2015 Chicago Regional Greenhouse Gas Emissions Inventory

CMAP

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2015 Chicago Regional Greenhouse Gas Emissions Inventory

Final Report

Prepared for:

The Chicago Metropolitan Agency for Planning (CMAP)

Prepared by:

ICF

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CMAP

ICF

Contents

Acronyms and Abbreviations

AFV	alternative fuel vehicle
CDD	cooling degree days
CH_4	methane
CMAP	Chicago Metropolitan Agency for Planning
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
ComEd	Commonwealth Edison
CTA	Chicago Transit Authority
eGRID	Emissions & Generation Resource Integrated Database
EPA	Environmental Protection Agency
FTA	Federal Transit Administration
GDP	Gross Domestic Product
GHG	greenhouse gas
GHGRP	Greenhouse Gas Reporting Program
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
GTM	gross ton mile
GWP	Global Warming Potential
HDD	heating degree days
N_2O	nitrous oxide
ICIS	Integrated Compliance Information System
IMEA	Illinois Municipal Electric Agency
IPCC	Intergovernmental Panel on Climate Change
MOVES	Motor Vehicle Emissions Simulator
MSA	Metropolitan Statistical Area
MWRD	Metropolitan Water Reclamation District
NICTD	Northern Indiana Commuter Transportation District
NTD	National Transit Database
ORNL	Oak Ridge National Laboratory
SWALCO	Solid Waste Agency of Lake County
TRAGIS	Transportation Routing Analysis Geographic Information System
VMT	vehicle miles traveled

Executive Summary

This report provides a summary of greenhouse gas (GHG) emissions for the seven-county Chicago Region, which includes Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will counties (see map to the right). Greenhouse gases are gases that trap heat in the atmosphere and contribute to climate change.

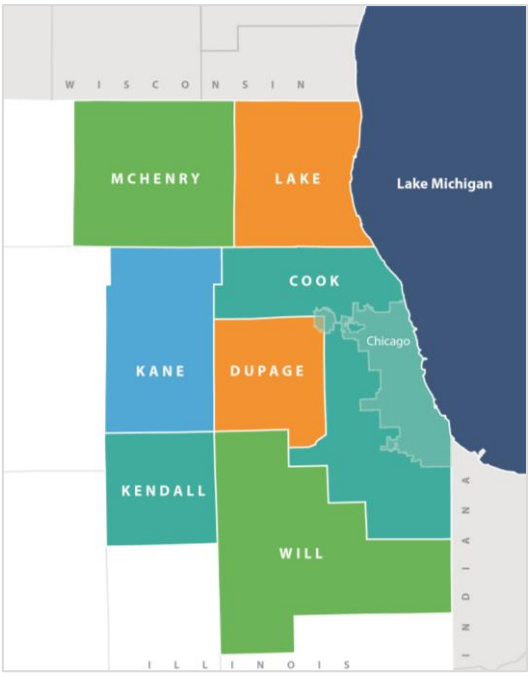
The Chicago Region is actively planning for climate change, including increasing regional resilience to anticipated climate change impacts and reducing emissions to help curb climate change overall. This inventory report is an important part of efforts to reduce emissions, as it identifies major sources of GHG emissions and provides information on emissions trends over time.

Summary of 2015 Emissions

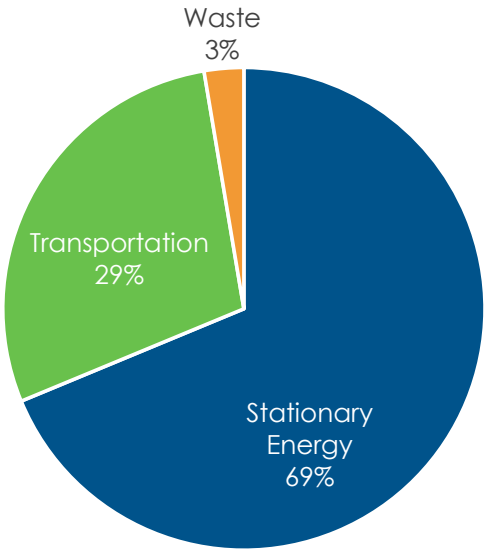
In 2015, the Chicago Region produced approximately 119 $MMTCO_2e$ of GHG emissions. The figure to the right provides a breakout of regional emissions by sector.

Cook County, which includes the City of Chicago, accounted for more than half of regional emissions, followed by Will County, DuPage County, Lake County, Kane County, McHenry County, and Kendall County, in that order.

Map of Chicago Region

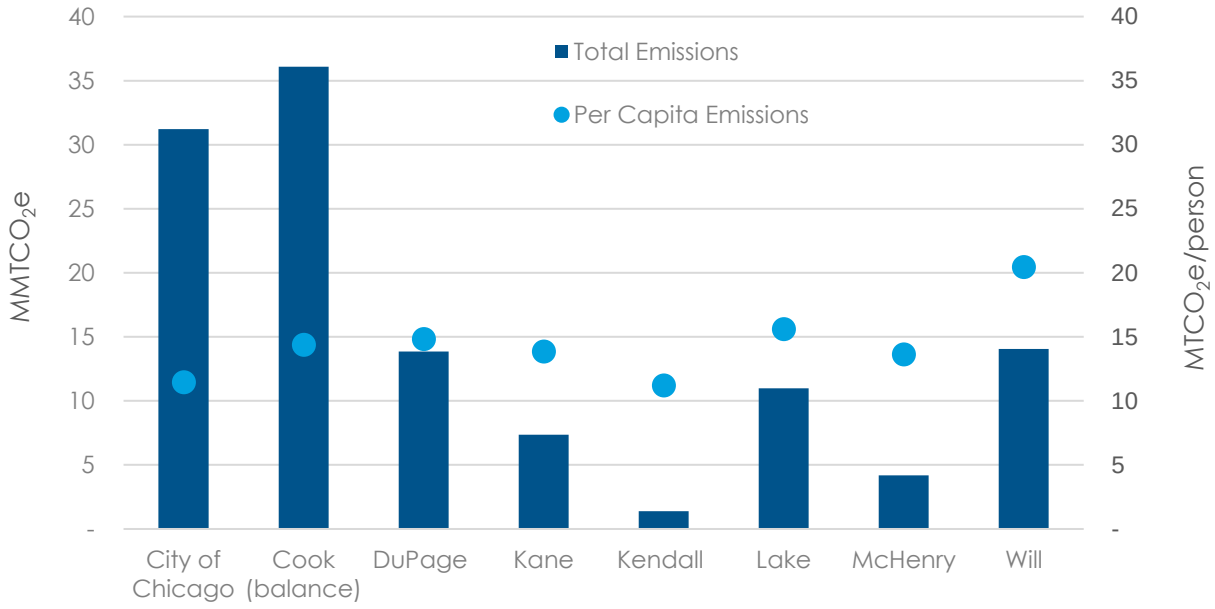


2015 Regional Emissions by Sector



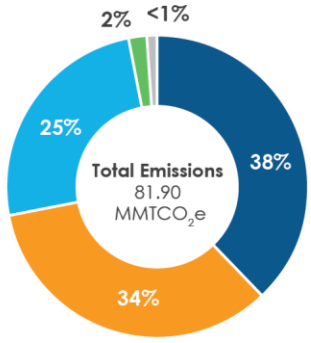
Note: Totals in figures do not always sum to 100 percent due to independent rounding.

2015 Chicago Region Emissions and Per Capita Emissions by County



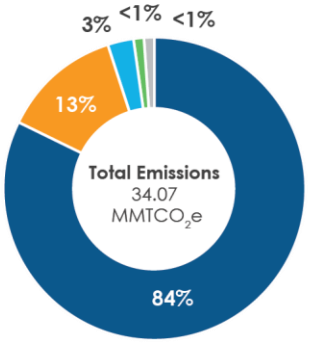
The three figures below show the breakdown of 2015 emissions within each sector.

Stationary Energy Emissions



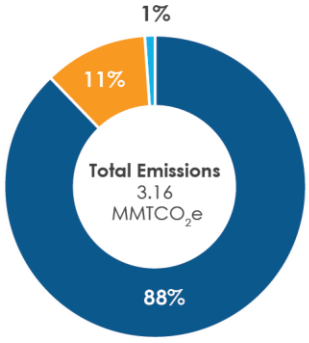
- Residential buildings
- Commercial and institutional buildings and facilities
- Manufacturing industries
- Fugitive emissions from oil and natural gas systems
- Energy industries

Transportation Emissions



- On-road
- Off-road
- Railways
- Waterborne navigation
- Aviation

Waste Emissions



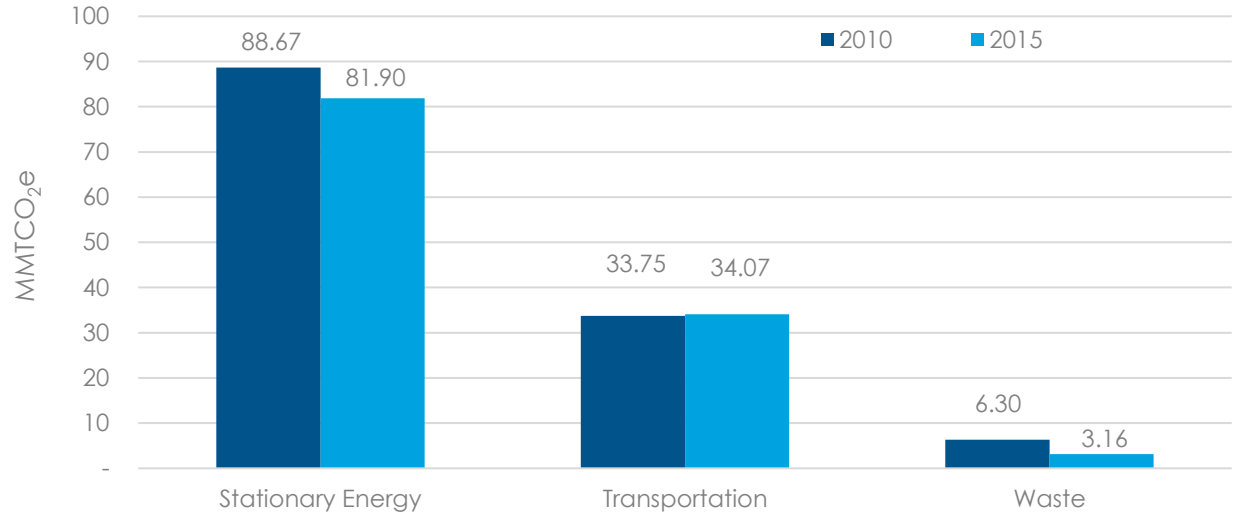
- Disposal of solid waste generated in the region
- Wastewater generated in the region
- Biological treatment of waste generated in the region

Notes: Energy industries refers to emissions from energy production and energy use on-site by power plants, excluding emissions associated with electricity generation for utility customers. Waterborne navigation and aviation represent emissions from intra-regional travel (trips that originate and end within the Chicago Region).

Emissions Trends

Total emissions for the Chicago Region decreased by 9.59 $MMTCO_2e$, or approximately 7%, from 2010 to 2015. This decrease resulted from decreases in emissions from the Stationary Energy and Waste sectors, which offset a slight increase in emissions from the Transportation sector. Per capita emissions for the Chicago Region similarly decreased from 2010 to 2015, by 1.29 $MTCO_2e$ per person, or approximately 8%.

Regional Emissions by Sector, 2010 and 2015



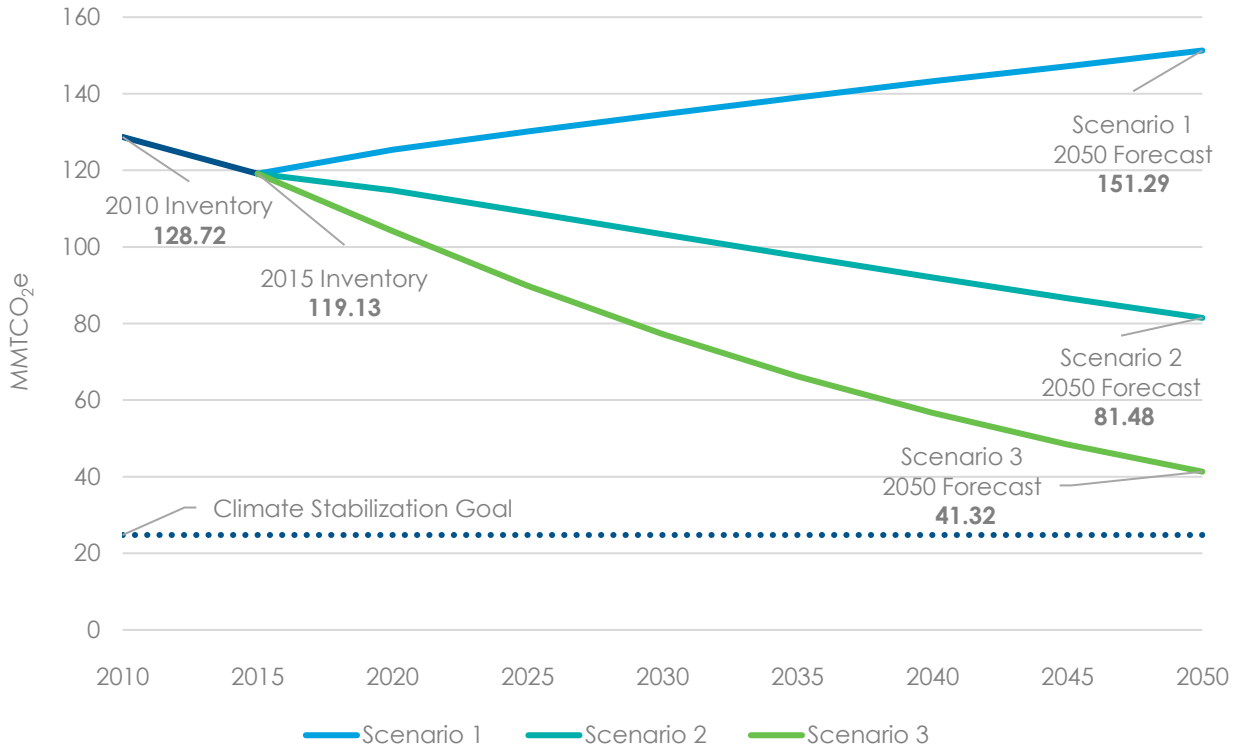
Stationary Energy emissions decreased due to a decrease in electricity use, which more than offset the impact from an increase in natural gas consumption by consumers. Weather played a factor in these trends with a milder summer and colder winter in 2015 relative to 2010. Waste emissions decreased due to an increase in methane capture at landfills. Transportation emissions increased slightly due to an increase in off-road fuel consumption.

Emissions Projections

The team projected emissions for the Chicago Region under three scenarios to show how emissions from the region may change in the future.

- **Scenario 1:** Assumes no change in emissions per capita from 2015 through 2050.
- **Scenario 2:** Assumes that per capita emissions will decrease by approximately 8.5% every five years (same rate of decrease as from 2010 to 2015).
- **Scenario 3:** Assumes that per capita emissions will decrease by approximately 17% every five years (double the rate of decrease from 2010 to 2015).

Emissions Estimates and Projections for the Chicago Region, 2010–2050



Note: The climate stabilization goal is equivalent to a reduction of emissions to 80% below 1990 levels by 2050. This goal aligns with the scientific consensus regarding the level of emissions necessary in developed countries to stabilize the climate with a global temperature increase of no more than 2 degrees Centigrade.

CHAPTER 1

Introduction

CHAPTER 1. Introduction

Climate Change Overview

Earth's climate is changing. Over the last several decades, the temperature of the atmosphere and ocean has increased, glaciers and sea ice levels have decreased, and the global mean sea level has risen (IPCC 2014). Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850 (IPCC 2014).

While there are several factors that can affect Earth's climate, scientists agree that it is extremely likely that most of the observed temperature increase since 1950 is due to human-caused increases in greenhouse gases (GHGs) in the atmosphere, along with other human-caused changes like deforestation (IPCC 2014). Greenhouse gases are gases that trap heat in the atmosphere and warm the planet (U.S. EPA 2017a). Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and several synthetic fluorinated gases.

While CO_2, CH_4, and N_2O occur naturally in the atmosphere, human activities have significantly increased their atmospheric concentrations. A wide range of sectors, activities, and sources produce GHG emissions (U.S. EPA 2017a):

- **CO_2:** Sources include burning fossil fuels (coal, natural gas, oil), solid waste, trees, and wood products, as well as some chemical reactions. Carbon dioxide can be removed from the atmosphere by plants.
- **CH_4:** Sources include the production and transport of fossil fuels; livestock and agricultural practices; and the decay of organic waste in landfills.
- **N_2O:** Sources include agricultural and industrial activities, as well as the combustion of fossil fuels and solid waste.
- **Fluorinated gases:** Sources include industrial processes.

All GHGs lead to warming; however, the amount of warming depends on how effectively the gas traps heat and how long it stays in the atmosphere. To compare the impact of each GHG, the Intergovernmental Panel on Climate Change (IPCC) developed the concept of the Global Warming Potential (GWP), which relates each gas's ability to trap heat in the atmosphere to the reference gas, CO_2 (IPCC 2014). By definition, CO_2 has a

GWP of one and all GWP-weighted emissions are measured in units of CO_2-equivalent (CO_2e). To the right is a table of GWPs for the GHGs used in this inventory report.[1]

Greenhouse gases stay in the atmosphere for different lengths of time, ranging from a few years to thousands of years. However, all gases stay in the atmosphere long enough to become well mixed, meaning that the amount of each gas in the atmosphere is roughly the same across the globe, regardless of where emissions occur (U.S. EPA 2017a). As a result, local emissions of GHGs have a global impact.

Table 1-1 ■ Global Warming Potentials used in this Report

Gas	GWP
CO_2	1
CH_4	28
N_2O	265

Source: IPCC (2014).
Note: Global Warming Potentials are for a 100-year time horizon.

Global climate change has had and will continue to have significant impacts on natural and human systems across the globe. The local impacts of climate change differ from region to region. Temperatures have increased by approximately 1°F in the State of Illinois since the beginning of the 20th century (NOAA 2017), with impacts that include longer droughts, increased heavy storm events, and greater flooding (CMAP 2016). Projected future impacts of continued warming include (CMAP 2016):

- Higher risk and severity of extreme weather
- Warmer winters with fewer freezing temperatures, resulting in increased wear on the built environment from freeze-thaw events
- Increases in annual precipitation and heavy precipitation events, as well as a greater risk of flash floods

Local Air Quality

Under the Clean Air Act, the air quality for a given area is assessed for six common air pollutants (particulate matter, ozone precursors, carbon monoxide, sulfur oxides, nitrogen oxides and lead), also known as criteria pollutants. The U.S. Environmental Protection Agency (EPA) designates "nonattainment areas", which are geographic areas where air pollution levels do not met the primary standard. The Chicago Region is in nonattainment of the Clean Air Act for ozone pollution. Ozone emissions come primarily from non-point pollution sources, such as private automobiles, commercial trucks, and heavy machinery (CMAP 2018a), all of which also emit GHGs. Emissions from ozone and other criteria pollutants are not included in this report.

[1] No emissions of fluorinated gases are reported in this inventory report because industrial process emissions are not included within the scope of this inventory.

- Changes in local ecosystems and increase in invasive species
- Increases in illness and deaths due to extreme temperatures and resulting exposure

Potential economic impacts of these changes include damages to transportation infrastructure from heavy rainfall events and extreme temperatures; damages to buildings and other infrastructure from increased flooding and extreme storms, with subsequent impacts on insurance coverage and rates; and shifts in the timing and amount of seasonal energy demand for both residential and commercial heating and cooling.

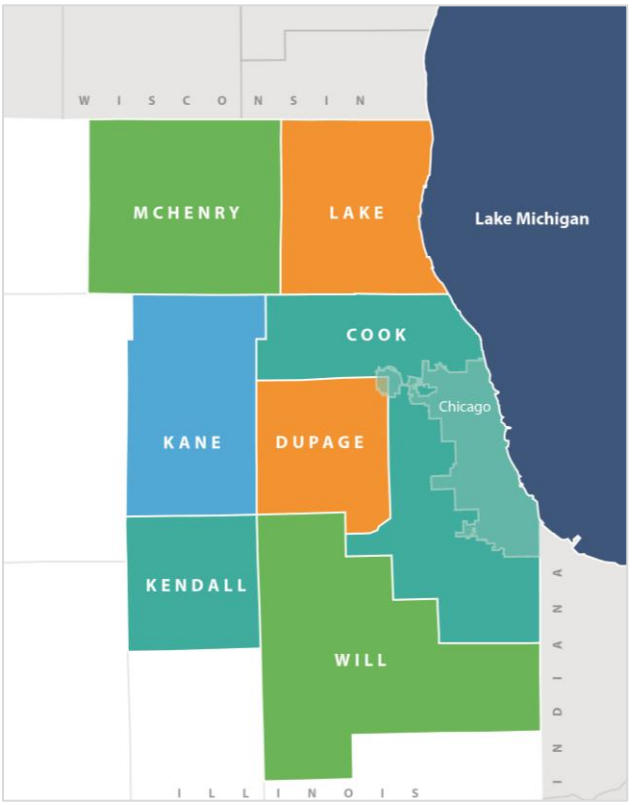
Overview of the Chicago Region

This report provides a summary of GHG emissions for the Chicago Region and therefore reflects the region's unique geography, climate, demographics, economic activity, and general character as well as planned future growth.

The seven-county Chicago Metropolitan Region (referred to as the Chicago Region) includes Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will counties and covers over 3,900 square miles on the flat Central Lowlands area of the Midwest (U.S. Census Bureau 2010). The region is relatively flat with broad, shallow floodplains.

The Chicago Region has a continental climate, meaning it experiences cold winters, warm summers, and frequent fluctuations in temperature, humidity, cloudiness, and wind direction. Lake Michigan moderates the region's temperature while increasing snowfall. Weather conditions and precipitation amounts in the Chicago Region vary considerably depending the time of year and location within the region (Angel n.d.).

Figure 1-1 ■ Map of the Chicago Region



The Chicago Region includes 284 municipalities and has a population of approximately 8.5 million in 2015. Cook County is the most populous county in Illinois, as it includes the City of Chicago, which had 2.7 million residents in 2015. Between 2010 and 2015, the Chicago Region's population grew from 8.4 to 8.5 million. The Chicago Metropolitan Agency for Planning (CMAP) projects that the region's total population will reach 10.8 million by 2050.

Table 1-2 ■ Demographic Data for the Chicago Region

	Population			Households		
County	**2010**	**2015**	**2050**	**2010**	**2015**	**2050**
City of Chicago	2,695,598	2,727,196	3,193,858	1,045,560	1,072,048	1,275,527
Cook	5,194,675	5,238,216	6,201.137	1,966,356	2,010,906	2,472,005
DuPage	916,924	933,736	1,102,631	337,132	350,329	431,017
Kane	515,269	530,847	796,143	170,479	181,339	298,212
Kendall	114,736	123,355	266,036	38,022	41,545	102,839
Lake	703,462	703,910	900,067	241,712	249,722	342,782
McHenry	308,760	307,343	482,851	109,199	111,629	191,460
Will	677,560	687,263	1,077,136	225,256	234,191	404,751
Chicago Region	**8,431,386**	**8,524,670**	**10,826,002**	**3,088,156**	**3,179,661**	**4,243,067**

Source: Chicago Metropolitan Agency for Planning (CMAP) (2018b).

The Chicago Region includes the corporate headquarters of 60 Fortune 1000 companies, including Boeing, McDonald's, Motorola, Discover Financial Services and United Airlines, representing a diverse group of industries. The area is a major financial center in North America, and is home to the largest futures exchange in the United States, the CME Group.

Purpose and Scope of this Study

The Chicago Region is actively planning for climate change, including increasing resilience to anticipated climate change impacts and reducing emissions to help curb climate change overall. This inventory report is an important part of efforts to reduce emissions, as it identifies major sources of GHG emissions and provides information on emissions trends over time.

More specifically, this report provides the region's GHG inventory for 2015, analyzes trends in emissions over time, and provides emission projections through 2050. In developing this inventory, the team also updated the 2010 inventory to allow for consistency when analyzing trends. The report does not discuss emissions for previous

inventory years due to methodological and scope differences that do not allow for an accurate comparison.

The team developed the inventory to comply with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) BASIC level requirements. As such, the report covers the following sectors, which are described further in Chapter 2:

- **Stationary Energy Emissions**, including emissions from residential buildings, commercial and industrial buildings and facilities, manufacturing industries, energy industries, and fugitive emissions from oil and natural gas systems
- **Transportation Emissions**, including emissions from on-road transportation, railways, waterborne navigation (intra-regional), aviation (intra-regional), and off-road transportation (including construction equipment)
- **Waste Emissions**, including emissions from the disposal of solid waste generated in the region, biological treatment of waste generated in the region, and wastewater generated in the region

This inventory includes GHG emissions from sources physically located within the regional boundary (referred to as Scope 1 emissions); GHG emissions occurring as a result of grid-supplied electricity, heat, steam, and cooling used within the regional boundary (Scope 2 emissions); and all other GHG emissions that occur outside of the regional boundary as a result of activities within the regional boundary (Scope 3 emissions). Specifically, this inventory includes emissions from the combustion of fossil fuels (Scope 1) and electricity use (Scope 2) within the region as well as emissions from waste and wastewater that is generated in the region and treated both within the region (Scope 1) and outside the region (Scope 3). A summary of the sources and scopes covered by this inventory is provided in Table 1-3 below.

Emission Sources and Sinks Not Included in this Inventory Report

The 2010 regional inventory (ICF 2012) estimated emissions from Agriculture as well as Stationary, Industrial, and Product Use, finding that these sources represented less than 1% of total regional emissions. In addition, the 2010 regional inventory estimated emissions removal from trees and other natural land-cover types in the region, finding that natural land cover removes approximately 1.6 $MMTCO_2e$ per year, or approximately 1.3% of total 2010 GHG emissions. Because they are not a requirement of GPC BASIC, this 2015 inventory does not include these sources and sinks.

Table 1-3 ■ Sectors and Scopes covered by this Inventory

Sector	Scope 1	Scope 2	Scope 3
Stationary energy	✓	✓	NR
Transportation	✓	✓	NR
Waste	✓	NA	✓
Industrial processes and product use	NR	NA	NR
Agriculture, forestry and other land use	NR	NA	NR

✓ = Covered in this inventory
NA (Emissions are Not Applicable, meaning there are no emissions in scope category)
NR (Emissions are Not Required because it is not required by the GPC BASIC protocol)

The results from this work will be used to gauge progress towards the *GO TO 2040* GHG reduction targets and to identify new targets for the *ON TO 2050* comprehensive plan.

CHAPTER 2

2015 GHG Emissions Inventory

CHAPTER 2. 2015 GHG Emissions Inventory

This chapter provides a summary of 2015 inventory results, followed by more detailed descriptions of results in each sector: Stationary Energy, Transportation, and Waste.

Summary of Results

In 2015, the Chicago Region produced approximately 119 $MMTCO_2e$ of GHG emissions. Table 2-1 presents a summary of emissions by sector for the Chicago Region. Appendix A presents emissions by sector and scope for the region, each of the region's seven counties, and the City of Chicago.

Table 2-1 ■ 2015 Regional Emissions by Sector ($MMTCO_2e$)

Sector	Total Emissions	Percent of Total
Stationary Energy	**81.90**	**69%**
Residential buildings	31.38	26%
Commercial and institutional buildings and facilities	28.13	24%
Manufacturing industries	20.48	17%
Energy industries	0.06	0.05%
Fugitive emissions from oil and natural gas systems	1.86	2%
Transportation	**34.07**	**29%**
On-road	28.65	24%
Railways	1.02	1%
Waterborne navigation	0.08	0.1%
Aviation	+	+
Off-road	4.32	4%
Waste	**3.16**	**3%**
Disposal of solid waste generated in the region	2.77	2%
Biological treatment of waste generated in the region	0.05	0.04%
Wastewater generated in the region	0.33	0.3%
Total	**119.13**	**100%**

+ Does not exceed 0.005 $MMTCO_2e$ or 0.005%

Emissions from the Stationary Energy sector accounted for the largest portion of emissions from the region, representing 69% of total emissions. Emissions from the Transportation sector accounted for the second largest portion of emissions, 29%, while the Waste sector accounted for approximately 3% of emissions.

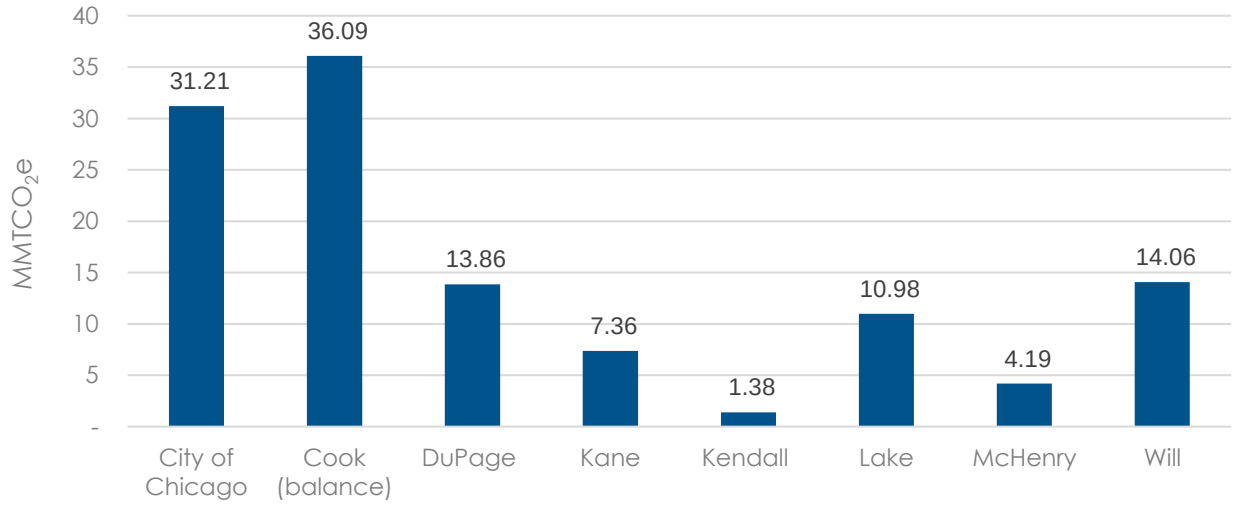
Table 2-2 ■ 2015 Emissions by Sector and County ($MMTCO_2e$)

Sector	City of Chicago	Cook (balance)	DuPage	Kane	Kendall	Lake	McHenry	Will	Chicago Region
Stationary Energy	**23.82**	**24.18**	**8.74**	**4.56**	**0.74**	**7.02**	**2.55**	**10.30**	**81.90**
Residential buildings	9.40	9.26	3.22	1.92	0.37	3.04	1.32	2.84	31.38
Commercial and institutional buildings and facilities	8.43	8.97	3.61	1.61	0.21	2.33	0.80	2.18	28.13
Manufacturing industries	5.75	5.95	1.74	1.03	0.14	1.61	0.43	3.82	20.48
Energy industries	+	+	+	0	+	0.04	0	0.01	0.06
Fugitive emissions from oil and natural gas systems	0.22	0	0.16	0	0.01	0	+	1.46	1.86
Transportation	**6.39**	**11.03**	**4.81**	**2.51**	**0.57**	**3.75**	**1.54**	**3.48**	**34.07**
On-road	5.13	9.42	4.13	2.07	0.46	3.22	1.27	2.96	28.65
Railways	0.53	0.24	0.08	0.04	0.01	0.07	0.01	0.04	1.02
Waterborne navigation	+	0.03	+	+	+	0.03	+	0.01	0.08
Aviation	NE	+	NE	NE	NE	NE	NE	NE	+
Off-road	0.72	1.34	0.59	0.39	0.11	0.43	0.25	0.47	4.32
Waste	**1.01**	**0.89**	**0.31**	**0.29**	**0.07**	**0.21**	**0.10**	**0.28**	**3.16**
Disposal of solid waste generated in the region	0.88	0.75	0.28	0.28	0.07	0.17	0.09	0.26	2.78
Biological treatment of waste generated in the region	+	0.01	+	+	+	0.02	+	0.01	0.05
Wastewater generated in the region	0.13	0.12	0.02	0.01	+	0.02	+	0.02	0.33
Total	**31.21**	**36.09**	**13.61**	**7.36**	**1.38**	**10.98**	**4.19**	**14.06**	**119.13**

+ Does not exceed 0.005 $MMTCO_2e$
NE (Emissions are Not Estimated due to a lack of data availability)

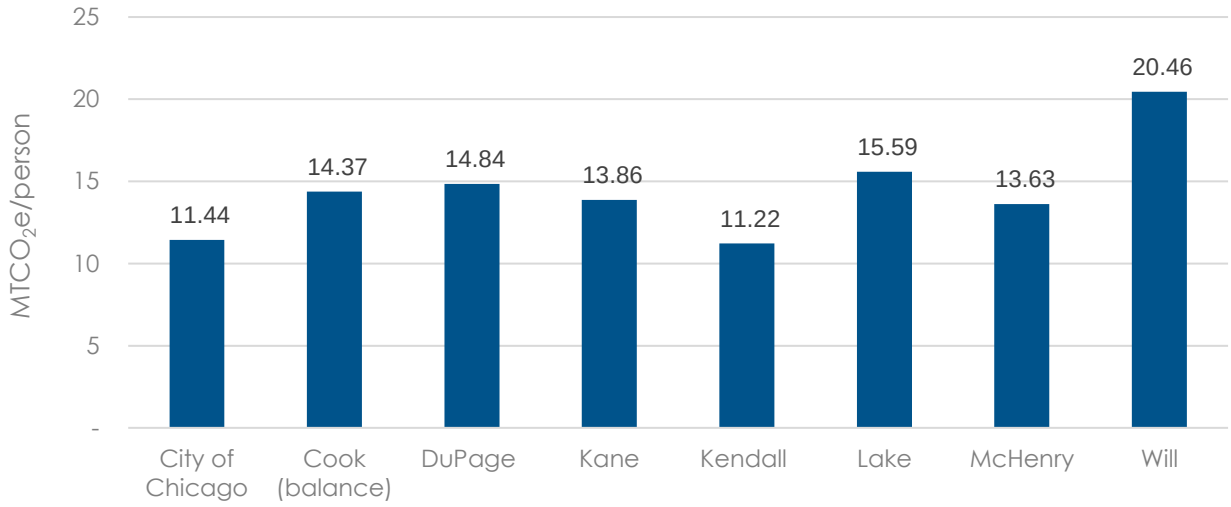
In 2015, Cook County, which includes the City of Chicago, accounted for more than half of regional emissions, followed by Will County, DuPage County, Lake County, Kane County, McHenry County, and Kendall County, in that order. Table 2-2 above presents emissions by county and sector. Figure 2-1 below shows emissions by county graphically.

Figure 2-1 ■ 2015 Chicago Region Emissions by County



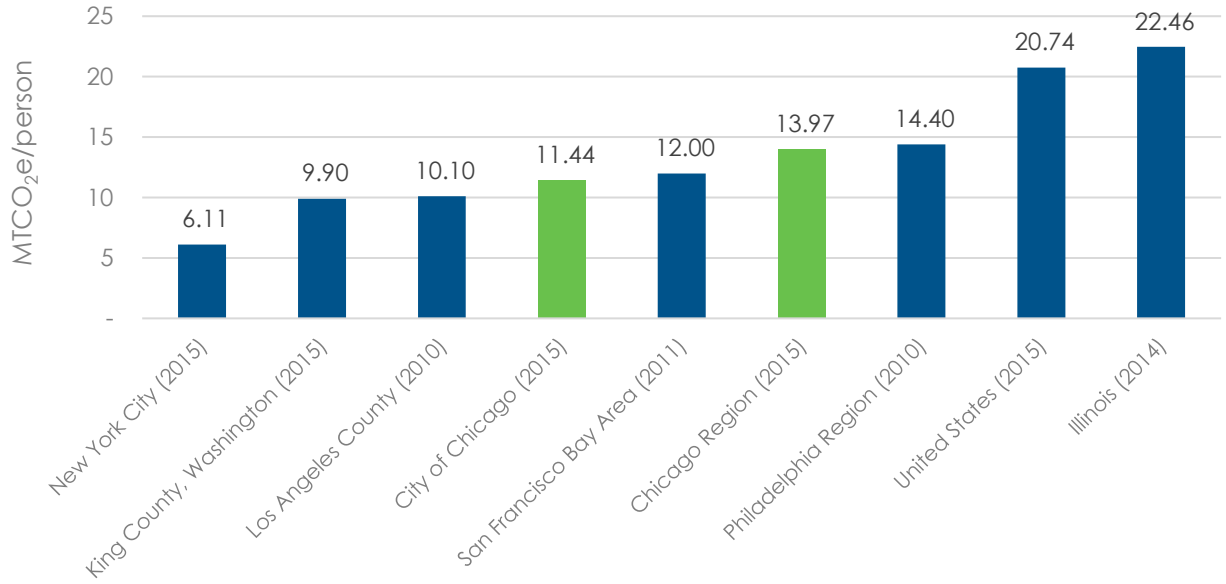
Per capita emissions for the Chicago Region were 13.97 $MTCO_2e$ per person in 2015. At the county level, per capita emissions ranged from 11.22 to 20.46 $MTCO_2e$ per person. Figure 2-2 shows per capita emissions by county.

Figure 2-2 ■ 2015 Per Capita Emissions by County



For the purposes of comparison, Figure 2-3 shows per capita emissions for the Chicago Region, City of Chicago, and other areas.

Figure 2-3 ■ Per Capita Emissions for the Chicago Region, City of Chicago, and Other Areas

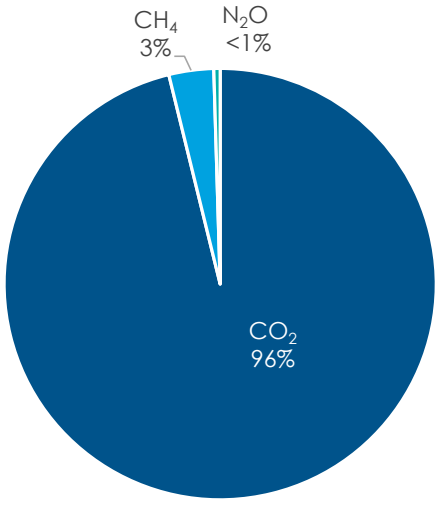


Sources: Cventure LLC (2017) (New York City); Cascadia Consulting Group (2017) (King County); LARC (2012) (Los Angeles County); BAAQMD (2015) (San Francisco Bay Area); DVRPC (2014) (Philadelphia Region); U.S. EPA (2017a) (United States); World Resources Institute (2017) (Illinois).
Note: The protocols for these inventories vary and thus strict comparisons may not be appropriate.

Carbon dioxide is the largest single contributor to regional emissions, accounting for 96% of total GWP-weighted emissions. Methane is the second largest contributor, representing 3% of total emissions. Nitrous oxide accounts for the remaining 1% of emissions. Figure 2-4 shows regional emissions by gas.

Carbon dioxide emissions account for the majority (99%) of emissions from both the Stationary Energy and Transportation sectors, while methane emissions account for the majority (98%) of emissions from the Waste sector. Appendix A provides a summary of regional emissions by sector and gas.

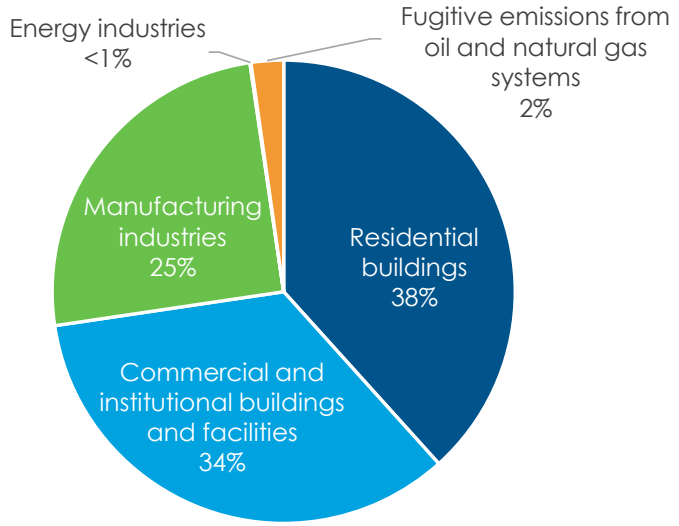
Figure 2-4 ■ 2015 Chicago Region Emissions by Gas ($MMTCO_2e$)



Stationary Energy Emissions

Emissions from the Stationary Energy sector represent the largest source of emissions in the Chicago Region, accounting for 69% of total emissions. Emissions from the Stationary Energy sector include emissions from the combustion of fuel in buildings and power plants, as well as fugitive emissions that occur during the extraction, transformation, and transportation of fossil fuels. This sector is divided into five sub-sectors: residential buildings, commercial and institutional buildings and facilities, manufacturing industries, energy industries, and fugitive emissions from oil and gas systems. The largest portion of emissions are from residential buildings (38%), followed closely by commercial and institutional buildings and facilities (34%), and manufacturing industries (25%). The remaining 2% of emissions are from energy industries and fugitive emissions from oil and natural gas systems. Figure 2-5 shows the breakout of stationary energy emissions by sub-sector. The sections below provide additional information on emissions from each sub-sector.

Figure 2-5 ■ 2015 Stationary Energy Emissions by Sub-Sector



Residential Buildings

Emissions from residential buildings include indirect emissions from electricity use and direct emissions from natural gas consumption by consumers. In 2015, emissions from electricity use accounted for 48% of emissions from residential buildings while natural gas consumption accounted for 52% of emissions. Table 2-3 presents emissions from residential buildings by county and energy source.

Table 2-3 ■ 2015 Emissions from Residential Buildings by County and Energy Source ($MTCO_2e$)

County	Electricity Use	Natural Gas Use	Total
City of Chicago	3,888,090	5,514,358	9,402,448
Cook (balance)	4,642,521	4,621,305	9,263,827
DuPage	1,552,561	1,672,182	3,224,743
Kane	1,025,331	896,426	1,921,757
Kendall	188,781	184,901	373,682
Lake	1,553,815	1,482,695	3,036,511
McHenry	709,392	609,682	1,319,074
Will	1,576,738	1,260,941	2,837,679
Chicago Region	**15,137,230**	**16,242,491**	**31,379,720**

Commercial and Institutional Buildings and Facilities

Emissions from commercial and institutional buildings and facilities include indirect emissions from electricity use, as well as direct emissions from natural gas consumption by consumers and other fuels (e.g., biogas). In 2015, emissions from electricity use accounted for 68% of emissions from commercial and institutional buildings and facilities, while natural gas consumption accounted for 32% of emissions. Other fuel use accounted for less than 1% of emissions from this sub-sector. Table 2-4 presents emissions from commercial and institutional buildings and facilities by county and energy source.

Table 2-4 ■ 2015 Emissions from Commercial and Institutional Buildings and Facilities by County and Energy Source ($MTCO_2e$)

County	Electricity Use	Natural Gas Use	Other Fuel Use	Total
City of Chicago	5,656,643	2,771,912	5,229	8,433,784
Cook (balance)	5,859,266	3,100,542	5,217	8,965,025
DuPage	2,361,344	1,244,260	210	3,605,813
Kane	1,120,633	486,707	3	1,607,342
Kendall	151,990	56,127	14	208,131
Lake	1,630,760	701,657	308	2,332,726
McHenry	607,837	189,081	5	796,923
Will	1,597,582	579,942	20	2,177,544
Chicago Region	**18,986,055**	**9,130,228**	**11,006**	**28,127,289**

Manufacturing Industries

Emissions from manufacturing industries include indirect emissions from electricity use and direct emissions from natural gas and other fuels. In 2015, emissions from electricity use accounted for 76% of emissions from manufacturing industries, while natural gas consumption accounted for 24% of emissions. Other fuel use accounted for less than 1% of emissions from this sub-sector. Table 2-5 shows emissions from manufacturing industries by county and energy source.

Table 2-5 ■ 2015 Emissions from Manufacturing Industries by County and Energy Source ($MTCO_2e$)

County	Electricity Use	Natural Gas Use	Other Fuel Use	Total
City of Chicago	4,907,792	847,018	2	5,754,812
Cook (balance)	4,583,209	1,342,263	20,918	5,946,390
DuPage	1,487,609	255,096	0	1,742,705
Kane	761,043	268,640	0	1,029,683
Kendall	50,011	90,549	21	140,581
Lake	1,238,219	370,621	79	1,608,918
McHenry	298,720	136,219	0	434,940
Will	2,164,721	1,653,046	4,255	3,822,022
Chicago Region	**15,491,324**	**4,963,453**	**25,274**	**20,480,051**

Energy Industries

Energy industries include direct emissions from energy production and energy use on-site by power plants other than emissions from electricity generation for utility consumers. Emissions from electricity generation that is sold and distributed to a grid are attributed to the electricity consumer, not the power plant. In the Chicago Region, emissions from energy industries account for less than 1% of emissions from the Stationary Energy sector and only occur in Cook, DuPage, Kendall, Lake, and Will counties. See Appendix A for detailed emissions by county.

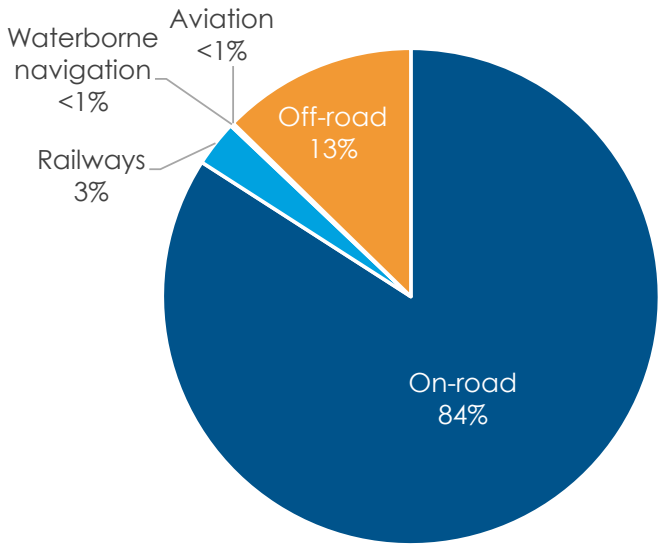
Fugitive Emissions from Oil and Natural Gas Systems

Fugitive emissions from oil and natural gas systems include fugitive equipment leaks, venting, flaring, and other accidental releases from activities conducted at refineries and natural gas transmission and distribution facilities. In the Chicago Region, fugitive emissions from oil and gas systems account for approximately 2% of emissions from the Stationary Energy sector and only occur in Cook, DuPage, Kendall, McHenry, and Will counties. See Appendix A for detailed emissions by county.

Transportation Emissions

Emissions from the Transportation sector represent the second largest source of emissions in the Chicago Region, accounting for 29% of total emissions. The Transportation sector reflects emissions from all transportation occurring within the region's geographical boundary, and includes all modes of transport that require the use of synthetic energy sources, such as gasoline, diesel fuel, compressed natural gas, and electricity. This sector is divided into five sub-sectors: on-road transportation, railways, waterborne navigation, aviation, and off-road transportation. The majority of transportation emissions are from on-road transportation (84%). Off-road transportation is the second largest source of transportation emissions (13%). Emissions from railways account for the remaining 3% of emissions, with waterborne navigation and aviation together accounting for less than 1% of emissions. Figure 2-6 shows the breakout of transportation emissions by sub-sector. The sections below provide additional information on emissions from each sub-sector.

Figure 2-6 ■ 2015 Transportation Emissions by Sub-Sector



On-Road Transportation

On-road transportation emissions include direct emissions from the combustion of fossil fuels (such as diesel and gasoline) in vehicle engines and indirect emissions from electricity consumed by alternative fuel vehicles (such as electric and plug-in hybrid electric vehicles) for miles traveled within the geographic boundary of the region. In 2015, direct emissions from on-road vehicles accounted for the vast majority of emissions from this sub-sector (99.9%). Passenger cars represented the largest source of emissions, accounting for 45% of emissions from on-road transportation. Meanwhile, light-duty trucks accounted for 31% of on-road emissions, medium- and heavy-duty trucks accounted for 23% of emissions, and motorcycles and buses accounted for the remaining 1% of emissions. Table 2-6 shows emissions from on-road vehicles by county and vehicle type.

Table 2-6 ■ 2015 On-Road Emissions by County and Vehicle Type ($MTCO_2e$)

County	Motorcycles	Passenger Cars	Light-Duty Trucks [a]	Medium-Duty Trucks	Heavy-Duty Trucks	Buses	Total
City of Chicago	58,135	2,547,923	1,690,266	263,826	498,778	67,177	5,126,106
Cook (balance)	89,434	3,923,309	2,726,708	649,930	2,008,396	20,022	9,417,799
DuPage	43,933	1,927,923	1,343,039	324,754	489,899	3,016	4,132,564
Kane	22,114	970,295	662,694	132,597	282,663	1,503	2,071,866
Kendall	5,062	222,091	153,303	31,573	43,915	4	455,947
Lake	33,777	1,482,239	1,015,117	211,917	471,333	2,125	3,216,508
McHenry	13,719	602,002	414,858	88,188	146,841	313	1,265,921
Will	29,978	1,315,404	909,131	202,981	504,283	1,702	2,963,479
Chicago Region	**296,152**	**12,991,187**	**8,915,116**	**1,905,765**	**4,446,107**	**95,862**	**28,650,190**

Note: Passenger cars, light-duty trucks, and buses include emissions from alternative fuel vehicles.
[a] Light-duty trucks include sports utility vehicles (SUVs).

Railways

The railways sub-sector includes emissions from passenger and freight trains for miles traveled within the geographic boundary of the region. Passenger rail providers include the Chicago Transit Authority (CTA), Metra, Northern Indiana Commuter Transportation District (NICTD), and Amtrak. Passenger train emissions, including direct emissions from the combustion of diesel fuel and indirect emissions from electricity use, account for 77% of emissions from this sub-sector. Freight train emissions, which only include direct emissions from the combustion of diesel fuel, account for the remaining 23% of emissions. Table 2-7 shows emissions from railways by county, rail type, and provider.

Table 2-7 ■ 2015 Railways Emissions by County, Rail Type, and Provider ($MTCO_2e$)

County	Freight	Passenger - CTA	Passenger - Metra	Passenger - NICTD	Passenger - Amtrak	Total
City of Chicago	50,256	402,751	121,050	4,082	4,300	582,439
Cook (balance)	53,756	33,373	93,964	409	4,897	186,399
DuPage	38,921	0	44,329	0	1,135	84,386
Kane	30,393	0	7,461	0	1,148	39,001
Kendall	8,888	0	0	0	0	8,888
Lake	24,521	0	41,579	0	2,953	69,054
McHenry	948	0	10,687	0	0	11,635
Will	22,874	0	12,214	0	3,185	38,273
Chicago Region	**230,558**	**436,124**	**331,285**	**4,491**	**17,619**	**1,020,076**

Waterborne Navigation

Waterborne navigation includes emissions from the combustion of diesel and gasoline used in recreational and commercial boat trips that both originate *and* end within the Chicago Region. Recreational boats, which include small yachts, sailboats, and other privately owned boats, account for 94% of emissions from waterborne navigation. Commercial boats, which include ferries and tour boats, account for the remaining 6% of emissions. Due to a lack of data availability, emissions from commercial boats were only quantified for the City of Chicago. Appendix B provides further discussion on data limitations. Table 2-8 shows emissions from waterborne navigation by county and boat type.

Table 2-8 ■ 2015 Waterborne Navigation Emissions by County and Type ($MTCO_2e$)

County	Recreational	Commercial	Total
City of Chicago	275	4,349	4,624
Cook (balance)	27,239	NE	27,239
DuPage	1,401	NE	1,401
Kane	2,102	NE	2,102
Kendall	1,168	NE	1,168
Lake	27,913	NE	27,913
McHenry	4,203	NE	4,203
Will	7,473	NE	7,473
Chicago Region	**71,774**	**4,349**	**76,123**

NE (Emissions are Not Estimated due to a lack of data availability)

Aviation

Aviation includes emissions from the combustion of fuel in aircraft engines during intra-regional flights (trips that originate *and* end within the Chicago Region). Intra-regional flights are largely limited to helicopters and small aircraft used for medical transport, local broadcasting, sightseeing, and training flights. Due to a lack of data availability, emissions from aviation were only quantified for Cook County. Appendix B provides further discussion on data limitations.

Off-Road Transportation

Off-road transportation emissions include emissions from the combustion of fossil fuels (such as diesel fuel, gasoline, and compressed natural gas) in off-road equipment and

vehicles that operate within the geographic boundary of region. Construction and mining equipment account for the largest share of emissions (46%), followed by industrial and commercial equipment (34%), and lawn and garden equipment (18%). Logging, railroad, and recreational equipment account for the remaining 2% of emissions. Table 2-9 shows emissions from off-road by county and equipment type.

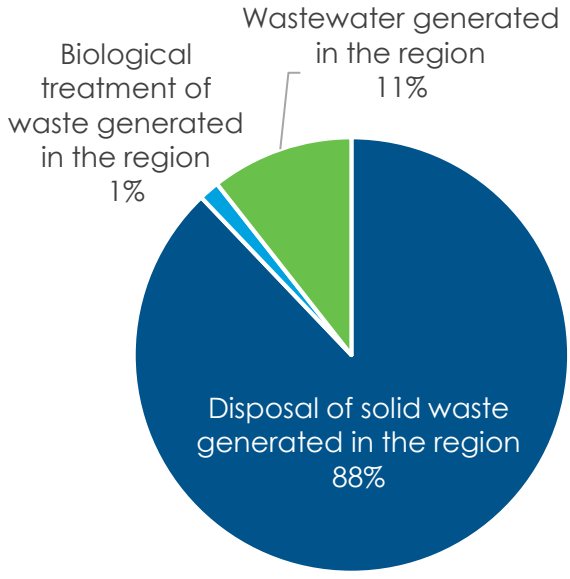
Table 2-9 ■ 2015 Off-Road Emissions by County and Equipment Type ($MTCO_2e$)

County	Construction & Mining	Industrial & Commercial	Lawn & Garden	Logging	Railroad	Recreational	Total
City of Chicago	320,737	304,632	80,227	5	1,728	16,541	723,870
Cook (balance)	620,249	454,878	253,817	222	553	15,230	1,344,947
DuPage	235,983	209,663	139,104	37	943	6,511	592,241
Kane	216,168	102,648	71,099	56	410	3,363	393,744
Kendall	0	80,721	6,651	98	66	18,540	106,076
Lake	174,294	122,829	120,334	135	305	16,236	434,133
McHenry	132,059	81,695	34,278	324	59	4,981	253,396
Will	309,594	99,520	57,353	340	504	7,134	474,444
Chicago Region	**2,009,084**	**1,456,586**	**762,863**	**1,216**	**4,569**	**88,535**	**4,322,852**

Waste Emissions

The Waste sector accounts for 3% of emissions in the Chicago Region. Waste sector emissions include emissions generated during the management and treatment of solid waste and wastewater. This sector is divided into three sub-sectors: disposal of solid waste generated in the region, biological treatment of waste generated in the region, and wastewater generated in the region. The majority of waste emissions are from the disposal of solid waste (88%).

Figure 2-7 ■ 2015 Waste Emissions by Sub-Sector



Wastewater is the second largest source of waste emissions (11%) while approximately 1% of these emissions are from the biological treatment of waste. Figure 2-7 shows the breakout of waste emissions by sub-sector. The sections below provide additional information on emissions from each sub-sector.

Disposal of Solid Waste Generated in the Region

Emissions from the disposal of solid waste generated in the region include methane emissions from waste sent to landfills located both within and outside the Chicago Region. In 2015, the region generated over 5 million metric tons of solid waste sent to a landfill for disposal, resulting in emissions of approximately 2.8 $MMTCO_2e$. Table 2-10 summarizes emissions from the disposal of solid waste and the amount of waste generated in the region by county.

Table 2-10 ■ 2015 Solid Waste Emissions and Waste Generated by County

County	Methane Emissions ($MTCO_2e$)	Waste Generated (metric tons)
City of Chicago	876,904	2,153,504
Cook (balance)	751,811	351,912
DuPage	283,156	943,620
Kane	275,300	480,521
Kendall	72,154	111,660
Lake	169,139	521,043
McHenry	92,024	306,669
Will	255,371	490,318
Chicago Region	**2,775,858**	**5,359,248**

Biological Treatment of Waste Generated in the Region

Emissions from the biological treatment of waste generated in the region include emissions from composting and the anaerobic digestion of organic waste, including food waste, yard waste, sludge, and other organic sources. In 2015, approximately 273,000 metric tons of organic waste was generated in the region and biologically treated, resulting in emissions of approximately 48,000 $MTCO_2e$. Table 2-11 shows emissions from the biological treatment of waste and the amount of waste treated in the region by county.

Table 2-11 ■ 2015 Biological Treatment of Waste Emissions and Waste Treated by County

County	Total Emissions ($MTCO_2e$)	Waste Treated (metric tons)
City of Chicago	102	583
Cook (balance)	14,136	80,500
DuPage	1,910	10,876
Kane	4,784	27,245
Kendall	354	2,016
Lake	18,752	106,787
McHenry	1,730	9,853
Will	6,222	35,432
Chicago Region	**47,990**	**273,290**

Wastewater Generated in the Region

Emissions from wastewater generated in the region include emissions from water that is anaerobically treated. In 2015, the region generated over half a million gallons of wastewater, resulting in emissions of approximately 335,000 $MTCO_2e$. Table 2-12 shows emissions from the treatment of wastewater and the amount of wastewater generated by county.

Table 2-12 ■ 2015 Wastewater Emissions and Wastewater Generated by County

County	Total Emissions ($MTCO_2e$)	Wastewater Generated (gallons)
City of Chicago	132,753	228,741
Cook (balance)	122,230	210,609
DuPage	24,501	42,217
Kane	12,842	22,127
Kendall	2,460	4,239
Lake	17,635	30,386
McHenry	4,685	8,073
Will	17,557	30,252
Chicago Region	**334,664**	**576,646**

CHAPTER 3

Emissions Trends

CHAPTER 3. Emissions Trends

This chapter discusses trends in emissions from 2010 to 2015 for the Chicago Region. To allow for time series consistency, the 2010 regional inventory (ICF 2012) was updated in accordance with GPC BASIC requirements. Appendix B provides documentation of the methodologies used for this inventory report, including a description of updates since the last inventory report.

Overall Emissions Trend from 2010 to 2015

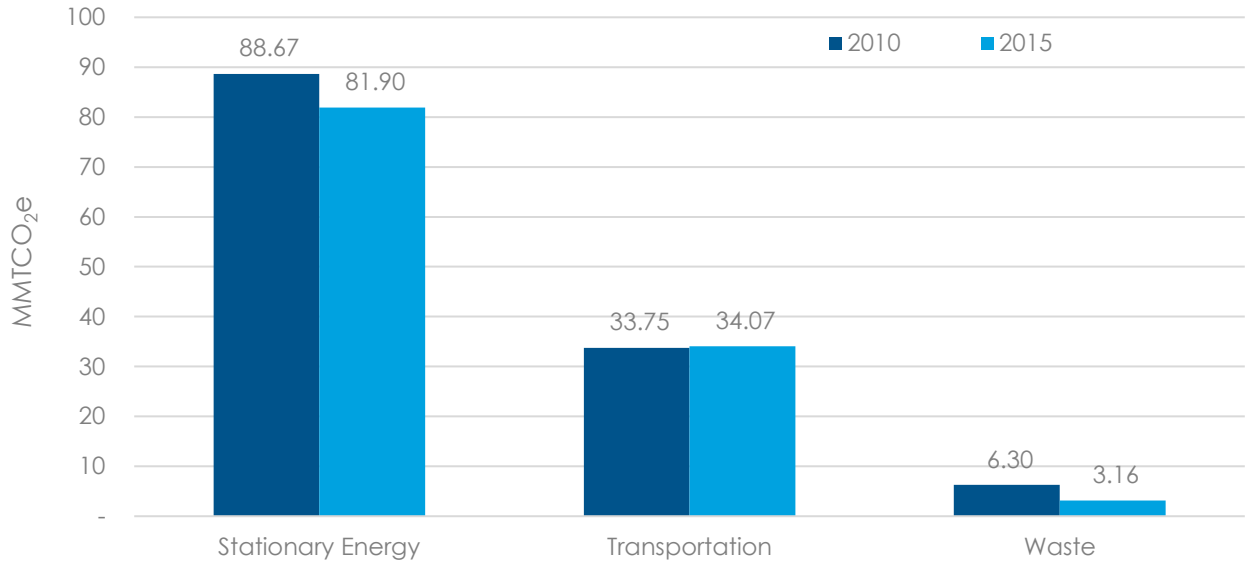
Total emissions for the Chicago Region decreased by 9.59 $MMTCO_2e$, or approximately 7%, from 2010 to 2015. This decrease resulted from decreases in emissions from the Stationary Energy and Waste sectors, which offset a slight increase in emissions from the Transportation sector. Table 3-1 summarizes the change in regional emissions by sector from 2010 to 2015. Figure 3-1 presents regional emissions by sector for 2010 and 2015.

Table 3-1 ■ Change in Regional Emissions, 2010 to 2015 ($MMTCO_2e$)

Sector	2010	2015	Percent Change
Stationary Energy	**88.67**	**81.90**	**-8%**
Residential Buildings	33.17	31.38	-5%
Commercial and institutional buildings and facilities	29.70	28.13	-5%
Manufacturing industries	23.27	20.48	-12%
Energy industries	0.09	0.06	-36%
Fugitive emissions from oil and natural gas systems	2.43	1.86	-23%
Transportation	**33.75**	**34.07**	**1%**
On-road	28.72	28.65	0%
Railways	1.04	1.02	-2%
Waterborne navigation	0.07	0.08	2%
Aviation	+	+	NE
Off-road	3.92	4.32	10%
Waste	**6.30**	**3.16**	**-50%**
Disposal of solid waste generated in the region	5.91	2.78	-53%
Biological treatment of waste generated in the region	0.04	0.05	14%
Wastewater generated in the region	0.35	0.33	-4%
Total	**128.72**	**119.13**	**-7%**

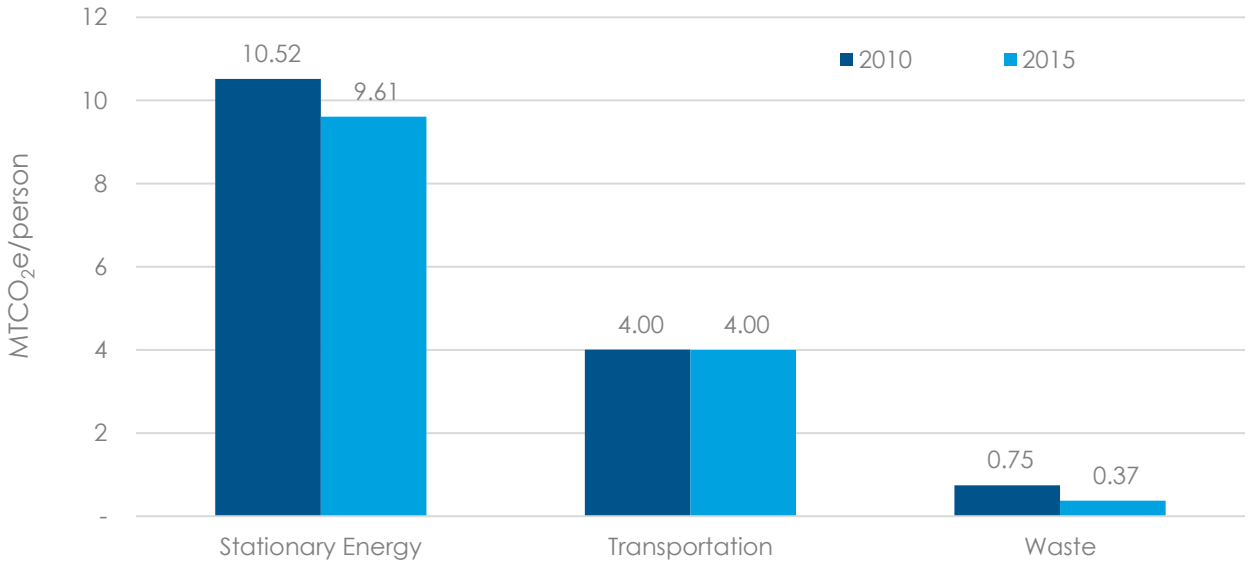
+ Does not exceed 0.005 $MMTCO_2e$
NE (Not Estimated due to insignificant magnitude of annual numbers)

Figure 3-1 ■ Regional Emissions by Sector, 2010 and 2015



Per capita emissions for the Chicago Region similarly decreased from 2010 to 2015, by 1.29 $MTCO_2e$ per person, or approximately 8%. This decrease primarily resulted from notable decreases in per capita emissions from the Stationary Energy and Waste sectors. Figure 3-2 presents regional per capita emissions by sector for 2010 and 2015.

Figure 3-2 ■ Regional Per Capita Emissions by Sector, 2010 and 2015



Total emissions and per capita emissions for the City of Chicago and each of the seven counties decreased from 2010 to 2015, with the exception of Will County, which saw a slight increase in total emissions. Figure 3-3 presents total emissions by county for 2010 and 2015. Table 3-2 summarizes the change in total and per capita emissions by county from 2010 to 2015.

Figure 3-3 ■ Regional Emissions by County, 2010 and 2015

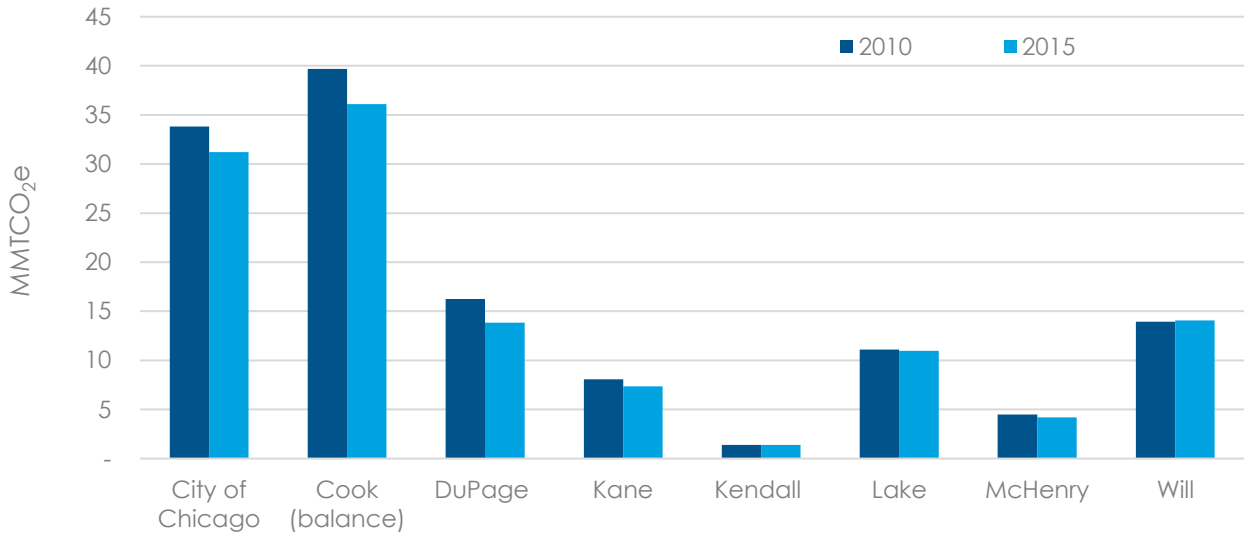


Table 3-2 ■ Change in Total and Per Capita Emissions by County, 2010 to 2015

	Total Emissions ($MMTCO_2e$)			Per Capita Emissions ($MTCO_2e$/person)		
County	**2010**	**2015**	**Percent Change**	**2010**	**2015**	**Percent Change**
City of Chicago	33.82	31.21	-8%	12.46	11.45	-8%
Cook (balance)	39.70	36.09	-9%	16.00	14.37	-10%
DuPage	16.25	13.86	-15%	17.72	14.84	-16%
Kane	8.06	7.36	-9%	15.65	13.86	-11%
Kendall	1.38	1.38	-0.02%	12.06	11.22	-7%
Lake	11.09	10.98	-1%	15.77	15.59	-1%
McHenry	4.49	4.19	-7%	14.53	13.63	-6%
Will	13.93	14.06	1%	20.56	20.46	-0.5%
Chicago Region	**128.72**	**119.13**	**-7%**	**15.27**	**13.97**	**-8%**

Source: CMAP (2018b) (Population).

In both 2010 and 2015, carbon dioxide was the largest single contributor to regional emissions. Total emissions of CO_2, CH_4, and N_2O all decreased from 2010 and 2015, with CH_4 emissions decreasing by the largest percent, due largely to an increase in methane capture from landfills. Table 3-3 summarizes the change in regional emissions by gas from 2010 to 2015.

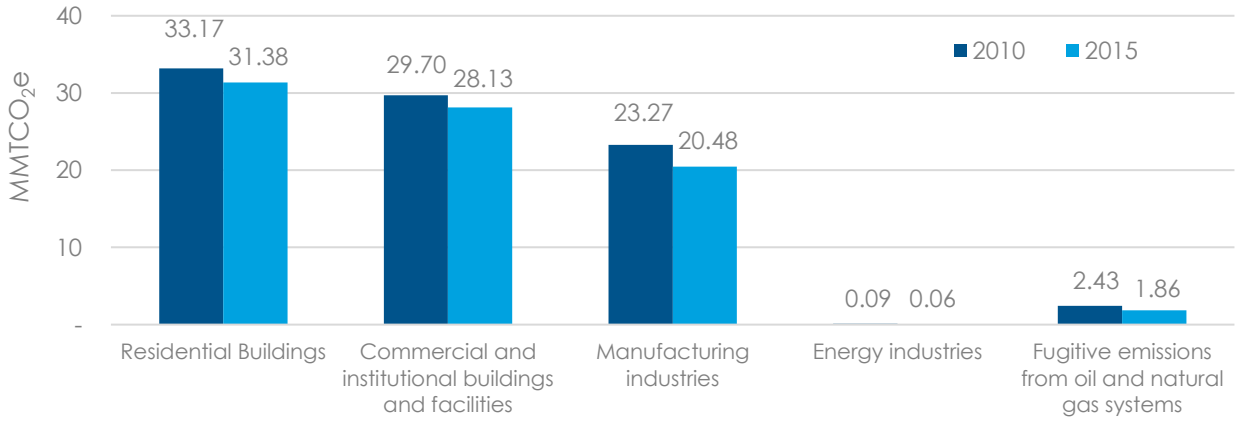
Table 3-3 ■ Change in Regional Emissions by Gas, 2010 to 2015 ($MMTCO_2e$)

Gas	2010	2015	Percent Change
CO_2	120.92	114.82	-5%
CH_4	7.02	3.75	-47%
N_2O	0.78	0.56	-28%
Total	**128.72**	**119.13**	**-7%**

Stationary Energy Emissions

Regional emissions from the Stationary Energy sector decreased by 6.76 $MMTCO_2e$, or approximately 8%, from 2010 to 2015. This decrease resulted from a decrease in electricity use in residential buildings, commercial and institutional buildings and facilities, and manufacturing industries, which more than offset the impact from an increase in natural gas consumption by consumers. Figure 3-4 summarizes Stationary Energy sector emissions by sub-sector for 2010 and 2015. The sections below provide additional information on emissions trends for each sub-sector.

Figure 3-4 ■ Stationary Energy Emissions by Sub-Sector, 2010 and 2015



Buildings and Facilities

Stationary energy emissions from residential buildings, commercial and institutional buildings and facilities, and manufacturing industries decreased from 2010 to 2015. This decrease resulted from a decrease in electricity use as well as a decrease in the

electricity emissions factor, which together more than offset the impact from an increase in natural gas consumption. Weather also played a factor in these trends with a milder summer and colder winter in 2015 relative to 2010.[2] Details by sub-sector are provided below.

Residential Buildings

Stationary energy emissions from residential buildings decreased by 1.79 $MMTCO_2e$, or approximately 5%, from 2010 to 2015. Table 3-4 shows the change in emissions from residential buildings and relevant sector-specific measures and characteristics for the region for 2010 and 2015.

Table 3-4 ■ Residential Building Emissions and Relevant Sector-Specific Measures and Characteristics for the Chicago Region, 2010 and 2015

Residential Buildings	2010	2015	Percent Change
Measures			
Total emissions ($MMTCO_2e$)	33.17	31.38	-5%
Electricity use (billion kWh)	25.76	23.99	-7%
Per capita electricity use (kWh/person)	3,056	2,814	-8%
Change in electricity demand due to weather [a]			-2%
Electricity emissions factor (lbs. CO_2/MWh)	1,503	1,381	-8%
Natural gas consumption (billion therms)	2.92	3.06	5%
Per capita natural gas consumption (therms/person)	347	359	4%
Change in natural gas demand due to weather [a]			1%
Characteristics			
Population	8,431,386	8,524,670	1%
Households	3,088,156	3,179,661	3%
Cooling degree days	1,181	806	-32%
Heating degree days	5,991	6,091	2%
Regional GDP ($2009 million)[b]	465,114	503,204	8%

Sources: ComEd (2018) and IMEA (2017) (Electricity Use); U.S. EPA (2017b) (Electricity Emissions Factor); Nicor Gas (2017) and People's Gas (2018) (Natural Gas Consumption); CMAP (2018b) (Population and Households); Illinois State Water Survey (2018) (CDD and HDD); Bureau of Economic Analysis (2017) (GDP).

[a] Based on a linear regression analysis conducted using data on cooling degree days and heating degree days.

[b] Gross Domestic Product (GDP) was scaled to the Chicago Region from the GDP for the Chicago-Naperville-Elgin, IL-IN-WI Metropolitan Statistical Area (MSA) using population.

[2] Weather comparison use data from the Illinois State Climatologist for Cooling Degree Days (CDD) and Heating Degree Days (HDD). Degree days are defined as the number of degrees by which the average daily temperature is higher than 65° Fahrenheit (CDD) or lower than 65° Fahrenheit (HDD). For example if the average daily temperature is 78 degrees, then 13 CDDs are accounted for that day.

Commercial and Institutional Buildings and Facilities

Stationary energy emissions from commercial and institutional buildings and facilities decreased by 1.58 $MMTCO_2e$, or approximately 5%, from 2010 to 2015. Table 3-5 shows the change in emissions from commercial and institutional buildings and facilities and relevant sector-specific measures and characteristics for the region for 2010 and 2015.

Table 3-5 ■ Commercial and Institutional Buildings and Facilities Emissions and Relevant Sector-Specific Measures and Characteristics for the Chicago Region, 2010 and 2015

Commercial and Institutional Buildings and Facilities	2010	2015	Percent Change
Measures			
Total emissions ($MMTCO_2e$)	29.70	28.13	-5%
Electricity use (billion kWh)	30.93	30.09	-3%
Per capita electricity use (kWh/person)	3,669	3,530	-4%
Change in electricity demand due to weather [a]			-2%
Electricity emissions factor (lbs. CO_2/MWh)	1,503	1,381	-8%
Natural gas consumption (billion therms)	1.60	1.72	7%
Per capita natural gas consumption (therms/person)	190	202	6%
Change in natural gas demand due to weather [a]			1%
Characteristics			
Population	8,431,386	8,524,670	1%
Households	3,088,156	3,179,661	3%
Cooling degree days	1,181	806	-32%
Heating degree days	5,991	6,091	2%
Regional GDP ($2009 million)[b]	465,114	503,204	8%

Sources: ComEd (2018) and IMEA (2017) (Electricity Use); U.S. EPA (2017b) (Electricity Emissions Factor); Nicor Gas (2017) and People's Gas (2018) (Natural Gas Consumption); CMAP (2018b) (Population and Households); Illinois State Water Survey (2018) (CDD and HDD); Bureau of Economic Analysis (2017) (GDP).

[a] Based on a linear regression analysis conducted using data on cooling degree days and heating degree days.

[b] Gross Domestic Product (GDP) was scaled to the Chicago Region from the GDP for the Chicago-Naperville-Elgin, IL-IN-WI Metropolitan Statistical Area (MSA) using population.

Manufacturing Industries

Stationary energy emissions from manufacturing industries decreased by 2.79 $MMTCO_2e$, or approximately 12%, from 2010 to 2015. Table 3-6 shows the change in emissions from manufacturing industries and relevant sector-specific measures and characteristics for the region for 2010 and 2015.

Table 3-6 ■ Manufacturing Industries Emissions and Relevant Sector-Specific Measures and Characteristics for the Chicago Region, 2010 and 2015

Manufacturing Industries	2010	2015	Percent Change
Measures			
Total emissions ($MMTCO_2e$)	23.27	20.48	-12%
Electricity use (billion kWh)	27.11	24.55	-9%
Per capita electricity use (kWh/person)	3,216	2,880	-10%
Change in electricity demand due to weather [a]			-2%
Electricity emissions factor (lbs. CO_2/MWh)	1,503	1,381	-8%
Natural gas consumption (billion therms)	0.88	0.93	6%
Per capita natural gas consumption (therms/person)	104	110	5%
Change in natural gas demand due to weather [a]			1%
Characteristics			
Population	8,431,386	8,524,670	1%
Households	3,088,156	3,179,661	3%
Cooling degree days	1,181	806	-32%
Heating degree days	5,991	6,091	2%
Regional GDP ($2009 million)[b]	465,114	503,204	8%

Sources: ComEd (2018) and IMEA (2017) (Electricity Use); U.S. EPA (2017b) (Electricity Emissions Factor); Nicor Gas (2017) and People's Gas (2018) (Natural Gas Consumption); CMAP (2018b) (Population and Households); Illinois State Water Survey (2018) (CDD and HDD); Bureau of Economic Analysis (2017) (GDP).

[a] Based on a linear regression analysis conducted using data on cooling degree days and heating degree days.

[b] Gross Domestic Product (GDP) was scaled to the Chicago Region from the GDP for the Chicago-Naperville-Elgin, IL-IN-WI Metropolitan Statistical Area (MSA) using population.

Energy Industries

Stationary energy emissions from energy industries decreased by 0.03 $MMTCO_2e$, or approximately 36%, from 2010 to 2015. This decrease largely resulted from the closure of the Geneva Energy incinerator, located in Cook County (Ford Heights), in 2011.

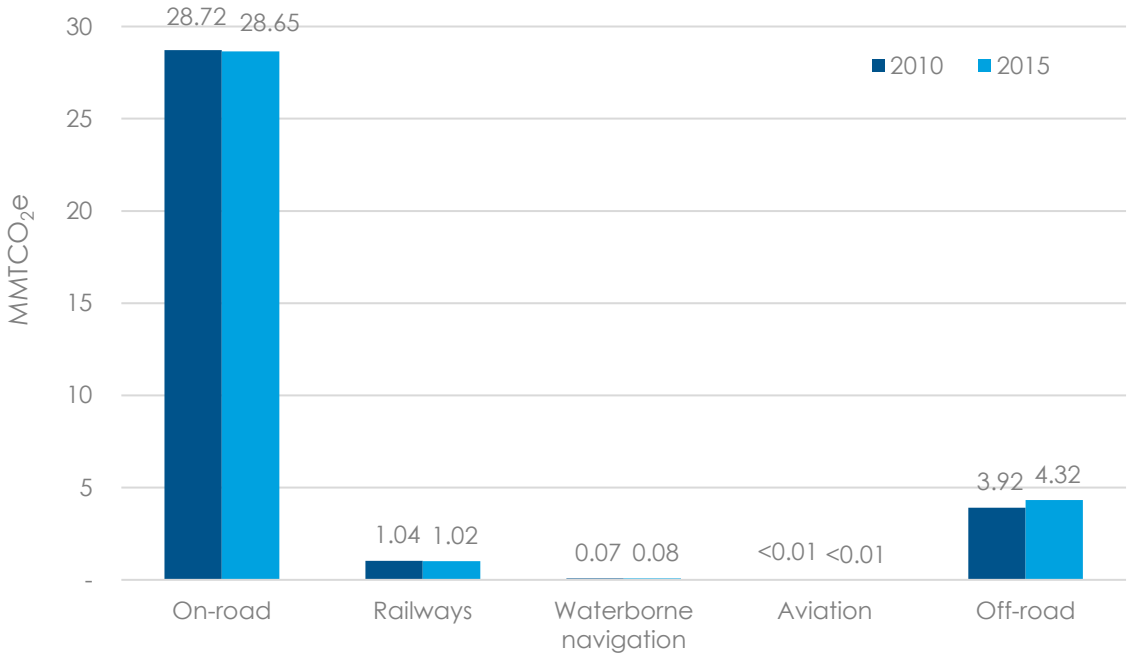
Fugitive Emissions from Oil and Natural Gas Systems

Fugitive emissions from oil and natural gas systems decreased by 0.57 $MMTCO_2e$, or approximately 23%, from 2010 to 2015. The source of this change is not known. Possible drivers include changes in handled volumes or improvements in practices and infrastructure at refineries and throughout oil and natural gas systems in the region.

Transportation Emissions

Emissions from the Transportation sector increased by 0.32 $MMTCO_2e$, or approximately 1%, from 2010 to 2015. This increase largely resulted from an increase in off-road fuel consumption. Figure 3-5 summarizes Transportation sector emissions by sub-sector for 2010 and 2015. The sections below provide additional information on emissions trends for each sub-sector.

Figure 3-5 ■ Transportation Emissions by Sub-Sector, 2010 and 2015



On-Road

Transportation emissions from on-road transportation decreased by 0.07 $MMTCO_2e$, or approximately 0.2%, from 2010 to 2015. This decrease resulted from improvements in vehicle fuel efficiency as well as increased use of alternative fuel vehicles (AFV), which more than offset the slight increase in vehicle miles traveled (VMT). Table 3-7 shows the change in emissions from on-road transportation and relevant sector-specific measures and characteristics for the region for 2010 and 2015.

Table 3-7 ■ On-Road Transportation Emissions and Relevant Sector-Specific Measures and Characteristics for the Chicago Region, 2010 and 2015

On-Road Transportation	2010	2015	Percent Change
Measures			
Total Emissions ($MMTCO_2e$)	28.72	28.65	-0.2%
Total VMT (billion miles)	54.88	56.13	2%
Passenger Car VMT (billion miles)	33.39	34.05	2%
Light-duty truck VMT (billion miles)	16.80	17.19	2%
Medium- and heavy-duty truck VMT (billion miles)	3.82	4.00	5%
AFV VMT (million miles)	3.00	115.06	3,740%
Per capita VMT (miles/person)	6,509	6,585	1%
Emissions intensity ($MTCO_2$/thousand miles)	0.52	0.51	-2%
Characteristics			
RTA ridership (million passenger trips) [a]	633.4	634.9	0.2%
Population	8,431,386	8,524,670	1%
Households	3,088,156	3,179,661	3%
Employment	3,687,398	4,085,553	11%

Sources: U.S. EPA (2018a) (VMT); U.S. EPA (2017a) (AFV VMT); RTA (2015 and 2016) (Ridership); CMAP (2018b) (Population, Households, and Employment).
[a] Includes ridership figures for CTA, Metra, and Pace.

Railways

Transportation emissions from railways decreased by 0.02 $MMTCO_2e$, or approximately 2%, from 2010 to 2015. This decrease resulted from a small overall decrease in diesel fuel consumption and electricity use by passenger rail providers in the region, which more than offset the increase in freight emissions that resulted from an increase in gross ton miles (GTM). Table 3-8 shows the change in emissions from railways and relevant sector-specific measures and characteristics for the region for 2010 and 2015.

Table 3-8 ■ Railways Emissions and Relevant Sector-Specific Measures and Characteristics for the Chicago Region, 2010 and 2015

Railways	2010	2015	Percent Change
Measures			
Total emissions ($MMTCO_2e$)	1.04	1.02	-2%
Passenger emissions ($MMTCO_2e$)	0.83	0.79	-5%
Passenger diesel consumption (million gallons)	46.12	45.32	-2%
Passenger electricity use (million kWh)	524.18	511.46	-2%
Freight emissions ($MMTCO_2e$)	0.21	0.23	12%
Freight GTM (million)	17,048	19,198	13%
Characteristics			
Employment	3,687,398	4,085,553	11%
Regional GDP ($2009 million)[a]	465,114	503,204	8%

Sources: FTA (2010 and 2015), Amtrak (2017a and 2017b), and Bureau of Transportation Statistics (2018) (Passenger Diesel Consumption and Electricity Use); ORNL (2018) (Freight GTM); CMAP (2018b) (Employment); Bureau of Economic Analysis (2017) (GDP).
[a] GDP was scaled to the Chicago Region from the GDP for the Chicago-Naperville-Elgin, IL-IN-WI Metropolitan Statistical Area (MSA) using population.

Waterborne Navigation

Transportation emissions from waterborne navigation increased by approximately 0.001 $MMTCO_2e$, or approximately 1%, from 2010 to 2015. This increase resulted from an increase in fuel consumption in both recreational and commercial boats. Due to a lack of data availability, further research is needed to evaluate the trend in emissions from commercial boats in the region, as discussed further in Appendix B.

Aviation

Transportation emissions from aviation remained relatively constant from 2010 to 2015. Due to a lack of data availability, further research is needed to evaluate the trend in emissions from intra-regional flights in the region, as discussed further in Appendix B.

Off-Road

Transportation emissions from off-road transportation increased by 0.4 $MMTCO_2e$, or approximately 10%, from 2010 to 2015. Emissions increased from all equipment types, with the exception of logging equipment. Table 3-9 shows the change in emissions from off-road equipment and relevant sector-specific measures and characteristics for the region for 2010 and 2015.

Table 3-9 ■ Off-Road Emissions and Relevant Sector-Specific Measures and Characteristics for the Chicago Region, 2010 and 2015

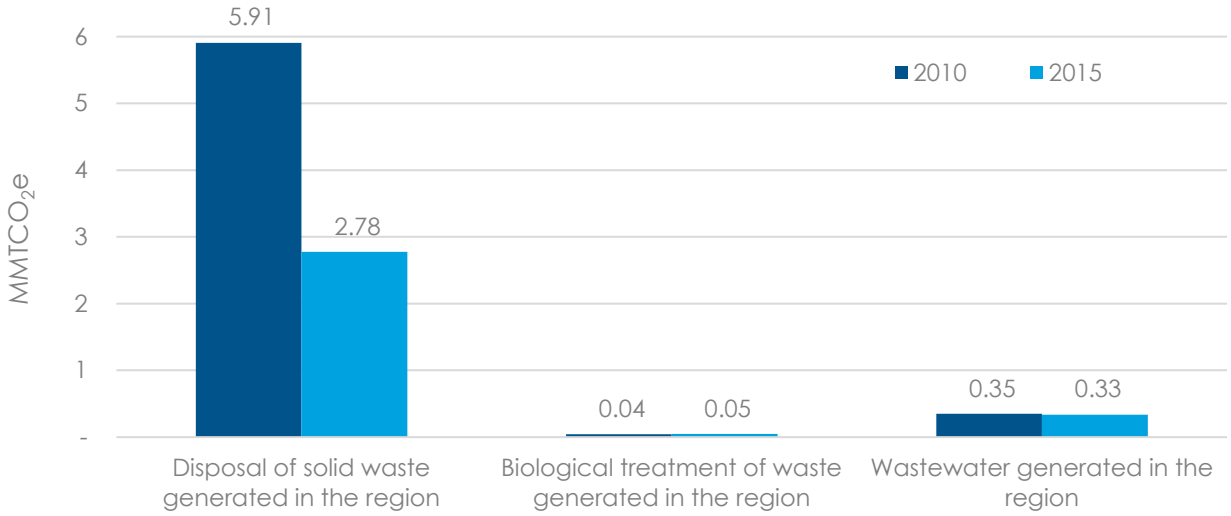
Off-Road Transportation	2010	2015	Percent Change
Measures			
Total emissions ($MMTCO_2e$)	3.92	4.32	10%
Construction and mining emissions ($MTCO_2e$)	1,855,051	2,009,084	8%
Industrial & commercial emissions ($MTCO_2e$)	1,279,645	1,456,586	14%
Lawn and Garden emissions ($MTCO_2e$)	699,916	762,863	9%
Logging emissions ($MTCO_2e$)	1,255	1,216	-3%
Railroad emissions ($MTCO_2e$)	4,039	4,569	13%
Recreational emissions ($MTCO_2e$)	78,891	88,535	12%
Characteristics			
Employment	3,687,398	4,085,553	11%
Regional GDP ($2009 million)[a]	465,114	503,204	8%

Sources: U.S. EPA (2018a) (Emissions); CMAP (2018b) (Employment); Bureau of Economic Analysis (2017) (GDP).
[a] GDP was scaled to the Chicago Region from the GDP for the Chicago-Naperville-Elgin, IL-IN-WI Metropolitan Statistical Area (MSA) using population.

Waste Emissions

Emissions from the Waste sector decreased by 3.14 $MMTCO_2e$, or approximately 50%, from 2010 to 2015. This decrease largely resulted from an increase in methane capture at landfills. Figure 3-6 summarizes Waste sector emissions by sub-sector for 2010 and 2015. The sections below provide additional information on emissions trends for each sub-sector.

Figure 3-6 ■ Waste Emissions by Sub-Sector, 2010 and 2015



Disposal of Solid Waste Generated in the Region

Waste emissions from the disposal of solid waste generated in the region decreased by 3.13 $MMTCO_2e$, or approximately 53%, from 2010 to 2015. This decrease largely resulted from an increase in methane capture at landfills. Table 3-10 shows the change in emissions from the disposal of solid waste and relevant sector-specific measures and characteristics for the region for 2010 and 2015.

Table 3-10 ■ Solid Waste Emissions and Relevant Sector-Specific Measures and Characteristics for the Chicago Region, 2010 and 2015

Disposal of solid waste generated in the region	2010	2015	Percent Change
Measures			
Total emissions ($MMTCO_2e$)	5.91	2.78	-53%
Solid waste landfilled (million metric tons)	5.48	5.36	-2%
Average weighted methane capture	64%	81%	25%
Characteristics			
Population	8,431,386	8,524,670	1%
Households	3,088,156	3,179,661	3%
Employment	3,687,398	4,085,553	11%

Sources: City of Chicago (2017), Cook County (2017), DuPage County Environmental Division (2017), SWALCO (2014), Will County (2017a), Will County (2018), and Illinois Recycling Association (2015) (Solid Waste Landfilled); CMAP (2018b) (Population, Households, and Employment).

Biological Treatment of Waste Generated in the Region

Waste emissions from the biological treatment of waste generated in the region increased by 5,957 $MTCO_2e$, or approximately 14%, from 2010 to 2015. This increase resulted from an increase in the amount of waste composted. Table 3-11 shows the change in emissions from the biological treatment of waste and relevant sector-specific measures and characteristics for the region for 2010 and 2015.

Table 3-11 ■ Biological Treatment of Waste Emissions and Relevant Sector-Specific Measures and Characteristics for the Chicago Region, 2010 and 2015

Biological treatment of waste generated in the region	2010	2015	Percent Change
Measures			
Total emissions ($MTCO_2e$)	42,033	47,990	14%
Amount of waste composted (metric tons)	239,366	273,290	14%
Characteristics			
Population	8,431,386	8,524,670	1%
Households	3,088,156	3,179,661	3%

Sources: City of Chicago (2017), DuPage County (2017), Kane County (2017), Kendall County (2017), and Will County (2017b) (Amount of Waste Composted); CMAP (2018b) (Population and Households).

Wastewater Generated in the Region

Waste emissions from wastewater generated in the region decreased by 0.02 $MMTCO_2e$, or approximately 4%, from 2010 to 2015. This decrease resulted from a decrease in the amount of wastewater generated. Table 3-12 shows the change in emissions from wastewater generation and relevant sector-specific measures and characteristics for the region for 2010 and 2015.

Table 3-12 ■ Wastewater Emissions and Relevant Sector-Specific Measures and Characteristics for the Chicago Region, 2010 and 2015

Wastewater generated in the region	2010	2015	Percent Change
Measures			
Total emissions ($MMTCO_2e$)	0.35	0.33	-4%
Wastewater volume (million gallons)	591,788	576,646	-3%
Characteristics			
Population	8,431,386	8,524,670	1%
Households	3,088,156	3,179,661	3%
Employment	3,687,398	4,085,553	11%

Sources: U.S. EPA (2017d) (Wastewater Volume); CMAP (2018b) (Population, Households, and Employment).

CHAPTER 4

Emissions Projections

CHAPTER 4. Emissions Projections

This chapter provides a summary of emissions projections through 2050 for the Chicago Region under three projection scenarios.

Projections Scenarios

The team projected emissions for the Chicago Region in five-year increments from 2015 to 2050 to show how emissions from the region may change in the future. The three scenarios used to forecast emissions are as follows.

- **Scenario 1:** Assumes no change in emissions per capita from 2015 through 2050. Under this scenario, emissions increase at the same rate as population growth in the region.
- **Scenario 2:** Assumes future emissions per capita decrease at the same rate as the rate between 2010 and 2015. Per capita emissions decreased by approximately 8.5% between 2010 and 2015, so this scenario assumes that per capita emissions will decrease by approximately 8.5% every five years.
- **Scenario 3:** Assumes more aggressive decreases in emissions per capita. Specifically, this scenario assumes that the 8.5% decrease in per capita emissions realized from 2010 to 2015 will double such that per capita emissions will decrease by 17% every five years.

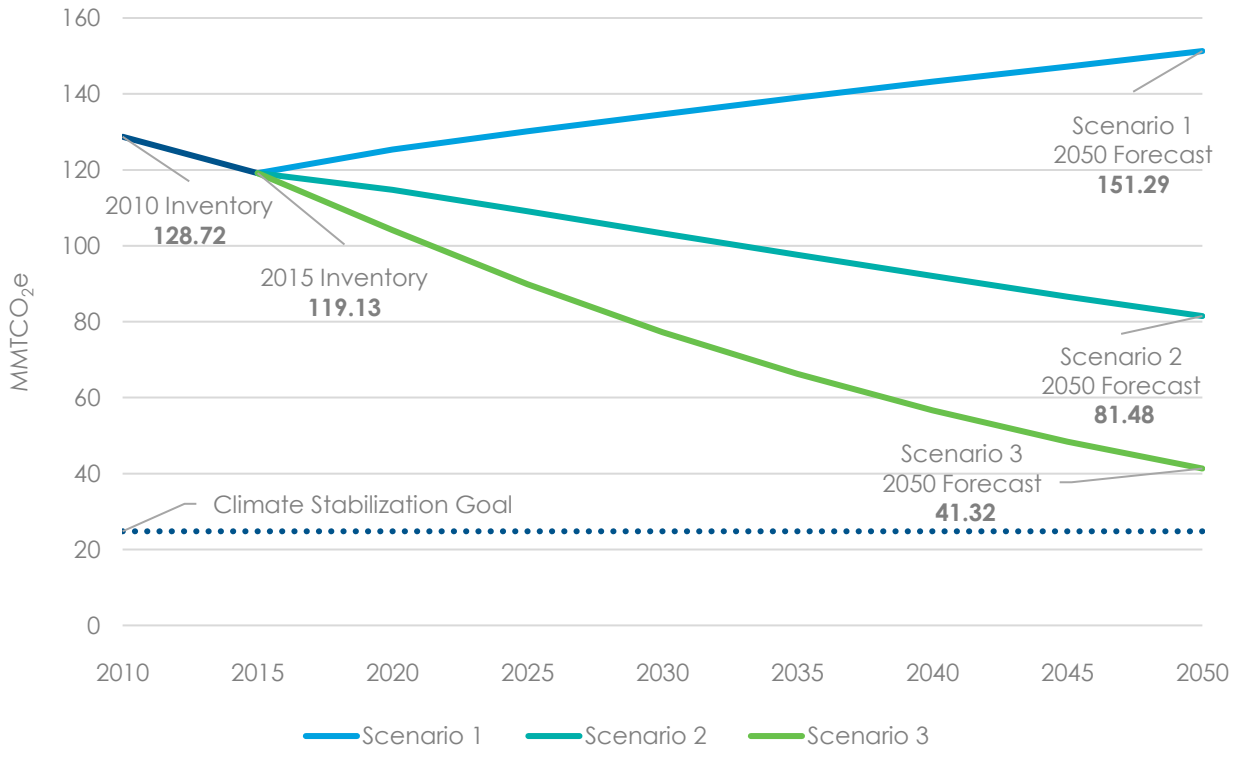
Summary of Results

Under Scenario 1, emissions increase, reaching approximately 151 $MMTCO_2$ in 2050. Under both Scenario 2 and Scenario 3, emissions decrease, reaching approximately 81 $MMTCO_2$ and 41 $MMTCO_2$ in 2050, respectively. Table 4-1 summarizes projection results for all three scenarios on a mass and per capita basis. Figure 4-1 presents emission estimates and projections graphically. None of these scenarios achieve the region's stabilization goal, as shown in Figure 4-1.

Table 4-1 ■ Total and Per Capita Emissions Projections for the Chicago Region, 2020-2050

Scenario	2020	2025	2030	2035	2040	2045	2050
Scenario 1							
Total emissions ($MMTCO_2e$)	125.36	130.16	134.66	139.04	143.23	147.20	151.29
Per capita emissions ($MTCO_2e$/person)	13.97	13.97	13.97	13.97	13.97	13.97	13.97
Scenario 2							
Total emissions ($MMTCO_2e$)	114.75	109.06	103.29	97.62	92.06	86.60	81.48
Per capita emissions ($MTCO_2e$/person)	12.79	11.71	10.72	9.81	8.98	8.22	7.53
Scenario 3							
Total emissions ($MMTCO_2e$)	104.14	89.83	77.21	66.23	56.68	48.39	41.32
Per capita emissions ($MTCO_2e$/person)	11.61	9.65	8.01	6.66	5.53	4.59	3.82

Figure 4-1 ■ Emissions Estimates and Projections for the Chicago Region, 2010–2050



Note: The climate stabilization goal is equivalent to a reduction of emissions to 80% below 1990 levels by 2050. This goal aligns with the scientific consensus regarding the level of emissions necessary in developed countries to stabilize the climate with a global temperature increase of no more than 2 degrees Centigrade.

CHAPTER 5

References

CHAPTER 5. References

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Appendix A
Detailed Emissions Results

APPENDIX A: Detailed Emissions Results

This appendix presents emissions by sector, scope, and gas for the region. It then presents emissions by sector and scope for each of the region's seven counties and the City of Chicago (in alphabetical order).

Chicago Region

Table A-1 ■ 2015 Emissions for the Chicago Region ($MMTCO_2e$)

Sector	Total by Scope			BASIC Total
	Scope 1	Scope 2	Scope 3	
Stationary Energy	**32.29**	**49.61**	**NR**	**81.90**
Residential buildings	16.24	15.14	NR	31.38
Commercial and institutional buildings and facilities	9.14	18.99	NR	28.13
Manufacturing industries	4.99	15.49	NR	20.48
Energy industries	0.06	NE	NR	0.06
Fugitive emissions from oil and natural gas systems	1.86	NA	NR	1.86
Transportation	**33.72**	**0.35**	**NR**	**34.07**
On-road	28.62	0.03	NR	28.65
Railways	0.70	0.32	NR	1.02
Waterborne navigation	0.08	0	NR	0.08
Aviation	+	0	NR	+
Off-road	4.32	0	NR	4.32
Waste	**0.74**	**NA**	**2.42**	**3.16**
Disposal of solid waste generated in the city	0.40	NA	2.37	2.77
Biological treatment of waste generated in the city	IE	NA	0.05	0.05
Wastewater generated in the city	0.33	NA	IE	0.33
Total	**66.75**	**49.96**	**2.42**	**119.13**
13.97 $MTCO_2e$/person				

+ Does not exceed 0.005 $MMTCO_2e$
NA (Emissions are Not Applicable, meaning there are no emissions in a particular scope)
NE (Emissions are Not Estimated due to a lack of data availability)
NR (Emissions are Not Required because it is not required by the GPC BASIC protocol)
IE (Emissions are Included Elsewhere); Scope 1 emissions from the biological treatment of waste are included under Scope 3 while Scope 3 emissions from wastewater are included under Scope 1

Stationary Energy

81.90

Transportation

34.07

Waste

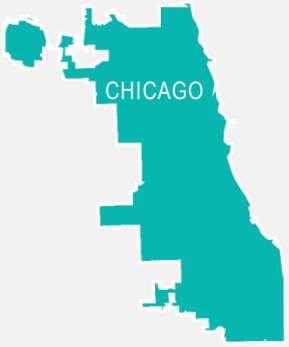
3.16

Table A-2 ■ 2015 Regional Emissions by Sector and Gas ($MMTCO_2e$)

Sector	CO_2	CH_4	N_2O	Total
Stationary Energy	**81.09**	**0.58**	**0.23**	**81.90**
Residential buildings	31.25	0.05	0.07	31.38
Commercial and institutional buildings and facilities	27.98	0.06	0.08	28.13
Manufacturing industries	20.36	0.05	0.07	20.48
Energy industries	0.06	+	+	0.06
Fugitive emissions from oil and natural gas systems	1.44	0.41	+	1.86
Transportation	**33.73**	**0.08**	**0.26**	**34.07**
On-road	28.40	0.04	0.21	28.65
Railways	1.01	+	0.01	1.02
Waterborne navigation	0.08	+	+	0.08
Aviation	+	+	+	+
Off-road	4.24	0.04	0.04	4.32
Waste	**0**	**3.09**	**0.07**	**3.16**
Disposal of solid waste generated in the region	0	2.78	0	2.78
Biological treatment of waste generated in the region	0	0.03	0.02	0.05
Wastewater generated in the region	0	0.28	0.05	0.33
Total	**114.82**	**3.75**	**0.56**	**119.13**
13.97 $MTCO_2e$/person				

+ Does not exceed 0.005 $MMTCO_2e$

City of Chicago



Stationary Energy

23.82

Transportation

6.39

Waste

1.01

Table A-3 ■ 2015 Emissions for the City of Chicago ($MMTCO_2e$)

Sector	Total by Scope			BASIC Total
	Scope 1	Scope 2	Scope 3	
Stationary Energy	**9.36**	**14.45**	**NR**	**23.82**
Residential buildings	5.51	3.89	NR	9.40
Commercial and institutional buildings and facilities	2.78	5.66	NR	8.43
Manufacturing industries	0.85	4.91	NR	5.75
Energy industries	+	NE	NR	+
Fugitive emissions from oil and natural gas systems	0.22	NA	NR	0.22
Transportation	**6.11**	**0.28**	**NR**	**6.39**
On-road	5.12	0.01	NR	5.13
Railways	0.26	0.27	NR	0.53
Waterborne navigation	+	0	NR	+
Aviation	NE	0	NR	NE
Off-road	0.72	0	NR	0.72
Waste	**0.13**	**NA**	**0.88**	**1.01**
Disposal of solid waste generated in the city	0	NA	0.88	0.88
Biological treatment of waste generated in the city	IE	NA	+	+
Wastewater generated in the city	0.13	NA	IE	0.13
Total	**15.61**	**14.73**	**0.88**	**31.21**
11.44 $MTCO_2e$/person				

+ Does not exceed 0.005 $MMTCO_2e$
NA (Emissions are Not Applicable, meaning there are no emissions in a particular scope)
NE (Emissions are Not Estimated due to a lack of data availability)
NR (Emissions are Not Required because it is not required by the GPC BASIC protocol)
IE (Emissions are Included Elsewhere); Scope 1 emissions from the biological treatment of waste are included under Scope 3 while Scope 3 emissions from wastewater are included under Scope 1

SUBURBAN COOK COUNTY (excludes the City of Chicago)

Stationary Energy

24.18

Transportation

11.03

Waste

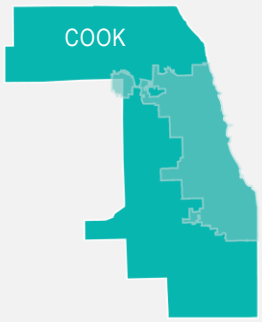
0.89

Table A-4 ■ 2015 Emissions for Suburban Cook County (excludes the City of Chicago) ($MMTCO_2e$)

Sector	Total by Scope			BASIC Total
	Scope 1	Scope 2	Scope 3	
Stationary Energy	**9.09**	**15.08**	**NR**	**24.18**
Residential buildings	4.62	4.64	NR	9.26
Commercial and institutional buildings and facilities	3.11	5.86	NR	8.97
Manufacturing industries	1.36	4.58	NR	5.95
Energy industries	+	NE	NR	+
Fugitive emissions from oil and natural gas systems	0	NA	NR	0
Transportation	**10.98**	**0.04**	**NR**	**11.03**
On-road	9.41	0.01	NR	9.42
Railways	0.20	0.04	NR	0.24
Waterborne navigation	0.03	0	NR	0.03
Aviation	+	0	NR	+
Off-road	1.34	0	NR	1.34
Waste	**0.12**	**NA**	**0.77**	**0.89**
Disposal of solid waste generated in the county	0	NA	0.75	0.75
Biological treatment of waste generated in the county	IE	NA	0.01	0.01
Wastewater generated in the county	0.12	NA	IE	0.12
Total	**20.20**	**15.13**	**0.77**	**36.09**
14.37 $MTCO_2e$/person				

+ Does not exceed 0.005 MM TCO_2e
NA (Emissions are Not Applicable, meaning there are no emissions in a particular scope)
NE (Emissions are Not Estimated due to a lack of data availability)
NR (Emissions are Not Required because it is not required by the GPC BASIC protocol)
IE (Emissions are Included Elsewhere); Scope 1 emissions from the biological treatment of waste are included under Scope 3 while Scope 3 emissions from wastewater are included under Scope 1

COOK COUNTY (including the City of Chicago)



Stationary Energy

47.99

Transportation

17.41

Waste

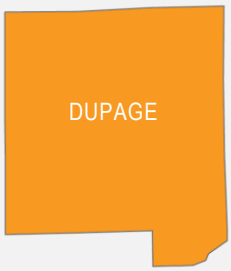
1.90

Table A-5 ■ 2015 Emissions for Cook County ($MMTCO_2e$)

Sector	Total by Scope			BASIC Total
	Scope 1	Scope 2	Scope 3	
Stationary Energy	**18.46**	**29.54**	**NR**	**47.99**
Residential buildings	10.14	8.53	NR	18.67
Commercial and institutional buildings and facilities	5.88	11.52	NR	17.40
Manufacturing industries	2.21	9.49	NR	11.70
Energy industries	+	NE	NR	+
Fugitive emissions from oil and natural gas systems	0.22	NA	NR	0.22
Transportation	**17.09**	**0.32**	**NR**	**17.41**
On-road	14.53	0.02	NR	14.54
Railways	0.46	0.30	NR	0.77
Waterborne navigation	0.03	0	NR	0.03
Aviation	+	0	NR	+
Off-road	2.07	0	NR	2.07
Waste	**0.25**	**NA**	**1.64**	**1.90**
Disposal of solid waste generated in the county	0	NA	1.63	1.63
Biological treatment of waste generated in the county	IE	NA	0.01	0.01
Wastewater generated in the county	0.25	NA	IE	0.25
Total	**35.80**	**29.86**	**1.64**	**67.31**
12.85 $MTCO_2e$/person				

+ Does not exceed 0.005 MM TCO_2e
NA (Emissions are Not Applicable, meaning there are no emissions in a particular scope)
NE (Emissions are Not Estimated due to a lack of data availability)
NR (Emissions are Not Required because it is not required by the GPC BASIC protocol)
IE (Emissions are Included Elsewhere); Scope 1 emissions from the biological treatment of waste are included under Scope 3 while Scope 3 emissions from wastewater are included under Scope 1

DuPage County



Stationary Energy

8.74

Transportation

4.81

Waste

0.31

Table A-6 ■ 2015 Emissions for DuPage County ($MMTCO_2e$)

Sector	Total by Scope			BASIC Total
	Scope 1	Scope 2	Scope 3	
Stationary Energy	**3.33**	**5.40**	**NR**	**8.74**
Residential buildings	1.67	1.55	NR	3.22
Commercial and institutional buildings and facilities	1.24	2.36	NR	3.61
Manufacturing industries	0.26	1.49	NR	1.74
Energy industries	+	NE	NR	+
Fugitive emissions from oil and natural gas systems	0.16	NA	NR	0.16
Transportation	**4.80**	**0.01**	**NR**	**4.81**
On-road	4.13	+	NR	4.13
Railways	0.08	0.01	NR	0.08
Waterborne navigation	+	0	NR	+
Aviation	NE	0	NR	NE
Off-road	0.59	0	NR	0.59
Waste	**0.02**	**NA**	**0.29**	**0.31**
Disposal of solid waste generated in the county	0	NA	0.28	0.28
Biological treatment of waste generated in the county	IE	NA	+	+
Wastewater generated in the county	0.02	NA	IE	0.02
Total	**8.16**	**5.41**	**0.29**	**13.86**
14.84 $MTCO_2e$/person				

+ Does not exceed 0.005 $MMTCO_2e$
NA (Emissions are Not Applicable, meaning there are no emissions in a particular scope)
NE (Emissions are Not Estimated due to a lack of data availability)
NR (Emissions are Not Required because it is not required by the GPC BASIC protocol)
IE (Emissions are Included Elsewhere); Scope 1 emissions from the biological treatment of waste are included under Scope 3 while Scope 3 emissions from wastewater are included under Scope 1

Kane County

Stationary Energy

4.56

Transportation

2.51

Waste

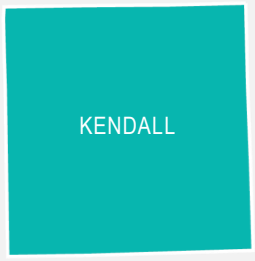
0.29

Table A-7 ■ 2015 Emissions for Kane County ($MMTCO_2e$)

Sector	Total by Scope			BASIC Total
	Scope 1	Scope 2	Scope 3	
Stationary Energy	**1.65**	**2.91**	**NR**	**4.56**
Residential buildings	0.90	1.03	NR	1.92
Commercial and institutional buildings and facilities	0.49	1.12	NR	1.61
Manufacturing industries	0.27	0.76	NR	1.03
Energy industries	0	NE	NR	NO
Fugitive emissions from oil and natural gas systems	0	NA	NR	NO
Transportation	**2.50**	**+**	**NR**	**2.51**
On-road	2.07	+	NR	2.07
Railways	0.04	+	NR	0.04
Waterborne navigation	+	0	NR	+
Aviation	NE	0	NR	NE
Off-road	0.39	0	NR	0.39
Waste	**0.01**	**NA**	**0.28**	**0.29**
Disposal of solid waste generated in the county	0	NA	0.28	0.28
Biological treatment of waste generated in the county	IE	NA	+	+
Wastewater generated in the county	0.01	NA	IE	0.01
Total	**4.17**	**2.91**	**0.28**	**7.36**
13.86 $MTCO_2e$/person				

+ Does not exceed 0.005 $MMTCO_2e$
NA (Emissions are Not Applicable, meaning there are no emissions in a particular scope)
NE (Emissions are Not Estimated due to a lack of data availability)
NR (Emissions are Not Required because it is not required by the GPC BASIC protocol)
IE (Emissions are Included Elsewhere); Scope 1 emissions from the biological treatment of waste are included under Scope 3 while Scope 3 emissions from wastewater are included under Scope 1

Kendall County



Stationary Energy

0.74

Transportation

0.57

Waste

0.07

Table A-8 ■ 2015 Emissions for Kendall County ($MMTCO_2e$)

Sector	Total by Scope			BASIC Total
	Scope 1	Scope 2	Scope 3	
Stationary Energy	**0.35**	**0.39**	**NR**	**0.74**
Residential buildings	0.18	0.19	NR	0.37
Commercial and institutional buildings and facilities	0.06	0.15	NR	0.21
Manufacturing industries	0.09	0.05	NR	0.14
Energy industries	+	NE	NR	+
Fugitive emissions from oil and natural gas systems	0.01	NA	NR	0.01
Transportation	**0.57**	**+**	**NR**	**0.57**
On-road	0.46	+	NR	0.46
Railways	0.01	0	NR	0.01
Waterborne navigation	+	0	NR	+
Aviation	NE	0	NR	NE
Off-road	0.11	0	NR	0.11
Waste	**+**	**NA**	**0.07**	**0.07**
Disposal of solid waste generated in the county	0	NA	0.07	0.07
Biological treatment of waste generated in the county	IE	NA	+	+
Wastewater generated in the county	+	NA	IE	+
Total	**0.92**	**0.39**	**0.07**	**1.38**
11.22 $MTCO_2e$/person				

+ Does not exceed 0.005 $MMTCO_2e$
NA (Emissions are Not Applicable, meaning there are no emissions in a particular scope)
NE (Emissions are Not Estimated due to a lack of data availability)
NR (Emissions are Not Required because it is not required by the GPC BASIC protocol)
IE (Emissions are Included Elsewhere); Scope 1 emissions from the biological treatment of waste are included under Scope 3 while Scope 3 emissions from wastewater are included under Scope 1

Lake County

Stationary Energy

7.02

Transportation

3.75

Waste

0.21

Table A-9 ■ 2015 Emissions for Lake County ($MMTCO_2e$)

Sector	Total by Scope			BASIC Total
	Scope 1	Scope 2	Scope 3	
Stationary Energy	**2.60**	**4.42**	**NR**	**7.02**
Residential buildings	1.48	1.55	NR	3.04
Commercial and institutional buildings and facilities	0.70	1.63	NR	2.33
Manufacturing industries	0.37	1.24	NR	1.61
Energy industries	0.04	NE	NR	0.04
Fugitive emissions from oil and natural gas systems	0	NA	NR	NO
Transportation	**3.74**	**0.01**	**NR**	**3.75**
On-road	3.21	+	NR	3.22
Railways	0.06	0.01	NR	0.07
Waterborne navigation	0.03	0	NR	0.03
Aviation	NE	0	NR	NE
Off-road	0.43	0	NR	0.43
Waste	**0.17**	**NA**	**0.04**	**0.21**
Disposal of solid waste generated in the county	0.15	NA	0.02	0.17
Biological treatment of waste generated in the county	IE	NA	0.02	0.02
Wastewater generated in the county	0.02	NA	IE	0.02
Total	**6.50**	**4.43**	**0.04**	**10.98**
15.59 $MTCO_2e$/person				

+ Does not exceed 0.005 $MMTCO_2e$
NA (Emissions are Not Applicable, meaning there are no emissions in a particular scope)
NE (Emissions are Not Estimated due to a lack of data availability)
NR (Emissions are Not Required because it is not required by the GPC BASIC protocol)
IE (Emissions are Included Elsewhere); Scope 1 emissions from the biological treatment of waste are included under Scope 3 while Scope 3 emissions from wastewater are included under Scope 1

McHenry County

Stationary Energy

2.55

Transportation

1.54

Waste

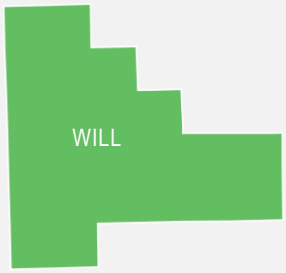
0.10

Table A-10 ■ 2015 Emissions for McHenry County ($MMTCO_2e$)

Sector	Total by Scope			BASIC Total
	Scope 1	Scope 2	Scope 3	
Stationary Energy	**0.94**	**1.62**	**NR**	**2.55**
Residential buildings	0.61	0.71	NR	1.32
Commercial and institutional buildings and facilities	0.19	0.61	NR	0.80
Manufacturing industries	0.14	0.30	NR	0.43
Energy industries	0	NE	NR	NO
Fugitive emissions from oil and natural gas systems	+	NA	NR	+
Transportation	**1.53**	**0**	**NR**	**1.54**
On-road	1.26	0	NR	1.27
Railways	0.01	0	NR	0.01
Waterborne navigation	+	0	NR	+
Aviation	NE	0	NR	NE
Off-road	0.25	0	NR	0.25
Waste	**+**	**NA**	**0.09**	**0.10**
Disposal of solid waste generated in the county	0	NA	0.09	0.09
Biological treatment of waste generated in the county	IE	NA	+	+
Wastewater generated in the county	+	NA	IE	+
Total	**2.48**	**1.62**	**0.09**	**4.19**
13.63 $MTCO_2e$/person				

+ Does not exceed 0.005 $MMTCO_2e$
NA (Emissions are Not Applicable, meaning there are no emissions in a particular scope)
NE (Emissions are Not Estimated due to a lack of data availability)
NR (Emissions are Not Required because it is not required by the GPC BASIC protocol)
IE (Emissions are Included Elsewhere); Scope 1 emissions from the biological treatment of waste are included under Scope 3 while Scope 3 emissions from wastewater are included under Scope 1

Will County



Stationary Energy

10.30

Transportation

3.48

Waste

0.28

Table A-11 ■ 2015 Emissions for Will County ($MMTCO_2e$)

Sector	Total by Scope			BASIC Total
	Scope 1	Scope 2	Scope 3	
Stationary Energy	**4.96**	**5.34**	**NR**	**10.30**
Residential buildings	1.26	1.58	NR	2.84
Commercial and institutional buildings and facilities	0.58	1.60	NR	2.18
Manufacturing industries	1.66	2.16	NR	3.82
Energy industries	0.01	NE	NR	0.01
Fugitive emissions from oil and natural gas systems	1.46	NA	NR	1.46
Transportation	**3.48**	**0**	**NR**	**3.48**
On-road	2.96	0	NR	2.96
Railways	0.04	0	NR	0.04
Waterborne navigation	0.01	0	NR	0.01
Aviation	NE	0	NR	NE
Off-road	0.47	0	NR	0.47
Waste	**0.27**	**NA**	**0.01**	**0.28**
Disposal of solid waste generated in the county	0.26	NA	NO	0.26
Biological treatment of waste generated in the county	IE	NA	0.01	0.01
Wastewater generated in the county	0.02	NA	NO	0.02
Total	**8.71**	**5.34**	**0.02**	**14.06**
20.46 $MTCO_2e$/person				

+ Does not exceed 0.005 $MMTCO_2e$
NA (Emissions are Not Applicable, meaning there are no emissions in a particular scope)
NE (Emissions are Not Estimated due to a lack of data availability)
NR (Emissions are Not Required because it is not required by the GPC BASIC protocol)
IE (Emissions are Included Elsewhere); Scope 1 emissions from the biological treatment of waste are included under Scope 3 while Scope 3 emissions from wastewater are included under Scope 1

Appendix B
Inventory Methodology

APPENDIX B: Inventory Methodology

For each sub-sector, this appendix describes methodologies used to develop the inventory estimates, updates made to the inventory methods since the previous inventory report, and limitations and recommendations for future inventory reports.

Methodology Overview

This inventory report complies with the accounting principles and reporting requirements identified in the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). The estimates were developed using the best available data and latest guidance for developing GHG inventories (e.g., the *2006 IPCC Guidelines for National Greenhouse Gas Inventories*).

Stationary Energy Emissions

Residential Buildings

Methodology. Stationary Energy emissions from residential buildings were calculated using electricity and natural gas data specific to each jurisdiction from utilities that serve the Chicago Region. Utilities that serve the region include Commonwealth Edison (ComEd), Illinois Municipal Electric Agency (IMEA), Nicor Gas, and People's Gas.

Emissions from electricity use were calculated by multiplying consumption data by a region-specific CO_2, CH_4, and N_2O emission factor obtained from the U.S. Environmental Protection Agency's (EPA) Emissions & Generation Resource Integrated Database (eGRID) (U.S. EPA 2017b). Emissions from natural gas were calculated by multiplying consumption data by CO_2, CH_4, and N_2O emission factors from EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (U.S. EPA 2017a).

Electricity use from residential charging of on-road electric vehicles was subtracted from residential building electricity use to avoid double-counting, as this consumption is included in the on-road transportation sector.

Method Changes since the Previous Inventory. In this inventory, average eGRID emission factors for the RFC West region were used to estimate emissions from electricity use rather than a value derived from plant-specific information. Average emission factors from EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (U.S. EPA 2017a) were used to estimate natural gas emissions, compared with facility-specific emission factors

used in the previous inventory. In addition, this inventory uses Global Warming Potentials (GWPs) from the *IPCC Fifth Assessment Report* (IPCC 2014) instead of values from the *IPCC Second Assessment Report*.

Limitations and Recommendations. Plant-specific emissions factors or fuel mix data were not provided by the electric utilities for this inventory report. As a result, a regional emissions factor was used to estimate emissions from electricity use. For natural gas emissions, an average emissions factor was similarly used in the absence of facility-specific emissions factors. To further improve the inventory, collection of utility-specific emissions factors is recommended.

Commercial and Institutional Buildings and Facilities

Methodology. Stationary Energy emissions from commercial and institutional buildings and facilities were calculated using electricity and natural gas data specific to each jurisdiction from utilities that serve the Chicago Region, as well as data on biogas consumption at wastewater treatment plants and facility-level stationary combustion data reported under EPA's Greenhouse Gas Reporting Program (GHGRP) (U.S. EPA 2017c). Utilities that serve the region include ComEd, IMEA, Nicor Gas, and People's Gas. Biogas consumption data were provided by the Metropolitan Water Reclamation District (MWRD).

Emissions from electricity use were calculated by multiplying consumption data by a region-specific CO_2, CH_4, and N_2O emission factor obtained from EPA's eGRID (U.S. EPA 2017b). Emissions from natural gas were calculated by multiplying consumption data by CO_2, CH_4, and N_2O emission factors from EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (U.S. EPA 2017a). Emissions from biogas were calculated by multiplying consumption data by emission factors from the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 2006).

Electricity use from commercial charging of on-road electric vehicles and buses was subtracted from commercial and institutional building electricity use to avoid double-counting, as this consumption is included in the on-road transportation sector. Similarly, compressed natural gas consumption for off-road equipment was subtracted from commercial and institutional building natural gas consumption totals to avoid double-counting, as this consumption is included in the off-road transportation sector. Electricity use in railroads was excluded from the consumption totals provided by ComEd; therefore, no double-counting is assumed.

Emissions from the combustion of natural gas in commercial and institutional buildings and facilities that were reported under EPA's GHGRP were excluded from the totals to avoid double-counting with the natural gas consumption data provided by the utilities.

Method Changes since the Previous Inventory. In this inventory, average eGRID emission factors for the RFC West region were used to estimate emissions from electricity use rather than a value derived from plant-specific information. Average emission factors from EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (U.S. EPA 2017a) were used to estimate natural gas emissions, compared with facility-specific emission factors used in the previous inventory. In addition, this inventory uses GWPs from the *IPCC Fifth Assessment Report* (IPCC 2014) instead of values from the *IPCC Second Assessment Report*.

Limitations and Recommendations. Plant-specific emissions factors or fuel mix data were not provided by the electric utilities for this inventory report. As a result, a regional emissions factor was used to estimate emissions from electricity use. For natural gas emissions, an average emissions factor was similarly used in the absence of facility-specific emissions factors. To further improve the inventory, collection of utility-specific emissions factors is recommended.

Manufacturing Industries

Methodology. Stationary Energy emissions from manufacturing industries were calculated using electricity and natural gas data specific to each jurisdiction from utilities that serve the Chicago Region, as well as facility-level stationary combustion data reported under EPA's GHGRP (U.S. EPA 2017c). Utilities that serve the region include ComEd, IMEA, Nicor Gas, and People's Gas.

Emissions from electricity use were calculated by multiplying consumption data by a region-specific CO_2, CH_4, and N_2O emission factor obtained from EPA's eGRID (U.S. EPA 2017b). Emissions from natural gas were calculated by multiplying consumption data by CO_2, CH_4, and N_2O emission factors from EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (U.S. EPA 2017a).

Emissions from the combustion of natural gas in manufacturing industries that were reported under EPA's GHGRP were excluded from the totals to avoid double-counting with the natural gas consumption data provided by the utilities.

Emissions from construction equipment, which the GPC guidance recommends including under the Manufacturing Industries and Construction sub-sector, are included

in off-road emissions in the Transportation sector in this inventory report. This is done to provide for more clear comparison of off-road emissions over time.

Method Changes since the Previous Inventory. In this inventory, average eGRID emission factors for the RFC West region were used to estimate emissions from electricity use rather than a value derived from plant-specific information. Average emission factors from EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (U.S. EPA 2017a) were used to estimate natural gas emissions, compared with facility-specific emission factors used in the previous inventory. In addition, this inventory uses GWPs from the *IPCC Fifth Assessment Report* (IPCC 2014) instead of values from the *IPCC Second Assessment Report*.

Limitations and Recommendations. Plant-specific emissions factors or fuel mix data were not provided by the electric utilities for this inventory report. As a result, a regional emissions factor was used to estimate emissions from electricity use. For natural gas emissions, an average emissions factor was similarly used in the absence of facility-specific emissions factors. To further improve the inventory, collection of utility-specific emissions factors is recommended.

Energy Industries

Methodology. Stationary Energy emissions from energy industries were taken directly from EPA's GHGRP (U.S. EPA 2017c). These estimates include facility-level stationary combustion emissions from power plants in the Chicago Region.

Method Changes since the Previous Inventory. This inventory uses GWPs from the *IPCC Fifth Assessment Report* (IPCC 2014) instead of values from the *IPCC Second Assessment Report*. Otherwise, there were no method changes.

Limitations and Recommendations. No notable limitations or recommendations.

Fugitive Emissions from Oil and Natural Gas Systems

Methodology. Fugitive emissions from oil and natural gas systems were taken directly from EPA's GHGRP (U.S. EPA 2017c). These estimates include facility-level fugitive emissions from petroleum refining, natural gas systems for refineries, and natural gas transmission and distribution facilities in the Chicago Region.

Method Changes since the Previous Inventory. This source was not included in the previous inventory.

Limitations and Recommendations. No notable limitations or recommendations.

Transportation Emissions

On-Road

Methodology. Transportation emissions from on-road transportation were calculated using estimates of vehicle miles traveled (VMT) by vehicle type in the Chicago Region. The VMT data were provided by CMAP and derived from EPA's Motor Vehicle Emissions Simulator (MOVES) model (version MOVES2014a [U.S. EPA 2018a]), which uses a national default fraction of 0% for electric vehicle VMT. Alternative fuel vehicle (AFV) VMT for the region was estimated separately using nationwide electric vehicle VMT data from the EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (U.S. EPA 2017a), scaled to the region based on population. The electric vehicle VMT totals were then subtracted from the VMT totals derived from MOVES to avoid double-counting.

Emissions from non-AFV VMT were estimated using CO_2-weighted emission factors for each vehicle type from MOVES. Emission factors for each gas (CO_2, CH_4, and N_2O) were derived using transportation emissions data from EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks* (U.S. EPA 2017a) and the breakout of emissions by gas. Electricity consumption of electric vehicles was quantified using the electric vehicle kilowatt hour-per-mile engine efficiency factors from the GREET2016 model (Argonne National Laboratory 2014). Emissions from electricity use were then calculated by multiplying consumption data by eGRID emission factors for the RFC West region (U.S. EPA 2017b).

Method Changes since the Previous Inventory. The previous inventory used an earlier version of the MOVES model to estimate VMT. Additionally, emissions from AFV were calculated using data from the U.S. Department of Energy in the previous inventory, while this inventory used data from the U.S. EPA. Finally, this inventory uses GWPs from the *IPCC Fifth Assessment Report* (IPCC 2014) instead of values from the *IPCC Second Assessment Report*.

Limitations and Recommendations. No notable limitations or recommendations.

Railways

Methodology. Transportation emissions from passenger transit rail (i.e., CTA, Metra, NICTD) were calculated from fuel consumption and electric propulsion data from the Federal Transit Administration's (FTA) National Transit Database (NTD) (FTA 2010 and 2015). Fuel and electricity consumption from the three transit agencies were apportioned to the counties using each county's share of rail VMT, as provided by

CMAP (2017). Emissions from electricity use were calculated by multiplying consumption data by a region-specific CO_2, CH_4, and N_2O emission factor obtained from EPA's eGRID (U.S. EPA 2017b). Emissions from diesel were calculated by multiplying consumption data by CO_2, CH_4, and N_2O emission factors from the U.S. EPA (2015 and 2016).

Emissions from other passenger train activity (i.e., Amtrak trains) were calculated using train route and frequency information from Amtrak's website (Amtrak 2017a and 2017b). The length of each route was determined using Google Earth. Fuel efficiency for Amtrak trains was calculated using total train miles and total fuel consumption for the entire Amtrak system (Bureau of Transportation Statistics 2018). The track miles were then multiplied by system fuel efficiency to estimate fuel consumption. Finally, emissions were calculated by multiplying consumption data by diesel fuel CO_2, CH_4, and N_2O emission factors from the U.S. EPA (2015 and 2016).

Transportation emissions from freight rail were calculated using ton-mile data for the Chicago Region provided by Oak Ridge National Laboratory (ORNL), which included the length, distance, carloads, and tonnage for each rail segment in each county (Oak Ridge National Laboratory 2018). ORNL sourced the geographic component (segment length, distance) from the Transportation Routing Analysis Geographic Information System (TRAGIS) model, and carload and tonnage from the Surface Transportation Board. Fuel consumption was then derived by multiplying ton-mile data by the miles-per-gallon efficiency from two of the largest Class I freight rail operators that serve the region (Union Pacific 2015 and Burlington Northern Santa Fe 2015). Finally, emissions were calculated by multiplying consumption data by diesel fuel CO_2, CH_4, and N_2O emission factors from the U.S. EPA (2015 and 2016).

Method Changes since the Previous Inventory. This inventory uses GWPs from the *IPCC Fifth Assessment Report* (IPCC 2014) instead of values from the *IPCC Second Assessment Report*. Otherwise, there were no method changes.

Limitations and Recommendations. No notable limitations or recommendations.

Waterborne Navigation

Methodology. Transportation emissions from waterborne navigation were calculated using fuel consumption data for recreational and commercial boats. Fuel consumption data for recreational boats was sourced from the NONROAD component of the MOVES2014a model (U.S. EPA 2018a). Fuel consumption data for commercial boats was taken from the 2015 Chicago inventory (City of Chicago 2017) and collected from commercial tour boat operators in the region (ICF 2017a). Emissions from recreational

boats were quantified using fuel consumption data from the MOVES2014a model. Emissions were calculated by multiplying the diesel and gasoline consumption data by emission factors from the U.S. EPA (2015). For commercial boats, emissions were also quantified by multiplying consumption data by diesel fuel CO_2, CH_4, and N_2O emission factors from the U.S. EPA (2015).

Method Changes since the Previous Inventory. This source was not included in the previous inventory.

Limitations and Recommendations. The companies contacted to collect fuel consumption data for commercial boats do not represent all of the commercial boat operators in the region. In addition, some companies that were contacted were unresponsive or unable to provide data. This inventory presents emission estimates based only on the data collected. Given the effort involved and data availability challenges associated with contacting companies individually to collect data, other approaches may be considered to quantity emissions from this source in the future.

Aviation

Methodology. Transportation emissions from aviation were calculated using fuel consumption data obtained from regional fuel service providers (ICF 2017b). Emissions were calculated by multiplying consumption data by aviation gasoline and jet fuel CO_2, CH_4, and N_2O emission factors from the U.S. EPA (2015).

Method Changes since the Previous Inventory. This source was not included in the previous inventory.

Limitations and Recommendations. The companies contacted to collect fuel consumption data for intra-regional flights do not represent all of the aviation fuel service providers in the region. In addition, most companies that were contacted were unresponsive or unable to provide data. This inventory presents emission estimates based only on the data collected. Given the effort involved and data availability challenges associated with contacting companies individually to collect data, other approaches may be considered to quantity emissions from this source in the future.

Off-Road

Methodology. Transportation emissions from off-road vehicles were quantified using emissions and fuel consumption data by equipment type from the NONROAD component of U.S. EPA's MOVES2014a model (U.S. EPA 2018a). Carbon dioxide emissions were taken directly from the MOVES2014a model. Methane and N_2O

emissions were quantified by multiplying consumption data by fuel-specific CH_4 and N_2O emission factors from *EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks* (U.S. EPA 2018b).

Method Changes since the Previous Inventory. The previous inventory used an earlier version of the MOVES model as its source for emissions and fuel consumption data. In addition, this report uses GWPs from the *IPCC Fifth Assessment Report* (IPCC 2014) instead of values from the *IPCC Second Assessment Report*.

Limitations and Recommendations. No notable limitations or recommendations.

Waste Emissions

Disposal of Solid Waste Generated in the Region

Methodology. Waste emissions from the disposal of solid waste generated in the region were calculated using the methane commitment method, which calculates downstream emissions associated with solid waste sent to landfills during the current inventory year. The methane commitment method takes a lifecycle approach, calculating landfill emissions based on the amount of waste disposed in a given year and assigning emissions to the year of waste generation under the assumption that the emissions will actually occur in future years as waste decays and produces methane. The methane commitment estimates for solid waste sent to landfill is calculated based on the mass of solid waste sent to landfill during the inventory year, the methane generation potential of waste based on the waste composition, the fraction of methane recovered at the landfill, and the oxidation factor for the landfill.

Estimates of the mass of solid waste sent to landfill in the inventory year were gathered from data and reports issued by county solid waste agencies and the City of Chicago (City of Chicago 2017; Cook County 2017; DuPage County Environmental Division 2017; SWALCO 2014; Will County 2017a; Will County 2018). For counties for which data was not available (i.e., DuPage, Kane, Kendall, and McHenry) disposal amounts were calculated based on the 2014 per capita waste generation rate for Illinois Region 2 and adjusted to account for the average recovery rate (Illinois Recycling Association 2015).

Data for the waste composition in the Chicago Region was retrieved from the 2015 *Illinois Commodity/Waste Generation and Characterization Update* (Illinois Recycling Association 2015).

The destination landfill for waste generated in the Chicago Region, the fraction of methane recovered at those landfills, and the oxidation factor for those landfills were gathered from data and reports issued by county solid waste agencies and the City of Chicago, as well as data from EPA's GHGRP (U.S. EPA 2017c). For instances where information on the destination landfill was not available, a standard value for the methane recovery rate, oxidation factor, and amount of methane contained in landfill gas was applied, as derived from a weighted average of the specified destination landfills for waste generation in the City of Chicago (City of Chicago 2017).

Method Changes since the Previous Inventory. Instead of the methane commitment method, the previous inventory used the waste-in-place method to quantify landfill emissions based on historical waste disposal in the region. In addition, this report uses GWPs from the *IPCC Fifth Assessment Report* (IPCC 2014) instead of values from the *IPCC Second Assessment Report*.

Limitations and Recommendations. Some county solid waste agencies report incomplete waste disposal data (e.g., the data represents a limited number of municipalities within the county). In addition, the methods used to track and estimate waste generation varies by county. In many cases, it is also not known where the waste that is generated in a given county is landfilled (e.g., within the regional boundary or outside the regional boundary). Further review of the waste generation and landfill destination data is recommended to further improve inventory estimates and confirm the observed trend.

Biological Treatment of Waste Generated in the Region

Methodology. Waste emissions from the biological treatment of waste generated in the region were calculated using data on the amount of waste diverted for composting. Estimates of mass of solid waste sent to composting facilities were gathered from data and reports issued by county solid waste agencies and the City of Chicago (City of Chicago 2017; DuPage County 2017; Kane County 2017; Kendall County 2017; Will County 2017b). For counties for which data was not available (i.e., Cook and McHenry), the amount of waste composted was estimated based on the average per capita composting rate reported for all other counties in the region. Emissions were then calculated by multiplying composting data by CH_4 and N_2O emission factors from the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 2006).

Method Changes since the Previous Inventory. This source was not included in the previous inventory.

Limitations and Recommendations. Based on the information provided by county solid waste agencies, all composting is assumed to occur at facilities outside the Chicago Region. In addition, some county solid waste agencies indicated that very small amounts of solid waste were sent for anaerobic digestion outside of the Chicago Region. However, estimates of the mass of waste sent for anaerobic digestion were unavailable; therefore, emissions from anaerobic digestion of waste generated in the Chicago Region are assumed to be negligible. Further research is needed to confirm these assumptions.

Wastewater Generated in the Region

Methodology. Waste emissions from wastewater generated in the region were calculated based on the quantity of wastewater generated and emissions measurements from plants treating wastewater generated in the region. The quantity of wastewater generated was gathered from the U.S. EPA Integrated Compliance Information System (ICIS) (U.S. EPA 2017d). Emissions measurements from MWRD plants treating wastewater generated in the region were provided by MWRD, including N_2O emissions from wastewater treatment and discharge, CH_4 emissions from incomplete biogas combustion, CH_4 emissions from Imhoff tank operation, and nonbiogenic CH_4 and N_2O emissions from biogas combustion (MWRD 2018). This information was used to calculate average emissions per million gallons of wastewater treated at MWRD plants. The MWRD emission factors were then multiplied by the total quantity of wastewater generated to calculate total emissions from wastewater generated in the region.

Method Changes since the Previous Inventory. The previous inventory did not include CH_4 emissions from Imhoff tanks. In addition, this report uses GWPs from the *IPCC Fifth Assessment Report* (IPCC 2014) instead of values from the *IPCC Second Assessment Report*.

Limitations and Recommendations. Emissions measurements were not available for non-MWRD wastewater treatment plants in the Chicago Region. Therefore, the MWRD emission factors were assumed to be representative of all wastewater treatment plants in the region. To further improve the inventory, collection of emission measurements from other wastewater treatment plants in the region is recommended. In addition, based on the information available from MWRD and in the EPA ICIS database, it is assumed that all wastewater generated in the region is treated at plants within the regional boundary. However, further research is needed to confirm this assumption.