THE CHICAGO REGION GREENHOUSE GAS BASELINE INVENTORY AND FORECAST

PREPARED FOR THE CHICAGO METROPOLITAN AGENCY FOR PLANNING

THE CENTER FOR NEIGHBORHOOD TECHNOLOGY
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TABLE OF CONTENTS

LIST OF TABLES AND CHARTS

EXECUTIVE SUMMARY

As the Chicago metropolitan area's population and economy grow, there is an opportunity for the region to direct its growth in a manner that responds to growing concerns about climate change and greenhouse gas emissions. As part of the of its *GO TO 2040* regional planning process, the Chicago Metropolitan Agency for Planning commissioned an inventory of current greenhouse gas emissions in the seven county region, including Cook, Lake, DuPage, Will, Kane, McHenry, and Kendall Counties.

The first step in addressing the Chicago region's contribution to global warming is understanding the scope, scale and source of the existing emissions. To conduct this research, the Center for Neighborhood Technology (CNT) used Intergovernmental Panel on Climate Change methods and local data sources, in combination with modeling of national data to local demographics, to document all direct sources of greenhouse gas (GHG) emissions in the seven county metropolitan region, as well as indirect emissions from electricity consumption and waste.

CNT calculated a GHG emissions inventory for the seven-county metropolitan region for the year 2005, included 2000 emissions data to provide context and trend data, and estimated future emissions if no mitigation actions were taken.

The primary findings of this research reveal that:

1) **Electricity, natural gas, and transportation are the main sources** of region's global warming impact—92 percent of the region's emissions come from these three sectors, therefore most emission reductions must come from these areas as well.
2) **If no action is taken, the region's GHG emissions will continue to grow**. The region's annual emissions of 118.5 million metric tons (MMT) of carbon dioxide equivalent (CO_2e) in 2000 (126.6 MMT if aviation emissions are included) will grow by 14.0 (16.9) percent by 2040, to a total of 135.2 (148.0) MMT.
3) **To achieve proposed national reduction targets, annual emissions in 2020 will have to be reduced 30% below their current projected values**, in order to meet the goal to reduce annual emissions to 1990 levels by 2020.
4) **Household emissions rates vary across the region and are related to urban form;** there is potential to mitigate household transportation emissions by encouraging more mixed use compact development in proximity to transit.
5) **There is significant potential to reduce emissions from energy used in buildings** through efficient new building design and retrofits of existing buildings.

CHICAGO REGION BASELINE INVENTORY

As part of the process for developing a long range plan, the Chicago Metropolitan Agency for Planning determined that it was essential to understand the region's contribution to global warming. As part of the *GO TO 2040* planning process, research was conducted to develop a baseline greenhouse gas emissions inventory and forecast for the seven-county Chicago region. Included in the analysis are Cook, Lake, DuPage, Will, Kane, McHenry, and Kendall Counties. The base year for this analysis is 2005. Emissions for 2000 were also calculated to provide context and trends.

The resulting 2005 Greenhouse Gas Emissions Inventory measures direct emissions from natural gas, transportation, agriculture, and industrial processes and product use. Indirect emissions were calculated for electricity and waste. Despite the fact that most electricity generation and waste handling facilities are located outside of regional boundaries, emissions for the electricity consumed and waste generated by residents of the region are included in the calculation. Aviation emissions for area airports are calculated and considered separately.

Emissions were calculated for the six major categories of greenhouse gases regulated under the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Emissions were converted into carbon dioxide equivalents (CO_2e) using global warming potentials from the United Nations Intergovernmental Panel on Climate Change (IPCC) Third Annual Assessment Report. Activity data were translated into emissions using standard emissions factors from national and international sources, as described in the Appendix.

The methodology used IPCC methods and local data sources in combination with modeling of national data to local demographics. All data is presented in metric tons (tons) or million metric tons (MMT), to enable comparison internationally. The methods for calculating emissions for each sector are summarized and presented with the resulting emissions data for each sector. A detailed methodology for the full inventory is presented in the Appendix.

In additional to full inventory results for the seven-county region, emissions are reported for each of the counties, and for six geographically diverse communities: Aurora, Schaumberg, Joliet, Blue Island, Algonquin, and Highland Park. Per household emissions for transportation, electricity, and natural gas are also calculated in order to examine the effect of urban form on household emissions. Finally, a forecast estimating the greenhouse gas emissions that would occur if no mitigation actions were taken was calculated to provide a basis for CMAP's process to develop alternative scenarios for future growth.

2005 GHG Baseline Inventory for the Chicago Region

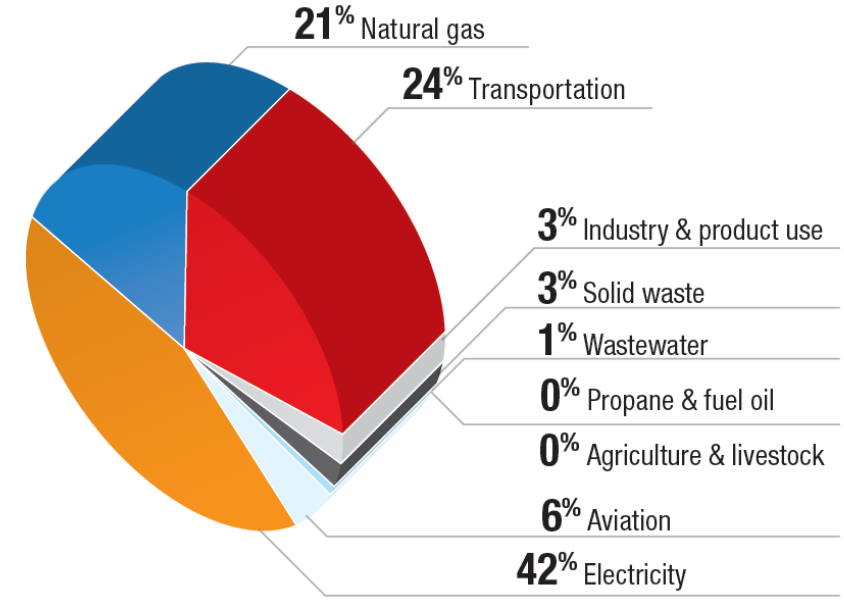
In the year 2005, the Chicago region emitted 131.18 million metric tons of carbon dioxide equivalents (MMT CO_2e) of greenhouse gases (GHG), not including aviation emissions. This represents 15.81 metric tons per person. When aviation emissions of 8.66 MMT CO_2e are included in the 2005 inventory, the region emitted a total of 139.83 MMT CO_2e, or 16.85 per person.

Total and per capita CO_2 emissions

Sector	Total CO_2 emissions (MMT CO_2e)		Per capita emissions (metric tons CO_2e / person)	
	2000	2005	2000	2005
Electricity	45.47	57.00	5.58	6.87
Natural Gas	30.98	29.05	3.80	3.50
Transportation	32.91	34.03	4.04	4.10
Industry & Product Use	4.74	4.59	0.58	0.55
Solid Waste	2.63	4.84	0.32	0.58
Wastewater	0.98	0.99	0.12	0.12
Agriculture & Livestock	0.60	0.51	0.07	0.06
Propane and Fuel Oil	0.22	0.16	0.03	0.02
Aviation	8.05	8.66	0.99	1.04
Total without Aviation	**118.52**	**131.18**	**14.55**	**15.81**
Total including Aviation	**126.56**	**139.83**	**15.54**	**16.85**

Source: Center for Neighborhood Technology

2005 CMAP emissions profile including aviation,
total MMT CO2e: 139.8



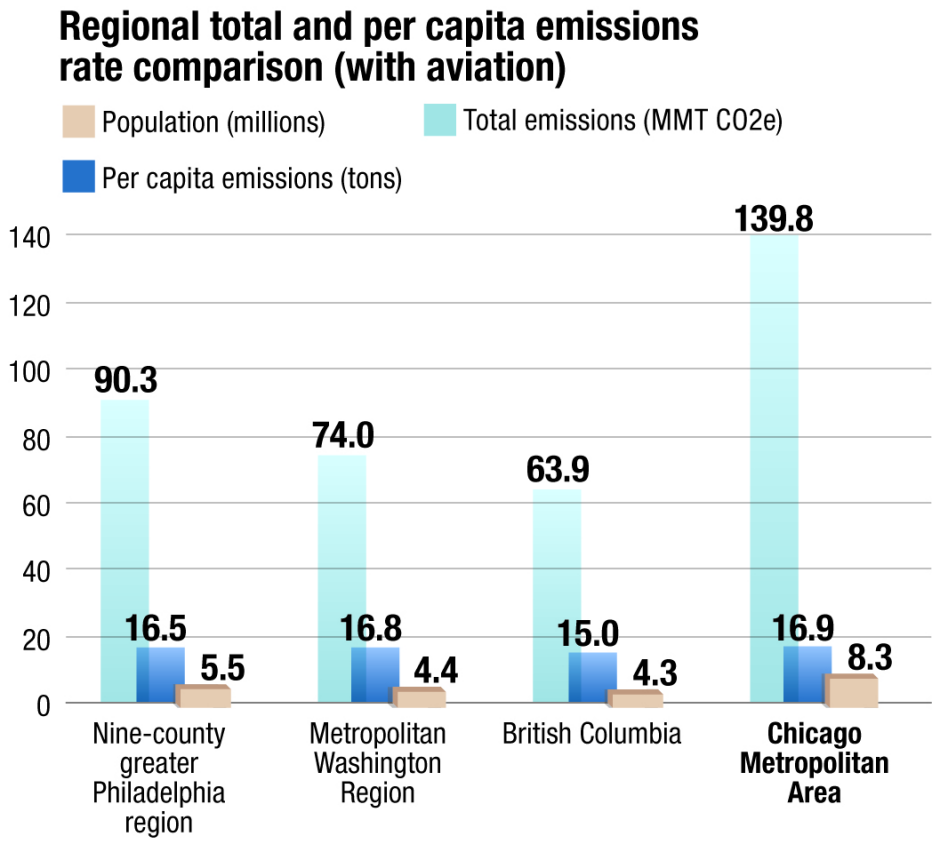
Source: Center for Neighborhood Technology

Baseline Inventory and Consideration of Aviation Emissions

Air travel is a significant source of greenhouse gases, but because aircraft emissions occur over the entire distance of a flight, cities and regions have undertaken varying methods for the calculation and inclusion of aviation emissions in their greenhouse gas inventories. The development of a generally accepted protocol for measuring aviation emissions is still evolving. In the absence of a standardized protocol, there are challenges in comparing one emissions inventory to another. Some cities and regions have elected to measure aviation emissions and report them separately from the full greenhouse inventory. Following the practice in the City of Chicago Greenhouse Gas Emissions Inventory and the London Emissions Inventory, aviation emissions for this report have been calculated separately for the Chicago region and presented both as a portion of, and separately from, the full greenhouse gas inventory. Guidance for airports on calculating aviation emissions was released by the Transportation Research Board in May 2009 which could alleviate these challenges in the future.

Per Capita Emissions

The Chicago region's per capita emissions rate including aviation in 2005 was 16.9 tons CO_2e for its 8,296,523 residents. This is comparable to other regions where a greenhouse gas inventory included aviation emissions. The Chicago region's per capita emissions are slightly higher than British Columbia, which has a per capita rate of 15.0 tons. The rate is similar to the Philadelphia region which has a per capita rate of 16.5 tons, and the Washington DC region with a rate of 16.8 tons.



Source: Center for Neighborhood Technology

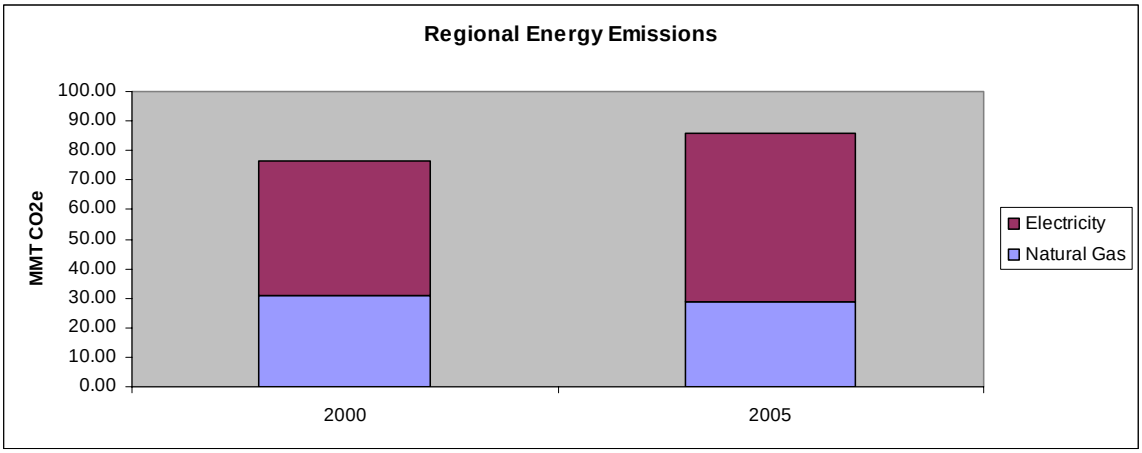
Energy Emissions

In 2005, the seven-county region's non-transportation energy use accounted for 86.21 MMT CO_2e, or 65.7 percent of total emissions (excluding aviation) in 2005. This was an increase of 9.54 MMT, or 12.4 percent, over 2000 energy emissions of 76.67 MMT CO_2e.

Energy emissions in this report include emissions associated with electricity and natural gas consumption. Of the total 2005 regional emissions, 43.4 percent were attributable to electricity consumption and 22.1 percent to natural gas. This energy use primarily represents natural gas and electricity used in buildings, but also includes smaller uses such as street lighting. The energy sector emissions were calculated using account level consumption data from Commonwealth Energy, Peoples Gas, North Shore Gas, and Nicor.

Two other non-transport energy sources, propane and fuel oil, are also used in small quantities to heat area buildings. Emissions from these sources are included in the inventory, but represent less than 0.02 percent of all energy emissions.

Regional Energy Emissions: Natural Gas and Electricity for 2000 and 2005[1]



The Chicago region's greenhouse gas emissions from energy use changed at a different rates from 2000 to 2005. Electricity emissions grew substantially, 25.3 percent, while natural gas emissions decreased slightly by 6.2 percent.

The emissions from electricity consumption are calculated based on the average emissions from all power plants in the North American Electric Reliability Council region, as the Chicago area buys and sells its electric power in a regional power pool that includes plants outside the region. This includes plants producing power from sources with different GHG impacts (e.g. coal, nuclear) and the exact mix of power being supplied by each plant in the region changes over time. In addition to any real changes within the electric supply, the boundaries of the power pool that includes Chicago

1 Propane and fuel oil emissions are relatively small and are omitted from this figure.

changed between 2000 and 2005. The resulting emissions factor for electricity grew nine percent from 2000 to 2005; in 2000 it was 0.609 kg per kWh and in 2005 it was 0.664 kg per kWh. The emissions factor will continue to change with public policy initiatives that promote more renewable supply sources or carbon pricing scenarios that will make fossil-fuel generated electricity more expensive.

Since such a large portion of electricity and natural gas use in Chicago heats and cools our buildings, the use is very dependent on the weather. This trend is seen in the residential sector: the number of cooling degree days—a measure of how hot weather is and how much air conditioning might be used—was 52 percent higher in 2005 than in 2000, and the residential electricity usage was 23 percent higher. Similarly, the number of heating degree days—a measure of how cold weather is and building heating needs—was 3 percent lower in 2005 and residential natural gas use was 13 percent lower.[2]

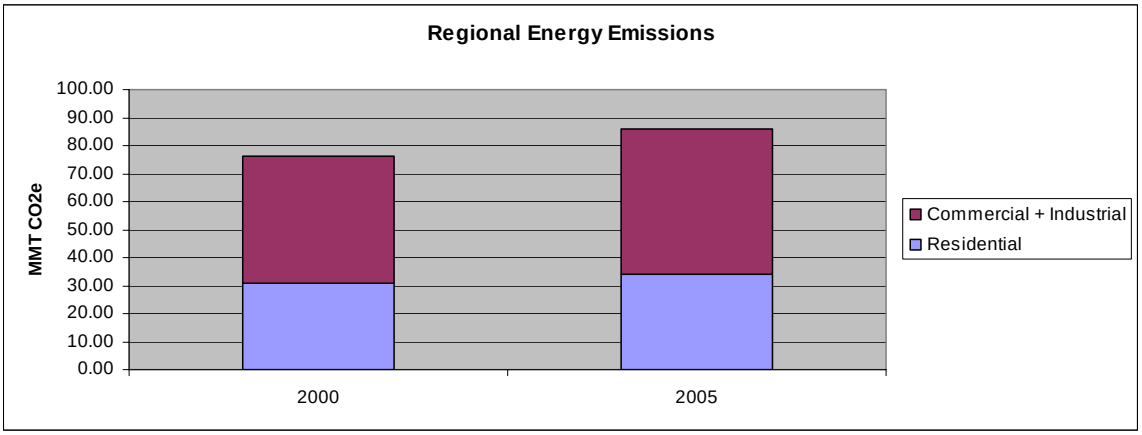
Regional Energy Emissions by User Class

Emissions in the commercial and industrial sector comprised 60.3 percent of the energy emissions in the region in 2005. The residential sector emitted 39.7 percent. This proportional distribution remained fairly constant in both 2000 and 2005.

Regional Energy Emissions by Subsector

	2000	2005
Residential	31.01	34.15
Commercial + Industrial	45.44	51.91
Total	**76.45**	**86.06**

Regional Energy Emissions: User Class for 2000 and 2005



County Energy Emissions

Energy emissions in the counties are highest in the most populous regions, and reflect both population densities and commercial and industrial activity. Natural gas emissions decreased regionally from 2000 to 2005. However, the change in usage differed substantially at the county level. Cook, DuPage and Lake experienced a decrease in

2 Illinois State Water Survey, "Illinois State Climatologist Data, Monthly Data for Station 111549 (Chicago O'Hare)," http://www.sws.uiuc.edu/data/climatedb/choose.asp?stn=111549

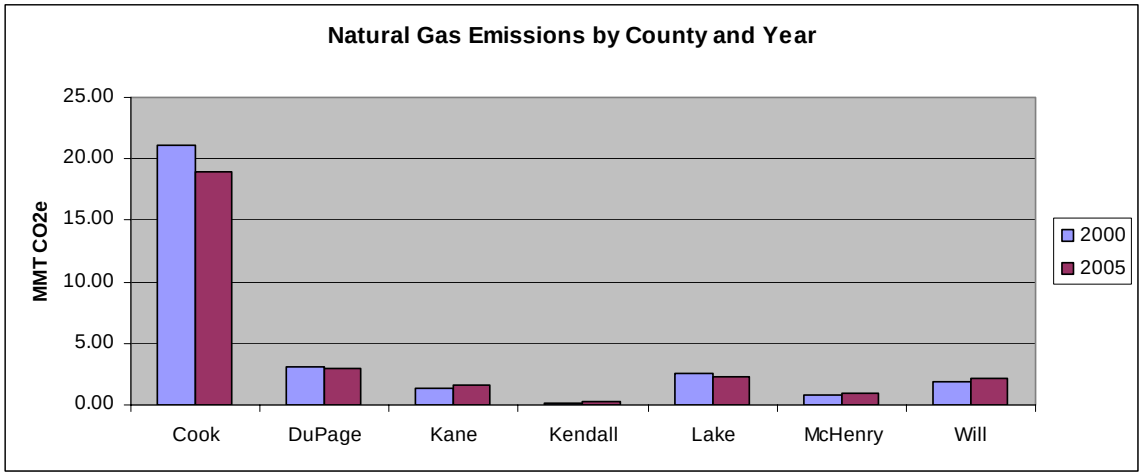
usage, but Kane, Kendall, Will and McHenry saw gas consumption increase. Electricity emissions increased in all the counties during the same time period.

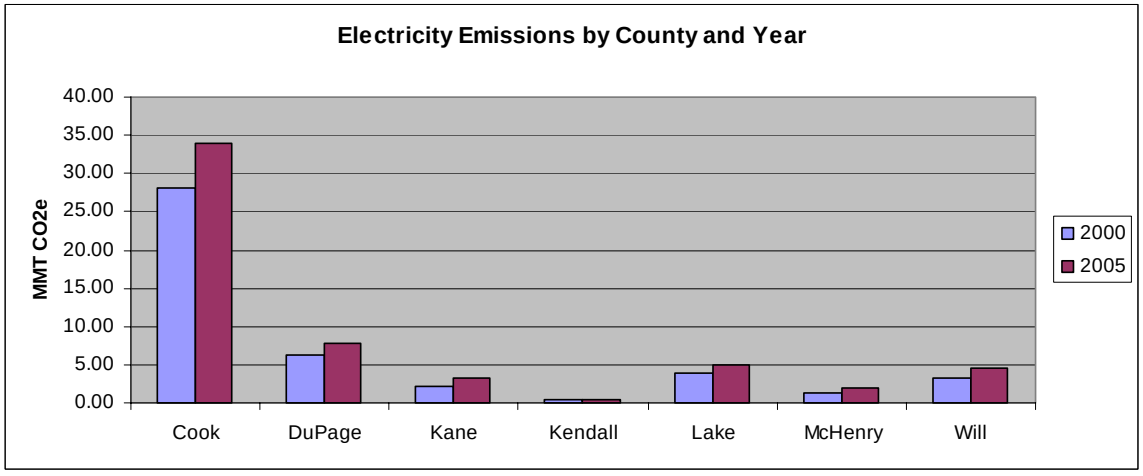
Natural Gas MMT CO_2e

	Cook	DuPage	Kane	Kendall	Lake	McHenry	Will
2000	21.11	3.07	1.39	0.20	2.54	0.86	1.82
2005	18.97	2.94	1.56	0.26	2.27	0.93	2.14

Electricity MMT CO_2e

	Cook	DuPage	Kane	Kendall	Lake	McHenry	Will
2000	28.19	6.21	2.21	0.33	3.98	1.38	3.16
2005	34.00	7.76	3.29	0.48	5.05	1.86	4.56



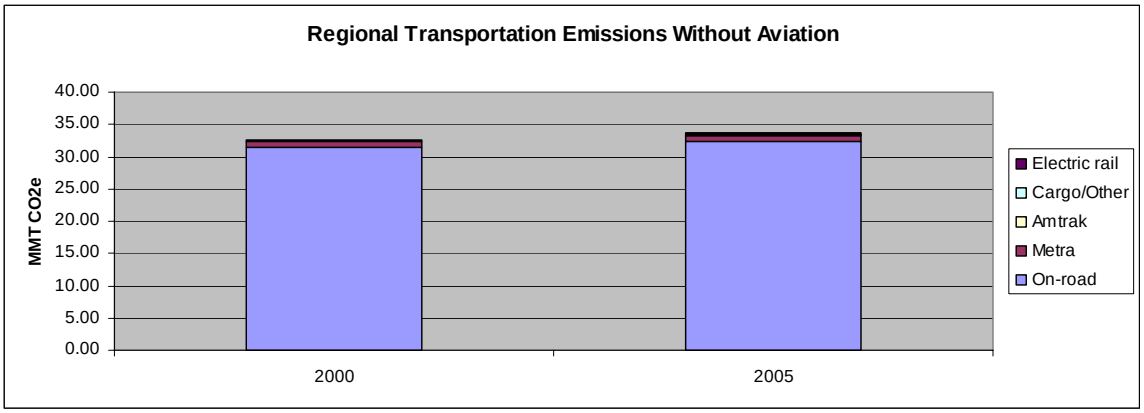


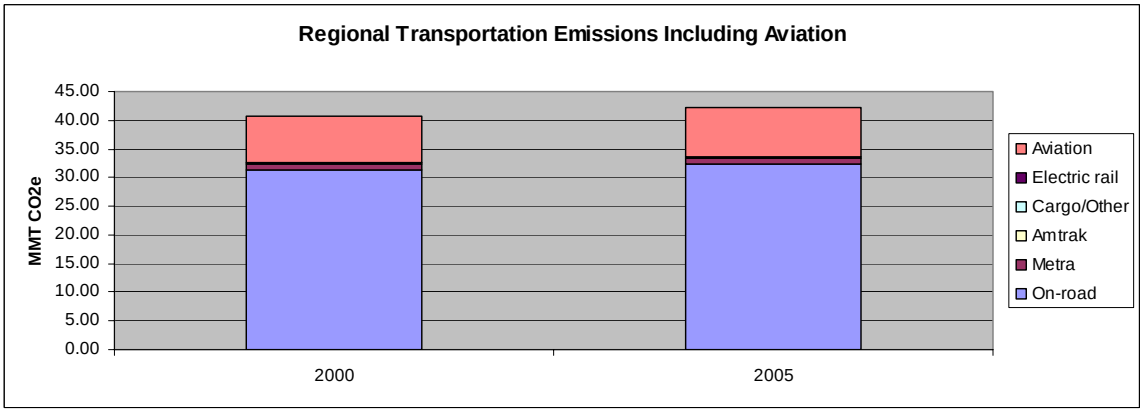
Transportation Sector

Transportation is the second largest source of GHG emissions in the Chicago region. The non-aviation transportation emissions for the region account for 34.03 MMT CO_2e in 2005, and represent 25.9 percent of total non-aviation regional emissions. This is an increase of 3.4 percent over the 2000 emissions of 32.91 MMT CO_2e. When aviation emissions are included, the total transportation emissions for 2005 are 42.69 MMT CO_2e,

representing 30.5 percent of total emissions; 20.2 percent of the transportation emissions are due to aviation.

Subsector	MMT CO_2e, 2000	MMT CO_2e, 2005
On-road	31.35	32.41
Class I line-haul	0.94	0.94
Class II/III line-haul	0.004	0.004
Amtrak	0.02	0.02
Metra	0.24	0.24
Yard Operations	0.11	0.11
Electric Railroads	0.24	0.30
Aviation	8.05	8.66
Total, no aviation	32.91	34.03
Total with avation	40.95	42.69





Vehicle Miles Travelled and Fleet Mix

On-road vehicles, including cars, trucks, and motorcycles, generated the majority of transportation GHGs in Chicago in 2000 and 2005—95.2 percent. The 3.4 percent increase in total GHGs in this sector from 2000 to 2005 was likely due to growth in suburban population, where households have a higher VMT per household rate. This is

even more significant due to the fact that the weighted average fuel economy for the vehicles on the road in the region increased from 16.5 miles per gallon (mpg) to 18.7 mpg, using Federal Highway Administration data. Vehicle efficiency increased between 2000 and 2005 for every vehicle type except light-duty gasoline and diesel trucks.

Transportation emissions were developed using VMT data from the Illinois Department of Transportation and Amtrak; fleet mix data from the Lake Michigan Air Directors Consortium (LADCO); vehicle efficiency data from the Federal Highway Administration (FHWA); and fuel sales and usage from the U.S. Department of Energy and the National Transit Database. Emissions factors for transportation are from the U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks and State Inventory Tool.

The total vehicle miles traveled (VMT) in the Chicago region increased 7.2 percent between 2000 and 2005 from 56.4 billion to 60.5 billion miles per year.[3] VMT in the US grew 9 percent over the same period.[4] The VMT in Chicago was 2.1 percent of the 2.7 trillion miles traveled by vehicles in the US in 2000.[5]

The vehicle mix and proportion of the total VMT traveled was obtained from LADCO for the Chicago Area Transportation Study (CATS) area in 2005 and assumed to be applicable for the Chicago region in 2000. According to the LADCO data, the majority of VMT, 90.9 percent, were driven by gasoline passenger cars and light duty trucks. Diesel heavy duty vehicles were the third largest share of VMT at 7.1 percent, and they were the third largest share of GHG emissions as well. At an average of 6.7 miles per gallon in 2005, these trucks emitted 6.5 MMT CO_2e over 4.29 billion miles. As a share of total VMT, light and heavy-duty trucks are a higher proportion regionally than they are nationally—52.1 percent in the Chicago region versus 41 percent nationally in 2000. Of the VMT due to trucks, 84% is due to light duty trucks, which include SUVs and pickups. The share of passenger cars is lower at 48 percent versus 58 percent nationally.[6]

Aviation Emissions

In 2005, aviation emissions for the region were 8.66 MMT CO_2e, an increase of 7.6 percent over the 2000 emissions of 8.05 MMT CO_2e. Air travel emissions were calculated based on passenger enplanement statistics from the US Department of Transportation Bureau of Transportation Statistics (BTS). In addition to O'Hare and Midway, there are numerous regional and private aviation facilities across the Chicago region for which data were unavailable, but are likely to be a small fraction of air travel emissions in the area.

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3 Illinois Department of Transportation. Illinois Travel Statistics 2000, http://www.dot.il.gov/travelstats/2000its.pdf, and Illinois Travel Statistics 2005, http://www.dot.il.gov/travelstats/2005its.pdf.

4 U.S. Department of Energy, "Transportation Energy Data Book, Edition 26," http://cta.ornl.gov/data/download26.shtml.

5 U.S. Department of Energy, "Transportation Energy Data Book, Edition 26," http://cta.ornl.gov/data/download26.shtml.

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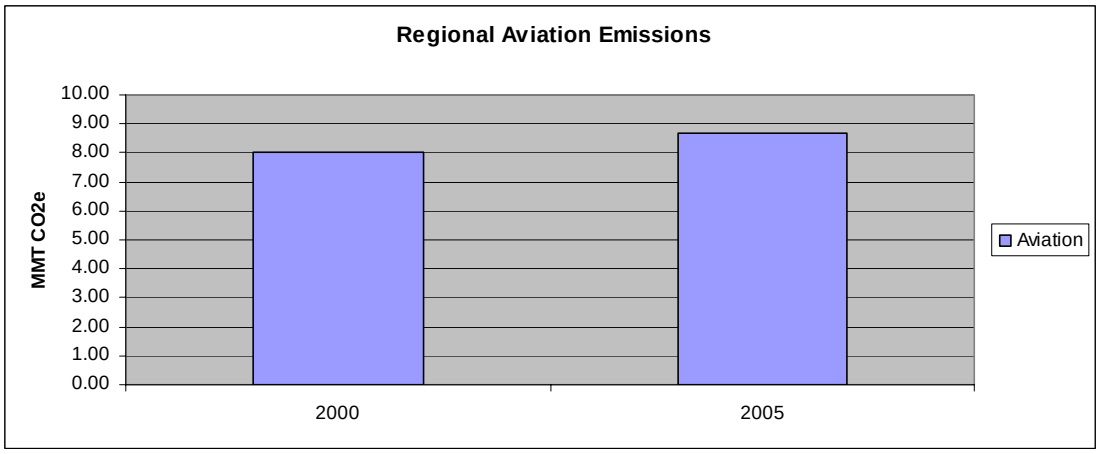
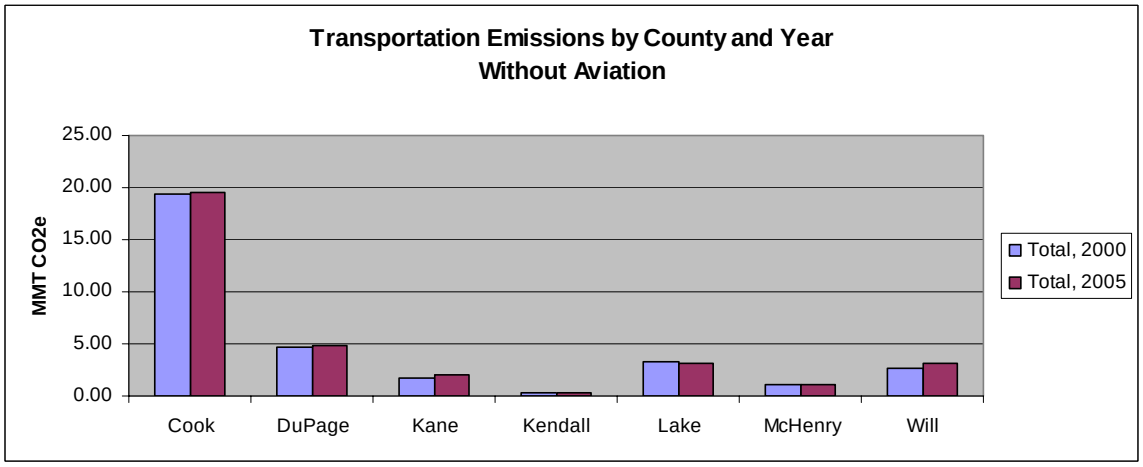


County Transportation Emissions

2005 transportation emissions were greatest in Cook County, where emissions were 19.46 MMT CO_2e, and the lowest in Kendall County, with emissions of 0.38 MMT CO_2e. Transportation emissions increased in all the counties between 2000 and 2005 except in Lake County, where emissions decreased slightly. The highest percentage of increase was seen in Kendall County where transportation emissions increased 27 percent from 2000 to 2005.

Transportation Emissions by County (without Aviation)

	Cook	DuPage	Kane	Kendall	Lake	McHenry	Will
Transportation, MMT CO_2e, 2000	19.31	4.67	1.72	0.30	3.21	1.09	2.60
Transportation, MMT CO_2e, 2005	19.46	4.81	1.97	0.38	3.17	1.17	3.07



2005 Onroad Transportation Emissions

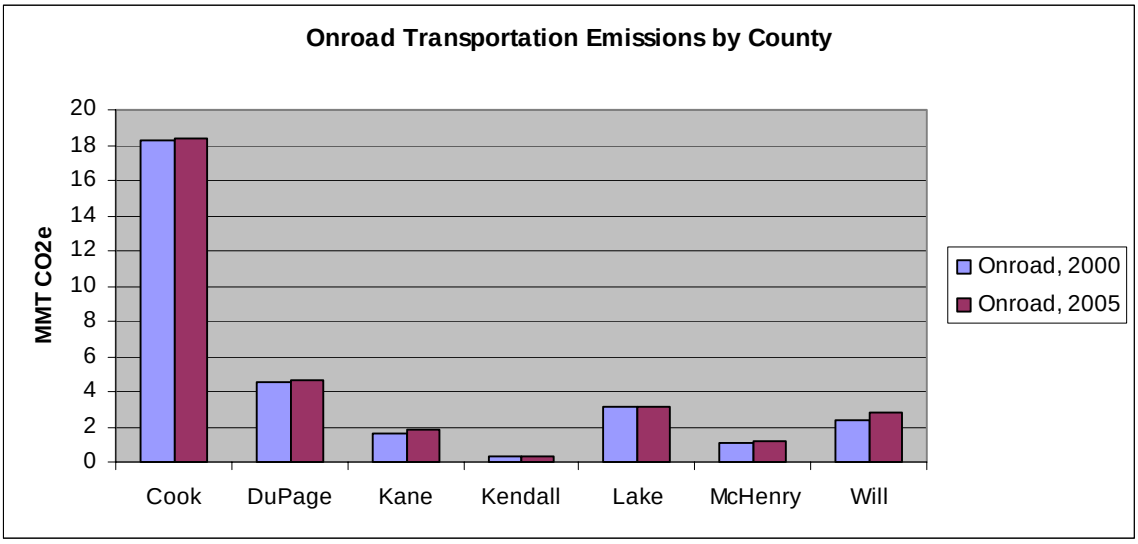
Onroad emissions account for 95 percent of the transportation emissions in the region. They are the greatest in Cook County, where 2005 emissions were 18.4 MMT CO_2e, and where the highest vehicle miles travelled (VMT) is recorded. 2005 emissions due to transportation are the lowest in Kendall County, with 0.37 MMT CO_2e.

	Cook	DuPage	Kane	Kendall	Lake	McHenry	Will
Onroad, 2000 MMT CO_2e	18.32	4.51	1.63	0.29	3.17	1.07	2.37
Onroad, 2005 MMT CO_2e	18.40	4.65	1.89	0.37	3.12	1.15	2.84

Emissions due to on-road travel were estimated using annual VMT statistics for each county from Illinois Highway Statistics reports by the Illinois Department of Transportation. Using fleet mix estimates from LADCO, VMT were divided between different vehicle classes.

Estimated VMT data

County	Household VMT	All on-road VMT
Cook	30,292,202,554	34,370,678,312
DuPage	7,283,778,000	8,675,394,497
Kane	3,663,012,000	3,520,486,524
Kendall	690,971,319	684,711,260
Lake	5,405,748,000	5,828,892,021
McHenry	2,675,387,500	2,146,275,643
Will	5,336,716,500	5,300,575,756
CMAP	**55,347,815,873**	**60,527,014,013**



Off Road Transportation Emissions

Emissions associated with off road transportation were estimated based on fuel consumption and accounted for 3 percent of the Chicago region's transportation emissions in 2005—1.27 MMT CO_2e. According to the National Transit Database, Metra, the Chicago regional commuter rail system, consumed 24.1 million gallons of diesel fuel

in 2005,[7] generating 0.24 MMT CO_2e. At 1.6 billion reported passenger miles, Metra's GHG emissions were 0.15 kg per passenger mile in 2005.

Based on data from the local utility, ComEd, electricity consumed by transportation in the Chicago region was 394 million kWh in 2000 and 456 million kWh in 2005, generating 0.24 and 0.30 MMT CO_2e respectively. Most of this can be attributed to the Chicago Transit Authority (CTA), operators of Chicago's "L", elevated electric train system. The CTA reported consumption of 406 (or 409) million kWh in 2005 in the National Transit Database[8], with associated emissions to 0.271 MMT CO_2e.

Emissions for Amtrak regional and long-distance rail emissions in the Chicago region were estimated at 0.018 MMT CO_2e in 2005 based on VMT and vehicle efficiency data in Chicago provided from Amtrak.[9] The Chicago region was one of the nation's busiest Amtrak locations with 2.5 million passengers riding Amtrak to or from Chicago in 2005.[10] As with air travel, which was discussed previously, the total emissions associated with Chicago region Amtrak passengers are much greater than those emitted only within Chicago regional boundaries, and for most purposes regional and long distance rail emissions should be examined at a geographic scale larger than a metropolitan region.

Household Energy Use

The previous calculations for energy use incorporate both residential and commercial uses. Given that a large share of emissions results from household energy use, and there is great potential to develop and apply mitigation strategies directed at such use, it is beneficial to calculate the emissions uniquely associated with it.

The calculations below measure greenhouse gas emissions by county for household VMT and natural gas and electricity used in residences. The impact of urban form is evident in less densely developed counties, where jobs and amenities are more dispersed, and increased VMT results in higher per household transportation emissions. More densely developed counties such as Cook County and Kane County (with urbanized centers Elgin and Aurora), where residents can drive shorter distances and rely on transit to reach key destinations, have lower per household transportation emissions. The average size of households varies from county to county, from a 2.69 persons per household in Cook to 3.10 persons per household in Will, which has some bearing on per household emissions measures.

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7 Federal Transit Administration, "National Transit Database." U.S. Department of Transportation, http://www.ntdprogram.gov/ntdprogram/

8 Federal Transit Administration, "National Transit Database." U.S. Department of Transportation, http://www.ntdprogram.gov/ntdprogram/

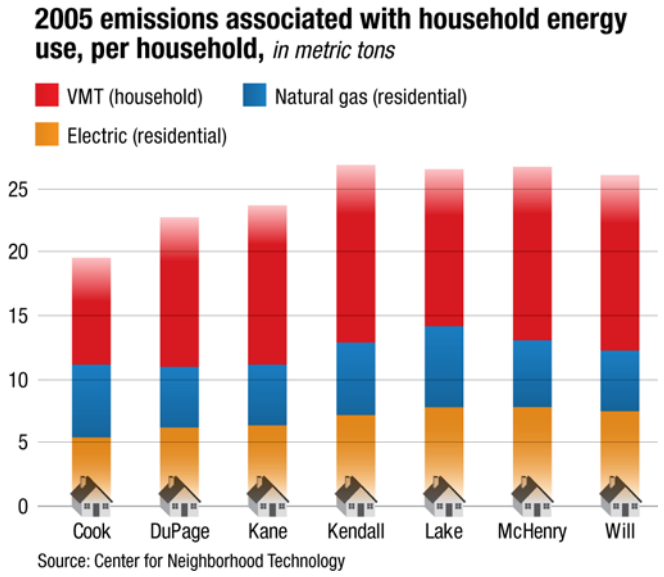
9 In possession of authors.

10 Amtrak. Amtrak Fact Sheet, Fiscal Year 2005 State of Illinois. December 2005, http://www.amtrak.com/pdf/factsheets/ILLINOIS05.pdf.

2005, Metric Tons CO_2 per household

Sector	Electric (Residential)	Natural Gas (Residential)	VMT (Household)	Propane and Fuel Oil	Total
Cook	5.29	5.77	8.37	0.08	**19.51**
DuPage	6.08	4.78	11.80	0.02	**22.68**
Kane	6.25	4.86	12.65	0.07	**23.82**
Kendall	7.11	5.74	14.05	0.22	**27.12**
Lake	7.75	6.28	12.47	0.04	**26.55**
McHenry	7.71	5.17	13.82	0.12	**26.81**
Will	7.41	4.69	13.97	0.08	**26.16**

Source: Center for Neighborhood Technology



Industrial Processes and Product Use

Industrial processes and product use generated 4.59 MMT CO_2e in 2005, or 3.5 percent of the region's total GHG emissions. This represents a 3 percent decrease from the 2000 emissions for this sector, which were 4.75 MMT CO_2e. The activity data in this sector are very difficult to find on at the regional level, so the emissions of this sector are estimated as a proportion of national emissions as reported by the US EPA.[11] Many of the emissions in this sector are compounds with high Global Warming Potentials (GWP)—they have relatively large impacts on global warming compared to CO_2 over 100 years and the CO_2e values shown reflect this.

The industrial processes sector includes all non-energy related GHG emissions produced by manufacturing. In the Chicago area, the relevant industries are iron and steel production (emissions are largely due to burning of coal during coking of iron ore)

11 U.S. Environmental Protection Agency. Inventory Of U.S. Greenhouse Gas Emissions And Sinks: 1990-2005. April 2007, http://www.epa.gov/climatechange/emissions/downloads06/07CR.pdf.

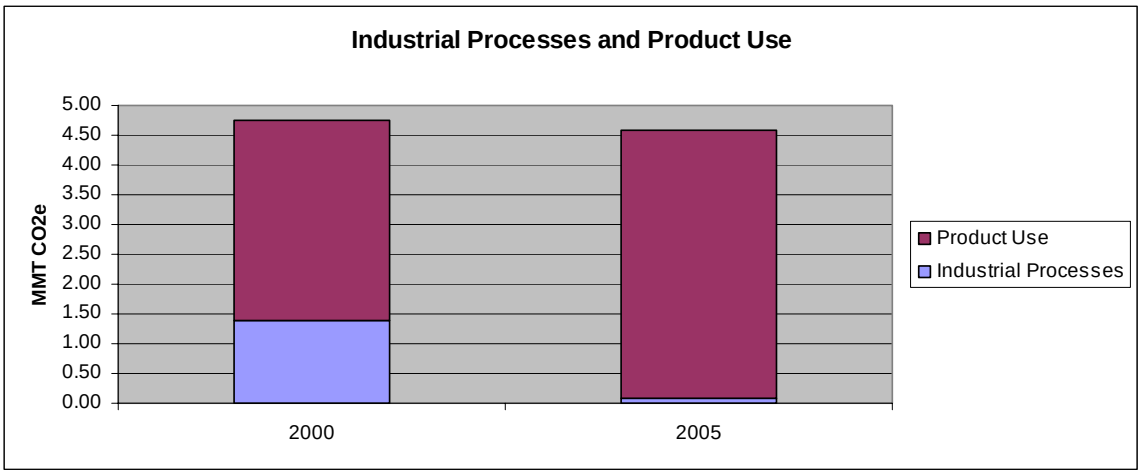
and semiconductor manufacturing (emissions due to various fluorinated gases used during production). The decline in the Chicago region's industrial process emissions is directly related to the decline in employment in the region as a share of national employment in these industries.

In addition to these industrial activities, there are a number of products used in the Chicago region that generate GHG emissions. These include the sulfur hexafluoride (SF6) used as an insulator in electrical equipment and the nitrous oxide (N2O) used as an anesthetic by dentists. Again, local data on these emissions were unavailable, so a similar method as the industrial process emissions was employed —national emissions were prorated by the regional share of the national population using US EPA National Inventory and US Census data. The result was emissions of 3.36 $MMTCO_2e$ in 2000 and 4.49 $MMTCO_2e$ in 2005 in Chicago.

The primary reason for the increase in product use emissions from 2000 to 2005 is an artifact of GHG accounting methods. Some greenhouse gases are also the substances that were found to be destroying the ozone layer in the 1980's. They are being phased out as part of the Montreal Protocol on Substances that Deplete the Ozone Layer and are therefore not regulated by the Kyoto Protocol, nor are they reported in this inventory. Many of these "Ozone Depleting Substances" have been replaced with other greenhouse gases that fulfill the same needs, such as refrigeration, but are regulated by the Kyoto Protocol. These substances are meant to be transitional—fulfilling our needs while more environmentally benign compounds and processes are invented and adopted—so tracking their use can be important in the effort to promote alternatives.

Industrial Processes and Product Use

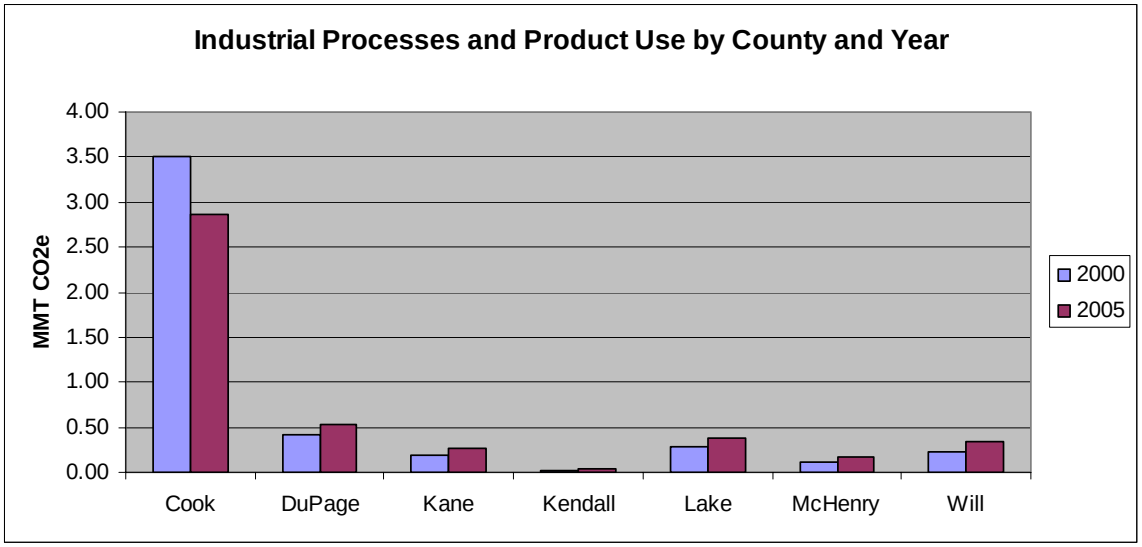
	2000	2005
Industrial Processes	1.39	0.10
Product Use	3.36	4.49
Total	4.74	4.59



2005 County Industrial and Product Use

2005 county emissions from industrial and product use range from a high of 2.86 MMT CO_2e in Cook County to 0.04 MMT CO_2e in Kendall County.

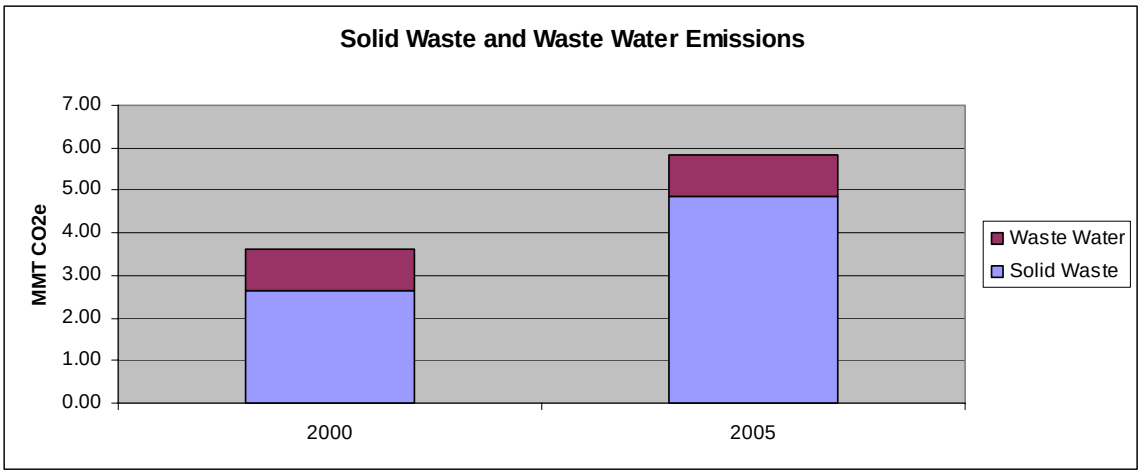
	Cook	DuPage	Kane	Kendall	Lake	McHenry	Will
2000	3.51	0.41	0.18	0.02	0.28	0.11	0.22
2005	2.86	0.52	0.27	0.04	0.38	0.16	0.34



Solid Waste and Waste Water

Solid waste accounted for 4.84 MMT CO_2e in 2005, and waste water treatment accounted for 0.99 MMT CO_2e, for a combined total of 5.83 MMT CO_2e, comprising 4.4 percent of total regional emissions. All of the GHG emissions associated with solid waste are methane (CH4) that is emitted during decomposition. Solid waste also produces CO_2 as it decomposes, but as the carbon stored in decomposing food, paper, and paper products is biogenic in origin—it was absorbed from the atmosphere by plants in recent history—its release does not contribute to global warming, and therefore is not counted in this inventory.

	2000	2005
Solid Waste	2.63	4.84
Waste Water	0.98	0.99
Total	3.61	5.83

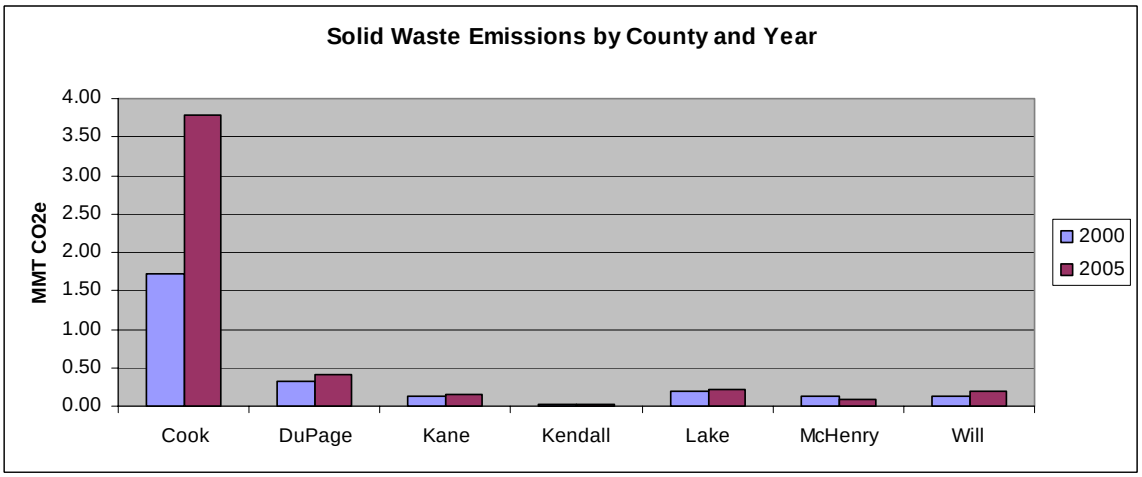


County Solid Waste

Regional and county emissions for solid waste are calculated using reported numbers from the Illinois EPA. Of note is a significant increase between 2000 and 2005 for Cook County, which, according to the Illinois EPA, could be a result of double counting due to current reporting methods.

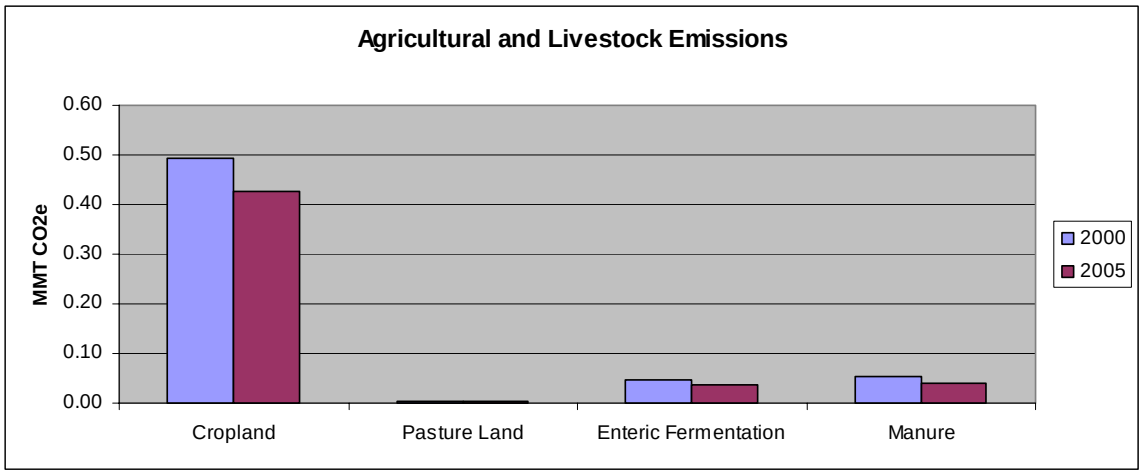
Solid Waste

	Cook	DuPage	Kane	Kendall	Lake	McHenry	Will
2000	1.72	0.32	0.13	0.02	0.19	0.13	0.12
2005	3.78	0.40	0.14	0.02	0.21	0.09	0.19



Agriculture Emissions

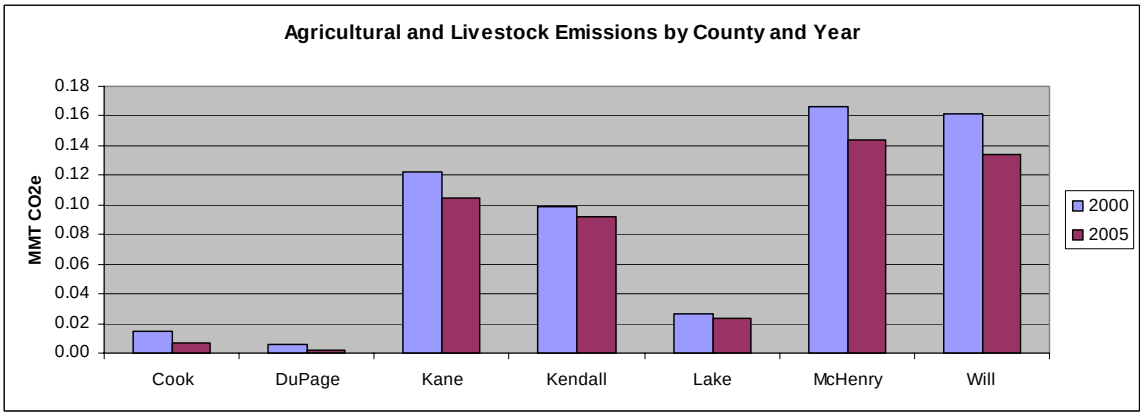
Regional agriculture emissions in 2005 are 0.51 MMT CO_2e, comprising less than 1 percent of total emissions. This is a 15.0 percent decrease from the 2000 agricultural emissions of 0.60 MMT CO_2e, likely due to increased land development and the elimination of agricultural land uses. The calculation includes emissions from cropland, pasture land, enteric fermentation, and manure.



County Agriculture Emissions

Agricultural emissions have decreased across all counties, and most significantly in McHenry and Will Counties. This decrease is reflective of increased land development and the loss of farmland in these counties.

	Cook	DuPage	Kane	Kendall	Lake	McHenry	Will
2000	0.01	0.01	0.12	0.10	0.03	0.17	0.16
2005	0.01	0.00	0.11	0.09	0.02	0.14	0.13



EMISSIONS PROFILES FOR COUNTIES AND MUNICIPALITIES

Emissions Inventories by County

The 2005 GHG emissions by county and by sector are summarized here, both in MMT CO_2e and as percentages of the total GHG emissions originating from each sector within each county.

Emissions by county, in MMT CO_2E and as percentages of total county emissions

	Cook		DuPage		Kane		Kendall		Lake		McHenry		Will	
Electricity	34.00	43%	7.76	47%	3.29	44%	0.48	37%	5.05	45%	1.86	42%	4.56	43%
Natural gas	18.97	24%	2.94	18%	1.56	21%	0.26	20%	2.27	20%	0.93	21%	2.14	20%
Transportation	19.46	24%	4.81	29%	1.97	27%	0.38	29%	3.17	28%	1.17	27%	3.07	29%
Industrial processes	0.04	0%	0.03	0%	0.01	0%	0.00	0%	0.01	0%	0.00	0%	0.00	0%
Product use	2.82	4%	0.49	3%	0.26	3%	0.04	3%	0.37	3%	0.16	4%	0.34	3%
Solid waste	3.78	5%	0.40	2%	0.14	2%	0.02	2%	0.21	2%	0.09	2%	0.19	2%
Wastewater	0.62	1%	0.11	1%	0.06	1%	0.01	1%	0.08	1%	0.04	1%	0.08	1%
Agriculture & Livestock	0.01	0%	0.00	0%	0.11	1%	0.09	7%	0.02	0%	0.14	3%	0.13	1%

Source: Center for Neighborhood Technology

Emissions Inventories for Selected Municipalities

Community-wide emissions inventories for a selected group of geographically diverse municipalities in the region were conducted for the year 2005. Inventories are presented for Aurora, Schaumberg, Joliet, Blue Island, Algonquin, and Highland Park. Both total emissions and per capita emissions were calculated.

Total Municipal Emissions, MMT CO_2e

Note: Industrial Processes, Agriculture and Livestock omitted due to lack of sufficient geographic resolution in data

2005

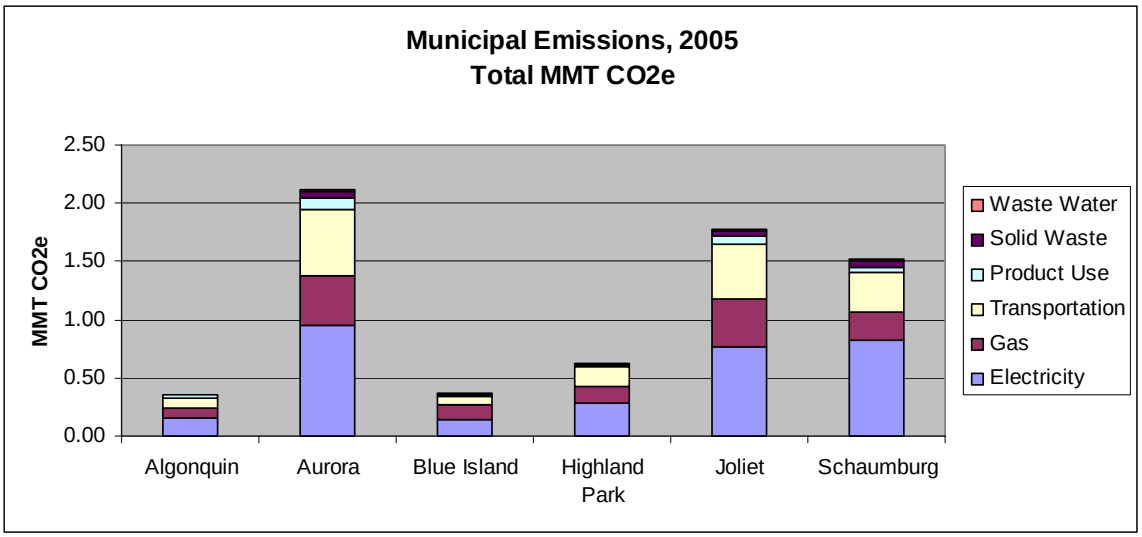
	Electricity	Natural Gas	Transportation	Product Use	Solid Waste	Waste Water	Total
Algonquin	0.16	0.09	0.09	0.02	0.01	0.00	**0.36**
Aurora	0.94	0.43	0.58	0.09	0.06	0.02	**2.12**
Blue Island	0.14	0.12	0.08	0.01	0.02	0.00	**0.38**
Highland Park	0.29	0.14	0.16	0.02	0.01	0.00	**0.62**
Joliet	0.77	0.41	0.47	0.07	0.04	0.02	**1.78**
Schaumburg	0.82	0.24	0.35	0.04	0.05	0.01	**1.52**

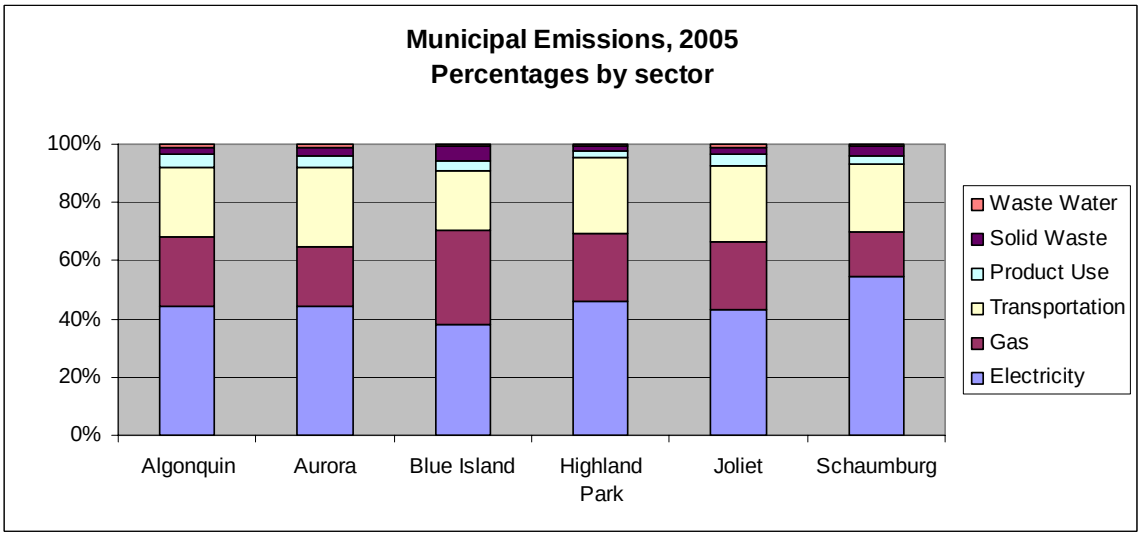
2005, tons per capita

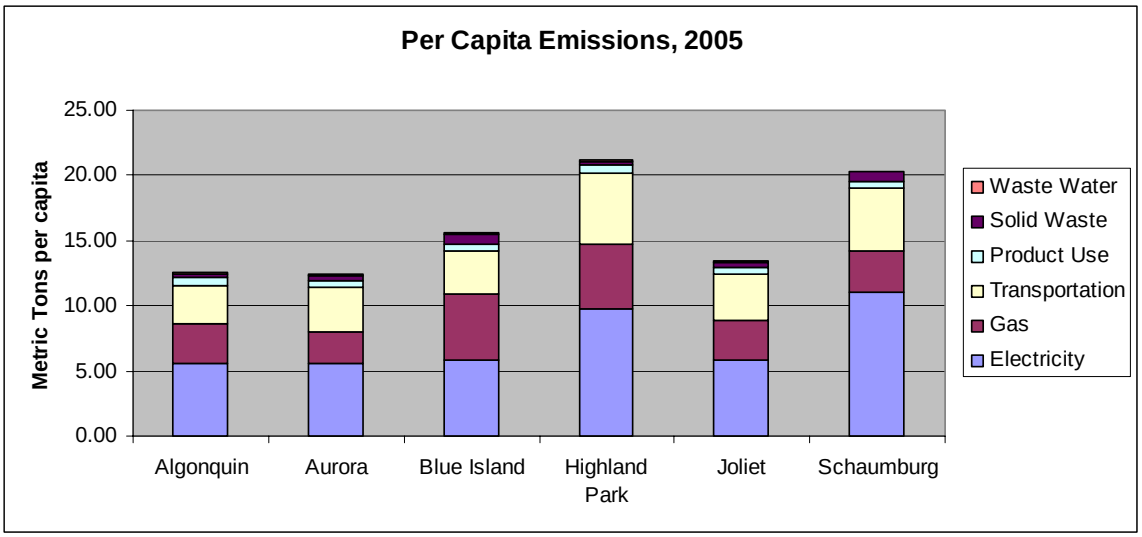
	Electricity	Natural Gas	Transportation	Product Use[12]	Solid Waste	Waste Water[13]	Total
Algonquin	5.57	3.02	3.00	0.54	0.31	0.12	**12.56**
Aurora	5.53	2.51	3.37	0.54	0.35	0.12	**12.42**
Blue Island	5.89	5.06	3.25	0.54	0.73	0.12	**15.59**
Highland Park	9.79	4.94	5.50	0.54	0.31	0.12	**21.20**
Joliet	5.81	3.07	3.54	0.54	0.30	0.12	**13.39**
Schaumburg	11.07	3.16	4.75	0.54	0.72	0.12	**20.37**

12 As described above, per capita emissions due to product uses are taken from EPA national estimates.

13 As described above, per capita emissions due to waste water treatment are taken from an MWRD regional study.


Municipal Emissions, 2005
Total MMT CO2e
MMT CO2e
2.50
2.00
1.50
1.00
0.50
0.00
Algonquin
Aurora
Blue Island
Highland Park
Joliet
Schaumburg
Waste Water
Solid Waste
Product Use
Transportation
Gas
Electricity


Municipal Emissions, 2005
Percentages by sector
100%
80%
60%
40%
20%
0%
Algonquin
Aurora
Blue Island
Highland Park
Joliet
Schaumburg
Waste Water
Solid Waste
Product Use
Transportation
Gas
Electricity



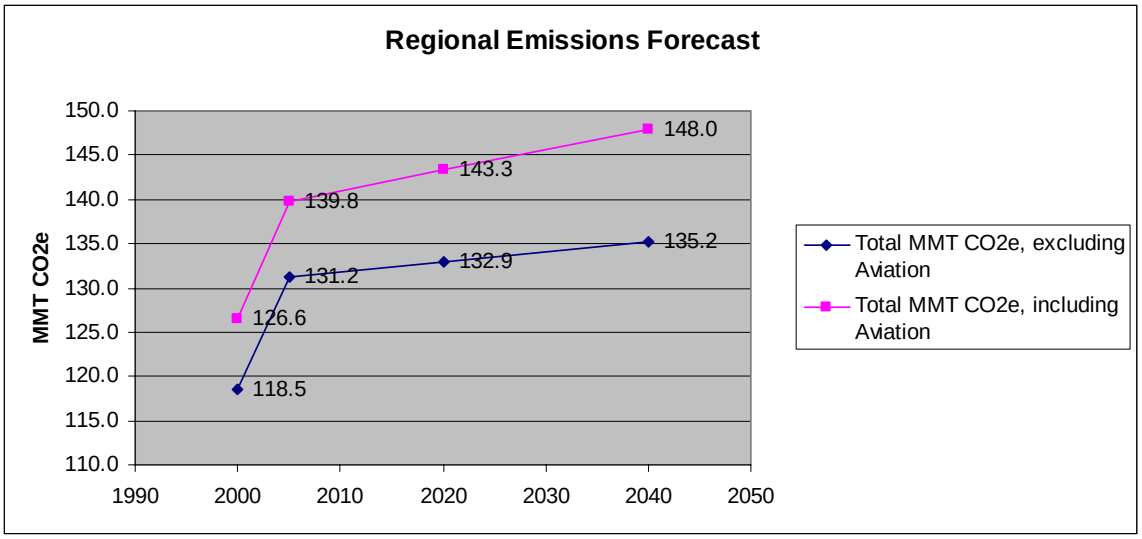
Aurora had the highest total emissions in 2005 with 2.12 MMT CO_2e, followed by Joliet with 1.78 MMT CO_2e. Algonquin and Blue Island had the lowest emissions with 0.36 and 0.38 MMT CO_2e respectively.

Highland Park had the highest per capita emissions, at 21.20 tons of CO_2e, followed by Schaumburg with 20.37 tons of CO_2e. For both Highland Park and Schaumburg, electricity was the highest portion of the per capita emissions rate.

This baseline emissions data provides the municipalities with key data to conduct further investigation into the largest emissions sources, and develop appropriate and effective strategies for reducing emissions in their communities. Each of the municipalities in this study was provided an individual report with a greenhouse gas emissions inventory for their city.

EMISSIONS FORECAST TO 2040

GHG emissions in the Chicago region are estimated to grow to 135.2 (148.0 including aviation) MMT CO_2e in 2040—a 14.0 (16.9) percent increase over 2000 levels. This is a slower rate of growth than the 33.8 percent population increase that is forecasted for the Chicago region between 2000 and 2040.



The regional emissions forecast was developed using federal government forecasts, which include assumptions of gains in energy efficiency and renewable energy generation, as well as data on historic emission trends. Local historic trends for GHG generating activities, such as energy use and vehicle miles traveled were also examined.

This study used the most recently available EIA data for forecasting. However, EIA data is revised annually as economic conditions change and new policies are enacted. The new forecast estimates will have some impact on the total forecasted emissions by 2040 and therefore the forecast and the nature and magnitude of the mitigation strategies should be reviewed periodically.

Energy

In order to forecast emissions from energy consumption in Chicago, the 2000 baseline was used for each sector and an annual growth rate was applied. The annual energy consumption rates used was from the 2008 Energy Outlook Report published by the Energy Information Administration. The values based on the forecast from 2005 to 2030 used were for the East North Central region which includes Illinois, Wisconsin, Indiana, Ohio, and Michigan. The annual growth rates for electricity range from 1 to 2 % by sector, and the residential natural gas rate estimates a slightly negative growth rate of less than 1%. These growth rates were compared with the historical utility data reported on the ICC website from 1990 to 2004 showing energy sales per year. ComEd's annual growth rate for all electricity consumption was 2.4% during this period. People's Energy's annual growth rate for all natural gas consumption was -0.02%. These data are not weather adjusted.

Transportation

The transportation forecast used three elements to determine the GHG emissions from on road transportation in 2020 and 2040. VMT projections were provided by CMAP from its travel model. Vehicle efficiency improvements and ethanol blending rates were also projected from 2000 levels based on national trends. The vehicle miles traveled was multiplied by the vehicle efficiency in miles per gallon to get a total fuel use, the portion

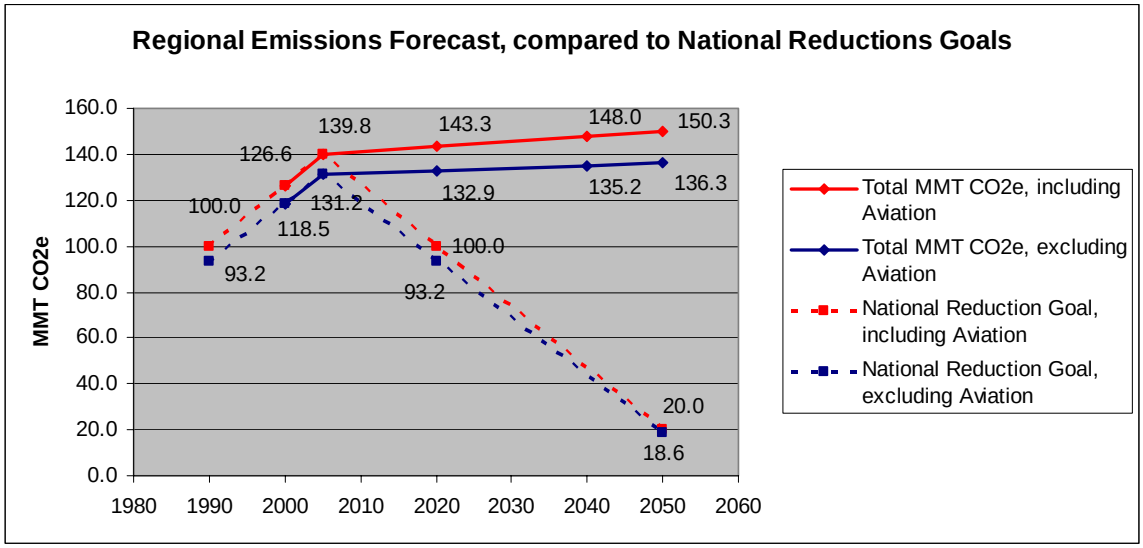
of ethanol was netted out from this total, and GHG emission factors were applied. The result is that transportation emissions (not including aviation) are projected to decrease to 28.9 MMT CO_2e in 2040 as vehicle efficiency improvements overtake increased VMT. Transportation electricity use was forecasted to increase at a rate of 1.26 percent using the electricity forecast methods described above.

Other Sectors

Emissions from industrial processes were forecasted to decrease to minimal values by 2040 based on the historic trends in local employment in these sectors. Product use, solid waste and waste water emissions were forecasted to increase based on national emission trends and local population forecasts from CMAP. Agricultural emissions were forecast based on an estimated loss of agricultural land of 57% from 2000 to 2040 provided by CMAP and based on current rates of agricultural land loss.

Comparison with National Reduction Goals

For context, the current reference forecast for the region is compared with national emissions reduction goals. The Obama administration has proposed two goals for GHG reductions: 1) a reduction to 1990 levels by 2020 and 2) a reduction of 80% below 1990 emissions by 2050. These reductions are based on the IPCC recommendation of stabilizing global warming at a global mean increase of 2 degrees Celsius. For the purposes of making this comparison, emissions were backcast linearly to 1990 using the 2000 and 2005 regional inventories. Projected emissions at 2020 and 2050 are also shown for illustrative purposes as points along on the line connecting the 2005 inventory and 2040 forecast. While the regional emissions will level off by 2040, they are still far above what current reductions targets demand.



APPENDIX

METHODOLOGY

The regional greenhouse gas emissions footprint was calculated for the years 2000 and 2005 using United Nations Intergovernmental Panel on Climate Change (IPCC) methods and local data sources in combination with modeling of national data to local demographics. All data presented are measured in metric tons (tons) or million metric tons (MMT), to enable comparison internationally. Emissions were calculated for all direct sources within the geographical boundaries of seven county metropolitan region. The inventory includes direct emissions for natural gas, transportation, and industrial process and product use. Indirect emissions were calculated for electricity and waste. Despite the fact that most electricity generation and waste handling facilities are located outside of the region, emissions for the electricity consumed and waste generated by its residents were included in the calculation. On-road transportation emissions were calculated using vehicle miles traveled data. Aircraft fuel consumption emissions for the area's major airports were estimated based on national figures. Emissions were calculated for the six major categories of greenhouse gases regulated under the Kyoto Protocol: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6). Emissions were converted into CO2e using global warming potentials from the IPCC Third Annual Assessment Report. CO2 formed the majority of the region's GHG emissions in all study years.

Methods for estimating emissions for the seven area counties and the six municipal case studies are detailed below.

ENERGY

Account level data was provided by the energy utilities for the entire region for 2005 and in some cases for 2000 as well. Where 2000 data was unavailable, backcasts were made using regional trends. The account level data does not contain information about the county in which the energy was used. While zip code and city names were available, these presented a challenge, since both municipalities and zip code areas can straddle two or more counties. Zip code and municipality boundaries were used to apportion energy usage to the counties, based on the fractional overlap of those boundaries with the counties. For example, if 50% of a zip code area lies within one county, then half of the total emissions in that zip code were assigned to that county. Usage in the municipal case studies was assigned based on the premise name given in the utility data.

Electricity

Electricity emissions were calculated by gathering electricity consumption data from the local utility, Commonwealth Edison, and applying CO2 emissions factors associated with the local North American Electric Reliability Council region from the U.S. EPA's Emissions & Generation Resource Integrated Database (eGRID) and other emissions

factors from the California Climate Action Registry General Reporting Protocol. Electricity consumption, in terms of kilowatt hours (kWh), was measured based on user account data for both 2000 and 2005, and transmission and distribution losses were not included. Electricity usage and resultant emissions were measured for residential and commercial/industrial accounts, as well as for rail transportation (CTA and Metra electric lines). Rail emissions are included in the transportation sector, rather than in electricity.

All electricity consumption data was obtained that has a zip code that is within one county and the data was then allocated to the appropriate county. Next, electricity consumption data that has no zip code was aggregated using municipalities/ township. Then, data that is within municipalities/townships that are split by a county boundary line were aggregated using the fractional area of the municipality in each county. Subsequently, electricity consumption data that has a point zip code (zip codes that weren't matched to a county) was aggregated by municipality/township, and then the same fractional split method was used to allocate the data.

Very large commercial and industrial sector accounts located in a zip code that crosses county lines were examined for accuracy. We took this important extra step because these large accounts were responsible for 90% of the usage in zip codes that straddled county lines. In order to ensure that these top accounts were placed in the correct county, we geocoded the top 10,000 accounts. Using a Google geocoding spreadsheet, these accounts were mapped, and the usage allocated to the correct county. Remaining accounts were aggregated by municipality/township and again the fractional split method was used.

Natural Gas

Natural gas emissions were calculated by gathering natural gas consumption data from People's Gas, North Shore Gas and Nicor Gas, and applying natural gas emissions factors from the U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks and the IPCC 2006 Guidelines for National Greenhouse Gas Inventories. The accounting of natural gas emissions is more straightforward than that of electricity, because it is combusted on site, so the consumer of the energy is the same entity as the direct emitter of the greenhouse gases, making the allocation of emissions more clear.

For 2005, account level usage was provided by all three gas providers. However, natural gas consumption was only provided for Nicor residential accounts with a full 12 months of billing. A total count of all residential accounts, including those with less than 12 months of billing was available. To estimate usage for these additional accounts, an average billing period of six months was assumed, at the same average rate of consumption per account as the 12 month accounts. By this method of estimation, the partial accounts represent 18% of the total residential usage in the Nicor service area.

For 2000, account level data was not available for North Shore or Nicor. Since North Shore and People's have adjacent service areas, the change in usage in People's between 2000 and 2005 was used to backcast the 2005 North Shore usage to 2000. Furthermore,

the 2000 North Shore usage was assumed to be divided between Lake and Cook counties by the same proportion as in 2005.

Because the Nicor service area is larger and has different development patterns than the People's service area, a different method was used to backcast usage to 2000. The total number of accounts (residential and commercial/industrial) was estimated and multiplied by an estimated per account usage to calculate the total consumption. The change in numbers of ComEd accounts, by county, between 2000 and 2005 was used as a proxy to scale the number of 2005 Nicor accounts back to 2000. The change in usage per account was estimated by using the change in usage for the entire Nicor service area (which extends beyond the seven county region), as reported by the Illinois Commerce Commission.

For commercial and industrial sector consumption, all natural gas (therms) consumption data was obtained that has a zip code within only one county and the data was then allocated to the appropriate county. Next, it was determined which natural gas consumption data has no zip code and this data was aggregated using municipalities/townships. Then, data that is within municipalities/townships that are split by a county boundary line were aggregated using the fractional area of the municipality in each county. Subsequently, natural gas consumption data that has a point zip code (zip codes that weren't matched to a county) was aggregated by municipality/township, and then the same fractional split method was used to allocate the data. Finally, natural gas consumption data that has a zip code but are across county lines was first aggregated by municipality/township, and then the same fractional split method was used.

Propane and Fuel Oil

A small number of households in the region utilize propane or fuel oil for heating. The US Decennial Census and American Community Survey provide counts of households using each fuel type. To estimate the total amount of fuel used, these household counts were multiplied by the average household consumption for the East North Central Region as provided by the Residential Energy Consumption Survey from the Energy Information Administration. GHG emissions were calculated using emissions factors from the EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks.

Data on propane and fuel oil use were not available at the municipal level, so no emissions from these sectors were estimated.

TRANSPORTATION

Transportation emissions were developed using vehicle miles traveled data from the Illinois Department of Transportation and Amtrak; fleet mix data from the Lake Michigan Air Directors Consortium (LADCO); vehicle efficiency data from the Federal Highway Administration (FHWA); and fuel sales and usage from the U.S. Department of Energy and the National Transit Database. Emissions factors for transportation are

from the U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks and State Inventory Tool.

On Road

Emissions due to on road travel were calculated as follows. Annual vehicle miles traveled (VMT) statistics for each county were taken from Illinois Highway Statistics reports by the Illinois Department of Transportation. Using fleet mix estimates from LADCO, VMT were divided between different vehicle classes. Average fuel efficiencies by vehicle class from FHWA were used to convert VMT to gallons of fuel used. Calculation of CO2 emissions from burning fuel is a straightforward multiplication of an emissions factor from EPA. However, estimating CH4 and N20 emissions from fuel use is more complicated, as control technologies for these gases have evolved over time. The EPA State Inventory Mobile Sources worksheet provides estimates of the on road mix of vehicles by age and control technology and calculates emissions. The default assumptions for 2000 and 2005 were used to estimate CH4 and N20 emissions.

Annual vehicle miles traveled (VMT) statistics for each county were taken from Illinois Highway Statistics reports by the Illinois Department of Transportation. The sum of all seven counties amounted to the total on-road VMT for the region.

Estimates of vehicle miles travelled (VMT) attributable to households were provided by CMAP. CMAP estimated median VMT per vehicle for each county by analyzing odometer readings collected by the Illinois Department of Transportation during emissions testing. To estimate total household VMT, the median VMT per vehicle were multiplied by the total autos owned in a given county, as reported in the 2005 American Communities Survey. These data pertain only to VMT; total county VMT values are reported directly from IDOT.

To estimate VMT for the municipal case studies, odometer readings from vehicle emissions testing were used. From these readings, typical VMT per auto were obtained, and, combined with Census figures on auto ownership, total household VMT for each zip code were calculated. Scale factors were determined by comparing IDOT VMT values with odometer-derived household VMT and these county factors were applied to scale municipal household VMT to all on-road

Rail

The 2005 LADCO NIF3 Emissions Report gives diesel fuel use by county for local, regional and national rail use, including line-haul operations. Emissions factors for CO2, CH4 and N20 from the EPA GHG Inventory were used to calculate emissions. Similar data were not available from LADCO for 2000, though fuel consumption for Metra trains is provided by the National Transit Database for both years. Since Metra fuel use changes by only 1% between these years and no better data is available on the other classes of rail use, the 2005 fuel use is also used for 2000. Emissions associated with rail were not estimated for the municipal case studies.

Aviation

Air travel emissions were calculated based on passenger enplanement statistics from the US Department of Transportation Bureau of Transportation Statistics (BTS). Since passenger enplanement data were not available for 2005, the ratio of airport passengers (which includes landings, transfers, and departures) to passenger enplanements was considered constant at the 2000 value. BTS air carrier statistics on the average flight distance for an enplanement at a U.S. were combined with a CO2 emissions factor to calculate air travel emissions for Chicago area airports. In addition to O'Hare and Midway, there are numerous regional and private aviation facilities across the Chicago region that data were unavailable for, so are excluded from these estimates, but are likely to be a small fraction of air travel emissions in the area. Emissions associated with aviation were not estimated for the municipal case studies, although residents and businesses in all municipalities contribute to air travel and air cargo use at the region's airports.

INDUSTRIAL PROCESSES AND PRODUCT USE

Many of the emissions in this sector are compounds with high Global Warming Potentials (GWP)—they have relatively large impacts on global warming compared to CO2 over 100 years and the CO2e values shown reflect this. The activity data in this sector are very difficult to find on at the city level, so the emissions of this sector are estimated as a proportion of national emissions as reported by the U.S. EPA.

Industrial Processes

The industrial processes sector includes all non-energy related GHG emissions, such as those generated in the process of cement or zinc manufacturing. The US Census Bureau's Economic Census and Annual Survey of Manufacturers was used to determine the proportion of US GHG producing industrial activity in the region. First, GHG producing industries located in the region were identified by North American Industry Classification System (NAICS) code. The relevant industries in the region were found to be Iron and Steel Production, Glass Production, and Integrated Circuit or Semiconductor manufacturing. The regional employment in these sectors was then calculated as a percentage of national employment by sector, and used to prorate the national GHG emissions in that sector. The potential for error in this method is substantial. The accuracy of the regional employment numbers may not be perfect and the particular facilities in the region may emit more or less GHGs per worker than the national averages. However, until better data are available for industrial processes, it is a fair approximation. The Economic Census indicated that there was no employment in the relevant industries in all of the municipal case studies, so no emissions were assigned.

Product Use

In addition to these industrial activities, there are a number of products used in the region that generate GHG emissions. These include the sulfur hexafluoride (SF6) used as an insulator in electrical equipment and the nitrous oxide (N2O) used as an anesthetic by dentists. Again, local data on these emissions were unavailable, so a similar method as the industrial process emissions was used — national emissions were prorated by the

regional share of the national population using US EPA National Inventory and US Census data to estimate both county and municipal emissions.

WASTE AND WASTEWATER

Solid Waste

Illinois EPA Landfill capacity reports provide tonnage of waste deposited to landfills for each county in the region. Data provided by the City of Chicago enabled the calculation of the portion of waste composed of degradable organic content and this percentage was used for the entire region. National data was used to estimate the portion of methane emissions that is recovered at the landfill sites, which was deducted from the resulting CH4 emissions. Solid waste also produces CO2 as it decomposes, but as the carbon stored in decomposing food, paper, and paper products is biogenic in origin—it was absorbed from the atmosphere by plants in recent history—its release does not contribute to global warming, and there for is not counted in this inventory.

The region has a number of closed landfills within its boundaries. Solid waste takes decades to decompose, so closed landfills continue to generate methane emissions. The IPCC uses a first order decay method to account for current year emissions from historic waste disposal, but data were unavailable at the time of this study to estimate these emissions for the region. This is an area that should continue to be investigated. Municipal emissions were assigned by prorating county emissions by population.

Wastewater

Fugitive methane emissions from water reclamation plants were estimated using a study conducted by the Metropolitan Water Reclamation District (MWRD), using the methodology detailed in the 2006 IPCC guidelines. It was assumed that all sewer discharge was delivered to the MWRD plants via a covered sewer collection system. The MWRD estimate of the fugitive methane emissions for the entire district (which is larger than Chicago) was then scaled by population to represent the water treatment for the entire region. Water reclamation plants recover methane during the water treatment process. This recovered methane is used on site for heating and/or electricity generation. There is no data available on the amount of methane that is recovered by MWRD annually. This is an area for further research. CO2 emissions associated with the consumption of the recovered methane were not included in this analysis, as the carbon is biogenic in origin and does not contribute to global climate change. Municipal emissions were assigned by prorating county emissions by population.

AGRICULTURE AND LIVESTOCK

Emissions associated with agriculture and livestock were estimated by prorating national emissions estimates from the EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks. Agricultural GHG emissions arise from nitrous oxide (N20) produced by various agricultural activities that increase mineral nitrogen (N) availability in soils, thereby increasing the amount available for nitrification and denitrification, and

ultimately the amount of N2O emitted. Data from the US Department of Agriculture Agricultural Census from 1997 and 2002 were used to estimate regional crop and pasture land acreage 2000 and 2005 and national emissions were then prorated by the fraction of national acreage in the region. Livestock produce GHG emissions due to enteric fermentation (CH4) and manure management (CH4 from decomposition of waste and N20, directly and indirectly from livestock manure and urine). National emissions were prorated based counts of heads of livestock in the region, relative to the national totals, using USDA Agricultural Census data.

Data on agricultural land and livestock were not available at the municipal level, so no emissions from these sectors were estimated.

DATA AVAILABILITY

One of the primary challenges in grappling with the task of reducing greenhouse gas emissions is accurate accounting of sources. The availability of data will be crucial for assessing progress towards reduction goals. As is detailed in this report, approximations were required for some sectors for which sufficient data were not available. An important part of any climate change strategy will be working with stakeholders to ensure that the necessary data are available to continue to monitor greenhouse gas emissions.