

Evanston Greenhouse Gas Emissions, 2005-2008: Observations and Interpretations

Report researched, analyzed and written by
Jessica Kunke, class of 2010
Northwestern University
under the direction of
Andrew D. Jacobson, Associate Professor
Department of Earth and Planetary Sciences
Northwestern University
and
Neal Edward Blair, Professor
Joint appointment in Civil and Environmental Engineering
Northwestern University

City of Evanston Office of Sustainability
June 2010



Executive Summary

Studying the Evanston Greenhouse Gas Inventory for the data collected so far (2005-2008) has provided some insights into Evanston's emissions and has raised some questions. Efficiency improvements and lack of growth have contributed to the annual decrease of city (municipal) emissions. The five biggest sources of community (residential and commercial) emissions each year have been commercial electricity, commercial natural gas, residential electricity, residential natural gas, and gasoline. Evanston weather has been an important factor affecting the overall rise in natural gas emissions, with an increase in heating demand contributing to the observed increase in both commercial and residential natural gas emissions. Recycling has increased each year during the four-year period and solid waste disposal has decreased each year from 2006 to 2008.

Evanston population, businesses, and jobs have all grown gradually from 2005 to 2008 and may be contributing to the increase in commercial and residential emissions. Since economic growth does not seem sufficient to explain commercial emissions during this time, it may not have been a dominant factor but rather one of multiple important factors. Future data will help to clarify the importance of economic growth.

No correlation was found between residential or commercial natural gas emissions and natural gas prices. In part, this makes sense since people and businesses can presumably only increase or decrease their heating and cooking to a certain extent, regardless of prices, and these activities are significant uses of natural gas. This does not mean that the natural gas market has no effect on Evanston emissions, but prices alone do not seem to explain Evanston natural gas emissions. However, to truly investigate the impact of price on natural gas emissions, a more detailed study of Evanston natural gas consumers' decision-making is needed.

In the midst of an otherwise gradual annual decrease in gasoline and diesel emissions, there was a nearly 20% increase in these emissions from 2006-2007. This great increase is only seen in community, not city emissions. The increase was not due to a population increase, since population rose steadily over the entire 2005-2008 period and the annual population increase was not dramatic. Nor does the increase appear to be due to gasoline prices, which rose over the entire 2005-2008 period. It is possible that something occurred from 2006 to 2007 that significantly shifted the baseline and caused the increase in emissions. In particular, a new gas station opened in Evanston in 2006; if this increased the total gasoline sales in Evanston, then the new gas station may have shifted the baseline gasoline emissions, disrupting an otherwise decreasing trend.

Future years' emissions may increase confidence in the presence or absence of relationships between the observed changes in emissions and the causes considered here, though these causes may also shift with time.

Introduction to the Inventory

Since 2005 the City of Evanston Office of Sustainability has prepared an annual greenhouse gas emissions inventory. The purpose of the inventory is to better understand the amounts of greenhouse gases being produced by various Evanston activities and sectors and how quickly those amounts are changing. This will allow Evanston to monitor its emissions and to better target its efforts to reduce those emissions.

The inventory divides emissions into city (municipal) emissions and community (residential and commercial) emissions. City emissions are calculated based on emissions from electricity, natural gas, gasoline, diesel, and biodiesel. Community emissions are calculated by adding the emissions from eight sources:

- Residential electricity
- Commercial electricity
- Rail electricity
- Residential natural gas
- Commercial natural gas
- Gasoline
- Diesel
- Solid waste disposal

and subtracting the emissions saved through two emission-reducing activities:

- Organic waste composting
- Solid waste recycling

Table I breaks down the city and community emissions by source and year. For further information on the inventory, see the March 2008 document *Community Greenhouse Gas Inventory and Forecast* available on the Office of Sustainability website.

Observations and Interpretations, 2005-2008

City Emissions

City emissions have decreased by 1% to 7% each year because the city (municipal) has not grown and has improved the efficiency of its facilities. City electricity emissions have decreased each year. (See Table I.)

Community Emissions

The five biggest sources of emissions each year, from greatest to least emissions, have been commercial electricity, commercial natural gas, residential electricity, residential natural gas, and gasoline. The other sources and emission-reducing activities have been a much smaller component in the total annual community emissions.

Residential electricity emissions have overall decreased over the four years, and residential natural gas emissions have increased each year. Commercial natural gas emissions have overall increased over the four years. Commercial electricity emissions increased each year from 2005 to 2007, then decreased almost to 2005 levels by 2008; until further years' data are collected, it is unclear whether emissions have since continued to decrease. (See Table 1 and Figure 1.)

The increases in residential and commercial natural gas emissions over the four-year period both correlate well with annual heating degree days. Therefore it is reasonable to conclude that Evanston weather has been an important factor affecting the overall rise in natural gas emissions. The population of Evanston has also increased each year from 2005 to 2008, although slowly compared to the increase in residential natural gas emissions. Similarly, the numbers of Evanston businesses and Evanston jobs have both increased gradually each year from 2005 to 2008 and may have contributed to the increasing commercial natural gas emissions. (See Table 2 and Figures 2 and 3.)

One might suspect that business and economic growth have been primarily responsible for the increase in commercial emissions from natural gas and electricity. Commercial emissions from natural gas and electricity have increased two of the three years, and as previously noted, the number of Evanston businesses and jobs have each increased annually from 2005 to 2008. However, commercial electricity emissions decreased substantially from 2007 to 2008. It is possible that other factors became dominant during this time. (See Figure 4.)

No correlation was found between residential or commercial natural gas emissions and natural gas prices. In part, this makes sense since people and businesses can presumably only increase or decrease their heating and cooking to a certain extent, regardless of prices, and these activities are significant uses of natural gas. This does not mean that the natural gas market has no effect on Evanston emissions, but prices alone do not seem to explain Evanston natural gas emissions. However, to truly investigate the impact of price on natural gas emissions, a more detailed study of Evanston natural gas consumers' decision-making is needed. (See Figures 5 and 6.)

In the midst of an otherwise gradual annual decrease in gasoline and diesel emissions, there was a nearly 20% increase in these emissions from 2006-2007. This great increase is only seen in community, not city emissions. The increase was not due to a population increase since population rose steadily over the entire 2005-2008 period and the annual population increase was not dramatic. It also does not appear to be due to gasoline prices, which rose over the entire 2005-2008 period. Perhaps something occurred from 2006 to 2007 that significantly shifted the baseline and caused the increase. In particular, a new gas station opened in Evanston in 2006; if this increased the total gasoline sales in Evanston, then the new gas station may have shifted the baseline gasoline emissions, disrupting an otherwise decreasing trend. (See Figure 7.)

While the emissions saved from recycling, composting, and decreased waste disposal do not constitute a great percentage of total Evanston emissions, the inventory shows they have been successful efforts. Recycling has increased each year during the four-year period and solid waste disposal has decreased each year from 2006 to 2008. (See Table 1.)

Future years' emissions may increase confidence in the presence or absence of relationships between the observed changes in emissions and the causes considered here, though these causes may also shift with time.

Table 1. City and community emissions by source, 2005-2008, in MTCO₂E.

	2005	2006	2007	2008
City of Evanston (Municipal)				
Electricity	17,588	16,430	16,172	15,464
Natural gas	3,975	3,624	3,323	3,515
Gasoline	1,321	1,378	1,445	878
Diesel	1,398	1,393	1,538	1,395
Biodiesel	278	278	305	277
TOTAL	24,559	23,102	22,783	21,529

Evanston Community				
Electricity - Residential	154,524	146,853	148,194	144,962
Electricity - Commercial	366,025	375,318	380,325	368,634
Electricity - Rail	18,785	17,400	18,424	19,037
Natural Gas - Residential	114,674	116,791	119,144	127,295
Natural Gas - Commercial	224,266	221,954	234,950	245,586
Gasoline	99,664	97,149	116,452	111,209
Diesel	25,869	25,216	30,226	28,865
Solid waste disposed	9,709	10,084	9,580	9,164
Organic Waste Composted*	-898	-930	-1,234	-1,008
Solid waste recycled*	-22,584	-24,467	-25,639	-25,706
TOTAL	992,039	987,374	1,030,423	1,028,040

City and Community Combined				
TOTAL	993,360	988,752	1,031,868	1,028,918

*Emissions listed for these starred categories are negative because they are emissions saved by these activities, not emissions generated.

Table 2. Population, number of jobs, and number of businesses in Evanston, 2005-2008.

	2005	2006	2007	2008
Population	75787	76410	77109	77693
Jobs	36021	37209	38597	39432
Businesses	2440	2457	2531	2611

Figure 1. Evanston emissions, 2005-2008.

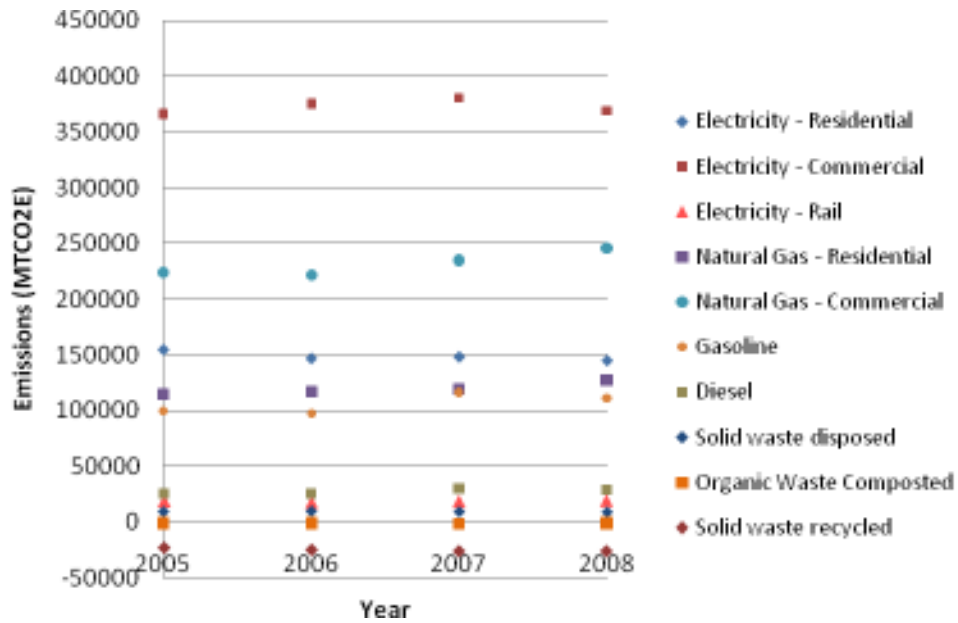


Figure 2. Residential natural gas emissions vs. heating degree days.

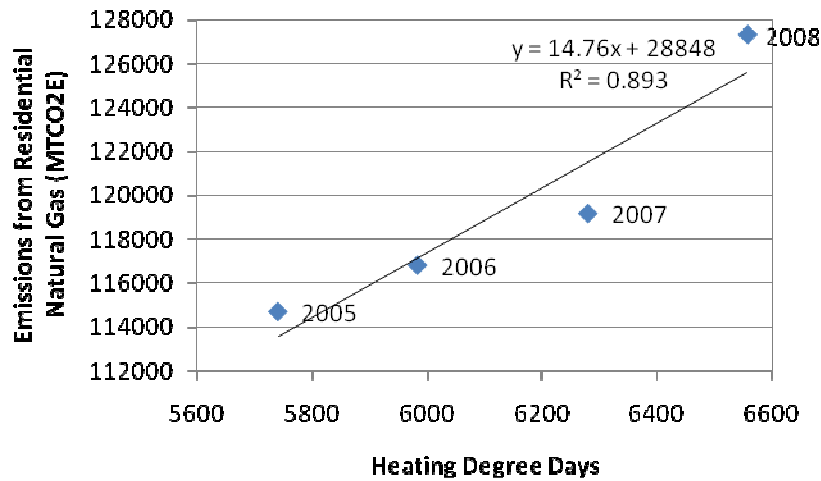


Figure 3. Commercial natural gas emissions vs. heating degree days.

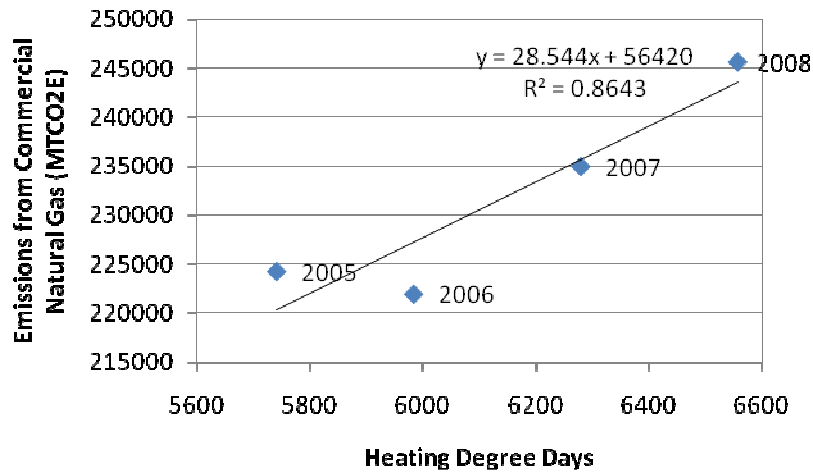


Figure 4. Commercial electricity emissions vs. number of Evanston businesses.

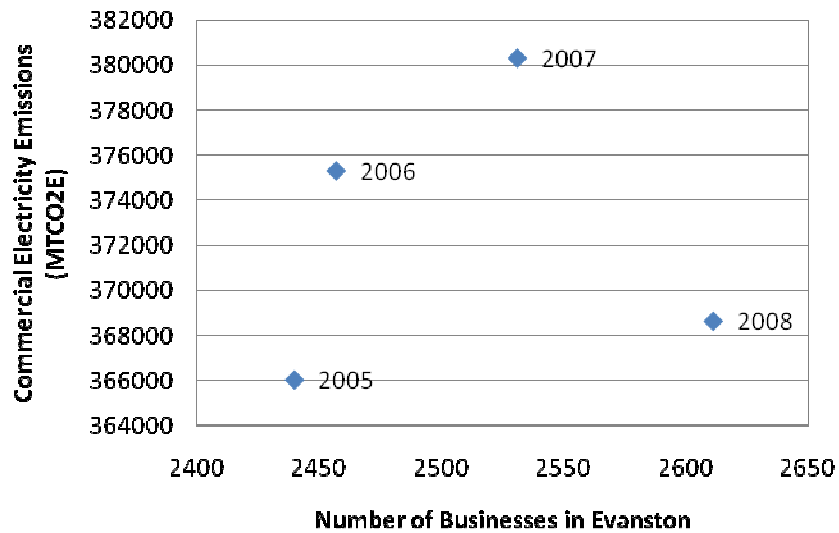


Figure 5. Commercial natural gas emissions vs. commercial natural gas prices.

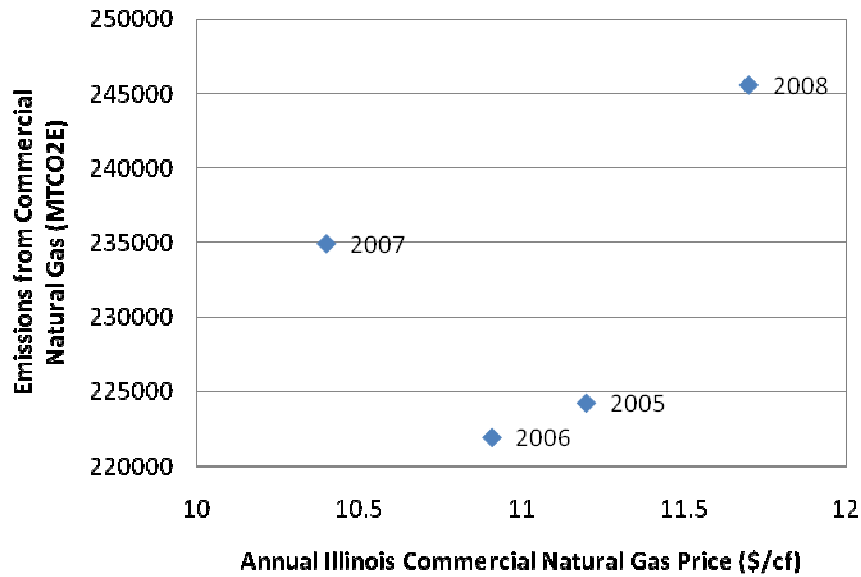


Figure 6. Residential natural gas emissions vs. residential natural gas prices.

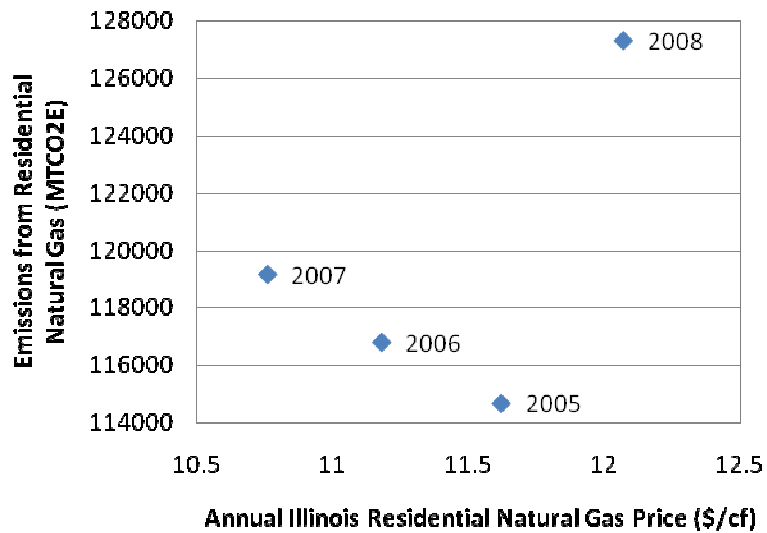


Figure 7. Gasoline emissions vs. gasoline prices.

