretch code adoption technical assistance; CRGA geothermal funding<br>Indiana: Indiana Home Appliance Rebate program; NIPSCO Custom Incentives Program; Indiana Energy Independence Fund<br>Wisconsin: PACE Wisconsin program (only available for commercial, industrial, and multifamily buildings (5+ units)); Focus on Energy residential and business rebates and incentives |
| | | Key implementing agency | Existing authority | Federal (Dept. of Energy); consumers; appliance designers and manufacturers |
| | | | Authority needed | States (IL, WI, IN) |
| | | Milestones for obtaining implementation authority | | Passage of state legislation granting state authority to set efficiency standards and/or initiation of rulemaking process; gathering public input; completing a technical and economic analysis of efficiency levels; draft standards; state adoption of standards; monitoring and enforcement of standards as needed |
| | | Metrics for tracking progress | | Annual sales share for heat pumps and other electric technologies; annual number of all-electric buildings |

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Commercial and residential buildings (continued)</th></tr>
<tr><td rowspan="10">Establish a heat pump incentives program</td><td rowspan="10">Provide $10,000 to $16,000 incentives for the installation of heat pumps for space and water heating that cover the majority of the home’s heating load.<br><br>The Pathways model assumes over 3.5 million heat pumps will be installed by 2050 across all strategies (including efficient and all-electric building codes, building performance standards, and incentive programs) to modernize heating systems. This is equivalent to nearly 150,000 heat pumps sold annually.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 1.3 MMT $CO_2e$</td></tr>
<tr><td>2050: 3.3 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>Massachusetts Mass Save 2025-2027 program</td></tr>
<tr><td colspan="2">Funding sources</td><td>Federal: None<br>Illinois: ComEd heat pump rebates; philanthropic funding, Illinois-based HOMES and HEAR rebate programs (pending funding)<br>Indiana: Indiana Home Appliance Rebate program; philanthropic funding<br>Wisconsin: Focus on Energy residential rebates and incentives (heat pumps discounts; geothermal heat pump rebates); philanthropic funding</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States (IL, WI, IN); public utility regulatory entities; public electricity and gas utilities</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Number of installed heat pumps; incentive dollars dispersed vs. total budgeted; number of participating customers, contractors, and distributors over time</td></tr>
</table>

| Modeled strategy | Description | | | |
|---|---|---|---|---|
| **Commercial and residential buildings (continued)** | | | | |
| Weatherize buildings | Retrofit 50% of existing residential buildings and 72% of commercial buildings with building envelope (weatherization) upgrades by 2050. | Scenario | | Plan implementation |
| | | Expected geographic location | | Full planning area |
| | | GHG emissions reduction from current policy scenario | | 2035: 1.0 MMT $CO_2e$ |
| | | | | 2050: 3.7 MMT $CO_2e$ |
| | | Reference policy/program | | 2019 American Council for an Energy-Efficient Economy report, Halfway There: Energy Efficiency Can Cut Energy Use and Greenhouse Gas Emissions in Half by 2050 |
| | | Funding sources | | Federal: U.S. Dept. of Health and Human Services Low Income Home Energy Assistance Program; U.S. Dept. of Energy Weatherization Assistance Program (WAP)<br>Illinois: Illinois Home WAP; Illinois Climate Bank Energy Efficiency Revolving Loan Fund; IEPA Energy Efficiency Trust Fund Grant Program; ComEd weatherization rebates; Green bank financing (e.g., Coalition for Green Capital (CGC)); C-PACE financing (only available for commercial, industrial, and multifamily buildings (5+ units)); IEPA CPRG stretch code adoption technical assistance<br>Indiana: Indiana Home Efficiency Rebate program; Indiana Energy Independence Fund; Green bank financing (e.g., CGC); Indiana Weatherization Assistance Program; Indiana Energy Efficiency Fund; Indiana Owner Occupied Rehabilitation Grant Program<br>Wisconsin: PACE Wisconsin program (only available for commercial, industrial, and multifamily buildings (5+ units)); Green bank financing (e.g., CGC); Focus on Energy residential and business rebates and incentives; Wisconsin WAP |
| | | Key implementing agency | Existing authority | States (IL, WI, IN); public electricity and gas utilities; workforce trainers and educators; local government entities associated with building code compliance and enforcement |
| | | | Authority needed | N/A |
| | | Milestones for obtaining implementation authority | | N/A |
| | | Metrics for tracking progress | | Number of homes and commercial buildings weatherized; reductions in energy use intensity per unit of floor area |

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Commercial and residential buildings (continued)</th></tr>
<tr><td rowspan="11">Establish a weatherization incentives program</td><td rowspan="11">Provide 100% cost coverage for weatherization upgrades in low- and moderate-income homes, improving efficiency in 21% of housing units (approximately 900,000 homes) by 2050.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 0.4 MMT $CO_2e$</td></tr>
<tr><td>2050: 1.0 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>Massachusetts Mass Save 2025-2027 program</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: U.S. Dept. of Health and Human Services Low Income Home Energy Assistance Program; U.S. Dept. of Energy Weatherization Assistance Program (WAP)<br><u>Illinois</u>: Illinois Home Weatherization Assistance Program; Illinois Environmental Protection Agency Energy Efficiency Trust Fund Grant Program; Commercial Property Assessed Clean Energy (C-PACE) financing (only available for multifamily buildings (5+ units)); ComEd weatherization rebates; Green bank financing (e.g., CGC); philanthropic funding; IEPA Climate Pollution Reduction Grant stretch code adoption technical assistance<br><u>Indiana</u>: Indiana Home Efficiency Rebate program; Indiana Energy Independence Fund; Green bank financing (e.g., Coalition for Green Capital (CGC)); Indiana Weatherization Assistance Program; philanthropic funding<br><u>Wisconsin</u>: Focus on Energy residential rebates and incentives (e.g., insulation & air sealing rebates); Green bank financing (e.g., CGC); Wisconsin WAP; philanthropic funding</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States (IL, WI, IN); public electricity and gas utilities</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Number of installed heat pumps; incentive dollars dispersed vs. total budgeted; number of participating customers, contractors, and distributors over time</td></tr>
</table>

| Modeled strategy | Description | | | |
|---|---|---|---|---|
| **Commercial and residential buildings (continued)** | | | | |
| Adopt energy-saving habits and technologies | Integrate smart technologies and energy management systems into buildings, cutting residential HVAC and lighting energy demand by 10% and commercial energy demand by 16% by 2050. | Scenario | | State and local |
| | | Expected geographic location | | Full planning area |
| | | GHG emissions reduction from current policy scenario | | 2035: 1.7 MMT $CO_2e$ |
| | | | | 2050: 4.2 MMT $CO_2e$ |
| | | Reference policy/program | | "Smart Buildings and Homes" measure in the 2019 American Council for an Energy-Efficient Economy report, Halfway There: Energy Efficiency Can Cut Energy Use and Greenhouse Gas Emissions in Half by 2050 |
| | | Funding sources | | Federal: None<br>Illinois: Illinois Climate Bank Energy Efficiency Revolving Loan Fund; Illinois Environmental Protection Agency Energy Efficiency Trust Fund Grant Program; Commercial Property Assessed Clean Energy (C-PACE) financing (only available for commercial, industrial, and multifamily buildings (5+ units)); ComEd smart thermostat rebates; CRGA geothermal funding<br>Indiana: Indiana Energy Independence Fund<br>Wisconsin: PACE Wisconsin program (only available for commercial, industrial, and multifamily buildings (5+ units)); Focus on Energy residential rebates and incentives (smart thermostats) |
| | | Key implementing agency | Existing authority | States and local governments (IL, WI, IN); public electricity and gas utilities |
| | | | Authority needed | N/A |
| | | Milestones for obtaining implementation authority | | N/A |
| | | Metrics for tracking progress | | Reductions in energy use intensity; number of participating customers in energy-saving utility programs; number of buildings with smart technologies (e.g., smart thermostats, bidirectional EV chargers) |

| Modeled strategy | Description | | | |
|---|---|---|---|---|
| **Transportation** | | | | |
| Transition vehicle fleet to EVs | Require manufacturers to sell 100 percent new light-duty EVs by 2035 and through 2050. | Scenario | | Plan implementation |
| | | Expected geographic location | | Full planning area |
| | | GHG emissions reduction from current policy scenario | | 2035: 3.7 MMT $CO_2e$ |
| | | | | 2050: 12.2 MMT $CO_2e$ |
| | | Reference policy/program | | California Air Resources Board (CARB) Advanced Clean Cars II (ACC II) program |
| | | Funding sources | | Federal: None<br>Illinois: Illinois Environmental Protection Agency Electric Vehicle (EV) Rebate Program; Illinois Reimagining Energy and Vehicles tax credit<br>Indiana: Indiana Volkswagen Environmental Mitigation Trust Program (EV infrastructure); GOEVIN Charging Infrastructure Funding Opportunity (EV infrastructure)<br>Wisconsin: Wisconsin Electric Vehicle Infrastructure Program (EV infrastructure equipment); Vehicle Battery and Engine Research Tax Credits |
| | | Key implementing agency | Existing authority | N/A |
| | | | Authority needed | Federal (U.S. Environmental Protection Agency (USEPA)); States (IL, IN, WI) |
| | | Milestones for obtaining implementation authority | | Assuming the revocation of federal Advanced Clean Cars II (ACC II) waivers are judicially upheld, federal legislation would be needed to reverse the June 2025 Congressional Review Act's recission of USEPA's ACC II waivers, followed by enactment of the legislation, either by presidential signature or congressional override. California would then adopt updated, more stringent ACC II requirements and obtain a new USEPA waiver. If granted, Illinois, Indiana, and Wisconsin would need to adopt the updated standards under Section 177 of the Clean Air Act. |
| | | Metrics for tracking progress | | Annual share of light-duty vehicle sales that are EVs; share of vehicle manufacturers in compliance; number of light-duty EV registrations |

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Transportation (continued)</th></tr>
<tr><td rowspan="11">Implement an EV incentives program (light-duty vehicles)</td><td rowspan="11">Establish state and local incentives to sustain EV purchases and charging infrastructure adoption levels after the expiration of Inflation Reduction Act incentives</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 0.5 MMT $CO_2e$</td></tr>
<tr><td>2050: 1.8 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>Salata Institute for Climate Sustainability and Harvard University 2025 policy brief: Trump EV Policy Overhaul: What Will Happen to EV Adoption, Emissions, and the Fiscal Balance?</td></tr>
<tr><td colspan="2">Funding sources</td><td>Federal: None<br>Illinois: Illinois Environmental Protection Agency Electric Vehicle Rebate Program<br>Indiana: Indiana Volkswagen Environmental Mitigation Trust Program (EV infrastructure); GOEVIN Charging Infrastructure Funding Opportunity (EV infrastructure)<br>Wisconsin: Wisconsin Electric Vehicle Infrastructure Program (EV infrastructure equipment)</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States (IL, IN, WI)</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Number of incentives claimed; share of incentives allocated/claimed by low- to moderate- income households; EV sales growth (before and after implementation program)</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Transportation (continued)</th></tr>
<tr><td rowspan="11">Fully electrify medium- and heavy-duty vehicles</td><td rowspan="11">Require manufacturers to increase the share of zero-emission vehicles sales for medium- and heavy-duty vehicles, reaching 100% of sales by 2050.<br><br>The Pathways model assumes model years 2027 to 2035 are consistent with the Advanced Clean Trucks program. After 2035, sales are interpolated to reach 100% by 2040.</td><td colspan="2">Scenario</td><td>Plan implementation</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 0.8 MMT $CO_2e$</td></tr>
<tr><td>2050: 5.7 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>Global Drive to Zero 2025 Global Memorandum of Understanding on Zero-emission Medium- and Heavy-duty Vehicles; California Air Resources Board (CARB) Advanced Clean Trucks (ACT) regulation</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: None<br><u>Illinois</u>: Illinois Environmental Protection Agency (IEPA) Driving a Cleaner Illinois - Volkswagen funding; Heavy-Duty Vehicle Charging Loan Program, IEPA Climate Pollution Reduction Grant Heavy Duty Vehicle charging infrastructure program for small and medium fleet operators (grants, low-cost loans), deployment of trackside power to reduce diesel engine idling<br><u>Indiana</u>: DieselWise Indiana program; Indiana Volkswagen Environmental Mitigation Trust Program<br><u>Wisconsin</u>: Clean Diesel Grant Programs</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>N/A</td></tr>
<tr><td>Authority needed</td><td>Federal (U.S. Environmental Protection Agency (USEPA)); States (IL, IN, WI)</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>Assuming the revocation of federal Advanced Clean Cars II (ACC II) waivers are judicially upheld, federal legislation would be needed to reverse the June 2025 Congressional Review Act’s recission of USEPA’s ACC II waivers, followed by enactment of the legislation, either by presidential signature or congressional override. California would then adopt updated, more stringent ACC II requirements and obtain a new USEPA waiver. If granted, Illinois, Indiana, and Wisconsin would need to adopt the updated standards under Section 177 of the Clean Air Act.</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Annual share of medium- and heavy-duty vehicle sales that are zero-emissions (battery-electric or fuel cell) vehicles; share of vehicle manufacturers in compliance; number of zero-emission medium- and heavy-duty vehicle registrations</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Transportation (continued)</th></tr>
<tr><td rowspan="11">Implement an EV incentives program (medium and heavy-duty vehicles)</td><td rowspan="11">Establish state and local incentives to sustain EV purchases and charging infrastructure adoption levels after the expiration of Inflation Reduction Act incentives</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 0.1 MMT $CO_2e$</td></tr>
<tr><td>2050: 0.8 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>Salata Institute for Climate Sustainability and Harvard University 2025 policy brief: Trump EV Policy Overhaul: What Will Happen to EV Adoption, Emissions, and the Fiscal Balance?</td></tr>
<tr><td colspan="2">Funding sources</td><td>Federal: None<br>Illinois: ComEd’s Business & Public Sector EV Program; Illinois Environmental Protection Agency (IEPA) Driving a Cleaner Illinois - Volkswagen funding; IEPA Climate Pollution Reduction Grant zero-emissions on-road and off-road vehicle deployment for small and medium fleet operators (loans, vehicle and equipment rebates), clean fleet and freight technical assistance, and workforce training<br>Indiana: DieselWise Indiana program; Indiana Volkswagen Environmental Mitigation Trust Program<br>Wisconsin: Clean Diesel Grant Programs</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States (IL, IN, WI)</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Number of incentives claimed; medium- and heavy-duty EV sales growth (before and after program implementation)</td></tr>
</table>

| Modeled strategy | Description | | | |
|---|---|---|---|---|
| **Transportation (continued)** | | | | |
| Electrify transit and school buses | Require all school buses to be electric by 2035, and all transit buses to be electric by 2040.<br><br>The Pathways model assumes all new bus purchases will be electric by 2026, given that the average bus lifetime is 14 years; and the annual sales share of electric school bus is 49%, starting in 2028. | Scenario | | State and local |
| | | Expected geographic location | | Full planning area |
| | | GHG emissions reduction from current policy scenario | | 2035: 0.05 MMT $CO_2e$ |
| | | | | 2050: 0.07 MMT $CO_2e$ |
| | | Reference policy/program | | Illinois proposed bill HB 2297; Chicago Transit Authority (CTA): Charging Forward: CTA Bus Electrification Planning Report |
| | | Funding sources | | <u>Federal</u>: Federal Transit Administration (FTA) Buses and Bus Facilities programs (formula and competitive grants); FTA Low or No Emission Grant (Low No) Program; FTA Public Transportation Innovation Program<br><u>Illinois</u>: ComEd's Business & Public Sector EV Program; Illinois Environmental Protection Agency Driving a Cleaner Illinois - Volkswagen funding<br><u>Indiana</u>: DieselWise Indiana program; Indiana Volkswagen Environmental Mitigation Trust Program<br><u>Wisconsin</u>: Clean Diesel Grant Programs; Bus and Bus Facilities Program (Section 5339 formula grant funds) |
| | | Key implementing agency | Existing authority | States (IL, IN, WI) |
| | | | Authority needed | N/A |
| | | Milestones for obtaining implementation authority | | N/A |
| | | Metrics for tracking progress | | Share of electric buses relative to total fleet size and target year; number of chargers installed relative to number of chargers planned |

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Transportation (continued)</th></tr>
<tr><td rowspan="11">Electrify public fleets</td><td rowspan="11">Require all public fleet vehicle purchases to be zero-emissions vehicles, starting in 2026.<br><br>For simplification purposes, the Pathways model assumes all public fleet vehicles are light-duty vehicles, and that electrification occurs to approximately 3% of the region's light-duty vehicle fleet.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 0.02 MMT $CO_2e$</td></tr>
<tr><td>2050: 0.1 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>City of Chicago fleet electrification target</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: Federal Transit Administration Low or No Emission Grant (Low No) Program<br><u>Illinois</u>: ComEd's Business & Public Sector EV Program; Illinois Environmental Protection Agency Driving a Cleaner Illinois - Volkswagen funding<br><u>Indiana</u>: DieselWise Indiana program; Indiana Volkswagen Environmental Mitigation Trust Program; Indiana Green Fleet Program<br><u>Wisconsin</u>: Clean Diesel Grant Programs</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States, municipalities, and counties (IL, IN, WI)</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Share of electric vehicles relative to total public fleet size and target year; number of public entities meeting requirements</td></tr>
</table>

| Modeled strategy | Description | | | |
|---|---|---|---|---|
| **Transportation (continued)** | | | | |
| Electrify lawn and landscaping equipment | Require all lawn and landscaping equipment to be zero emissions by 2035. | Scenario | | State and local |
| | | Expected geographic location | | Full planning area |
| | | GHG emissions reduction from current policy scenario | | 2035: 0.3 MMT $CO_2e$ |
| | | | | 2050: 0.4 MMT $CO_2e$ |
| | | Reference policy/program | | California Air Resources Board Small Off-Road Engines (SORE) regulations |
| | | Funding sources | | <u>Federal</u>: None<br><u>Illinois</u>: Illinois Environmental Protection Agency Clean landscaping rebate program (CPRG grant); municipal rebate programs (e.g., Elgin, Skokie, etc.)<br><u>Indiana</u>: None<br><u>Wisconsin</u>: None |
| | | Key implementing agency | Existing authority | |
| | | | Authority needed | States (IL, IN, WI) |
| | | Milestones for obtaining implementation authority | | Passage of legislation authorizing a state entity to adopt California's SORE regulations; passage of legislation adopting the regulations; completed rulemaking process; assurance of market readiness; implementation of enforcement mechanisms; monitoring and review |
| | | Metrics for tracking progress | | Reductions in NOx emissions; reductions in $CO_2e$ emissions; reduction in fuel consumption; share of electric (zero-emission) equipment sales; number of certified zero-emission models of equipment available; number of landscaping businesses transitioned to zero-emission equipment |

| Modeled strategy | Description | | |
|---|---|---|---|
| **Transportation (continued)** | | | |
| Require shore power for marine vessels | Require all large vessels (e.g., containers, cruise, and tanker vessels) to use shore power or equivalent emission controls by 2030.<br><br>The Pathways model assumes a 76% reduction in diesel fuel demand by 2050, achieving a 67% decline in emissions. | Scenario | State and local |
| | | Expected geographic location | Full planning area |
| | | GHG emissions reduction from current policy scenario | 2035: 0.002 MMT $CO_2e$ |
| | | | 2050: 0.016 MMT $CO_2e$ |
| | | Reference policy/program | California Air Resources Board Ocean-Going Vessels at Berth regulation |
| | | Funding sources | Federal: U.S. Environmental Protection Agency Clean Ports Program ($2.0 million Climate and Air Quality Planning Competition funds to Illinois Environmental Protection Agency (IEPA) (Illinois Waterway Ports and Terminals Port Statistical Area, IL); $92 million Zero-Emission Technology Deployment Competition funds to IEPA (Illinois International Port District))<br>Illinois: Illinois Port Facilities Capital Investment Grant Program<br>Indiana: Indiana Volkswagen Environmental Mitigation Trust Program<br>Wisconsin: Harbor Assistance Program |
| | | Key implementing agency — Existing authority | None |
| | | Key implementing agency — Authority needed | States and/or ports (IL, IN, WI) |
| | | Milestones for obtaining implementation authority | Passage of legislation authorizing a state entity to adopt California's Ocean-Going Vessels at Berth regulations; passage of legislation adopting the regulations; completed rulemaking process; implementation of enforcement mechanisms; monitoring and review |
| | | Metrics for tracking progress | Reductions in NOx emissions; reductions in fine particulate matter (PM2.5); number of vessels in compliance with regulations; number of vessels visiting a port that are equipped for shore power; number of vessels visiting a port connected to shore power; number of shore power connections installed/available at a port |

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Transportation (continued)</th></tr>
<tr><td rowspan="11">Adopt a low carbon fuel standard</td><td rowspan="11">Sets a carbon intensity target for on-road transportation fuels that requires a 20% reduction by 2034 through electrification and renewable diesel blending.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 6.2 MMT $CO_2e$</td></tr>
<tr><td>2050: 7.3 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>Washington Clean Fuel Standard; California Air Resources Board Low Carbon Fuel Standard regulation</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: None<br><u>Illinois</u>: Climate and Equitable Jobs Act funding; Illinois CPRG funding<br><u>Indiana</u>: None<br><u>Wisconsin</u>: None</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States of IL and WI</td></tr>
<tr><td>Authority needed</td><td>State of IN</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>Revocation of Indiana Governor Executive Orders 25-49 and 25-50; passage of Indiana state legislation authorizing a relevant state entity to adopt a low carbon fuel standard; completed rule making process; adoption, enforcement and monitoring of standards</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Average carbon intensity for the state's entire fuel pool; share of fuel that has been replaced with low carbon fuel alternatives; reductions in GHG emissions</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Transportation (continued)</th></tr>
<tr><td rowspan="10">Require renewable diesel in off-road vehicle fleets</td><td rowspan="10">Require 100% renewable diesel use for off-road vehicle fleets, beginning in 2027.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 3.2 MMT $CO_2e$</td></tr>
<tr><td>2050: 3.3 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>California Air Resources Board In-Use Off-Road Diesel-Fuel Fleets regulation</td></tr>
<tr><td colspan="2">Funding sources</td><td>Federal: Federal Highway Administration Resilient Surface Transportation Grants; U.S. Treasury Clean Fuel Production Credit; U.S. Dept. of Energy (DOE) Clean Fuels and Products Demonstration Projects; DOE Biofuel Research and Development Grants; Community Waste-to-Biofuel Development Grants; U.S. Dept. of Agriculture Advanced Biofuel Production Grants and Loan Guarantees; Clean Fuel Production Credit (45Z) (expires December 31, 2029)<br>Illinois: Illinois Environmental Protection Agency Driving a Cleaner Illinois grant program; Biofuels Tax Exemption<br>Indiana: DieselWise Indiana Program; Indiana Volkswagen Environmental Mitigation Trust Program<br>Wisconsin: Clean Diesel Grant Programs</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>None</td></tr>
<tr><td>Authority needed</td><td>States (IL, IN, WI)</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>Passage of legislation authorizing a state entity to adopt California's In-Use Off-Road Diesel-Fuel Fleets regulation; passage of legislation adopting the regulations; completed rulemaking process; implementation of enforcement mechanisms; monitoring and review</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Total gallons of renewable diesel purchased annually; total gallons of renewable diesel purchased annually; number of off-road vehicles in compliance with regulations after 2027</td></tr>
</table>

| Modeled strategy | Description | | | |
|---|---|---|---|---|
| **Transportation (continued)** | | | | |
| Adopt sustainable aviation fuel (SAF) blending requirements | Coordinate with the region's airports and carriers to increase use of sustainable aviation fuel, supporting the national goal of achieving a 100% sustainable aviation fuel blend in jet fuel by 2050.<br><br>The Pathways model assumes 3 billion gallons of domestic SAF are produced annually by 2030, totaling 35 billion gallons to achieve a 100% SAF blend for jet fuel by 2050. | Scenario | | Plan implementation |
| | | Expected geographic location | | Full planning area |
| | | GHG emissions reduction from current policy scenario | | 2035: 1.4 MMT $CO_2e$<br>2050: 4.9 MMT $CO_2e$ |
| | | Reference policy/program | | U.S. Dept. of Energy (DOE), U.S. Department of Transportation (USDOT), and U.S. Department of Agriculture (USDA) |
| | | Funding sources | | Federal: DOE SAF grants; DOE Biofuel Research and Development Grants; Internal Revenue Service tax credits for SAF, if lifecycle emissions exceed 50%; Clean Fuel Production Credit (45Z) (expires December 31, 2029)<br>Illinois: Sustainable Aviation Fuel Purchase Credit; Illinois Dept. of Commerce Reimagining Energy and Vehicles Illinois Program<br>Indiana: None<br>Wisconsin: None |
| | | Key implementing agency | Existing authority | U.S. federal government |
| | | | Authority needed | N/A |
| | | Milestones for obtaining implementation authority | | N/A |
| | | Metrics for tracking progress | | Total gallons of SAF produced annually; share of SAF relative to total jet fuel demand |

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Transportation (continued)</th></tr>
<tr><td rowspan="10">Reduce vehicle miles traveled (VMT)</td><td rowspan="10">Achieve a 5% reduction in VMT by 2030 and 16% by 2050 below business-as-usual trends. While overall VMT increases, the trend equates to a 12% reduction in VMT per capita from 2020 to 2050.[33]<br><br>The Pathways model applies different assumptions within the planning area. In CMAP's seven counties, VMT growth is limited to a 1% increase by 2035 and a 2% increase by 2050. Within NIRPC's three counties, VMT growth is constant throughout all three scenarios, resulting in a 20% increase in VMT from 2020 to 2050.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 2.5 MMT $CO_2e$</td></tr>
<tr><td>2050: 3.8 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>CMAP travel modeling analyses and new modeling work with Argonne National Laboratory through the Energy to Communities program</td></tr>
<tr><td colspan="2">Funding sources</td><td>Federal: Federal Highway Administration (FHWA) Transportation Alternatives Program; FHWA Congestion Mitigation and Air Quality Improvement Program; FHWA Carbon Reduction Program; Federal Recreational Trails Program; Federal Transit Administration Capital Investment Grants program<br>Illinois: Illinois Volkswagen Settlement funds; Illinois Environmental Protection Agency Driving a Cleaner Illinois; Illinois Trails Grant Program; motor fuel sale taxes; Regional Transportation Authority sales tax; Illinois Road Fund<br>Indiana: Indiana Dept. of Transportation Public Mass Transportation Fund<br>Wisconsin: Wisconsin State Transit Planning Grant Program</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States (IL, IN, WI)</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Per capita VMT; comparison of per capita VMT forecasts and actuals; annual VMT growth; transit ridership; trip lengths</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Waste</th></tr>
<tr><td rowspan="11">Establish statewide targets and plans to reduce food waste</td><td rowspan="11">Set statewide targets to reduce food waste going to landfills by 50% by 2030 (equivalent to a 29% reduction in methane (CH4) emissions).<br><br>The Pathways model assumes shifts in methane (CH4) emissions start in 2027; and the share of landfill emissions from food waste is equivalent to 58%.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 0.3 MMT $CO_2e$</td></tr>
<tr><td>2050: 0.3 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>Food Well Washington Plan and Washington House Bill 2301; U.S. Environmental Protection Agency (USEPA) Quantifying Methane Emissions from Landfilled Food Waste</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: U.S. Environmental Protection Agency (USEPA) Solid Waste Infrastructure for Recycling Grants; U.S. Dept. of Agriculture (USDA) Resilient Food Systems Infrastructure (RFSI) program; USDA Composting & Food Waste Reduction Cooperative Agreements<br><u>Illinois</u>: IL Dept. of Agriculture Local Food Infrastructure Grant; IL RFSI program; IEPA County Solid Waste Planning Grants<br><u>Indiana</u>: Indiana Community Recycling Grant Program<br><u>Wisconsin</u>: WI Dept. of Natural Resources Basic Recycling Grant to Responsible Units; WI RFSI program</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States (IL, IN, WI)</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Total food waste relative to baseline year; food waste generated per capita; food waste diversion rates; reductions in waste methane emissions</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Waste (continued)</th></tr>
<tr><td rowspan="10">Expand and improve the collection of biogas from landfills</td><td rowspan="10">Require capture and/or restrict open-air flaring of landfill gas at more landfills.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 0.11 MMT $CO_2e$</td></tr>
<tr><td>2050: 0.12 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>California Global Warming Solutions Act (AB32) and code regulation 95464</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: USEPA Renewable Electricity Production Tax Credit; USDA Solid Waste Management Grants; U.S. Dept. of Energy Biofuel Feedstock Research and Development Grants; USDA Advanced Biofuel Production Grants and Loan Guarantees; Clean Fuel Production Credit (45Z) (expires December 31, 2029)<br><u>Illinois</u>: IEPA CPRG biomethane emission reduction, capture, and utilization grant program<br><u>Indiana</u>: None<br><u>Wisconsin</u>: None</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States of IL and WI</td></tr>
<tr><td>Authority needed</td><td>State of IN</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>Revocation of Indiana Governor Executive Orders 25-49 and 25-50; passage of legislation authorizing a state entity to require expansion of biogas collection; completed rule making process, including the required installation of collection systems; adoption of statewide requirements; approval of requirements through state's Statewide Implementation Plan; monitoring and preview of standards as needed.</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Reduction in methane emissions; number of landfills in compliance; biogas production (by total volume); gas flared (by total volume)</td></tr>
</table>

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Agriculture</th></tr>
<tr><td rowspan="11">Improve nutrient management and soil health</td><td rowspan="11">Increase the adoption of alternative fertilizer application practices, such as optimized application and nitrification inhibitors, that reduce non-$CO_2$ (nitrous oxide) emissions at costs below $100/t$CO_2$e.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 0.5 MMT $CO_2$e</td></tr>
<tr><td>2050: 0.5 MMT $CO_2$e</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>USEPA U.S. State-level Non-$CO_2$ GHG Mitigation Report</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: USDA Agricultural Conservation Easement Program; USDA Climate-Smart Commodities; USDA Environmental Quality Incentives Program; USDA Natural Resources Conservation Service (NRCS) Regional Conservation Partnership Program; USEPA Section 319 planning and implementation grants<br><u>Illinois</u>: Illinois Dept. of Agriculture (IDOA) Climate Smart Agriculture Program; IDOA Illinois Cover Crops Premium Discount Program; Illinois Farm Bureau Nutrient Stewardship Grant Program; county-level cover crop cost-share programs; IEPA Section 319 grants; IEPA CPRG Climate-Smart Agriculture Program<br><u>Indiana</u>: Indiana Dept. of Agriculture Soil Sampling Program; county-level cover crop cost-share programs; IDEM Section 319 grants<br><u>Wisconsin</u>: Commercial Nitrogen Optimization Pilot Program; Crop Insurance Premium Rebates for Planting Cover Crops; county-level cover crop cost-share programs; Nutrient Management Farmer Education Grants; Wisconsin Farmland Preservation Program; Farmland Preservation Program-Agricultural Enterprise Area; Conservation Innovation Grants program</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>Local governments and academic institutions: Indiana Office of the State Chemist regulates agricultural fertilizer and manure application plans.</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Reduction in nitrous oxide emissions; number of dollars spent on incentives; adoption rate of alternative fertilizer practices; types of fertilizer purchased; reduction in environmental pollution through water quality testing</td></tr>
</table>

| Modeled strategy | Description | | | |
|---|---|---|---|---|
| **Agriculture** | | | | |
| Improve feed and manure management | Provide financial incentives to increase the adoption of alternative livestock feeding and manure management practices that reduce methane emissions at costs below $100/tCO_2e$. | Scenario | | State and local |
| | | Expected geographic location | | Full planning area |
| | | GHG emissions reduction from current policy scenario | | 2035: 0.1 MMT $CO_2e$ |
| | | | | 2050: 0.1 MMT $CO_2e$ |
| | | Reference policy/program | | U.S. Environmental Protection Agency (USEPA) U.S. State-level Non-$CO_2$ GHG Mitigation Report |
| | | Funding sources | | Federal: U.S. Dept. of Agriculture (USDA) Agricultural Conservation Easement Program; USDA Climate-Smart Commodities; USDA Environmental Quality Incentives Program; USDA NRCS Regional Conservation Partnership Program; USEPA Section 319 planning and implementation grants<br>Illinois: IDOA Partners For Conservation Program; IEPA Section 319 grants; IEPA CPRG biomethane emission reduction, capture, and utilization grant program<br>Indiana: IDEM Section 319 grants; cost-sharing for Comprehensive Nutrient Management Plan for Animal Feeding Operations<br>Wisconsin: Wisconsin Nutrient Management Farmer Education Grants; Wisconsin Farmland Preservation Program; Wisconsin Farmland Preservation Program-Agricultural Enterprise Area |
| | | Key implementing agency | Existing authority | Local governments and academic institutions |
| | | | Authority needed | N/A |
| | | Milestones for obtaining implementation authority | | N/A |
| | | Metrics for tracking progress | | Reduction in methane emissions; number of dollars spent on incentives; adoption rate of alternative fertilizer practices (number of farms participating or practice-specific adoption rates) |

<table>
<tr><th>Modeled strategy</th><th>Description</th><th colspan="3"></th></tr>
<tr><th colspan="5">Carbon sequestration</th></tr>
<tr><td rowspan="10">Increase the carbon storage potential of the region’s natural and working lands</td><td rowspan="10">Achieve the technical potential for increased natural carbon sinks through protection, restoration, and management activities and/or conversion of natural lands (e.g., forest, wetlands, grasslands) and working lands (e.g., agricultural and grazing lands) in the greater Chicago region by 2050.<br><br>The Pathways model assumes sequestered carbon is based on cropland, forest, grasslands, shrublands, savanna, and wetlands measures that capture more than 1,000 tonnes of $CO_2e$ per year, as identified by the Naturebase Tool. It also assumes payment of \$100/t$CO_2e$ sequestered to implement measures.</td><td colspan="2">Scenario</td><td>State and local</td></tr>
<tr><td colspan="2">Expected geographic location</td><td>Full planning area</td></tr>
<tr><td colspan="2" rowspan="2">GHG emissions reduction from current policy scenario</td><td>2035: 1.4 MMT $CO_2e$</td></tr>
<tr><td>2050: 3.4 MMT $CO_2e$</td></tr>
<tr><td colspan="2">Reference policy/program</td><td>The Nature Conservancy’s Naturebase Tool</td></tr>
<tr><td colspan="2">Funding sources</td><td><u>Federal</u>: U.S. Dept. of Agriculture Agricultural Conservation Easement Program; U.S. Dept. of Interior Land and Water Conservation Fund; National Fish and Wildlife Foundation America’s Ecosystem Restoration Initiative; State Coastal Management Programs; Great Lakes Restoration Initiative<br><u>Illinois</u>: Illinois Open Space Lands Acquisition Development program; Illinois Natural Areas Acquisition Fund; Illinois Natural Areas Stewardship Grant Program; Openlands TreePlanters Grant program; Conservation Innovation Grants program<br><u>Indiana</u>: Indiana Dept. of Natural Resources Community & Urban Forestry Annual Grants; Conservation Innovation Grants program<br><u>Wisconsin</u>: Conservation Innovation Grants program; Wisconsin Forest Landowner Grant Program; Wisconsin Dept. of Natural Resources Urban Forestry Grants; Sustainable Forestry Implementation Committee Grants</td></tr>
<tr><td rowspan="2">Key implementing agency</td><td>Existing authority</td><td>States (IL, IN, WI), local governments (counties, municipalities, forest preserves, park districts), nonprofits, land trusts</td></tr>
<tr><td>Authority needed</td><td>N/A</td></tr>
<tr><td colspan="2">Milestones for obtaining implementation authority</td><td>N/A</td></tr>
<tr><td colspan="2">Metrics for tracking progress</td><td>Tonnes of $CO_2e$ captured per hectare/acre per year; hectare/acres of land use/land cover change; total acres of natural and working lands under permanent protection</td></tr>
</table>

# Appendix E: Workforce planning analysis

A skilled and adaptable workforce is essential to achieving the region's climate and clean-energy goals. As communities across Greater Chicago advance strategies to reduce greenhouse gas emissions, the labor market must evolve to meet demand in building electrification, renewable energy, transportation decarbonization, grid modernization, and sustainable industry.

The transition to a low-carbon economy will generate new, high-quality jobs while transforming existing sectors. Demand for electricians, HVAC specialists, solar installers, and other skilled trades is expected to grow sharply, supporting both economic competitiveness and long-term sustainability. At the same time, workers in carbon-intensive industries will require access to retraining, certification, and placement programs that create pathways into emerging clean-energy careers.

Workforce development is, therefore, a core pillar of this plan's implementation. Coordinated action among employers, labor organizations, workforce boards, and educational institutions will be critical to ensure that new jobs are accessible to all residents — particularly those in historically marginalized communities. Programs should align with the U.S. Department of Labor's Good Jobs Principles to promote fair wages, worker protections, and career advancement.

## Overview

This appendix assesses the region's current workforce capacity, quantifies future labor demand based on the modeled climate strategies, and identifies the workforce systems, partnerships, and job-quality standards required to support a fair transition. The analysis integrates labor-market data, economic modeling, and insights from stakeholder interviews to provide a regional blueprint for building the workforce that will enable implementation of the *Comprehensive Climate Action Plan for Greater Chicago*.

### Purpose and process

This workforce analysis quantifies the labor needs associated with implementing the plan's modeled strategies and outlines the actions required to align training supply, project demand, and job quality standards.

The analysis follows four steps:

- **Assess current employment:** Measures the size and composition of today's workforce in occupations central to implementation.
- **Estimate future demand:** Applies job-per-dollar ratios from national decarbonization studies to modeled investment levels through 2050 under both full-implementation and state-and-local scenarios.

- **Identify gaps and risks:** Evaluates potential shortages, geographic mismatches, and program capacity constraints affecting workforce readiness.
- **Engage stakeholders:** Conducts structured interviews with state agencies, unions, employers, workforce boards, community colleges, and community-based organizations to ground findings in practitioner experience.

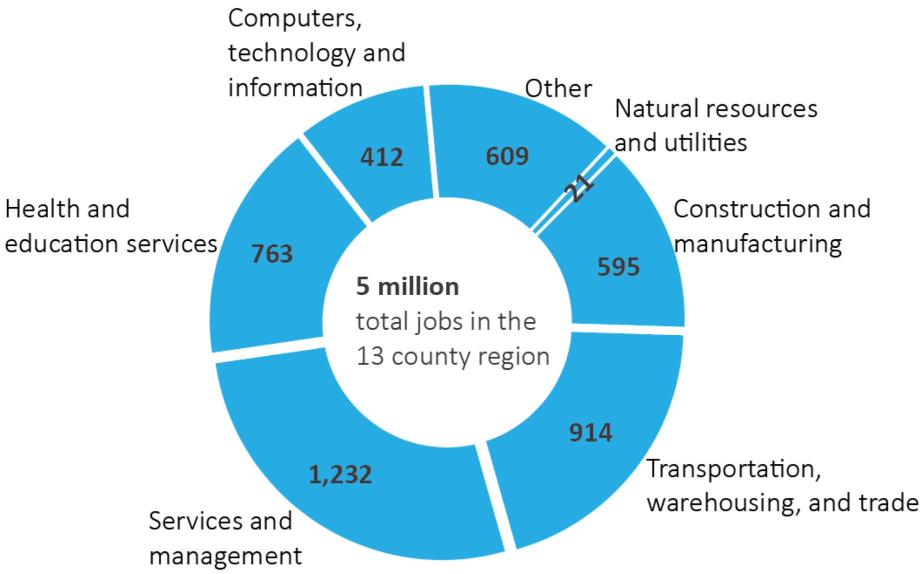
Together, these steps provide a complete picture of where the workforce stands today, what the plan will require, and how to bridge the gap.

## Existing workforce context

Greater Chicago is one of the world's major economic centers. Its 13-county region sits at the crossroads of the nation's rail, road, and air transportation networks, supporting strong specializations in manufacturing, logistics, and emerging industries. Together, these sectors create a diverse economy that attracts investment and talent. With more than 5 million jobs and a Gross Regional Product (GRP) of nearly $924 billion, the region's economy is larger than that of 44 individual states — offering broad opportunity for both workers and businesses.[34]

The largest job sectors include professional services and management, transportation, warehousing, trade, and health and education services (Figure E-1). In the fourth quarter of 2024, the Chicago metropolitan statistical area's (MSA) average weekly wage was $1,600, surpassing the national average of $1,507.[35] However, these benefits are not evenly distributed: Illinois counties such as Cook, DuPage, and Lake exceed the regional average, while others remain below $1,200 per week, underscoring persistent intraregional disparities.[36]

**Figure E-1. 2024 jobs in Greater Chicago, in nearest thousand**




Source: CMAP analysis of Lightcast Industry Table. (2025). Q3 2025 data set, 2025.

## Economic and demographic shifts

Despite its size and diversity, the region faces significant structural and demographic challenges. The population is aging rapidly: between 2010 and 2023, the share of seniors grew from 11 to 16 percent, while the share of children declined from 21 to 18 percent in Greater Chicago.[37] As a result, the number of working-age adults has begun to shrink — a trend projected to continue in the coming decades.

Employment volatility has also characterized the past two decades. The Great Recession (2007-2009) and the COVID-19 pandemic both caused major employment shocks. Since 2010, the CMAP region added approximately 430,000 jobs, including 322,000 recovered from the recession.[38] Between 2015 (after full recovery) and 2019, employment grew by an additional 150,000 jobs, before pandemic-related losses of about 311,000. Roughly 270,000 jobs have since returned, but overall employment growth of 2.4 percent since 2015 has lagged household growth of 8 percent, meaning two new households have formed for every job created.[39]

## Labor market conditions

As of mid-2025, regional labor market conditions are improving but remain uneven. Unemployment in the Chicago MSA reached 6.2 percent in mid-2024[40] — well above the national rate of 4.3 percent at the time — before easing to 4.9 percent by July 2025,[41] roughly matching the U.S. average of 4.6 percent. Average annual household expenditures in 2022–2023 totaled $80,264, above the national average of $75,172.[42] Notably, Chicago-area households spend a smaller share of their budgets on transportation,[43] reflecting stronger transit access and urban density compared to national patterns.

However, affordability pressures continue to mount. Between 2018 and 2024, the median homes sales price in northeastern Illinois grew by 40 percent, while median household income rose only about 30 percent from 2018 to 2023.[44] Nearly half of renter households and 27 percent of homeowners now spend more than 30 percent of income on housing.[45]

Transportation costs have also increased, particularly in suburban and exurban communities where longer travel distances and limited transit access make households more dependent on driving. These combined housing and transportation pressures leave many residents with fewer resources for other essential needs.

Higher income households have been better able to absorb rising costs. Between 2018 and 2023, the number of households earning over $150,000 annually increased by more than 50 percent, and many higher-income homeowners benefited from both increasing wages and rapidly rising home values.[46] Nationally, the top 10 percent of households by income (those earning $250,000 or more) account for nearly half of all consumer spending, underscoring the outsized role of high-income households in shaping market trends.[47]

Collectively, these trends point to widening disparities in how residents experience the region's economy and highlight the importance of pairing the clean energy transition with intentional workforce development and economic inclusion strategies.

## Regional variation

The CMAP region's 7 counties support approximately 4.5 million jobs. The City of Chicago anchors the regional economy, providing 1.4 million jobs, or about 1 in 3 across the region. DuPage and suburban Cook counties also host significant employment concentrations.

Across the three Indiana counties of the NIRPC region, the economy remains rooted in industrial production, historically anchored by iron and steel production and heavy manufacturing. The area now supports 400,000 jobs across all industries.[48] According to NIRPC's 2025 Community Economic Development Strategy, local leaders are working to diversify into new sectors such as energy and advanced computing, pharmaceuticals, machinery manufacturing, and primary metals. However, demographic change poses long-term challenges: between 2010 to 2020, the working-age population declined while the share of residents aged 55 and older increased, creating potential labor shortages.[49]

## Employment trends in the clean economy

The 13-county greater Chicago region is home to one of the largest clean energy workforces in the Midwest, reflecting both legacy manufacturing strengths and emerging clean technology sectors. Clean economy employment spans renewable energy generation, energy efficiency, clean transportation, and supporting industries such as advanced manufacturing and grid modernization. Together, these sectors position the region to benefit from federal and private investment in the clean energy transition.

As of 2024, Illinois alone supported nearly 129,000 clean energy and clean vehicle workers, an increase of roughly 4.2 percent over the prior year.[50] When combined with employment in northwestern Indiana and southeastern Wisconsin, the broader region accounts for well over 150,000 clean energy jobs, with particularly strong representation in energy efficiency, clean vehicles, and grid infrastructure.

Nationally, clean energy occupations are among the fastest growing. The U.S. Bureau of Labor Statistics projects employment for wind turbine service technicians to grow by nearly 50 percent and for solar photovoltaic installers by 42 percent from 2024 and 2034.[51] However, recent federal policy shifts and delays in funding and rulemaking may temper the pace of job growth originally anticipated. Continued investment and policy certainty will be essential to realizing the full employment potential of the clean energy transition.

As of 2022, modeling from the National Renewable Energy Laboratory[52] suggested that job growth will be substantial in four major clean energy sectors — solar, wind, battery storage, and energy efficiency — under both business-as-usual and accelerated deployment scenarios.[53] Key findings for Illinois, Indiana, and Wisconsin include:[54]

- Solar energy jobs may grow by up to 158 percent between 2020 and 2030 under an accelerated scenario.
- Battery storage jobs could see the largest relative increase, with projected growth of 196 to 463 percent.
- Energy efficiency jobs may grow more than 300 percent by 2030, though projections vary slightly across states.

Despite these promising forecasts, Greater Chicago has seen mixed results across clean energy subsectors in recent years. Data from the U.S. Department of Energy's annual U.S. Energy & Employment Report show that between 2016 and 2022:

- Solar jobs increased modestly, while wind energy employment declined slightly.
- Energy efficiency jobs grew consistently, especially in ENERGY STAR appliances and lighting.
- Fossil fuel-related jobs — including coal, petroleum, and corn ethanol — declined steadily.
- Motor vehicle employment declined overall, though national trends show rapid growth in battery electric vehicle manufacturing (+26.8 percent from 2021–2022).

## Job quality in clean energy occupations

Job quality varies widely across occupations associated with the clean-energy transition. While some positions offer family-sustaining wages and stable schedules, others mirror the low wages, limited benefits, and employment volatility of the sectors they replace. Nationally, solar photovoltaic installers typically require only a high school diploma and receive most training on the job or through short technical programs. While work can be physically demanding and sometimes weather-dependent, automation risk remains low because installation tasks require manual precision and site-specific adaptation. In the Chicago region, pay and employment patterns are generally lower than national averages, with median installer wages around $40,000.[55]

By contrast, fossil fuel–related occupations such as petroleum and refinery operators remain fewer in number locally but offer higher wages — often exceeding $90,000[56] annually — and more stable schedules. These differences help explain why some workers may hesitate to transition to newer industries: the jobs they currently hold are stable, well-paid, and have relatively low formal educational barriers. To attract and retain talent, emerging clean-energy sectors will need to provide comparable wages, predictable hours, and clear career pathways.

Analysis of regional job quality underscores this challenge. Only half of automotive technician and mechanic positions in the region pay a living wage[57] for a family with two adults and two children, and these roles are disproportionately held by Hispanic men. Even related clean-energy positions, such as electric motor repairers, offer only modest improvement — roughly two-thirds pay a living wage but are rated lower in overall job quality due to higher unemployment and fewer employer-provided benefits.[58] Without deliberate action, new clean-energy roles may replicate existing inequities and wage instability.

National data also show persistent diversity gaps in the clean energy workforce: women represent roughly 30 percent of all clean energy workers but fewer than 10 percent of solar and wind technicians.[59] Ensuring equitable access in the region will require targeted outreach, training, and placement programs for women, people of color, and workers from disinvested communities.

## Workforce participation and access barriers

Even where high-quality jobs exist, not all residents have equitable access to them. Whether people can access a job depends on the education and experience requirements, the structured or flexible nature of the job, the demographic composition of the workforce, and its location.[60] Higher-wage, full-time positions are concentrated in professional and management services and specialized trades which often have high barriers to entry. Large employment sectors such as logistics, retail, and personal services often have lower barriers to entry, such as fewer educational requirements. However, more accessible jobs may provide lower pay, limited benefits, and less job stability. It is important to create jobs that are both high quality and accessible.

Workforce participation varies across the region due to overlapping socioeconomic barriers. The overall unemployment rate in northeastern Illinois is 6.1 percent.[61] In communities like Calumet Park[62] in south Cook County and the Austin[63] neighborhood of Chicago, the unemployment rate is more than double the regional average. These same communities have fewer college graduates and a lower median household income compared to the regional average, exemplifying how workforce barriers compound.

A spatial analysis of workforce access disparities across Greater Chicago identified significant concentrations of residents facing overlapping socioeconomic challenges — such as low income, high poverty and unemployment, linguistic isolation, and low levels of high school attainment. These factors collectively limit access to employment and training pathways by constraining residents' ability to reach, afford, or qualify for available programs and jobs.

The analysis found that about 30 percent of all census tracts in the region experience the highest levels of workforce access challenges.[64] These tracts are unevenly distributed: Cook County contains roughly 83 percent, followed by Lake County, Indiana (6 percent) and Lake County, Illinois (3 percent). Several counties — including McHenry, Kendall, and Grundy, Illinois — had no tracts meeting these thresholds.

Linguistic isolation emerged as a particularly localized barrier, concentrated almost entirely in northeastern Illinois. 14 percent of northeastern Illinois residents speak English "less than very well."[65] Only one tract in Kenosha County, Wisconsin, met the threshold for linguistic isolation. In fact, many tracts in northwestern Chicago and its nearby suburbs were classified as disadvantaged primarily due to a combination of language barriers and lower educational attainment.

These findings illustrate how demographic and economic disparities serve as proxies for broader disadvantages in workforce access. Residents in these areas are more likely to encounter obstacles such as language barriers, program costs, time constraints, and educational prerequisites when seeking training or employment.

Ensuring that new clean-energy and climate-related jobs are accessible to all communities will require addressing the barriers that prevent residents from entering and advancing in high-quality careers. Overcoming these barriers will require targeted investment in pre-training, bridge programs, and pre-apprenticeships that lower entry thresholds and connect underserved communities to the emerging clean-energy economy.

## Workforce demand for plan implementation

Implementing the strategies in this plan will require a large and skilled workforce across the 13-county region. This analysis identifies the occupations most directly responsible for carrying out decarbonization activities — such as retrofitting buildings, installing clean-energy systems, modernizing the electric grid, and electrifying transportation. These priority occupations represent the workforce backbone of implementation.

Rather than compiling a static list of clean-energy job titles, the analysis quantifies the scale of the workforce needed to deliver the plan. By linking each decarbonization strategy to the specific trades and occupations that perform the work, the analysis projects where employment will grow, where job transitions will occur, and where additional training capacity will be required across Illinois, Indiana, and Wisconsin.

## Current employment and projected workforce needs

Meeting the region's climate goals will require a large, skilled workforce capable of installing new clean-energy systems, retrofitting buildings, expanding the electric grid, modernizing industrial processes, and managing natural and working lands. This analysis estimates the scale of current employment in occupations most directly affected by decarbonization measures and projects how workforce needs may grow through 2050 under different policy scenarios. It provides directional estimates to illustrate the magnitude of change and help state, county, and local partners prepare for the workforce needed to implement the plan.

### Methodology

Primary occupations were identified for each emissions sector to represent the workforce needed to implement the plan's strategies (Table E-1). These occupations were then linked to corresponding six-digit North American Industry Classification System (NAICS) codes to estimate current employment levels and project how workforce demand may change under plan implementation.[66] For example, within the residential HVAC emissions sector, the primary occupations HVAC technicians and installers most closely align with are NAICS 238221 residential plumbing and HVAC contractors.

Because NAICS codes classify firms by industry rather than by the specific work performed, alignment is not always exact. A single code may include workers not engaged in clean-energy activities (leading to over-counting), while other relevant workers may be distributed across multiple codes (leading to under-counting). As a result, the employment figures should be interpreted as directional indicators of workforce scale and demand, rather than precise counts of individual job titles.

After decarbonization objectives were defined and GHG reduction measures modeled for each major emission sector (see Appendix D), the project team estimated the number of jobs required in key occupations to implement the plan. This workforce analysis draws on established studies that model the employment impacts of energy transition policies, including:

- *BW Commonwealth Edison Jobs & Equitable Energy Transition Study (2022).*[67]
  Models economywide job impacts for two transition scenarios based on E3's Illinois Decarbonization Study. The analysis covers four sectors — electricity, fuels, buildings, and transportation — and provides incremental investment and resulting net job changes for a more aggressive climate mitigation scenario relative to a reference (or business-as-usual) scenario. These incremental investment and net job change values were used to calculate job-per-dollar ratios for each sector.

- *America's Zero Carbon Action Plan (2021).* [68] This national framework outlines pathways to a carbon-neutral economy by 2050 through four pillars — energy efficiency, clean electricity, electrification, and carbon management. The study provides direct job-per-dollar ratio for all economic sectors, and was used as a supplement for sectors that were not included in the BW Study, including industry, waste, and agriculture.

Job-per-dollar ratios calculated from these studies were applied to incremental county-level investment estimates from the Pathways model for the plan implementation scenario and the state and local implementation scenario, to estimate sectoral employment changes through 2050 relative to the current policy scenario. Most projected job growth reflects capital-phase work — construction, installation, and commissioning — while long-term operations and maintenance jobs represent a smaller but ongoing share of total employment. This means that anticipated job creation includes both temporary, project-based jobs during construction and permanent, career-sustaining roles in operations and maintenance.[69]

Percent changes were derived by comparing projected jobs to current employment levels using Census Quarterly Workforce Indicators data. The analysis assumes uniform job-per-dollar ratios across all 13 counties, including those outside Illinois.

**Table E-1. Primary occupation categories supporting full plan implementation**

| Category | Focus area | Example primary occupations | NAICS codes |
|---|---|---|---|
| Agriculture and working lands | Sustainable farming and land management | Conservation agronomists, agroforestry specialists, soil and water technicians, carbon farming consultants | 924120 |
| Charging stations | Planning, installation, and maintenance of EV infrastructure | EV charging techs, electricians, civil engineers, urban planners, network specialists | n/a |
| Commercial HVAC | HVAC installation and maintenance in commercial buildings | HVAC technicians, mechanical engineers, refrigeration mechanics, EMS techs, building automation specialists | 238222 |
| Commercial other | Broader energy improvements in commercial facilities | Electricians, lighting techs, building energy auditors, facility managers, solar energy systems engineers | 238212 |

| | | | |
|---|---|---|---|
| Industry | Industrial decarbonization and process improvement | Energy efficiency engineers, industrial maintenance techs, process engineers, carbon capture and storage technicians | 331110, 331210<br>331221, 331222<br>327310, 327410<br>324110, 324191<br>324199, 324121<br>324122, 311, 336<br>332120 |
| Renewable energy generation | Operations, maintenance and expansion of renewable energy generation | Distributed and utility-scale solar, hydrogen, onshore wind, hydropower | 221114 |
| Residential HVAC | Installation, maintenance, and repair of heating, ventilation, and air conditioning systems in residential settings | HVAC installers and technicians, refrigeration mechanics, residential energy auditors, smart thermostat installers | 238221 |
| Residential other | Additional clean energy work in homes | Solar PV installers, battery storage techs, electricians, plumbers, home automation specialists | 238211 |
| Residential shell | Improving the energy efficiency of residential building envelopes | Insulation workers, weatherization techs, home energy auditors, window/door installers, air-sealing specialists | 238311, 238161,<br>238151 |

| | | | |
|---|---|---|---|
| Transmission and distribution | Modernizing transmission and distribution systems; energy storage deployment | Storage, distribution, transmission, biomass electricity generation, natural gas electricity generation, other fossil generation, nuclear | 221121, 221122, 237130 |
| Transportation | Electrification and sustainable mobility systems | EV technicians, battery techs, automotive service techs, transportation planners | 811111, 811114, 811191, 811198 |
| Waste | Circular economy and waste diversion | Recycling coordinators, composting techs, landfill gas techs, MRF operators, waste auditors | 562212, 221320 |

Sources: CMAP analysis of BW Commonwealth Edison Jobs & Equitable Energy Transition Study, CA, America's Zero Carbon Action Plan, and Bureau of Labor Statistics NAICS.

Approximately 3.4 percent of the region's workforce is currently employed in priority occupations directly affected by GHG reduction measures.[70] Full implementation would require nearly doubling the number of workers in these occupations, while the state and local action scenario would expand the workforce by about 39 percent (Table E-2). Both scenarios indicate substantial new demand for skilled labor across multiple sectors. County-level estimates are provided at the end of this appendix.

## Commercial and residential buildings

The buildings sector shows the largest increase in employment demand. Retrofitting and upgrading existing structures — including HVAC, building shell, and related efficiency work — would require about 60,130 additional jobs. More than 70 percent of these could be created through state and local actions alone. Even without new federal investment, these measures would generate 43,758 new positions, effectively one new job for every job that currently exists in this sector.

## Energy transmission and distribution

Employment in electric grid transmission and distribution would expand dramatically. The current workforce of 2,421 employees would grow by 55,967 jobs under full implementation — an increase of more than 2,000 percent — and by over 700 percent under the state and local scenario. This reflects the scale of workforce expansion needed to modernize and extend the grid to support electrification and renewable integration.

## Industry

The industrial sector would also see employment growth as facilities adopt more efficient and lower-carbon technologies. Under the full implementation scenario, growth is substantial, supported by federal investment and technological innovation. With state and local actions alone, industrial workforce needs would still rise by roughly 10 percent, supporting the modernization of existing facilities.

## Transportation

The transportation sector is expected to experience modest job declines linked to the transition from internal-combustion to electric vehicles, which require less maintenance. Under the state and local scenario, workforce needs decline by about 10 percent, with deeper reductions under full federal implementation. These losses, however, are partly offset by strong job growth in electric-vehicle charging infrastructure, which will require new construction, electrical, and planning roles.

## Geographic distribution

Workforce impacts will vary across the 13-county region with some smaller counties experiencing the largest proportional increases. For example, Lake County, Indiana, currently employs about 8,000 workers in occupations affected by decarbonization. Under full plan implementation, that number could exceed 53,000, underscoring the need for coordinated planning to ensure that housing, infrastructure, and essential services keep pace with rapid employment growth.

## Limitations

Employment related to the manufacturing of decarbonization equipment — such as solar panels, batteries, and electric vehicles — was not included in this analysis, though this represents a potential area of future growth for the region. Job losses tied to declining natural gas use were also not modeled, as employment in gas distribution depends more on the number of connected customers than on total fuel volume. Estimating these impacts would require detailed assumptions about disconnection timelines and infrastructure decommissioning strategies beyond this study's scope.

**Table E-2. Current employment (2023) and projected workforce needs by industry subsector by 2050**

| Subsector | Current employment | Plan implementation | | | |
|---|---|---|---|---|---|
| | | Number of new jobs | Percent change | State and local action only | |
| | | | | Number of new jobs | Percent change |
| Agriculture and working lands | 1,023 | 31 | 3% | 31 | 3% |
| Charging stations | n/a* | 3,389 | n/a | 635 | n/a |
| Commercial HVAC | 14,607 | 14,143 | 97% | 12,203 | 84% |
| Commercial other | 16,449 | 17,387 | 106% | 15,683 | 95% |
| Industry | 88,898 | 51,615 | 58% | 9,033 | 10% |
| Residential HVAC | 14,992 | 15,964 | 106% | 9,626 | 64% |
| Residential other | 5,089 | 5,731 | 113% | 3,147 | 62% |
| Residential shell | 3,925 | 6,904 | 176% | 3,099 | 79% |
| Renewable energy generation | 58 | 8,826 | 15217% | 484 | 834% |
| Transmission and distribution | 2,421 | 55,967 | 2312% | 17,964 | 742% |
| Transportation | 17,267 | -11,720 | -68% | -1,772 | -10% |
| Waste | 2,713 | 2 | 0% | 2 | 0% |
| Total | 167,442 | 168,239 | 100% | 70,135 | 42% |

Notes: *NAICS does not currently capture this industry as a distinct industry, making current employment difficult to assess.

Source: CMAP analysis of Bureau of Labor Statistics employment by NAICS and E3 projected jobs, 2025.

## Workforce challenges and capacity

The clean energy transition has the potential to intensify existing labor shortages in skilled trades and technical occupations. Persistent gaps in available labor could delay projects and raise costs, particularly amid elevated interest rates and material expenses. Ensuring an adequate supply of trained workers is therefore essential to successful implementation.

Labor shortages are most acute in building trades such as HVAC, electrical, and construction services; these occupations are projected to see the largest demand increase under plan implementation. The Great Recession triggered a long-term contraction in the construction workforce, as many skilled workers retired early or transitioned to other industries. Housing starts have yet to return to pre-recession levels, and the pipeline of new workers remains constrained. Nationally, more than one million craftworkers left the industry between 2005 and 2022.[71] Yet, unemployment in the trades remains near historic lows,[72] and building-industry pay grew roughly 10 percent from 2023 to 2024 — outpacing average wage growth.[73] With a median age of 42 and one in five workers age 55 or older, further attrition is expected.[74] Because most construction and energy occupations require multi-year apprenticeships and on-the-job training, expanding program capacity and improving access are critical to meet future labor needs.

The transportation sector will also experience a major workforce transition as the region shifts toward electric mobility. The analysis projects a net decline of roughly 11,700 jobs under full plan implementation, concentrated largely in Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will counties. Automotive service technicians and mechanics — currently about 21,800 workers[75] regionwide — will be most affected due to the reduced maintenance needs for electric vehicles compared with internal combustion engines.[76]

While vehicle maintenance employment is projected to decline, new opportunities will emerge in electric-vehicle charging infrastructure, power systems, and advanced mobility technologies. Climate and Equitable Jobs Act (CEJA) Workforce Hubs and community college partnerships offering EV and battery-technology training can help prepare workers for these roles.[77] Given the high representation of Hispanic workers in automotive maintenance, expanding bilingual and ESL-integrated programs will be essential to facilitating the transition.[78]

At the same time, public transit agencies face ongoing staffing challenges. Nationally, 96 percent report shortages, with 84 percent citing impacts to service reliability.[79] The Chicago Transit Authority (CTA) has made progress, surpassing pre-pandemic bus-operator staffing levels and expanding rail-operator training. By the end of 2025, the CTA expects to train an additional 200 rail operators, returning to 2019 staffing levels through active recruitment, higher starting wages, and expanded training programs.[80]

Together, these trends highlight the importance of proactive workforce transition planning — not only to train workers for emerging clean energy occupations but also to retain and redeploy workers from sectors undergoing decline.

## Bridging the gap between current and future workforce needs

This section summarizes findings from stakeholder interviews and workforce analysis conducted to understand the region's current workforce capacity, existing training infrastructure, and the systems needed to support a just and effective clean energy transition. It highlights opportunities to strengthen coordination, improve access, and ensure that new climate investments create high-quality, family-sustaining jobs across the greater Chicago region.

Stakeholder interviews with leaders across the greater Chicago region — representing unions, government agencies, apprenticeship providers, business associations, and educational institutions — highlighted the deep interconnections within the workforce system, from early education through long-term career support.

Key themes emphasize the importance of integrated, people-focused approaches to building the clean energy workforce. Strong industry-labor partnerships, such as Powering Chicago and PowerForward DuPage, are central to scaling apprenticeship programs and creating robust pipelines into the skilled trades. Pre-apprenticeship and apprenticeship models remain the gold standard for entering occupations such as electrical work, HVAC, roofing, and mechanics — even as clean-energy technologies evolve.

Illinois is widely recognized as a national leader in aligning climate action with workforce development through CEJA. CEJA established pre-apprenticeship programs, contractor incubators, and 13 Clean Jobs Workforce Hubs to connect residents — particularly those from historically marginalized communities — to emerging clean-energy careers. This infrastructure, paired with local workforce boards, community colleges, and trade unions, provides a strong foundation for fair job growth across the region. Yet, stakeholders emphasized that retention and long-term career advancement are as critical as access. Sustained support at every stage — from pre-apprenticeship entry through job placement and advancement — is needed to ensure that workers remain in the field and build lasting, family-sustaining careers.

Despite these strengths, several persistent barriers and structural weaknesses must be addressed. Career awareness often begins too late, and many potential participants lack access to foundational requirements such as a high-school diploma. Training completion is frequently hindered by logistical and financial barriers, including transportation, childcare, and exam preparation. Even with CEJA's significant investments, stakeholders noted a gap between the law's ambitions and the administrative capacity required to realize them. Many programs are still ramping up, and stronger coordination among grantees, training providers, and state agencies is needed. Improved partnerships between apprenticeship programs and employer or contractor associations are also essential to ensure that training leads to stable, high-quality employment.

Job quality and labor standards are equally vital. Without deliberate action, the clean energy transition could replicate existing inequities in job access, wage stability, and working conditions. To ensure that climate investments generate broadly shared economic benefits, states and local governments should pair workforce initiatives with strong labor standards — including prevailing wage requirements, project labor agreements, and registered apprenticeship utilization for publicly funded or ratepayer-funded projects. Aligning with CEJA's workforce framework ensures that new jobs are not only numerous but also high quality and family sustaining. Expanding CEJA's Workforce Hubs, Contractor Incubators, and Climate Works Pre-Apprenticeships — alongside partnerships with trade unions and community colleges —can strengthen job quality across sectors while improving equitable access to opportunity. These standards also help link training to long-term career pathways, ensuring the clean energy transition strengthens both worker well-being and regional economic resilience.

Building coordinated regional systems will be essential to meet long-term workforce needs. Illinois' CEJA provides a statewide framework through its Workforce Hubs, Contractor Incubator Programs, and Climate Works Pre-Apprenticeships, designed to prepare residents for clean-energy careers and ensure fair access to emerging opportunities. Across Greater Chicago, trade unions, community colleges, and workforce intermediaries are expanding programs in energy efficiency, electrification, and renewable energy. In Illinois, partners such as Powering Chicago, PowerForward DuPage, Chicago Women in Trades, HIRE360, and the Illinois Green Economy Network demonstrate how coordinated partnerships can connect training pipelines to real project demand. In Wisconsin, the Wisconsin Energy Workforce Consortium brings together utilities, contractors, and educators to align energy-sector training with employer needs. In Indiana, Ivy Tech Community College's Energy Technology Program and the Power Up Indiana initiative are developing clean energy and advanced-manufacturing pathways through stackable credentials and employer-based training.

Aligning these systems with plan implementation will be critical to connect training supply with project demand, track labor-market trends, and ensure that recruitment, apprenticeship, and reskilling opportunities reach every community. Continued collaboration among state agencies, unions, employers, and educational institutions will help the region build a workforce capable of meeting the scale and ambition of the clean energy transition.

However, significant uncertainty now surrounds the federal landscape that was expected to accelerate these efforts. While the Inflation Reduction Act and Bipartisan Infrastructure Law established historic funding commitments, recent federal rollbacks and implementation delays have created new challenges for states and regions planning around these resources. The Illinois EPA's Climate Pollution Reduction Grant remains a critical opportunity to align job creation with climate implementation, but realizing this potential will require sustained coordination and investment at the state and local levels. Strengthening regional partnerships, aligning funding streams, and maintaining focus on workforce equity will be essential to build the inclusive workforce needed to implement this plan.

At the same time, broader workforce shortages across multiple sectors — including healthcare, education, logistics, and skilled trades — create competition for qualified workers. These shortages could delay or increase the cost of climate implementation, particularly for strategies requiring large-scale expansion of renewable energy, building electrification, and transportation decarbonization. The challenge ahead is to ensure that the region can recruit, train, and retain the skilled workforce necessary to meet the plan's ambitious goals, while adapting its workforce systems to new demands and opportunities. Comparable programs and partnerships in Indiana and Wisconsin — modeled after CEJA's integrated, people-focused approach — will be critical to achieving a cohesive regional workforce strategy and ensuring that all 13 counties benefit from the clean-energy transition.

Through the course of stakeholder interviews and workforce analysis, several priority actions emerged to ensure the region can meet this plan's workforce needs:

1. **Strengthen and align regional workforce systems:** Establish formal coordination among workforce boards, unions, community colleges, and training providers across Illinois, Indiana, and Wisconsin to match training supply with project demand. Develop shared data and tracking tools to monitor job growth, training capacity, and equity outcomes across the 13-county region.
2. **Expand and sustain high-quality training pathways:** Scale up CEJA's Workforce Hubs, Contractor Incubators, and Climate Works Pre-Apprenticeships to meet rising labor demand, while supporting comparable programs in Indiana and Wisconsin. Prioritize expansion of programs that prepare workers for occupations in energy efficiency, building electrification, renewable energy, and grid modernization.
3. **Advance job quality and labor standards:** Adopt prevailing wage, project labor agreements, and registered apprenticeship utilization for all publicly funded or ratepayer-funded projects. Encourage employers to adopt the Ten Good Jobs Principles and strengthen connections between training and long-term career pathways.
4. **Improve access and retention for underrepresented workers:** Expand wraparound services — such as childcare, transportation, and test preparation — and integrate bilingual or ESL training where needed. Support community-based recruitment through trusted local organizations, especially in areas identified as facing workforce access disparities.
5. **Strengthen career awareness and early exposure:** Partner with school districts, career and technical education programs, and employers to provide early exposure to clean-energy careers beginning in middle and high school. Emphasize the economic and environmental importance of these fields to build long-term interest among students.
6. **Address systemic and administrative barriers:** Enhance the implementation capacity of existing programs by improving coordination between state agencies, grantees, and training providers. Streamline reporting, funding, and program evaluation requirements to help workforce programs focus on training outcomes rather than administrative burden.

7. **Plan for resilience amid federal uncertainty:** Develop state and regional contingency strategies to sustain workforce development momentum amid changing federal funding conditions. Coordinate state and local investment to ensure that workforce pipelines remain stable even if federal programs are delayed or reduced.

## County-level data

**Table E-3. Current jobs by subsector and by county (2022)**

| Primary occupations | Cook County | DuPage County | Kane County | Kendall County | Lake County (IL) | McHenry County | Will County | DeKalb County | Grundy County | Lake County (IN) | La Porte County | Porter County | Kenosha County | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture and working lands | 33 | 587 | 5 | 0 | 0 | 0 | 54 | 20 | 6 | 239 | 30 | 49 | 0 | 1,023 |
| Charging stations | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Commercial HVAC | 6725 | 3022 | 727 | 0 | 805 | 594 | 794 | 0 | 172 | 879 | 190 | 433 | 266 | 14,607 |
| Commercial other | 8133 | 3694 | 1143 | 158 | 720 | 428 | 491 | 114 | 42 | 1160 | 113 | 145 | 108 | 16,449 |
| Industry | 53849 | 9494 | 4414 | 575 | 3158 | 1262 | 4395 | 468 | 0 | 2790 | 1804 | 4403 | 2286 | 88,898 |
| Residential HVAC | 6323 | 2362 | 1130 | 209 | 1413 | 691 | 1176 | 135 | 128 | 782 | 159 | 360 | 124 | 14,992 |
| Residential other | 2333 | 564 | 312 | 0 | 590 | 254 | 559 | 101 | 0 | 225 | 0 | 86 | 65 | 5,089 |
| Residential shell | 1287 | 565 | 490 | 70 | 528 | 141 | 499 | 0 | 0 | 325 | 9 | 11 | 0 | 3,925 |
| Renewable energy generation | 58 | 0 | 0 | NA | 0 | 0 | 0 | NA | NA | NA | NA | NA | NA | 58 |
| Transmission and distribution | 610 | 986 | 376 | 0 | 0 | 0 | 449 | 0 | 0 | 0 | 0 | 0 | 0 | 2,421 |
| Transportation | 8126 | 2240 | 951 | 0 | 1142 | 708 | 2149 | 0 | 13 | 1229 | 159 | 331 | 219 | 17,267 |
| Waste | 2533 | 52 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 128 | NA | 0 | NA | 2,713 |
| Total | 90,010 | 23,566 | 9,548 | 1,012 | 8,356 | 4,078 | 10,566 | 838 | 361 | 7,757 | 2,464 | 5,818 | 3,068 | 167,442 |

Source: CMAP analysis of Bureau of Labor Statistics Quarterly Census of Employment and Wages, 2022.

**Table E-4. Jobs needed by type and by county to implement the full plan implementation scenario (2050)**

| Primary occupations | Cook County | DuPage County | Kane County | Kendall County | Lake County (IL) | McHenry County | Will County | DeKalb County | Grundy County | Lake County (IN) | La Porte County | Porter County | Kenosha County | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture and working lands | 6 | - | - | - | 3 | 1 | 1 | - | - | 9 | 1 | 10 | 1 | 31 |
| Charging stations | 1,357 | 439 | 203 | 85 | 322 | 189 | 271 | 60 | 72 | 196 | 58 | 92 | 47 | 3,389 |
| Commercial HVAC | 7,019 | 1,386 | 1,004 | 270 | 936 | 469 | 1,724 | 118 | 123 | 434 | 160 | 145 | 356 | 14,143 |
| Commercial other | 8,655 | 1,735 | 1,251 | 321 | 1,163 | 564 | 2,111 | 150 | 144 | 518 | 197 | 164 | 415 | 17,387 |
| Industry | 8,382 | 1,522 | 706 | 273 | 1,001 | 406 | 2,063 | 78 | 1,084 | 23,851 | 450 | 11,612 | 188 | 51,615 |
| Residential HVAC | 8,744 | 1,378 | 858 | 245 | 1,070 | 579 | 1,183 | 165 | 89 | 846 | 178 | 277 | 352 | 15,964 |
| Residential other | 3,241 | 499 | 307 | 87 | 388 | 210 | 418 | 58 | 31 | 247 | 58 | 83 | 103 | 5,731 |
| Residential shell | 3,952 | 629 | 338 | 88 | 474 | 209 | 437 | 68 | 34 | 359 | 83 | 119 | 114 | 6,904 |
| Renewable energy generation | 2,796 | 543 | 280 | 61 | 392 | 169 | 460 | 43 | 85 | 2,433 | 343 | 1,081 | 142 | 8,826 |
| Transmission and distribution | 21,864 | 4,096 | 2,003 | 540 | 3,142 | 1,314 | 3,865 | 307 | 926 | 11,295 | 760 | 5,073 | 781 | 55,967 |
| Transportation | -5,243 | -1,295 | -754 | -239 | -927 | -543 | -1,083 | -133 | -104 | -715 | -189 | -250 | -246 | -11,720 |
| Waste | 0 | 0 | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | 2 |
| Total | 60,772 | 10,933 | 6,195 | 1,732 | 7,964 | 3,568 | 11,450 | 914 | 2,484 | 39,472 | 2,099 | 18,405 | 2,253 | 168,239 |

Source: E3, 2025.

**Table E-5. Jobs needed by type and by county to implement state and local portion of the plan implementation scenario (2050)**

| Primary occupations | Cook County | DuPage County | Kane County | Kendall County | Lake County (IL) | McHenry County | Will County | DeKalb County | Grundy County | Lake County (IN) | La Porte County | Porter County | Kenosha County | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture and Working Lands | 6 | - | - | - | 3 | 1 | 1 | - | - | 9 | 1 | 10 | 1 | 31 |
| Charging Stations | 402 | 94 | 6 | 14 | 22 | 6 | 47 | 7 | 20 | 20 | 1 | 2 | (5) | 635 |
| Commercial HVAC | 6,046 | 1,194 | 867 | 237 | 807 | 406 | 1,492 | 102 | 106 | 374 | 138 | 125 | 309 | 12,203 |
| Commercial Other | 7,807 | 1,565 | 1,128 | 290 | 1,049 | 508 | 1,904 | 135 | 130 | 467 | 178 | 148 | 374 | 15,683 |
| Industry | 2,441 | 472 | 239 | 73 | 304 | 145 | 949 | 24 | 296 | 2,759 | 180 | 1,094 | 58 | 9,033 |
| Residential HVAC | 5,281 | 832 | 516 | 148 | 646 | 349 | 715 | 99 | 53 | 505 | 107 | 165 | 209 | 9,626 |
| Residential Other | 1,760 | 279 | 173 | 49 | 216 | 118 | 236 | 30 | 17 | 136 | 31 | 47 | 55 | 3,147 |
| Residential Shell | 1,774 | 282 | 152 | 39 | 213 | 94 | 196 | 30 | 15 | 161 | 37 | 54 | 51 | 3,099 |
| Renewable energy generation | 257 | 45 | 20 | 5 | 37 | 14 | 36 | 2 | 6 | 39 | 4 | 17 | 3 | 484 |
| Transmission and distribution | 9,860 | 1,738 | 774 | 197 | 1,413 | 529 | 1,365 | 83 | 221 | 927 | 103 | 400 | 354 | 17,964 |
| Transportation | (789) | (197) | (115) | (36) | (141) | (83) | (167) | (20) | (21) | (104) | (27) | (37) | (38) | (1,772) |
| Waste | - | - | - | - | - | - | - | - | - | - | - | - | - | 2 |
| Total | 34,846 | 6,305 | 3,761 | 1,016 | 4,570 | 2,088 | 6,774 | 493 | 842 | 5,293 | 753 | 2,025 | 1,371 | 70,136 |

Source: E3, 2025.

# Endnotes

[1] Gift cards were made possible through the generous support of the MacArthur Foundation.
[2] Pandemic-related changes in transportation and energy consumption make 2020 an anomalous year for some datasets, but it is still a viable year for this analysis. The inventory is built using modeled and reported data from various time scales and geographies, which reduces the impacts of short-term fluctuations, such as those experienced in 2020. The inventory results are comparable to past efforts to study emissions in the region.
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[32] The full list of health impacts evaluated in COBRA includes adult mortality; nonfatal heart attacks; infant mortality; hospital admits, all respiratory; hospital admits, cardiovascular; acute bronchitis; upper respiratory symptoms; lower respiratory symptoms; emergency room visits, asthma; asthma exacerbation; minor restricted activity days; work loss days.
[33] Reduction in VMT is assumed to be the result of shortened trip lengths and mode shifts to lower-emission modes, such as transit or active transportation, among other strategies. While individual VMT reduction strategies are not modeled within Pathways, internal CMAP modeling suggests that improvements to transit frequency, pricing strategies, and supportive land use policies are all necessary to achieve this level of VMT reduction, given the projected population increases in the region.
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[35] U.S. Bureau of Labor Statistics Midwest Information Office, "Chicago Area Economic Summary," September 4, 2025, accessed September 2025, https://www.bls.gov/regions/midwest/summary/blssummary_chicago.pdf. The Chicago metropolitan statistical area (MSA) consists of 14 counties, compared to 13 in the plan. The MSA includes Jasper and Newton counties in Indiana, which are not part of the plan, while the plan includes La Porte County, Indiana, which is not part of the MSA.
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[38] Lightcast, "The Standard for Labor Market Intelligence - Employment and Gross Regional Product."
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[54] National Renewable Energy Laboratory projections use national multipliers and do not reflect differences in local or state policy, labor supply, or training infrastructure. For instance, Illinois, Indiana, and Wisconsin show nearly identical growth percentages despite differences in clean energy policy.

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[62] Chicago Metropolitan Agency for Planning, *Community Data Snapshot: Calumet Park*, https://cmap.illinois.gov/data/community-snapshots/calumet-park.

[63] Chicago Metropolitan Agency for Planning, *Community Data Snapshot: Austin*, https://cmap.illinois.gov/data/community-snapshots/austin.

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Chicago Metropolitan Agency for Planning

The Chicago Metropolitan Agency for Planning (CMAP) is the comprehensive planning organization for the seven counties and 284 communities of northeastern Illinois. The agency and its partners developed and are now implementing ON TO 2050, a long-range plan to help the region implement strategies that address transportation, housing, economic development, open space, the environment, and other quality-of-life issues. Visit cmap.illinois.gov for more information.

Metropolitan Mayors Caucus

The Metropolitan Mayors Caucus is a membership organization of the Chicago region's 275 cities, towns and villages. Founded in 1997, the Caucus pushes past geographical boundaries and local interests to work on public policy issues. The organization provides a forum for metropolitan Chicago's chief elected officials to collaborate on common problems and work toward a common goal of improving the quality of life for the millions of people who call the region home. For more information, visit mayorscaucus.org, and connect with the organization on Facebook, LinkedIn, Instagram, YouTube, and X.

Northwestern Indiana Regional Planning Commission nirpc

The Northwestern Indiana Regional Planning Commission (NIRPC) is the official council of northwest Indiana governments, organized under Indiana Code 36-7-7.6t to serve the citizens of Lake, Porter, and LaPorte counties. NIRPC brings communities together to address issues of regional concern related to transportation, the environment, and economic development. Learn more at in.gov/nirpc.