Chicago Metropolitan Agency for Planning

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Memorandum

To: Metropolitan Mayors Caucus

From: Chicago Metropolitan Agency for Planning staff

Date: January 31, 2024 (Updated October 31, 2024)

Subject: Priority Climate Action Plan memo #1: Greenhouse gas inventory

Purpose: Provide a greenhouse gas inventory for the Chicago metropolitan statistical area.

To inform the development of the Chicago metropolitan statistical area's (MSA) Priority Climate Action Plan, this memo includes a summary of the greenhouse gas (GHG) emissions inventory for the 13 counties in the Greater Chicago Area (2020 Greater Chicago Area inventory) and an overview of the methodology used to develop the inventory. The memo details 2020 GHG emissions by both sector and relevant subsectors, and also reports total and per-capita emissions by county.

The process by which emission sources and sinks are identified and quantified within the planning geography is critical to the climate action planning process and will help the region identify and assess GHG reduction measures, conduct benefit analyses, and both set and track progress toward its emission reduction targets. The GHG inventory was developed in accordance with U.S. Environmental Protection Agency (EPA) guidance provided via the Climate Pollution Reduction Grant program.

CMAP will continue to update the inventory, as needed, during the development of the Climate Action Plan for the Chicago MSA. As of October 2024, this update includes the addition of aviation emissions, additional sources of carbon sequestration, and removing duplicate emissions within the industrial sector.

Methodology

Underlying data

The 2020 Chicago MSA Greenhouse Gas Inventory includes 2020 county-level emissions data for three major GHGs: carbon dioxide, methane, and nitrous oxide. CMAP chose the year 2020 because it was the most recent year available across the geography.[1] CMAP also reviewed past inventories for northeastern Illinois (2019) and northwestern Indiana (2017).

[1] 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.

The 2020 Chicago MSA Greenhouse Gas Inventory covers emissions from eight sectors: transportation, residential (electricity and natural gas usage), commercial (electricity and natural gas usage), industrial (electricity usage, natural gas usage, and emissions from industrial processes), agriculture, waste, and wastewater. It also estimates carbon dioxide equivalent (CO2e) removed due to carbon sequestration from natural lands within the region. Table 1 lists the GHG inventory sectors and their data sources.

Table 1. Greenhouse gas inventory sectors and data sources

Sector	Source
Transportation: Non-Aviation	National Emissions Inventory (NEI)
Transportation: Aviation	Federal Aviation Administration (FAA) and Re-Evaluation of the O'Hare Modernization Environmental Impact Statement Report
Residential: Natural gas	DOE/NREL SLOPE Tool
Residential: Electricity	DOE/NREL SLOPE Tool and IL, IN, and WI eGRID rates
Commercial: Natural gas	DOE/NREL SLOPE Tool
Commercial: Electricity	DOE/NREL SLOPE Tool and IL, IN, and WI eGRID rates
Industrial: Natural gas	DOE/NREL SLOPE Tool
Industrial: Electricity	DOE/NREL SLOPE Tool and IL, IN, and WI eGRID rates
Industrial: Processes, Fugitive Emissions and Industrial Stationary Energy Combustion (excluding Natural Gas)	EPA Greenhouse Gas Reporting Program (EPA GHGRP)
Agriculture and Land Management	EPA State Inventory Tool (SIT) scaled with USDA cropland acreage
Solid Waste	EPA FLIGHT Tool/EPA GHGRP
Wastewater	MWRD data scaled with U.S. Census population data
Water Conveyance	CMAP water demand forecast, Illinois Section American Water Works Association, Indiana Department of Environmental Management
Carbon Sinks: Trees	Tree canopy data from U.S. Department of Agriculture tool, i-Tree. Land use data from Replica
Carbon Sinks: Wetlands & Land Use Change	EPA State Inventory Tool (SIT) scaled with USDA cropland acreage

Source: CMAP, 2024.

Emissions calculation by sector

To calculate emissions for each sector, CMAP used the U.S. EPA's Local Greenhouse Gas Inventory Tool (LGGIT) for community-wide inventories, following guidance outlined in the U.S. EPA Climate Pollution Reduction Grant Program.[2]

Commercial and residential sector stationary energy emissions include emissions resulting from grid-supplied electricity and natural gas used for heat, steam, cooling, and other processes. Calculations for these emissions used data on electricity and natural gas fuel consumption supplied by the Department of Energy (DOE) and National Renewable Energy Laboratory (NREL) SLOPE tool,[3] Emissions from electricity used in the region were calculated using the U.S. EPA Emissions and Generation Resource Integrated Database (eGRID),[4] which discloses environmental characteristics of electricity generated in

[2] U.S. EPA, 2023, Climate Pollution Reduction Grant Program, GHG Inventory guidance, https://www.epa.gov/inflation-reduction-act/cprg-tools-and-technical-assistance-greenhouse-gas-inventory

[3] SLOPE, or State and Local Planning for Energy platform, is available at https://www.energy.gov/scep/slsc/state-and-local-planning-energy-slope-platform

[4] eGrid is available at https://www.epa.gov/egrid

the multi-state electrical transmission region and within each state. The 2020 Chicago MSA Greenhouse Gas Inventory uses state eGRID emission rates.

For industrial emissions, stationary energy emissions from natural gas and grid-supplied electricity were calculated using DOE and NREL SLOPE data, following the same approach used for the commercial and residential sectors. To fill gaps in SLOPE data and capture a more accurate scope of industrial emissions, we incorporated additional data from the EPA Greenhouse Gas Reporting Program (GHGRP). [5] GHGRP data provided emissions estimates for industrial processes and fugitive emissions, as well as stationary combustion emissions from non-natural gas fuels. Since SLOPE data already accounts for natural gas combustions, we excluded GHGRP natural gas emissions to avoid double counting.

The GHGRP also includes emissions from other types of facilities, such as electricity generation, waste, and wastewater facilities, which were already represented in other sectors of the inventory. These emissions were excluded from the industrial sector calculations to ensure they were only counted once, maintaining the inventory's accuracy and consistency across sectors.

Emissions for the transportation sector, not including aviation, were calculated using results from the National Emissions Inventory (NEI),[6] and captured mobile sources, including on-road emissions, non-road equipment, locomotives, and commercial marine vessels. Aviation emissions were calculated using results from the Federal Aviation Administration (FAA)[7] and the *Re-Evaluation of the O'Hare Modernization Environmental Impact Statement Report*.[8] This approach captures emissions from the direct combustion of fuel consumed during landing and takeoff at airports that serve the region.

Emissions from the waste sector were calculated using the U.S. EPA Facility Level Information on Greenhouse Gases Tool (FLIGHT),[9] a publicly accessible database that reports on large GHG emissions sources. The FLIGHT tool reports carbon dioxide, methane, and nitrous oxide emissions in CO2e using the Global Warming Potential Values,[10] which allows for comparisons of global warming impacts of different gases. These values were informed by a report by the Intergovernmental Panel on Climate Change (IPCC). The Chicago MSA Greenhouse Gas Inventory uses the conversion values from the IPCC's fifth assessment report. However, the FLIGHT tool uses values from the IPCC fourth assessment report, which differ from the conversion values used in this inventory. As a result, these values were converted to raw emissions values and then into CO2e using the fifth assessment report rates for this inventory.

Emissions associated with biogas emissions from wastewater treatment facilities within the MSA region were calculated and scaled based on data provided by the Metropolitan Water Reclamation District (MWRD). This data was utilized to calculate kilograms of methane and nitrous oxide per person for the CMAP region. Since data from all wastewater treatment plants in the region were not available, CMAP used MWRD methane and nitrous oxide per-person rates to scale wastewater sector biogas emissions to the MSA level based on county population totals from the 2020 U.S. Census.

[5] The U.S. EPA GHGRP requires reporting of greenhouse gas data and other relevant information from large GHG emission sources, fuel and industrial gas suppliers, and carbon dioxide injection sites in the United States. See https://www.epa.gov/ghgreporting

[6] NEI is available at https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei

[7] Airport operations data is available at https://aspm.faa.gov/opsnet/sys/airport.asp

[8] Fuel consumption rate is available at https://www.faa.gov/airports/great_lakes/omp/eis_re_eval/media/Appendix_F.pdf

[9] FLIGHT is available at https://ghgdata.epa.gov/ghgp/main.do?site_preference=normal

[10] More information about Global Warming Potential Values can be found at https://www.epa.gov/ghgemissions/understanding-global-warming-potentials

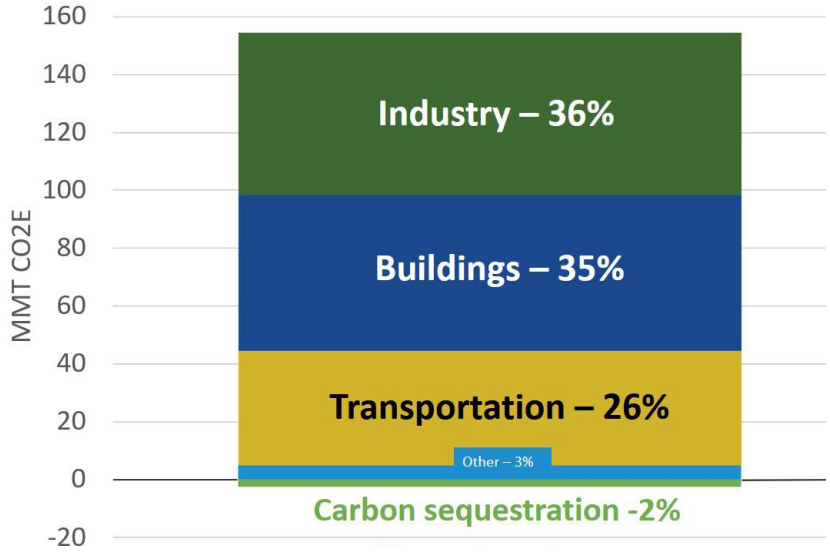
Agriculture emissions from fertilizer consumption, are scaled from the agriculture module of the U.S. EPA State Inventory Tool (SIT).[11] This dataset lists total nitrogen consumption in metric tons by state. After state-level data was calculated, it was downscaled to the county level using the proportion of state cropland acreage found within each of the counties in the MSA region. Total cropland acres in each relevant county and state were downloaded from the U.S. Department of Agriculture (USDA) QuickStats database.[12]

All emissions within the inventory are expressed in million metric tons of carbon dioxide equivalent (MMTCO2e).

2020 Chicago MSA Greenhouse Gas Inventory

In 2020, the 13 counties in the Chicago MSA produced approximately 152 million metric tons of carbon dioxide equivalent (MMTCO2e) of GHG emissions. Figure 1 provides the greenhouse gas emissions inventory for the Chicago MSA region, broken down by the following sectors: transportation, buildings, industry, other, and carbon sequestration. The other category consists of emissions from the following sectors: waste, wastewater, water conveyance, and agriculture. Figure 2 provides the same information, broken down by subsector and highlights the relative contributions of electricity and natural gas across the building sectors. Figure 3 rank orders the subsectors based on greatest to least share of the total inventory.

Figure 1. Greenhouse gas emissions in the Chicago MSA region by sector, 2020



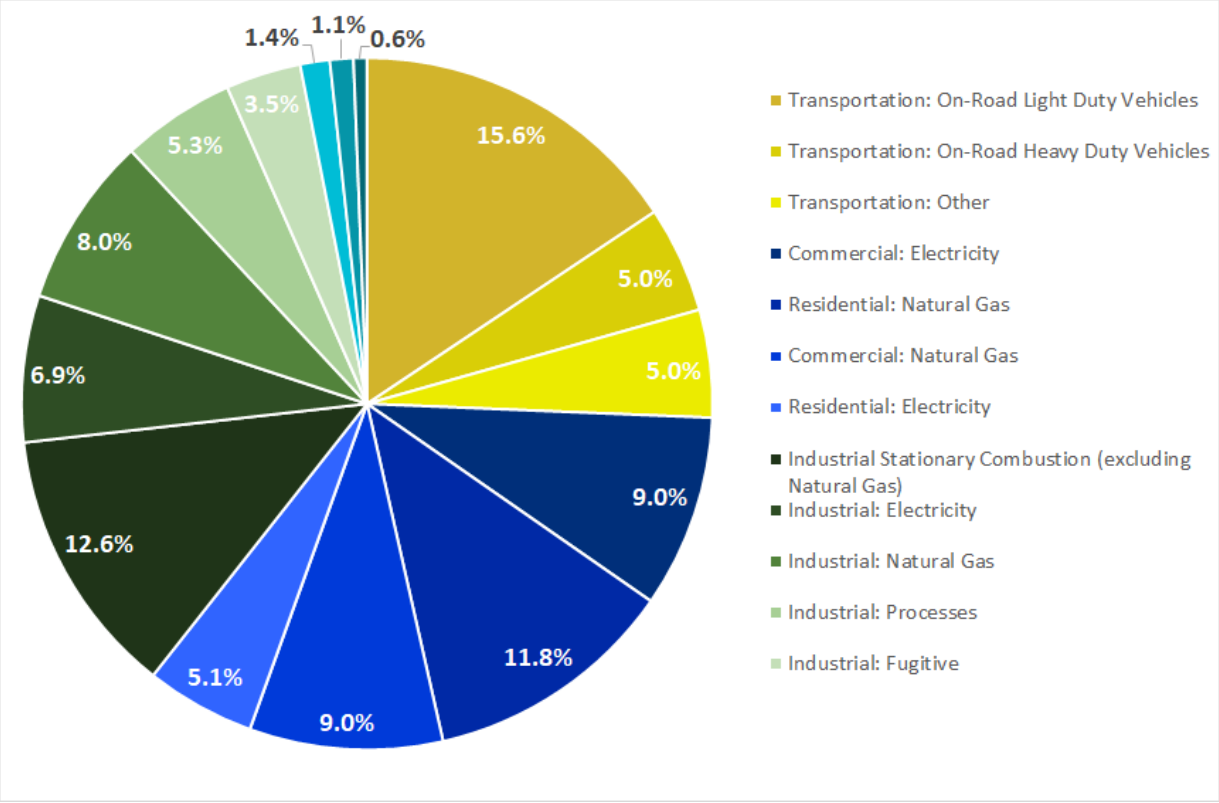
Source: CMAP, 2024.

The MSA's GHG inventory shows that industry and transportation — two prominent emission sectors — comprise over 60 percent of total emissions. This is likely due to the region's important role as national transportation and manufacturing hubs. The Chicago region is home to 10 interstate highways, six Class I railroads, one of the nation's busiest air-cargo hubs, and the only maritime connection between the St. Lawrence Seaway and the Mississippi River system. These transportation resources directly produce greenhouse gas emissions and make the region an ideal location for industry. The Chicago region's current and historical role as manufacturing and transportation centers, combined with its dependance on fossil fuels, make the region a major contributor to the United States' total GHG output.

[11] SIT is available at https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool
[12] Crop acreage by state and county can be found at https://quickstats.nass.usda.gov/

Approximately 26 percent of regional emissions come from transportation. On-road transportation, which includes public and private cars, buses, and trucks, is overwhelmingly the largest source of transportation emissions (80 percent) and is the single largest subsector overall. Approximately 61 percent of transportation emissions come from light duty vehicles, such as private cars, SUVs, and small trucks. An additional 19 percent of transportation emissions come from heavy duty vehicles such as large trucks. See Figure 2 for more detail. Other transportation sources include non-road equipment, locomotives, commercial marine vessels, and aviation.

Figure 2. Greenhouse gas emissions in the Chicago MSA region by subsector, 2020



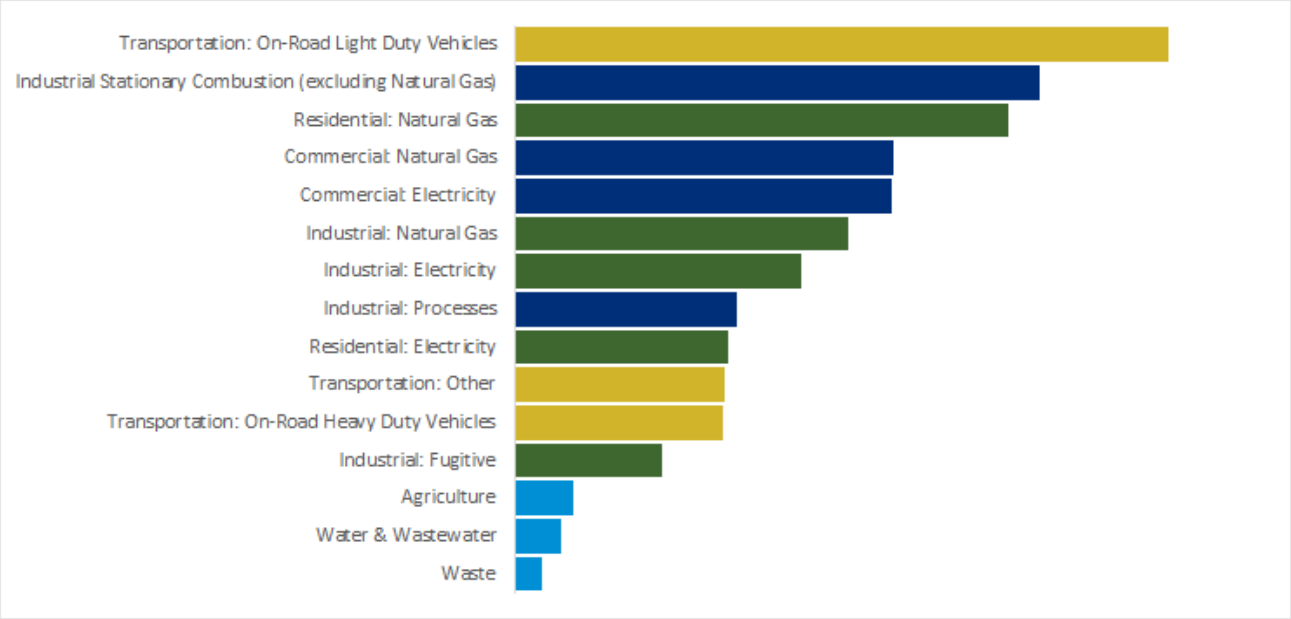
Source: CMAP, 2024.

Industrial emissions from electricity, fuel use (natural gas and other fuels), industrial process emissions, and fugitive emissions account for 36 percent of the MSA's total emissions. Within industry, natural gas use accounts for approximately 22 percent and electricity use accounts for about 19 percent of GHG emissions. Stationary combustion of fuels excluding natural gas account for 35 percent of all industrial emissions in the region.

Emissions from commercial and residential buildings are also notable, as shown in Figure 2. Commercial buildings, including institutional buildings, accounted for 18 percent of all emissions, while residential buildings accounted for 17 percent. This is likely due to the region's northern climate, leading to significant heating and cooling needs, as well as regional concentrations of older building stock. Within the residential buildings sector, natural gas use accounts for approximately 70 percent of emissions while electricity use accounts for 30 percent. Within the commercial buildings sector, natural gas use accounts for about 50 percent of GHG emissions while electricity use accounts for 50 percent.

Agriculture (1.4 percent), water and wastewater (1.1 percent), and waste (0.6 percent) are the smallest shares of the overall GHG emissions inventory, shown in Figure 2. Carbon sequestration, focused on trees and wetlands, removed an estimated 2.74 MMTCO2e in 2020.

Figure 3. Greenhouse gas emissions in the Chicago MSA region by subsector, listed in order of greatest to least share of the total inventory, 2020



Source: CMAP, 2024.

Natural gas emissions associated with onsite residential, commercial fuel use account for 21 percent of total emissions. Most emissions in the transportation sector are associated with gasoline and diesel.[13]

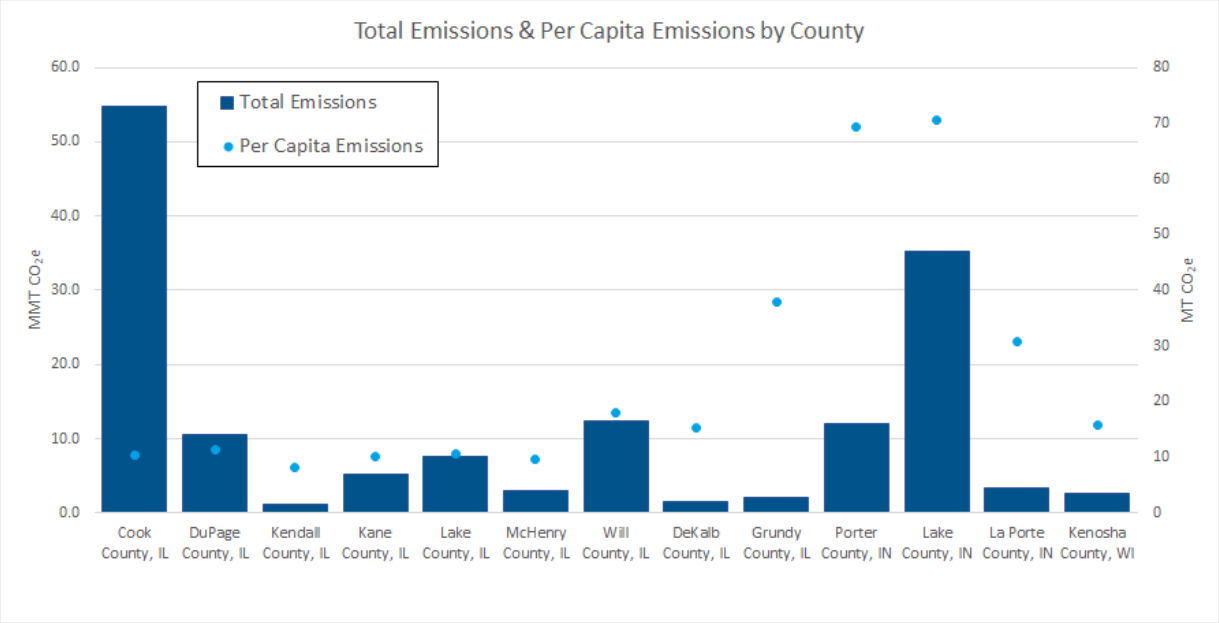
Results by county

Figure 4 and Table 2 provide total and per capita GHG emissions respectively at the county level for 2020. Notably, Cook County, IL generated the most emissions of any geography in the region by a significant margin (36 percent of total emissions, or 54.8 MMTCO2e), followed by Lake County, IN (23 percent, or 35.2 MMT C02e); Will County, IL (8 percent, or 12.5 MMT C02e), and Porter County, IN (8 percent, or 12.5 MMT CO2e).

On a per capita basis, Lake County, IN (70.5 MT C02e/person); Porter County, IN (69.3 MT C02e/person); and Grundy County, IL (37.9 MT C02e/person) produced the most emissions per capita. Kendall County, IL (8.2 MT CO2e/person); McHenry County, IL (9.6 MT C02e/person); and Kane County, IL (10.2MT CO2e/person) were the most efficient.

[13] Electricity used to power electric vehicles cannot be attributed to the transportation sector at this time.

Figure 4. Greenhouse gas emissions in the Chicago MSA region, total and per capita, by county, 2020



Source: CMAP, 2024.

Table 2. Greenhouse gas emissions in the Chicago MSA region, total and per capita, by county, 2020

County	Total emissions (MMT C02e)	(Percent)	Per capita emissions (MT C02e/person)
Cook County, IL	54.8	36%	10.4
DuPage County, IL	10.5	7%	11.3
Kendall County, IL	1.1	1%	8.2
Kane County, IL	5.3	3%	10.2
Lake County, IL	7.6	5%	10.6
McHenry County, IL	3.0	2%	9.6
Will County, IL	12.5	8%	17.9
DeKalb County, IL	1.5	1%	15.2
Grundy County, IL	2.0	1%	37.9
Porter, IN	12.0	8%	69.3
Lake County, IN	35.2	23%	70.5
La Porte, IN	3.4	2%	30.9
Kenosha County, WI	2.7	2%	15.7

Source: CMAP, 2024

Results by state

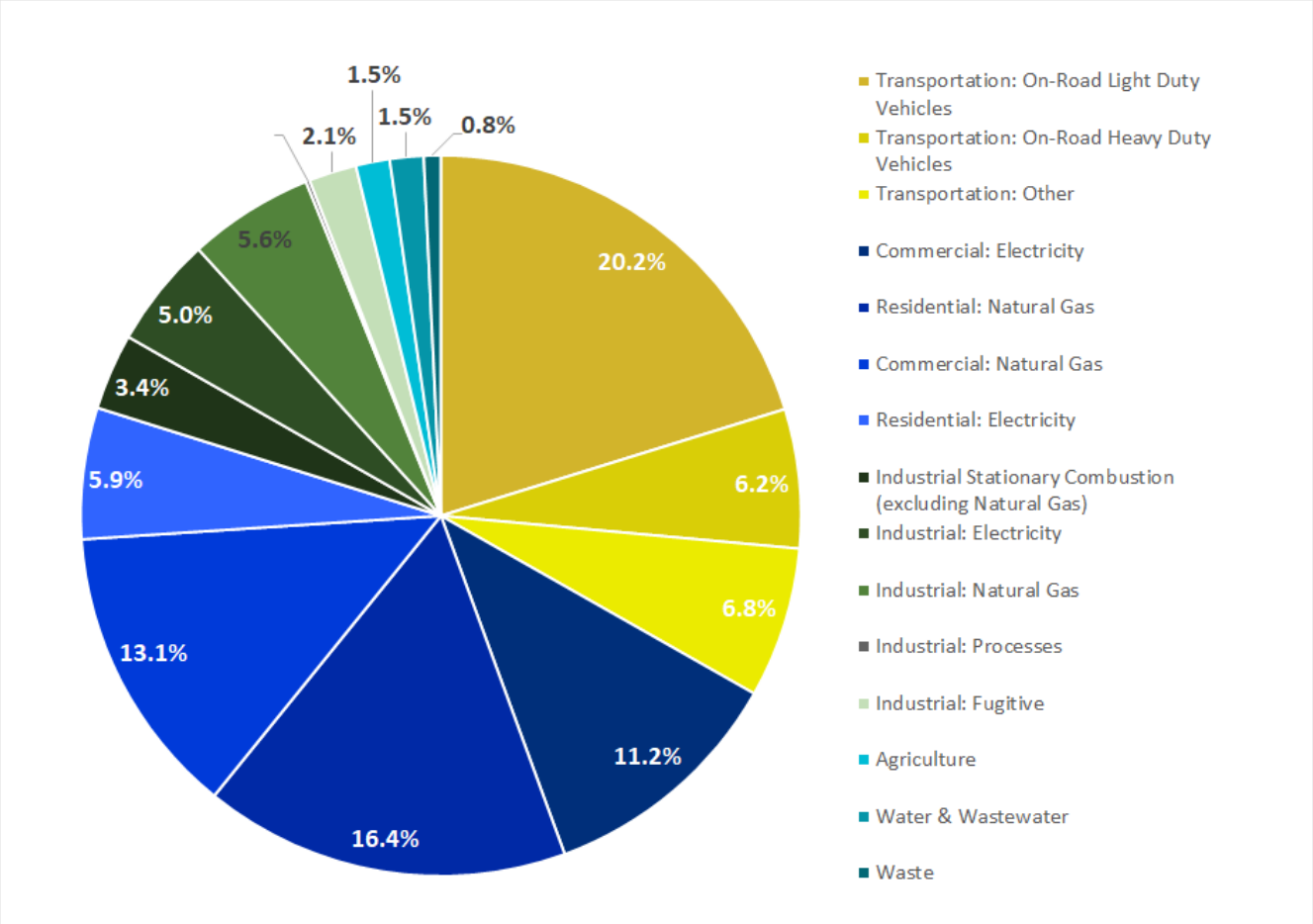
When viewing Chicago MSA GHG emissions by state, stark differences in the types of regional emissions come into focus. For example, 80 percent of all industrial emissions are concentrated in Lake County, IN; Porter County, IN; and Cook County, IL.

Illinois portion of the Chicago MSA

The Illinois portion of the Chicago MSA represents 64 percent of the region's total GHG emissions and includes the counties of Cook, DuPage, Kendall, Kane, Lake, McHenry, Will, DeKalb, and Grundy. These emissions are detailed by subsector in Figure 5.

Emissions attributed to Illinois mirror the rest of the MSA; however, Illinois industrial emissions represent a much smaller portion of the overall MSA's emissions profile — a total of 16 percent versus 36 percent for the total Chicago MSA inventory.

Figure 5. Illinois portion of the Chicago MSA GHG emissions by subsector, 2020.

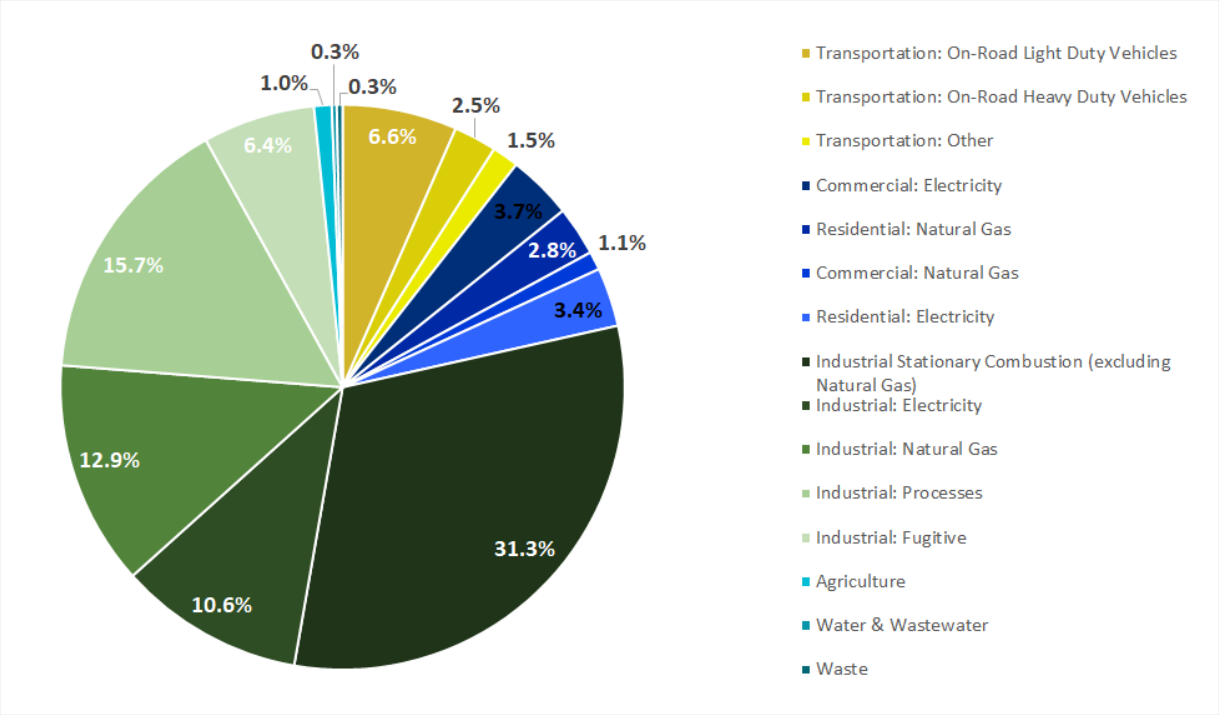


Source: CMAP, 2024

Indiana portion of the Chicago MSA

The Indiana portion of the Chicago MSA represents 33 percent of the total MSA emissions and includes the counties of Porter, La Porte, and Lake. As shown in Figure 6, northwest Indiana has a significantly larger percentage of emissions from industrial energy emissions compared with other parts of the MSA. The Northwest Indiana Regional Planning Commission's (NIRPC) 2017 GHG emissions inventory attributed 77.9 percent of the area's GHG emissions to this source. Similarly, the 2020 Chicago MSA inventory also found that 77.6 percent of GHG emissions in the NIRPC region come from industrial sources.

Figure 6. Indiana portion of the Chicago MSA GHG emissions by subsector, 2020



Source: CMAP, 2024