City of St. Louis

2005 & 2010 Greenhouse Gas Emissions Inventory Report

05.04.12

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Overview

PURPOSE

This greenhouse gas inventory represents the first step in a comprehensive approach to reducing the City's GHG emissions. Its objective was to identify the sources and quantities of GHG emitted by government operations and community activities in the City of St. Louis during the 2005 and 2010 calendar years. It allows the City to understand the scale of emissions from the various sectors within its operations and within the community. It establishes a foundation upon which to track emission trends and base forecasts in order to address the progress of mitigation strategies and policies. In October 2005, Mayor Francis G. Slay signed onto the U.S. Conference of Mayors' Climate Protection Agreement, an effort now supported by 1055 mayors nationwide. In a statement released by his office at the signing, Mayor Slay indicated: "I am particularly interested in considering environmental policies that will create jobs for the residents of our City. As we assess implementation of new policies, their potential to create new jobs will be the priority consideration."

METHOD

This inventory measures emissions generated by nine sectors of the community that function within the political boundaries of the City of St. Louis, including government operations of the City of St. Louis. The latter is a subset of the former, but it is studied separately because the government has direct control over its operations, while it can only aspire to guide and influence community emissions through encouragement and policy. Emissions in this inventory were calculated for the baseline calendar year 2005 and the calendar year 2010.

The Mayor's Climate Protection Agreement relates to the Kyoto Protocol, which references 1990 as its baseline year. Because it is difficult to access data going that far into the past, the City of St. Louis – like many others—selected a baseline year that is "typical," and for which data can be obtained and/or estimated with sufficient reliability. For St. Louis, the calendar year of 2005 was selected. The partnership between the City of St. Louis and St. Louis Community College (see below) is designed to develop updates to the inventory, and through this partnership a GHG inventory update was developed for 2010, the most recent calendar year for which data was available. The update represents an interval of five years following the baseline inventory. In addition, a backcast to 1990 and a forecast to 2050, both based on population change, were calculated. The results of both inventories and the associated forecast are included in this report.

Greenhouse gases vary in their capacity to trap heat (global warming potential–GWP). Some of them, most commonly used as refrigerants and fire suppressors, have extremely high GWPs, and even small emissions have the capacity to trap large amounts of heat. Others, like nitrous oxide and methane, have moderately high GWPs. Carbon dioxide, however, has been "the dominant greenhouse gas of concern."[1]It is not among the GHGs with the highest GWPs. However, it is emitted in such a large quantity – especially due to burning fuel for energy, that its total effect has the greatest overall impact.

[1] *Limiting the Magnitude of Future Climate Change* (National Academy of Sciences, 2010), p. 1.

Six major greenhouse gases were analyzed: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Because they vary in their GWP, it is necessary to convert their effect to a single metric. Because carbon dioxide has been the GHG of dominant concern, the heat-trapping effect of other gases is converted mathematically to how many metric tons of carbon dioxide it would take to trap an equivalent amount of heat, called a metric ton of carbon dioxide equivalent (mtCO2e). This method allows for the global warming effects of various gases to be compared, and it allows for the construction of a single overall estimate combining the effects of many gases.

The government operations portion of this inventory follows the method outlined in the Local Governments Operations Protocol (LGOP),[2] which serves as a national standard for quantifying and reporting greenhouse emissions from local government operations. No similar standard was available for the community side of this inventory at the time it was conducted, and so a process developed by ICLEI-Local Governments for Sustainability for their Cities for Climate Protection Program was employed. (See "City of St. Louis and St. Louis Community College Partnership" for a description of ICLEI.)

By convention, GHG emissions are categorized into three "scopes." Scope 1 emissions are direct emissions. For the community side of this inventory, direct means emissions that occur within the physical boundary of the City of St. Louis. For the government side, it means emissions that are under the direct operational control of the city government. Scopes 2 and 3 represent indirect emissions. Scope 2 consists of emissions from the consumption of electricity, steam, heat, and cooling generated at power plants outside the city boundary and purchased for use at a particular source such as a building or piece of stationary equipment. Scope 3 consists of all other indirect emissions, such as emissions from solid waste, wastewater processing, or the daily commute of government employees.

In some instances, it is possible to measure GHG emissions directly. However, GHGs are emitted from hundreds of thousands of sources, many of which are mobile, and most of which are not directly monitored. Consequently, emissions that cannot be directly measured are estimated using other measurements, particularly energy consumption; a detailed description of the methods used in conducting this inventory is included in the Appendix.

CITY OF ST. LOUIS AND ST.LOUIS COMMUNITY COLLEGE PARTNERSHIP

This greenhouse gas inventory was conducted through an innovative partnership involving the City of St. Louis, St. Louis Community College (STLCC), HOK, and ICLEI-Local Governments for Sustainability.
The project was led by HOK, a global design firm dedicated to advancing sustainability in the built environment. It was supported by ICLEI-Local Governments for Sustainability, whose mission is to build, serve, and drive a movement of local governments to advance deep reductions in greenhouse gas emissions and achieve tangible improvements in local sustainability. ICLEI has managed over 600 GHG inventories and routinely trains student interns and municipal staff to create complete inventories with the local jurisdictional staff and master the educational tools and standards in order to build their career skills.

STLCC students and their faculty advisors participated through STLCC's Workforce Training and Training for Tomorrow programs. These programs provide a broad knowledge base in key forms of renewable energy,

[2] *Local Government Operations Protocol,* Version 1.1. (ICLEI-Local Governments for Sustainability, 2010.) Downloaded from www.icleiusa.org.

GHG emissions reduction and data collection, and energy efficiency, leading to certificates in sustainable construction and energy technology.

STLCC faculty will carry this one-time activity and training onward to future semesters, providing the structure for ongoing annual updates to the City's GHG Inventory. Thus, the partnership is intended to develop into a long-term affiliation that simultaneously increases the City's capacity to monitor and abate its GHG emissions, while providing education and training for STLCC students.

Executive Summary

BASELINE 2005 AND UPDATE 2010 GHG INVENTORY OVERVIEW

In 2011, the City of St. Louis conducted a greenhouse gas (GHG) emissions inventory for baseline calendar year 2005 with an update for CY 2010. Each year's inventory is organized into two parts: 1) GHG emissions produced by the whole "Community" within the boundaries of the City, and 2) GHG emissions resulting from operations of the City "Government".

In October 2005, Mayor Francis G. Slay signed onto the U.S. Conference of Mayors' Climate Protection Agreement, an effort now supported by 1055 mayors nationwide. This agreement aligns itself with the Kyoto Protocol, which references 1990 as its baseline year. Because it is difficult to access data going that far into the past, the City of St. Louis – like many others—selected a baseline year that is "typical," and for which data can be obtained and/or estimated with sufficient reliability. For St. Louis, the calendar year of 2005 had sufficient data and aligned with Mayor Slay's commitment and so was chosen as the City's baseline year.

2005 baseline year Community Emissions were 7,947,477 mtCO2e. This amounts to 24.6 mtCO2e per capita. The Commercial Sector accounted for the largest fraction of emissions (40%), followed by the Residential Sector (24%), Vehicle Miles Traveled (22%), the Industrial Sector (12%) Metro Vehicles and Facilities (1%) and finally by Ports, Rail, Solid Waste and Wastewater Treatment which altogether totaled 1%. Roughly 64% of community emissions came from the built environment, while 23% came from various modes of transportation. The consumption of electricity was by far the largest community emission source, accounting for 60% of all emissions, followed by transportation fuels (gasoline and diesel) at 22%. Fifty-seven percent of electrical consumption occurred in the Commercial Sector, and commercial consumption of electricity accounted for more than 33% of all emissions in the City.

2005 baseline year emissions from Government Operations were 316,240 mtCO2e – roughly 4% of community emissions. Operations at Lambert-St. Louis International Airport (Lambert Field) were the largest government sector (27%), followed by other Buildings and Facilities (23%), Water Treatment (21%), Streetlights and Traffic Signals (16%), Fleet Vehicles (7%), Employee Commute (5%) and emissions from Solid Waste (1%). About 75% of the City government's emissions came from the consumption of electricity, with gasoline/diesel (12%) and natural gas (7%) following far behind. Seventy-nine percent of emissions from government electrical consumption occurred in the built environment and accounted for more than 40% of all government emissions from 2005. Water Division pumps are the most concentrated source of GHG emissions, accounting for 21% of emissions. Transportation-related activities (fleet and employee commute) accounted for 12% of emissions.

2010 update year Community Emissions were 7,549,862 mtCO2e - a 6% decrease. This total amounts to 23.6 mtCO2e per capita, a 4% per capita decrease from 2005 on a 1.7% population decrease. The Commercial Sector still accounted for the largest fraction of emissions (42%), followed by the Residential Sector (25%), Vehicle Miles Traveled (19%), the Industrial Sector (12%) Metro Vehicles and Facilities (1%) and finally by Ports, Rail, Solid Waste and Wastewater Treatment which altogether totaled 1%. Decreases were primarily driven by a 17% decrease in VMT, an 11% decrease in industrial emissions, and a 1% decrease in commercial emissions, due most likely to the decrease in population and industry in the City as well as the economic downturn starting in 2007. These decreases were slightly offset by a 1% increase in

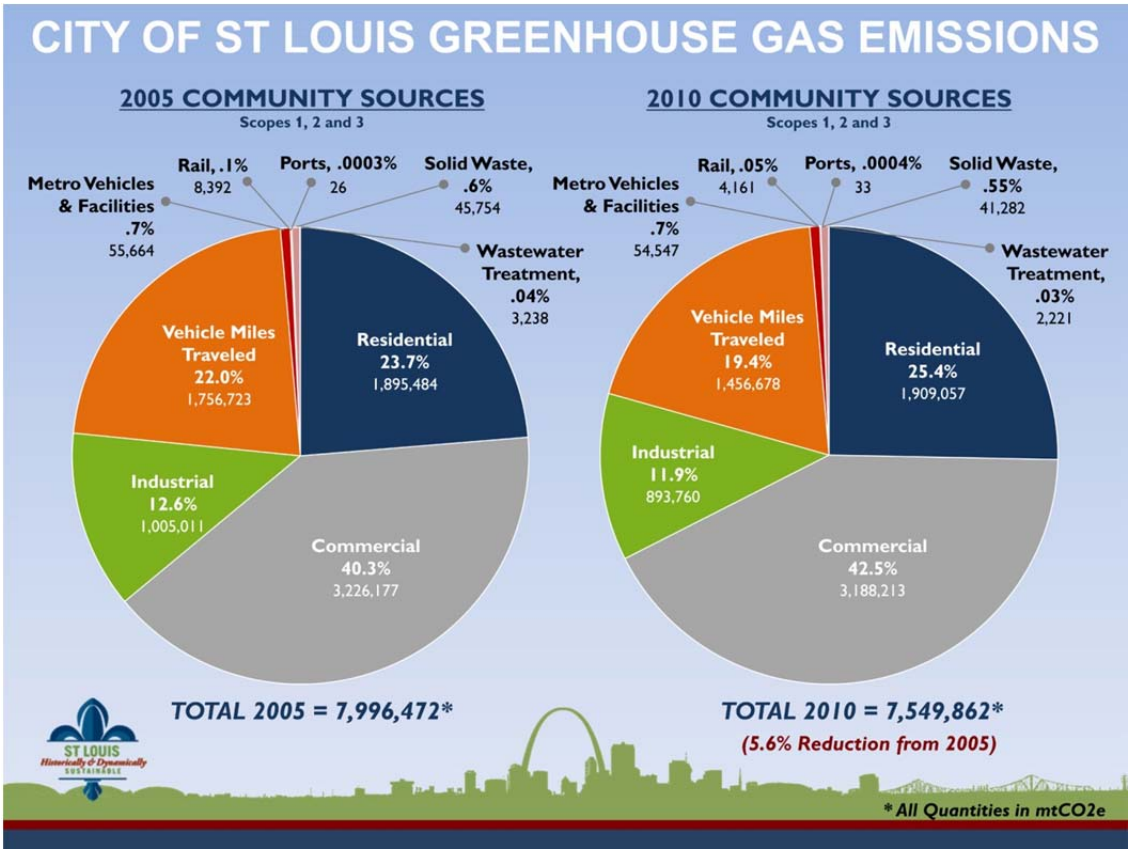
residential emissions which nationally have been on the rise (along with commercial emissions) due to increasing electricity consumption for lighting, heating, air conditioning, and appliance operation.

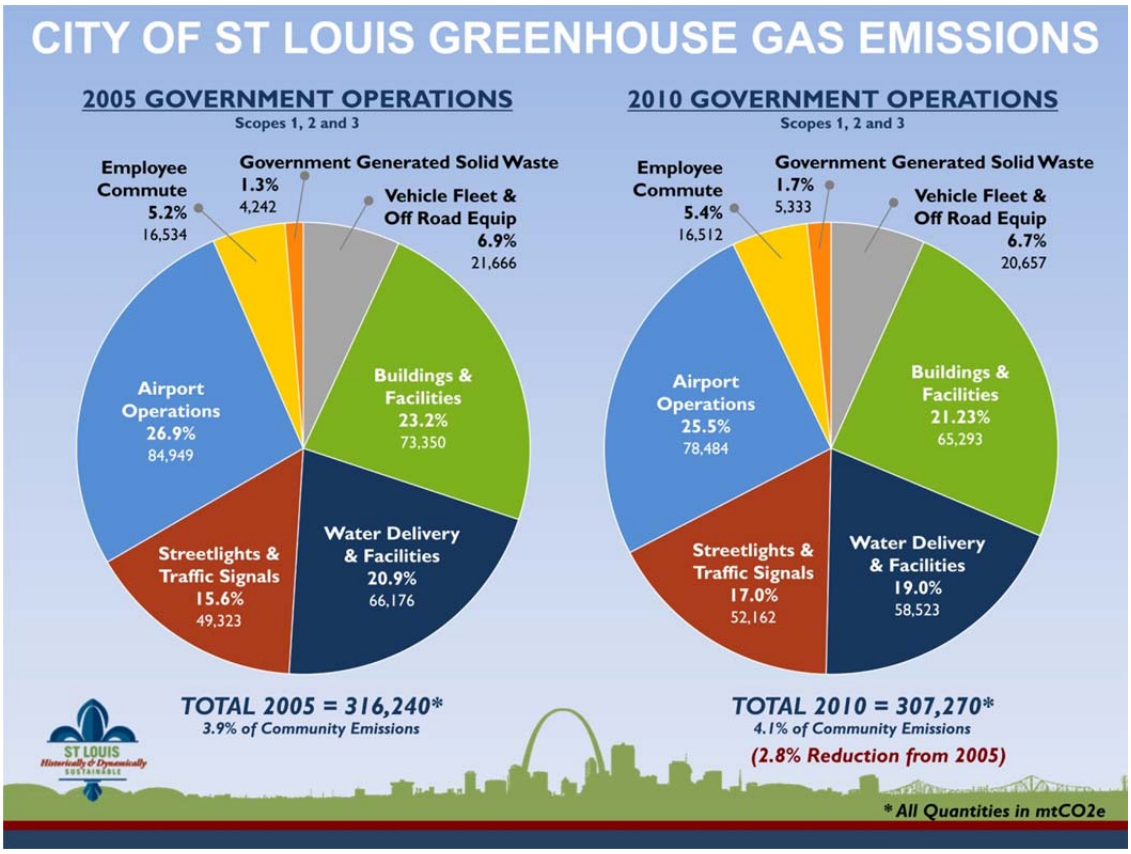
2010 update year emissions from Government Operations were 307,270 mtCO2e – again roughly 4% of community emissions but an overall 3% decrease from 2005 levels. Operations at Lambert-St. Louis International Airport (Lambert Field) were the largest government sector (25%), followed closely by other Buildings and Facilities (25%), then Water Treatment (19%), Streetlights and Traffic Signals (17%), Fleet Vehicles (7%), Employee Commute (5%) and emissions from Solid Waste (2%). About 71% of the City government's emissions came from the consumption of electricity, with gasoline/diesel (13%) and natural gas (8%) again following far behind. The overall City government emissions 3% decrease from 2005-2010 was primarily driven by a 12% decrease in water delivery emissions, an 8% decrease in airport emissions, a 5% decrease in fleet emissions, and a 3% decrease in emissions from buildings and facilities. These were partially offset by a 6% increase in streetlight emissions and a 26% increase in solid waste emissions.

Greenhouse gas emissions do not remain static over time, they increase or decrease with population and other factors. In looking ahead to forecast potential GHG emission scenarios, we have adopted a "continued growth" scenario. It estimates that, even if nothing additional is done to abate them, overall community GHG emissions will remain below 2005 levels through 2040, rising to 2% above 2005 levels in 2050. This occurs because even the "continued growth" scenario forecasts slow population growth, and 2010 emissions were 6% lower than 2005.

The U.S. Mayors' Climate Protection Agreement referenced at the beginning of this section adopted the goal of reducing total community GHG emissions by 7% from 1990 levels by 2012. To calculate the City's performance against this target, a backcast estimate of the City's 1990 community emissions was created based on 2005 emissions using population change as the adjusting factor. Accordingly, we estimate that in 1990, community GHG emissions for the City were 9,761,896 mtCO2e. When compared to the 2010 total of 7,549,862 mtCO2e, a 20% decrease from 1990 levels was realized which exceeds the commitment level in the U.S. Mayors' Climate Protection Agreement. While most of this can be attributed to population decrease over the same time period, as the City looks to the future and aspired population, commercial and industrial growth, continued energy efficiency and emissions reduction initiatives as well as per capita reduction targets will have to become the significant drivers for GHG emissions reduction in the City of St Louis.

The following page includes summary charts of inventoried 2005 and 2010 GHG emissions from the community and government operations…


CITY OF ST LOUIS GREENHOUSE GAS EMISSIONS
2005 COMMUNITY SOURCES
Scopes 1, 2 and 3
Metro Vehicles & Facilities .7% 55,664
Rail, .1% 8,392
Ports, .0003% 26
Solid Waste, .6% 45,754
Wastewater Treatment, .04% 3,238
Vehicle Miles Traveled 22.0% 1,756,723
Residential 23.7% 1,895,484
Industrial 12.6% 1,005,011
Commercial 40.3% 3,226,177
TOTAL 2005 = 7,996,472*
2010 COMMUNITY SOURCES
Scopes 1, 2 and 3
Metro Vehicles & Facilities .7% 54,547
Rail, .05% 4,161
Ports, .0004% 33
Solid Waste, .55% 41,282
Wastewater Treatment, .03% 2,221
Vehicle Miles Traveled 19.4% 1,456,678
Residential 25.4% 1,909,057
Industrial 11.9% 893,760
Commercial 42.5% 3,188,213
TOTAL 2010 = 7,549,862*
(5.6% Reduction from 2005)
* All Quantities in mtCO2e


CITY OF ST LOUIS GREENHOUSE GAS EMISSIONS
2005 GOVERNMENT OPERATIONS
Scopes 1, 2 and 3
Employee Commute 5.2% 16,534
Government Generated Solid Waste 1.3% 4,242
Vehicle Fleet & Off Road Equip 6.9% 21,666
Airport Operations 26.9% 84,949
Buildings & Facilities 23.2% 73,350
Streetlights & Traffic Signals 15.6% 49,323
Water Delivery & Facilities 20.9% 66,176
TOTAL 2005 = 316,240*
3.9% of Community Emissions
2010 GOVERNMENT OPERATIONS
Scopes 1, 2 and 3
Employee Commute 5.4% 16,512
Government Generated Solid Waste 1.7% 5,333
Vehicle Fleet & Off Road Equip 6.7% 20,657
Airport Operations 25.5% 78,484
Buildings & Facilities 21.23% 65,293
Streetlights & Traffic Signals 17.0% 52,162
Water Delivery & Facilities 19.0% 58,523
TOTAL 2010 = 307,270*
4.1% of Community Emissions
(2.8% Reduction from 2005)
* All Quantities in mtCO2e

BASELINE 2005 AND UPDATE 2010 GHG INVENTORY SUMMARY

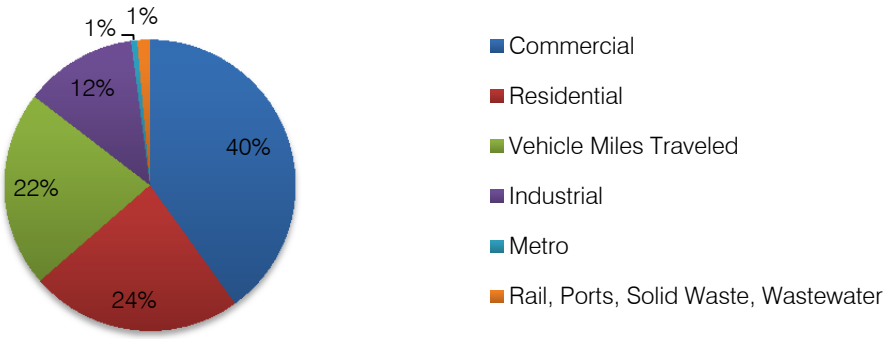
In 2011, the City of St. Louis conducted a greenhouse gas (GHG) inventory for baseline calendar year 2005, with an update for CY 2010. The following summary information assesses GHGs emitted by the whole community within the boundaries of the City of St. Louis, and by the operations of the City government.

BASELINE YEAR 2005

CY 2005 Community Emissions

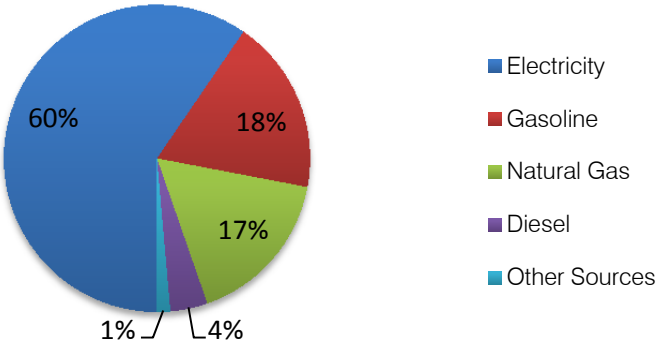
In 2005, community emissions for the City of St. Louis totaled 7,996,469 mtCO2e. Of this, Scope 1 and 2 activities emitted 7,947,477 mtCO2e of GHG. Scope 3 sectors generated an additional 48,992 mtCO2e. Commercial buildings accounted for the largest portion, followed by residential buildings and vehicle miles traveled (cars and trucks). Together, these three sectors accounted for 86% of GHG emissions.

Figure 1: Community Emissions by Sector (2005)



The consumption of electricity accounted for almost 60% of community GHG emissions, more than all other fuels sources combined, followed by the consumption of gasoline, then natural gas. Combined, they accounted for 95% of community emissions.

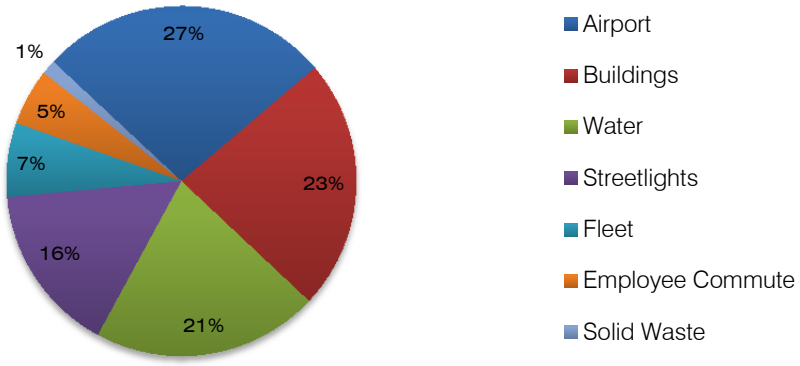
Figure 2: Community Emissions by Source (2005)



CY 2005 Government Emissions

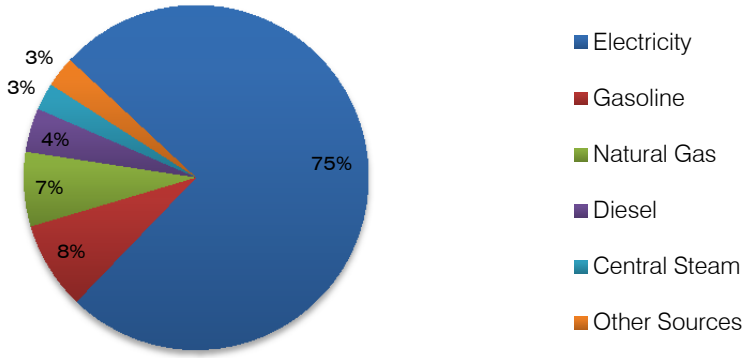
During 2005, greenhouse gas emissions from government operations totaled 316,240 mtCO2e. Of these, 295,464 mtCO2e came from Scope 1 and 2 operations, and 20,776 mtCO2e came from Scope 3 operations. The City's airport, portfolio of buildings and facilities, water delivery system, and public street lighting were the largest emitters, together accounting for about 87% of emissions.

Figure 3: Government Emissions by Sector (2005)



The consumption of electricity produced about 75% of the City's GHG emissions, three times as much as all other sources combined.

Figure 4: Government Emissions by Source (2005)

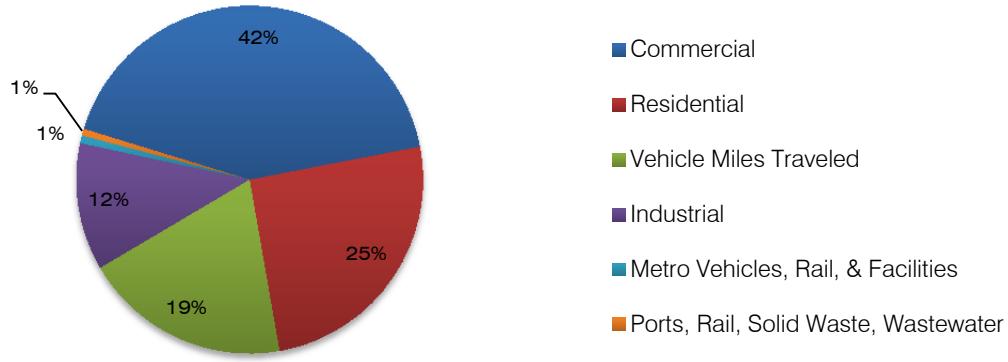


UPDATE YEAR CY 2010

CY 2010 Community Emissions

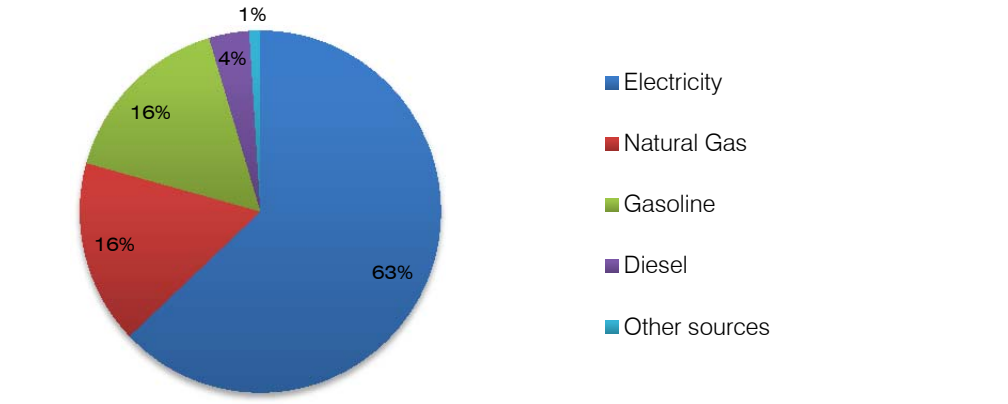
In 2010, community emissions for the City of St. Louis were 7,549,862 mtCO2e. Of this, Scope 1 and 2 activities occurring within the City's boundaries emitted 7,506,359 mtCO2e. In addition, Scope 3 emissions generated an additional 43,503 mtCO2e. Commercial buildings again accounted for the largest portion, followed by residential buildings and vehicle miles traveled (cars and trucks). Together, these three sectors accounted for 87% of GHG emissions.

Figure 5: Community Emissions by Sector (2010)



The consumption of electricity accounted for almost 63% of community GHG emissions, more than all other fuels sources combined, followed by the consumption of gasoline, then natural gas. Together, they accounted for 95% of community emissions.

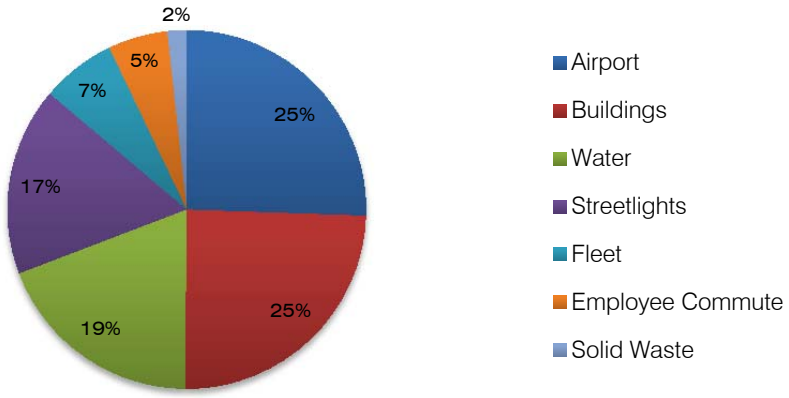
Figure 6: Community Emissions by Source (2010)



CY 2010 Government Emissions

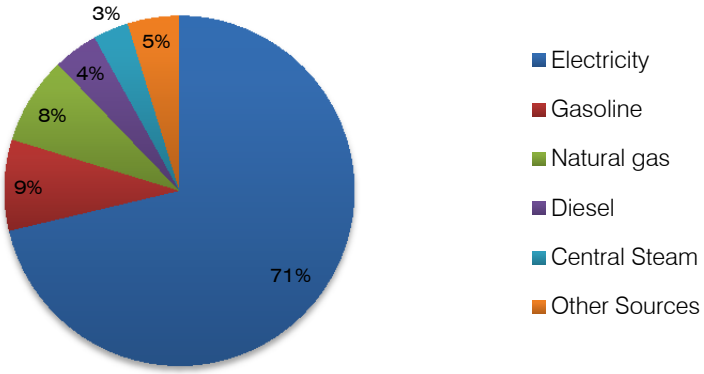
During 2010, greenhouse gas emissions from government operations totaled 307,270 mtCO2e. Of these, 285,425 mtCO2e came from Scope 1 and 2 operations, and 21,845 mtCO2e came from Scope 3 operations. The City's airport, portfolio of buildings and facilities, water delivery system, and public street lighting were again the largest emitters, together accounting for about 86% of emissions.

Figure 7: Government Emissions by Sector (2010)



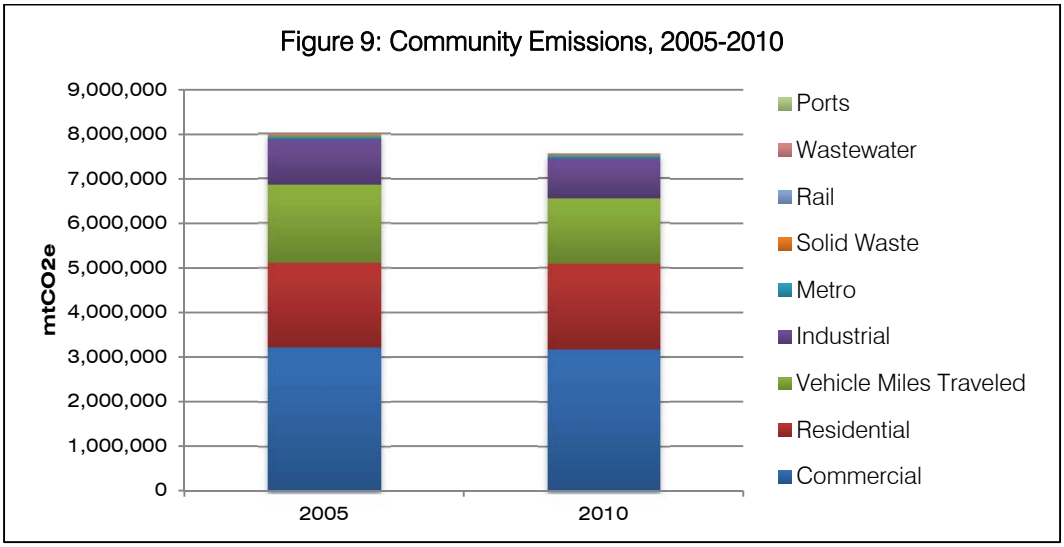
The consumption of electricity produced about 71% of the City's GHG emissions, almost eight times as much as the next largest source.

Figure 8: Government Emissions by Source (2010)

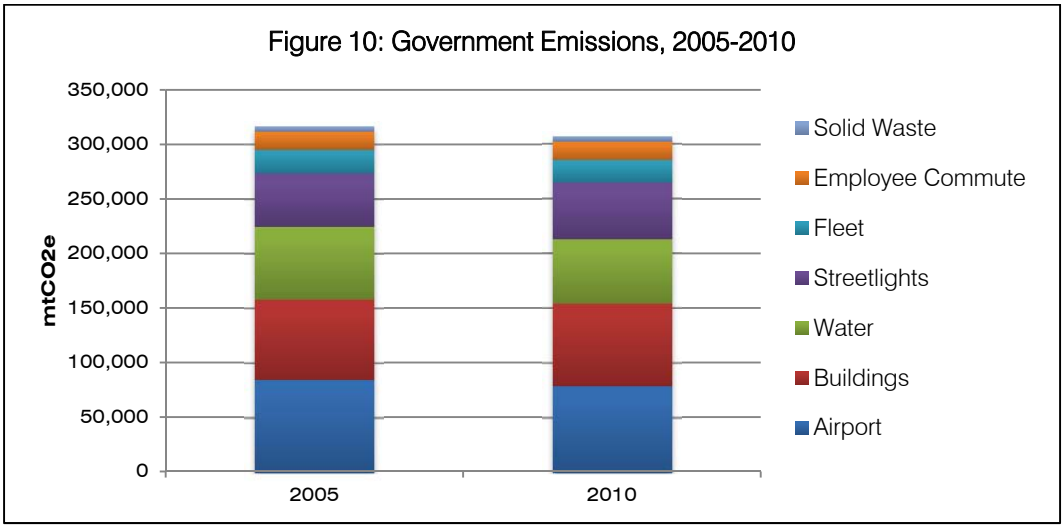


COMPARISON OF CY 2005 AND CY 2010 EMISSIONS

Between 2005 and 2010, total community GHG emissions decreased by 446,607 mtCO2e, or 6% against an overall decrease in population of about 2% and a decrease in per capita emissions from 22.7 mtCO2e per capita to 23.6 mtCO2e per capita, or about 4%. The community decreases were driven by reductions in emissions from Vehicle Miles Traveled (17%), industrial emissions (11%), and commercial emissions (1%), and partially offset by an increase in residential emissions (1%). There were also changes in wastewater, solid waste, and port emissions. These sectors represent a small portion of overall emissions and did not drive the change in overall emissions, despite the fact that their changes were large on a percentage basis.



Between 2005 and 2010, city government emissions decreased by 8,970 mtCO2e, or 3%. The decrease was primarily driven by decreases in water delivery emissions (12%), an airport emissions (8%), buildings and facilities (3%), and fleet emissions (5%). They were partially offset by increases in streetlight emissions (6%), and solid waste emissions (26%).

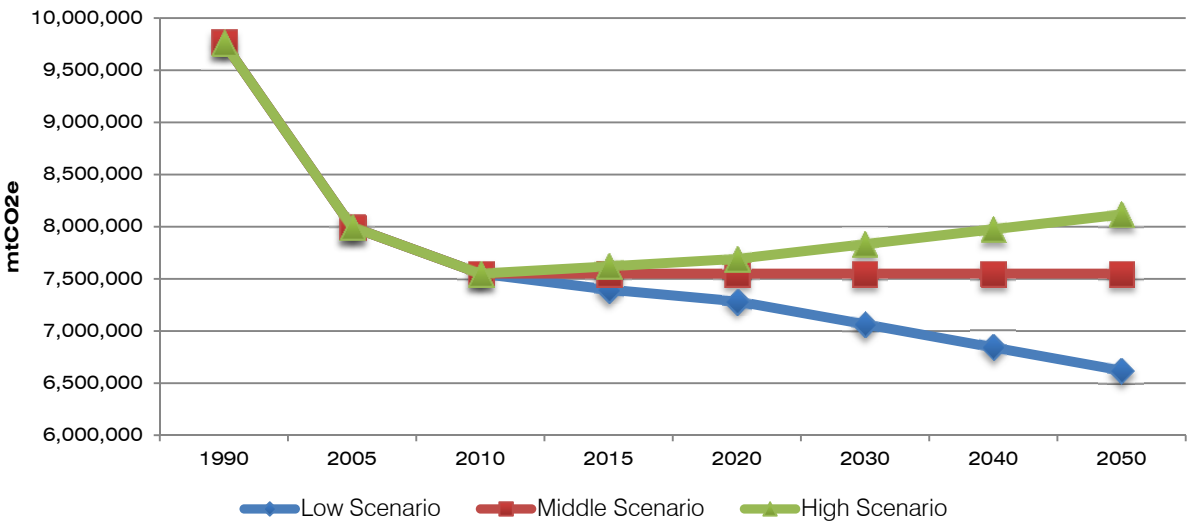


GREENHOUSE GAS EMISSIONS FORECAST

From the baseline of GHG data, the City is able to forecast likely results based on the premise that no action is taken to mitigate or abate GHG emissions. While the reality is many factors (such as total economic activity, energy mix, and Corporate Average Fuel Economy standards) are likely to drive GHG emissions, this forecast uses population trends to outline community source emission scenarios. Governmental emissions, however, are driven more by specific policies that vary from year-to-year, such as budget, staffing, and specific operating practices. These factors are difficult to estimate, so the forecast is limited to the community as a whole.

Three population change scenarios were provided by the St. Louis Planning and Urban Design Agency. One scenario involved a declining population over time, one involved a constant population, and one involved population growth. Using these three scenarios a "business as usual" forecast of emissions was created, extending to the year 2050. In addition, using census data, population data was used to "backcast" GHG emissions to the year 1990, the baseline year referenced in the U.S. Mayor's Climate Protection Agreement, which commits signatories to support reducing GHG emissions 7% below 1990 levels by the end of 2012.[3]

Figure 11: Community Emissions Forecast and Backcast



The population in 1990 was 396,685, in 2005 was 324,945, and in 2010 was 319,294, a 19.5% decrease from 1990-2010. Total community emissions in 1990 were backcast at 9,761,896 mtCO2e; total community emissions in 2010 were 7,549,862 mtCO2e representing a 22.7% decrease from 1990 levels.

[3] *U.S. Mayors Climate Protection Agreement,* http://www.usmayors.org/climaterotection/agreement.htm

PART I: BASELINE GREENHOUSE GAS EMISSIONS INVENTORY – CY 2005

This section of the report describes the detail for the City of St Louis's 2005 Baseline Year Greenhouse Gas Inventory which has been established as the foundation on which the City will track emission trends and base forecasting in order to assess progress of mitigation strategies and policies.

2005 was identified as the oldest year for which reasonably reliable data could be obtained and/or estimated for the City of St Louis. It was also selected to align with Mayor Francis G. Slay's 2005 commitment to precept outlined in the U.S. Conference of Mayors' Climate Protection Agreement.

COMMUNITY EMISSIONS INVENTORY – CY 2005

In 2005, community GHG emissions for the City of St. Louis totaled 7,996,469 mtCO2e, or 24.6 mtCO2e per person.[4] Of this, Scope 1 and 2 activities emitted 7,947,477 mtCO2e of GHGs. In addition, Scope 3 activities created an additional 48,992 mtCO2e.

Summary of Community Emissions by Sector

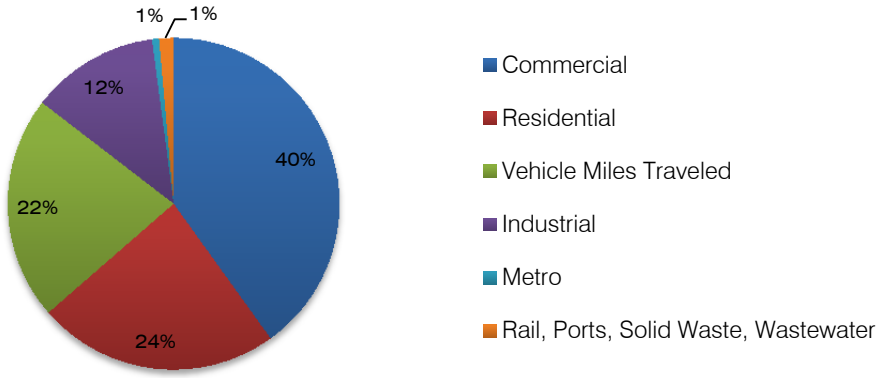
By better understanding the relative scale of emissions from each sector, the City can more effectively focus strategies to reduce them. Commercial buildings accounted for the largest percentage of emissions. Next came residential buildings, followed by vehicle miles traveled (cars and trucks). Together, these three sectors accounted for 86% of GHG emissions. Industry was the fourth largest emitting sector.

Table 1: Community Emissions by Sector (2005)

	Emissions (mtCO2e)	Energy Consumption (MMBTU)	Percent Emissions	Percent Energy
Scopes 1 and 2:				
Commercial	3,226,177	20,646,551	40%	29%
Residential	1,895,484	16,198,636	24%	23%
Vehicle Miles Traveled	1,756,723	24,304,874	22%	35%
Industrial	1,005,011	8,379,432	13%	12%
Metro Transit Vehicles & Facilities	55,664	502,598	1%	1%
Rail	8,392	112,426	<1%	<1%
Ports	26	348	<1%	<1%
Scope 3:				
Solid Waste	45,754		1%	<1%
Wastewater Treatment & Facilities	3,238		<1%	<1%
Total	7,996,469	70,144,865		

[4] Based on 2005 population of 324,945. (Source: Planning and Urban Design Agency, City of St. Louis)

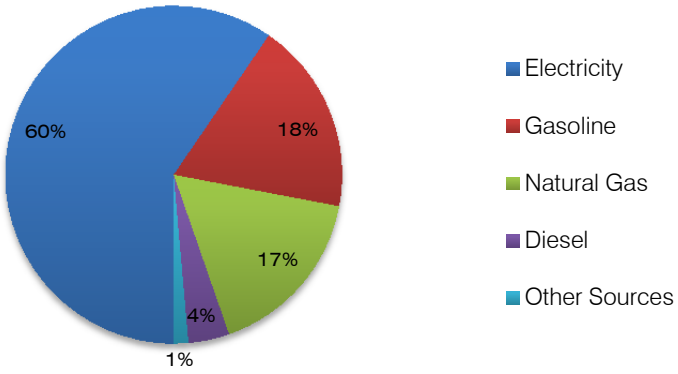
Figure 12: Community Emissions by Sector (2005)



Summary of Community Emissions by Source

Electricity accounted for almost 60% of GHG emissions in the City of St. Louis community, more than all other fuel sources combined. Gasoline accounted for 18%, and natural gas 17%. Combined, they accounted for 95% of all emissions.

Figure 13: Community Emissions by Source (2005)



Many factors influence the emissions profile of a city; understanding these differences in the future may be helpful in identifying abatement opportunities.

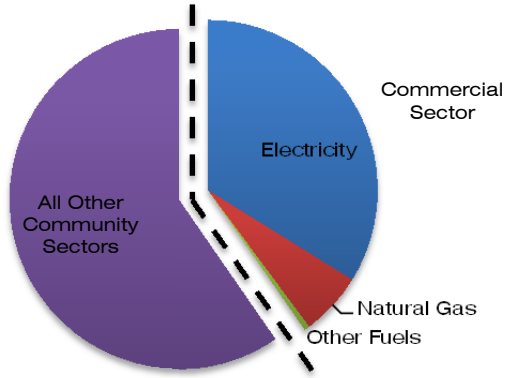
Detailed 2005 Community Sector Analyses

Commercial Buildings and Facilities

Commercial buildings and facilities consume energy and emit GHGs to operate systems such as lighting and HVAC. In addition, activities occurring in commercial buildings often involve equipment that consumes energy, such as appliances, retail displays, and refrigeration equipment. Sometimes this equipment consumes as much or more energy than the basic building systems. Consequently, it is not unusual for commercial buildings to account for a significant portion of total GHG emissions.

Commercial buildings emitted 3,226,177 mtCO2e, or 40% of all GHGs emitted by the City of St. Louis community. Eighty-four percent of their emissions (2,704,757 mtCO2e) came from the consumption of electricity. Thus, approximately 1/3 of all GHG emissions in the City of St. Louis community derived from electricity consumption in the commercial sector. Another 15% of commercial emissions (480,381mtCO2e) came from the consumption of natural gas.

Figure 15: Commercial Emissions by Source (2005)



Residential

Residential buildings generate GHGs primarily by consuming fossil fuel for HVAC and to operate household appliances and equipment. They account for a significant percentage of total community emissions because households are so numerous. In St. Louis in 2005, residential buildings emitted 1,895,484 mtCO2e, or 24% of total community emissions. Seventy percent of residential emissions (1,320,109 mtCO2e) derived from electrical consumption, and 30% (571,191 mtCO2e) derived from consumption of natural gas. Small amounts of kerosene and fuel oil continue to be used for residential heating, but together they accounted for less than 1% of residential emissions.

Industrial

In St. Louis, industry was the fourth largest emitting sector with 1,005,011 mtCO2e of GHG, or 13% of the community total. Seventy-one percent of industrial emissions (709,047 mtCO2e) came from the consumption of electricity, while 28% (278,143 mtCO2e) came from the consumption of natural gas, and 2% (16,275 mtCO2e) came from the consumption of fuel oils 1, 2, and 4. Small amounts of kerosene and residual fuel oil were also consumed, accounting for less than 1% of emissions combined.

Vehicle Miles Travelled

Vehicle Miles Traveled (VMT) primarily accounts for emissions from automobiles and trucks. Trips that originate or terminate in the City of St. Louis are included, as well as trips that transit through the City on its highways and roads. Emissions generated by the Metro Transit system are accounted for separately, as are heavy rail traffic and operations at river ports.

VMT accounted for 1,756,723 mtCO2e of GHG emissions in 2005, or 22% of total community emissions. Eighty-four percent of those emissions (1,473,237 mtCO2e) came from gasoline consumption, 16% (283,487 mtCO2e) came from diesel fuel, and less than 1% came from the consumption of diesel fuel to operate off road equipment. Though the correspondence is not perfect, gasoline consumption most often represents the operation of cars and light trucks, while diesel fuel consumption represents the operation of heavier trucks and equipment.

Metro Transit

Metro Transit (Bi-State Development Agency) operates the public bus, light rail, and "Call-A-Ride" systems in the St. Louis Metropolitan Area. Only facilities and operations in the City of St. Louis are considered in this inventory. The Metro Train light rail system generated 32,111 mtCO2e in 2005. Eighty-nine percent of it (28,539 mtCO2e) came from the consumption of electricity, while 11% (3,572 mtCO2e) came from the consumption of natural gas.

The Metro Bus system generated 23,553 mtCO2e in 2005. Ninety-six percent came from the consumption of diesel fuel, while 4% (865 mtCO2e) came from the consumption of gasoline.
Combined, the whole Metro Transit system generated 55,664 mtCO2e, less than 1% of total community emissions.

Rail and Ports

The City of St. Louis is one of the nation's largest rail hubs, served by six Class 1 railroads, and several local ones.[5] Rail operations generate GHG emissions, primarily via the consumption of diesel fuel to operate locomotives. Emissions come from operations that originate or terminate in the City of St. Louis, as well as operations that transit through the City. Emissions from the Metro Transit light rail system are discussed in the Metro Transit section.

The Metropolitan Port of St. Louis is the third largest inland river port in the country, moving about 32 million tons of product annually by barge and tug. The regional port extends 70 miles along the Illinois and Missouri sides of the Mississippi River, and is operated by several different port authorities.[6] The St. Louis Port Authority is one of them, running 19 miles along the Missouri side of the river along the boundary of the City of St. Louis. This inventory considers only river vehicle freight traffic originating in the St. Louis Port Authority.
Rail transportation generated 8,392 mtCO2e in 2005, and the port generated 26 mtCO2e. Combined they represented less than 1% of total community emissions.

Solid Waste

Solid waste generates GHG emissions in several ways. Some GHG is emitted by trucks burning fossil fuel as they collect the waste. Some solid waste may be incinerated, releasing GHGs. Most solid waste is landfilled

[5] "Transportation Advantages" (St. Louis Regional Commerce and Growth Association), downloaded December, 2011, http://www.stlrcga.org/x523.xml.
[6]"River Transportation Through and To St. Louis," *St. Louis Commerce Magazine* (March 2005), http://www.stlcommercemagazine.com/archives/march2005/river.html.

where organic compounds in the waste decay, releasing methane, a powerful greenhouse gas. Local governments have some control over the size and composition of the community waste stream, via reuse, recycling, and recovery policies. However, there are no operational landfills within the City of St. Louis. Emissions from solid waste are categorized as Scope 3 and have been estimated using standardized methodologies.

In 2005, solid waste generated 45,754 mtCO2e of GHG emissions, less than 1% of total community emissions. Seventy-seven percent (35,068 mtCO2e) came from paper waste, 20% (9,097 mtCO2e) came from food waste, and 3% (1,589 mtCO2e) came from wood and textile waste. Other typical components of solid waste such as metals and glass do not produce GHG, and so are not recognized in GHG inventories. Plastics are also not recognized because their decay rate is too long to be of near-term consequence. Landscape and plant-based agricultural waste are not included as their decay is considered part of and in balance with the natural cycles of plant life. This inventory does not break out the GHGs emitted by trucks collecting the waste.

Wastewater Treatment

In the City of St. Louis, wastewater is collected and treated by the Metropolitan St. Louis Sewer District (MSD), a public agency not under the control of the City. MSD's collection area covers 525 square miles, encompassing all of the City of St. Louis and about 80% of St. Louis County. It serves a population of about 1.4 million, a minority of which live in the City of St. Louis.[7] Only emissions specific to the City of St. Louis were considered in this inventory.

As wastewater is treated, it can release several GHGs. At MSD, the emissions are limited to small amounts of nitrous oxide.[8] In 2005, wastewater treatment emissions attributable to the City of St. Louis totaled 3,238 mtCO2e, less than 1% of total community GHG emissions.

[7] "About M.S.D," St. Louis Metropolitan St. Louis Sewer District, downloaded December, 2011, http://www.stlmsd.com/aboutmsd.
[8] Nitrous oxide is 310 time more effective at trapping heat than carbon dioxide. (Source: "Nitrous Oxide," E.P.A. http://www.epa.gov/nitrousoxide/scientific.html)

GOVERNMENT OPERATIONS EMISSIONS INVENTORY – CY 2005

During 2005, greenhouse gas emissions from government operations totaled 316,240 mtCO2e. Of these, 295,464 mtCO2e came from operations directly controlled by the City (Scopes 1 & 2), and 20,776 mtCO2e came from operations partially controlled (Scope 3).

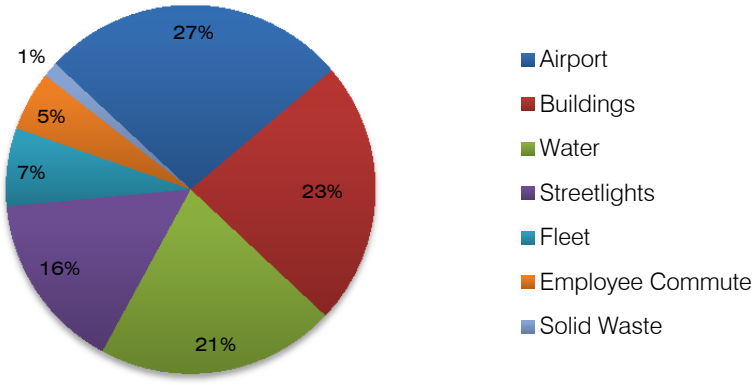
Summary of Government Operations Emissions by Sector

By better understanding the relative scale of emissions from each sector of its operations, the City can more effectively focus emissions reductions strategies to achieve the greatest reductions. Operations at Lambert St. Louis International Airport accounted for more greenhouse gas emissions than any other sector of city operations, followed by other City buildings and facilities, water delivery operations, and public street lighting (traffic signals, street lights, and other types of lighting). Together, these sectors accounted for about 87% of greenhouse gas emissions from city operations.

Table 2: Government Emissions by Sector (2005)

	Emissions (mtCO2e)	Energy (MMBtu) Consumption	Percent Emissions	Percent Energy
Operations Directly Controlled (Scope 1 & 2):				
Airport Facilities	84,949	511,246	27%	25%
Buildings and Facilities	73,350	528,252	23%	25%
Water Delivery Facilities	66,176	308,240	21%	15%
Streetlights & Traffic Signals	49,323	201,653	16%	10%
Vehicle Fleet & Off Road Equipment	21,666	295,764	7%	14%
Operations Partially Controlled (Scope 3):				
Employee Commute	16,534	229,287	5%	11%
Government Generated Solid Waste	4,242		1%	
Total	**316,240**	**2,074,442**		

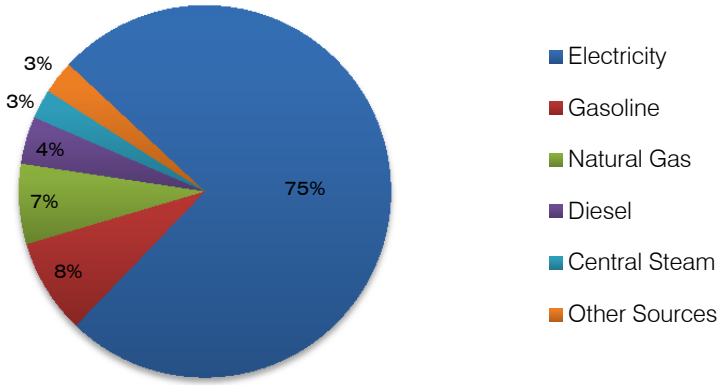
Figure 16: Government Emissions by Sector (2005)



Summary of Government Operations Emissions by Source

Figure 17 provides a summary of City government emissions by source. Electricity use dominates the City's emissions, accounting for about 75% of GHGs (three times as much as all other sources combined). Vehicle fuels (gasoline and diesel) together accounted for the second most emissions. Natural gas was third.

Figure 17: Government Emissions by Source (2005)



Detailed 2005 Government Sector Analyses

Airport Facilities and Operations

Lambert-St. Louis International Airport (Lambert Field) is the principle commercial airport for the St. Louis Metropolitan Statistical Area and the surrounding region. In 2005, 14.7 million passengers transited Lambert Field, and over 15,000 people were employed by airport-related operations. Lambert Field is located 11 miles northwest of downtown St. Louis in St. Louis County. It is operated by the St. Louis Airport Authority, which is majority controlled by officials from the City of St. Louis. [9] Therefore, its greenhouse gas emissions have been consolidated as emissions directly controlled by the City, though it may serve even more citizens from surrounding counties than from the City itself. Options are available to resolve the distortion.[10]

Operations at Lambert Field generated 84,949 mtCO2e of GHG emissions in 2005, consuming 511,246 MMBtu of energy. The airport operates numerous buildings and facilities, and they accounted for 97% of Lambert Field emissions. A substation located at 10579 Natural Bridge Rd. and which serves several airport facilities accounted for 75% of building emissions. Regarding sources, electricity accounted for 83%, natural gas accounted for 13%, and the remaining 4% was divided among five other fuels (fuel oil, gasoline, diesel, biodiesel, and compressed natural gas).

[9] Source: Lambert-St. Louis International Airport website, http://www.lambert-stlouis.com.
[10] One possibility would be to attribute fractions of airport emissions to a particular city or county based on proportions of regional population or based on the analysis of passenger origin and destination points from within the region.

Table 3: GHG Emissions & Energy Consumption, Lambert-St. Louis International Airport (2005)

	Percent of emissions	Emissions (mtCO2e)	Energy (MMBtu) Consumption
Operations Contributing to GHG Emissions:			
Buildings/Facilities	96%	81,788	497,649
All Other Sectors Combined	4%	3,161	13,597
Fuels Contributing to GHG Emissions:			
Electricity	83%	70,466	288,093
Natural Gas	13%	10,683	200,698
Solid Waste (8,425 metric tons)	4%	1,948	n/a
Largest Emitting Buildings/Facilities:			
10579 Natural Bridge Rd.	76%	62,920	257,243
10701 Natural Bridge Rd. Climate Boilers	8%	6,692	123,435
10155 Natural Bridge Rd. Climate Boilers	4%	3,418	63,517

City Buildings and Other Facilities

The City operates a large number of other buildings and facilities for a wide variety of purposes. Emissions from Lambert Field buildings & facilities are discussed in the Lambert-St. Louis International Airport Section above. Emissions from the City's other portfolio of buildings are discussed here. Through their use of energy for heating, cooling, lighting, and other equipment, they account for a significant portion of greenhouse gas emissions: approximately 73,350 mtCO2e (528,252 MMBtu). Seventy-four percent were created by electrical consumption (54,562 mtCO2e, 223,071 MMBtu), 12% came from the consumption of natural gas (8,798 mtCO2e, 165,512 MMBtu), and 11% came from the consumption of Central loop steam (8,057 mtCO2e, 139,669 MMBtu).

In addition, the chemicals used in fire suppression, air conditioning, and refrigeration equipment are very harmful GHGs. If the equipment leaks, the amount leaked can be small, but have significant effects. Only a portion of these emissions could be tracked and included in this inventory.

Information regarding specific St. Louis Metropolitan Police buildings and facilities was not available. However, consolidated emissions from all Police buildings and facilities were included in the analysis, and they were 10,886 mtCO2e, or 15% of total emissions from buildings and facilities.

Water Delivery Facilities

The City of St. Louis operates water delivery facilities that purify, distribute, and transport water used for potable water, sprinkler systems, and irrigation. As water delivery facilities are particularly large users of energy, and thus, large emitters of greenhouse gas, the City's water delivery facilities have been separated from other buildings and facilities for more specific examination.

The City of St. Louis Water Division maintains two water treatment plants that draw water from the area's two main rivers. The Chain of Rocks Plant is located on the Mississippi River about eleven miles north of the center of the City. The Howard Bend Treatment Facility is located in St. Louis County on the Missouri River,

37 miles above the confluence of the Missouri and Mississippi Rivers. Combined, these two plants have the capacity to treat and distribute 380 million gallons of water per day[11].

Water Delivery Facilities emitted 66,176 mtCO2e in 2005, consuming 308,240 MMBtu of energy. Approximately 63% of this total was attributable to the high pressure pumps at the two water treatment plants, and about 89% to pumps overall. About 96% of emissions came from electricity.

Street Lights, Traffic Signals, and Other Public Lighting

The City of St. Louis operates a range of public lighting, including traffic signals and streetlights. Public lighting in the City emitted approximately 49,323 mtCO2e (201,653 MMBtu), about 16% of City government emissions.

Vehicle Fleet and Mobile Equipment

The City of St. Louis operates a fleet of on-road and off-road vehicles and equipment. In addition, the Metropolitan St. Louis Police also operate a fleet. This section discusses emissions of those combined fleets. Emissions attributable to the fleet operated by Lambert-St. Louis International Airport are discussed in the Lambert Field section and are omitted here.

The City fleet emitted 21,666 mtCO2e (309,362 MMBtu), or 7% of the City's direct emissions. Of this, 50% came from the consumption of gasoline and 50% came from the combustion of diesel. The City also operates small fleets of biodiesel and Compressed Natural Gas vehicles, and these had near-zero GHG emissions.

The vehicles and mobile equipment used in the operation of public transportation within the City of St. Louis, such as buses and rail, are operated by Metro Transit and reported in the Community section of this report.

Employee Commute

Many City employees use vehicles to commute to and from work. When vehicles burn fuel, greenhouse gases are released into the atmosphere. Although the individual employees maintain control over their personal commuting decisions, the City can opt to influence actions via incentives, commuting programs, and other policies. For this reason, emissions from this sector have been estimated in this inventory as Scope 3, but have been considered separately from the Scope 1 and 2 emissions over which the City has direct operational control.

Employees were estimated to have travelled about 28.1 million miles commuting to work in 2005, emitting 16,534 mtCO2e (229,287 MMBtu), about 5% of total government emissions. The methods by which this estimate could be constructed allowed for only a rough estimate of straight-line distances between origin and destination, not actual road distance travelled. The methods used are discussed in the Appendix.

Government Generated Solid Waste

Local government operations generate solid waste, which cause GHG emissions in several ways. Some GHG is emitted by the trucks that burn fossil fuel as they collect the waste. Some solid waste may be incinerated, releasing GHG. Most solid waste is landfilled. There, organic compounds in the waste decay, releasing methane, a powerful greenhouse gas. Local governments have some control over the size and composition of their waste stream, via reuse, recycling, and recovery policies. However, there are no

[11] "Water Treatment," City of St. Louis Water Division, downloaded December, 2011, www.stlwater.com/treatment.php.

operational landfills in the City, and the landfills used by the City are not under the control of the City. For these reasons, emissions from solid waste have been estimated in this inventory as part of Scope 3, and have been separated from the Scope 1 and 2 emissions over which the City has direct operational control.

Waste generated by Lambert-St. Louis International Airport is discussed in the Lambert Field section of this report. Other City operations generated 18,766 metric tons of solid waste, causing an estimated 4,242 mtCO2e of GHG emissions, about 1% of total government emissions. About 77% were from decomposition of paper waste, and 20% from food waste. (Note: waste information was not available from the St. Louis Metropolitan Police Department, and has not been included in the total.)

PART II: GREENHOUSE GAS EMISSIONS INVENTORY UPDATE – CY 2010

This section of the report describes an update to the City of St. Louis Greenhouse Gas Inventory for calendar year 2010, the last full calendar year for which data was available. In order to develop the 2010 inventory in a relatively short time frame, the information was gathered at a higher summary level with less detail breakout than was performed for the 2005 baseline year inventory. Some of the data gathering processes were able to be streamlined due to lessons learned in the 2005 inventory process.

COMMUNITY EMISSIONS INVENTORY – CY 2010

In 2010, community GHG emissions for the City of St. Louis totaled 7,549,862 mtCO2e, or 23.6 mtCO2e per person.[12] Of this, Scope 1 and 2 activities emitted 7,506,359 mtCO2e of GHGs, Scope 3 activities generated an additional 43,503 mtCO2e.

Summary of Community Emissions by Sector

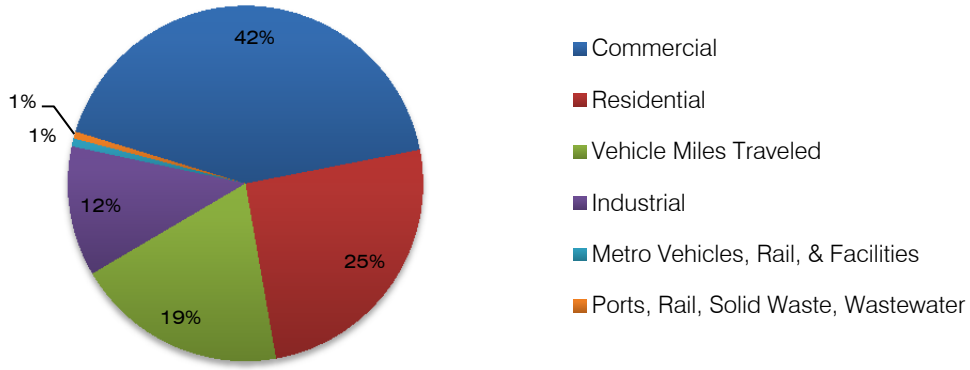
By better understanding the relative scale of emissions from each sector, the City can more effectively focus strategies to reduce them. Commercial buildings accounted for the largest percentage of emissions. Next came residential buildings, followed by vehicle miles traveled (cars and trucks). Together, these three sectors accounted for 87% of GHG emissions. Industry was the fourth largest emitting sector.

Table 4: Community Emissions by Sector (2010)

	Emissions (mtCO2e)	Energy (MMBtu)	Percent Emissions	Percent Energy
Scopes 1 and 2				
Commercial	3,188,213	20,261,363	42%	32%
Residential	1,909,057	15,497,749	25%	24%
Vehicle Miles Traveled	1,456,678	20,190,017	19%	32%
Industrial	893,760	7,314,140	12%	11%
Metro Vehicles, Rail, & Facilities	54,457	482,957	1%	1%
Rail	4,161	56,275	0%	0%
Ports	33	445	0%	0%
Scope 3				
Solid Waste	41,282		1%	
Wastewater Treatment & Facilities	2,221		0%	
Total	7,549,862	63,802,946		

[12] Based on 2010 population of 319,294. (Sources: Planning and Urban Design Agency, City of St. Louis and United States Census 2010, http://2010.census.gov/2010census/popmap/ipmtext.php?fl=29)

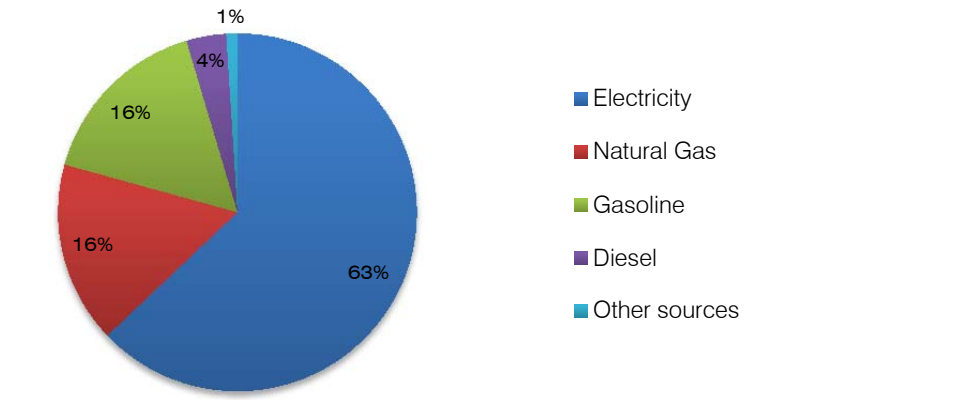
Figure 18: Community Emissions by Sector (2010)



Summary of Community Emissions by Source

Electricity accounted for 63% of GHG emissions in the City of St. Louis community, more than all other fuel sources combined. Next came natural gas, with 16% and gasoline with 16%. Combined, they accounted for 95% of all emissions.

Figure 19: Community Emissions by Source (2010)



Many factors influence the emissions profile of a city; understanding these differences in the future may be helpful in identifying abatement opportunities.

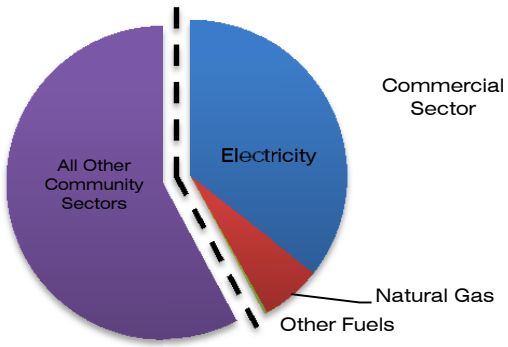
Detailed 2010 Community Sector Analyses

Commercial Buildings & Facilities

Commercial buildings and facilities consume energy, and emit GHGs, to operate systems such as lighting and HVAC. In addition, activities occurring in commercial buildings often involve equipment that consumes energy, such as appliances, retail displays, and refrigeration equipment. Sometimes this equipment consumes as much or more energy than the basic building systems. Consequently, it is not unusual for commercial buildings to account for a significant portion of total GHG emissions.

In 2010, commercial building emissions (energy use) were 3,188,213 mtCO2e (20,261,363 MMBtu), or 42% of all GHGs emitted by the St. Louis community. Eighty-four percent of their emissions (2,690,344 mtCO2e, 10,999,175 MMBtu) came from the consumption of electricity, while 12% (474,506 mtCO2e) came from the consumption of natural gas. Thus, in 2010, approximately 36% of all GHG emissions in the City of St. Louis community derived from electricity consumption in the commercial sector.

Figure 21: Commercial Emissions by Source (2010)



Residential

Residential buildings generate GHGs primarily by consuming fossil fuel for HVAC and to operate household appliances and equipment. They account for a significant percentage of total community emissions because households are so numerous.

In St. Louis in 2010, residential buildings emitted 1,909,057 mtCO2e (15,497,749 MMBtu), or 25% of total community emissions. Seventy-three percent of residential emissions (1,386,102 mtCO2e) derived from electrical consumption, and 27% (521,609 mtCO2e) derived from consumption of natural gas. Small amounts of kerosene and fuel oil continue to be used for residential heating, but together they accounted for less than 1% of residential emissions.

Industrial

In St. Louis, industry was the fourth largest emitting sector with 893,760 mtCO2e (7,314,140 MMBtu), or 12% of the community total. Seventy-two percent of industrial emissions (709,047 mtCO2e, 2,621,765 MMBtu) came from the consumption of electricity, while 26% (278,143 mtCO2e) came from the consumption of natural gas, and 1% (16,275 mtCO2e, 156,929 MMBtu) came from the consumption of fuel oils 1, 2 and 4. Small amounts of kerosene and residual fuel oil were also consumed, accounting for less than 1% of emissions combined.

Vehicle Miles Travelled

Vehicle Miles Traveled (VMT) primarily accounts for emissions from automobiles and trucks. Trips that originate or terminate in the City of St. Louis are included, as well as trips that transit through the City on its highways and roads. Emissions generated by the Metro Transit system are accounted for separately, as are heavy rail traffic and operations at river ports.

VMT accounted for 1,456, 678 mtCO2e of GHG emissions in 2010 (20,190,017 MMBtu), or 19% of total community emissions. Eighty-two percent of those emissions (1,214,501 mtCO2e) came from gasoline consumption, 17% (242,177 mtCO2e) came from diesel fuel, and less than 1% came from the consumption of diesel fuel to operate off road equipment. Though the correspondence is not perfect, gasoline consumption most often represents the operation of cars and light trucks, while diesel fuel consumption represents the operation of heavier trucks and equipment.

Metro Transit

Metro Transit (Bi-State Development Agency) operates the public bus, light rail, and "Call-A-Ride" systems in the St. Louis Metropolitan Area. Only facilities and operations in the City of St. Louis are considered in this inventory.

The Metro Transit system generated 54,457 mtCO2e in 2010 (482,957 MMBtu), less than 1% of total community emissions. Fifty-three percent of Metro's emissions were from the consumption of electricity, while 38% were from the consumption of diesel fuel. Seven percent came from the consumption of natural gas.

Rail & Ports

The City of St. Louis is one of the nation's largest rail hubs, served by six Class 1 railroads and several local ones.[13] Rail operations generate GHG emissions, primarily via the consumption of diesel fuel to operate locomotives. Emissions come from operations that originate or terminate in the City of St. Louis, as well as operations that transit through the City. Emissions from the Metro Transit light rail system are discussed in the Metro Transit section.

The Metropolitan Port of St. Louis is the third largest inland river port in the country, moving about 32 million tons of product annually by barge and tug. The regional port extends 70 miles along the Illinois and Missouri sides of the Mississippi River, and is operated by several different port authorities.[14] The St. Louis Port Authority is one of them, running 19 miles along the Missouri side of the river along the boundary of the City of St. Louis. This inventory considers only river vehicle freight traffic originating in the St. Louis Port Authority. Rail transportation generated 4,161 mtCO2e in 2010 (56,275), and the port generated 33 mtCO2e (445 MMBtu). Combined they represented less than 1% of total community emissions.

Solid Waste

Solid waste generates GHG emissions in several ways. Some GHG is emitted by trucks burning fossil fuel as they collect the waste. Some solid waste may be incinerated, releasing GHG. Most solid waste is landfilled where organic compounds in the waste decay, releasing methane, a powerful greenhouse gas. Local governments have some control over the size and composition of the community waste stream, via reuse, recycling, and recovery policies. However, there are no operational landfills within the City of St. Louis. Emissions from solid waste are categorized as Scope 3 and have been estimated using standardized methodologies.

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[13] "Transportation Advantages," St. Louis Regional Commerce and Growth Association, downloaded December 2011, http://www.stlrcga.org/x523.xml.

[14] "River Transportation Through and To St. Louis." *St. Louis Commerce Magazine.* St. Louis Regional Commerce and Growth Association, (March 2005.)

In 2010, solid waste generated 41,282 mtCO2e of GHG emissions, less than 1% of total community emissions. Seventy-seven percent (31,641 mtCO2e) came from paper waste, 20% (8,208 mtCO2e) came from food waste, and 3% (1,433 mtCO2e) came from wood and textile waste. Other typical components of solid waste such as metals and glass do not produce GHG, and so are not recognized in GHG inventories. Plastics are also not recognized because their decay rate is far too long to be of near-term consequence. Landscape and plant-based agricultural waste are not included as their decay is considered part of and in balance with the natural cycles of plant life.
This inventory does not break out the GHGs emitted by trucks collecting the waste.

Wastewater Treatment

In the City of St. Louis, wastewater is collected and treated by the Metropolitan St. Louis Sewer District (MSD), a public agency not under the control of the City. MSD's collection area covers 525 square miles, encompassing all of the City of St. Louis and about 80% of St. Louis County. It serves a population of about 1.4 million, a minority of which live in the City of St. Louis. Only emissions specific to the City of St. Louis were considered in this inventory.[15]

As wastewater is treated, it can release several GHGs. At MSD, the emissions are limited to small amounts of nitrous oxide.[16] In 2010, wastewater treatment emissions attributable to the City of St. Louis totaled 2,221 mtCO2e, less than 1% of total community GHG emissions.

GOVERNMENT OPERATIONS EMISSIONS INVENTORY – CY 2010

During 2010, greenhouse gas emissions from government operations totaled 307,270 mtCO2e. Of these, 285,425 mtCO2e came from operations directly controlled by the City (Scopes 1 & 2), and 21,845 mtCO2e came from operations partially controlled (Scope 3).

Summary of Government Operations Emissions by Sector

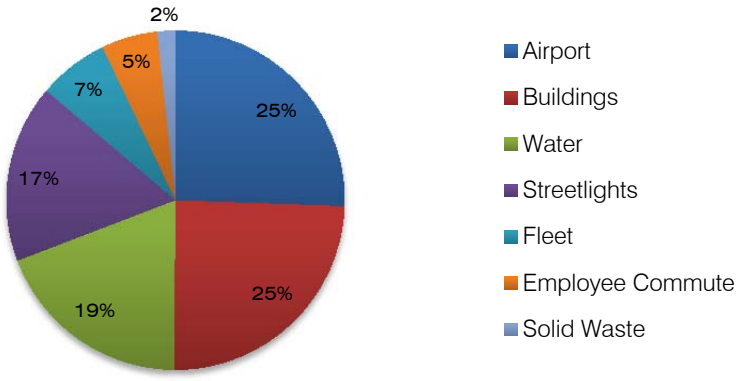
As in 2005, operations at Lambert St. Louis International Airport accounted for more greenhouse gas emissions than any other sector of city operations, followed by other City buildings and facilities, water delivery operations, public street lighting (traffic signals, street lights, and other types of lighting). Together, these sectors accounted for about 86% of greenhouse gas emissions from City operations.

[15] "About M.S.D." Metropolitan St. Louis Sewer District, downloaded December 2011 http://www.stlmsd.com/aboutmsd.
[16] Nitrous oxide is 310 time more effective at trapping heat than carbon dioxide. (Source: "Nitrous Oxide," E.P.A. http://www.epa.gov/nitrousoxide/scientific.html)

Table 5: Government Emissions by Sector (2010)

	Emissions (mtCO2e)	Energy (MMBtu)	Percent Emissions	Percent Energy
Scopes 1 & 2				
Airport Facilities	78,484	515,098	26%	24%
Buildings and Facilities	75,599	610,273	25%	29%
Water Delivery Facilities	58,523	254,350	19%	12%
Streetlights & Traffic Signals	52,162	213,259	17%	10%
Vehicle Fleet & Off Road Equipment	20,657	283,417	7%	13%
Scope 3				
Employee Commute	16,512	229,481	5%	11%
Government Solid Waste	5,333		2%	
Total	307,270	2,105,878		

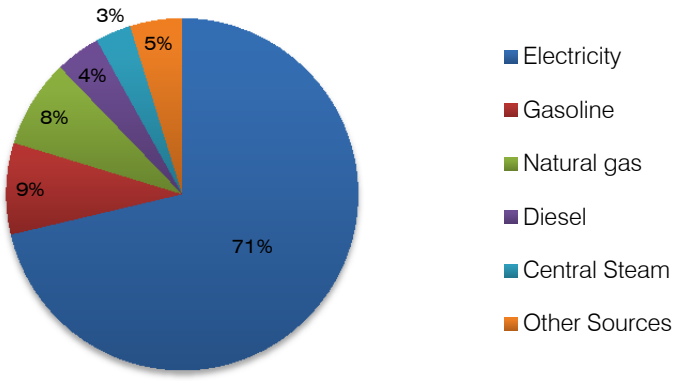
Figure 22: Government Emissions by Sector (2010)



Summary of Government Operations Emissions by Source

Electricity use dominated the city government's emissions in 2010, accounting for about 71% of emissions, almost three times as much GHG as all other sources combined. Vehicle fuels (gasoline and diesel) together accounted for the second most emissions, about 12%. Natural gas was third, accounting for about 8%.

Figure 23: Government Emissions by Source (2010)



Electricity is widely used for lighting, HVAC systems, and tools and equipment. In addition, electricity is commonly generated by burning coal, a fuel that releases relatively high amounts of GHG per unit of energy. The consumption of electricity dominates the GHG emissions of different local governments to different extents depending on differences in government operations, regional differences in the fuel used to generate electricity, or from a combination of factors.

Detailed 2010 Government Sector Analyses

By better understanding the relative scale of emissions from each sector of its operations, the City can more effectively focus emissions reductions strategies to achieve the greatest reductions. Operations at Lambert St. Louis International Airport accounted for more greenhouse gas emissions than any other sector of city operations, followed by other buildings and facilities, water delivery operations, and public street lighting (traffic signals, street lights, and other types of lighting). Together, these sectors accounted for about 86% of greenhouse gas emissions from city operations.

Airport Facilities and Operations

Lambert-St. Louis International Airport (Lambert Field) is the principle commercial airport for the St. Louis Metropolitan Statistical Area and the surrounding region, serving, 12.3 million passengers in 2010. Lambert Field is located 11 miles northwest of downtown St. Louis in St. Louis County. It is operated by the St. Louis Airport Authority, which is majority controlled by officials from the City of St. Louis.[17] Therefore, its greenhouse gas emissions have been consolidated as emissions directly controlled by the City, though it may serve even more citizens from surrounding counties than from the City itself. Future inventories should seek to resolve this distortion in the attribution of emissions from Lambert Field. Options may be to attribute fractions of airport emissions to a particular City or County based on proportions of regional population or based on the analysis of passenger origination and destination points from within the region.

Operations at Lambert Field generated 78,484 mtCO2e of GHG emissions in 2010 consuming 456,410 MMBtu of energy and representing 26% of total government emissions. Of airport emissions, 88% came from the many buildings and facilities operated by the airport, 91% of which were attributed to a substation at 10579 Natural Bridge Rd., which serves several airport facilities. Regarding sources, electricity accounted for 72%, natural gas for 15%, and 12% came from vehicle fuels (diesel, gasoline, CNG, and biodiesel).

Table 6: Lambert Field Emissions (2010)

	Emissions (mtCO2e)	Percent Emissions
Buildings and Facilities		
Electricity	56,846	72%
Natural Gas	11,480	15%
Fuel Oils 1,2 & 4	598	1%
Solid Waste	6,001	8%
Vehicle Fleet	3,559	5%
Total	78,484	

[17]Source: Lambert-St. Louis International Airport website, http://www.lambert-stlouis.com.

Buildings and Other Facilities

The City operates a large number of other buildings and facilities for a wide variety of purposes. Emissions from Lambert Field buildings & facilities are discussed in the Lambert-St. Louis International Airport Section. Emissions from the City's other portfolio of buildings are discussed here. Through their use of energy for heating, cooling, lighting, and other equipment, they account for a significant portion of greenhouse gas emissions at 75,599 mtCO2e (610,273 MMBtu). Seventy percent were from electrical consumption (53,279 mtCO2e,l 217,826 MMBtu), 14% came from the consumption of natural gas (10,850 mtCO2e, 204,114 MMBtu), and 13% came from the consumption of central loop steam (10,052 mtCO2e, 188,333 MMBtu). In addition, the chemicals used in fire suppression, air conditioning, and refrigeration equipment are very harmful GHGs. If the equipment leaks, the amount leaked can be small, but have significant effects. Only a portion of these emissions could be tracked and included in this inventory.

Information regarding specific St. Louis Metropolitan Police buildings and facilities was not available, though consolidated emissions from all Police buildings and facilities were included in the analysis of buildings and facilities and totaled 10,288 mtCO2e, or 14% of total emissions from buildings and facilities. Table 7 presents information regarding all City buildings and facilities with emissions over 1,000 mtCO2e in 2010:

Table 7: Top Emitting Buildings (2010)

	Bldg Sq Footage	Total mtCO2e	Total MMbtu	MMbtu Electric	Emissions Electric	MMbtu Nat Gas	Emissions Nat Gas	MMbtu Steam	Emissions Steam
Carnahan Building, 1114 Market	520,085	8,202	57,201	47%	80%	1%	0%	52%	19%
Justice Center, 200 S. Tucker	280,000	7,826	61,352	39%	74%	2%	1%	59%	25%
Medium Security Inst, 7600 Hall	141,204	5,434	63,496	17%	48%	83%	52%	0%	0%
Civil Courts, 12 North Tucker	290,761	6,698	59,558	31%	67%	0%	0%	69%	33%
City Hall Bldg/Pkg 1200 N. Tucker	327,252	4,140	27,839	50%	82%	0%	0%	50%	18%
1520 Building, 1520 Market Street	453,644	3,824	37,719	25%	61%	0%	0%	75%	39%
Juvenile Courts, 920 N Vandeventer	153,509	2,229	15,598	47%	80%	53%	20%	0%	0%
Greenhouse, 5600 Clayton Road	42,941	1,099	20,673	0%	0%	100%	100%	0%	0%
Municipal Garage, 1100/1122 Clark St	114,116	1,108	6,155	66%	90%	0%	0%	34%	10%
Forest Park Rink, 400 s Kingshighway	15,460	1,090	6,486	60%	88%	40%	12%	0%	0%
Street Dept Offices, 1900 Hampton	83,089	1,048	11,272	21%	55%	79%	45%	0%	0%

MMbtu = 1,000,000 Btus

Water Delivery Facilities

The City of St. Louis operates water delivery facilities that purify, distribute, and transport water used for potable water, sprinkler systems, and irrigation. As water delivery facilities are particularly large users of energy, and thus, large emitters of greenhouse gas, they are separated from other buildings and facilities for more specific examination.

The City of St. Louis Water Division maintains two water treatment plants that draw water from the area's two main rivers. The Chain of Rocks Plant is located on the Mississippi River about eleven miles north of the center of the City. The Howard Bend Treatment Facility is located in St. Louis County on the Missouri River, 37 miles above the confluence of the Missouri and Mississippi Rivers. Combined, these two plants have the capacity to treat and distribute 380 million gallons of water per day[18].

Water Delivery Facilities emitted 58,523 mtCO2e in 2010 (276,722 MMBtu) or 19% of total government emissions. Approximately 97% of emissions came from the consumption of electricity.

Street Lights, Traffic Signals, and Other Public Lighting

The City of St. Louis operates a range of public lighting, including traffic signals and streetlights. In 2010, GHG emissions from public lighting in the City were 52,162 mtCO2e (213,259 MMBtu), about 17% of City government emissions. Emissions from this sector derive almost entirely from the consumption of electricity.

Vehicle Fleet and Mobile Equipment

The City of St. Louis operates a fleet of on-road and off-road vehicles and equipment. In addition, the Metropolitan St. Louis Police also operate a fleet. This section discusses emissions of those combined fleets, except for emissions attributable to the fleet operated by Lambert-St. Louis International Airport, which are discussed in the Lambert Field section.

The City fleet emitted 20,657 mtCO2e (342,108 MMBtu), or 7% of the City's emissions. Of this, 47% came from the consumption of diesel, 44% came from the combustion of gasoline, and 9% came from CNG. The City also operates a small fleet of biodiesel vehicles, and it accounted for less than 1% of GHG emissions.

The vehicles and mobile equipment used in the operation of public transportation within the City of St. Louis, such as buses and rail, are operated by Metro Transit and reported in the Community section of this report.

Employee Commute

Many City employees use vehicles to commute to and from work. When vehicles burn fuel, greenhouse gases are released into the atmosphere. Although the individual employees maintain control over their personal commuting decisions, the City can opt to influence actions via incentives, commuting programs, and other policies. For this reason, emissions from this sector have been estimated in this inventory as Scope 3, but have been considered separately from the Scope 1 and 2 emissions over which the City has direct operational control.

Employees commuting to work were estimated to have emitted 16,512 mtCO2e (229,481 MMBtu), or 5% of total government emissions. The methods by which this estimate could be constructed allowed for only a rough estimate of straight-line distances between origin and destination, not actual road distance travelled. The methods used are discussed in the Appendix.

[18] "Water Treatment," City of St. Louis Water Division, downloaded December 2011, www.stlwater.com/treatment.php.

Government Generated Solid Waste

Local government operations generate solid waste, which cause GHG emissions in several ways. Some GHG is emitted by the trucks that burn fossil fuel as they collect the waste. Some solid waste may be incinerated, releasing GHG. Most solid waste is landfilled. There, organic compounds in the waste decay, releasing methane, a powerful greenhouse gas. Local governments have some control over the size and composition of their waste stream, via reuse, recycling, and recovery policies. However, there are no operational landfills in the City and the landfills used by the City are not under the control of the City. For these reasons, emissions from solid waste have been estimated in this inventory as part of Scope 3, but have been separated from the Scope 1 and 2 emissions over which the City has direct operational control.

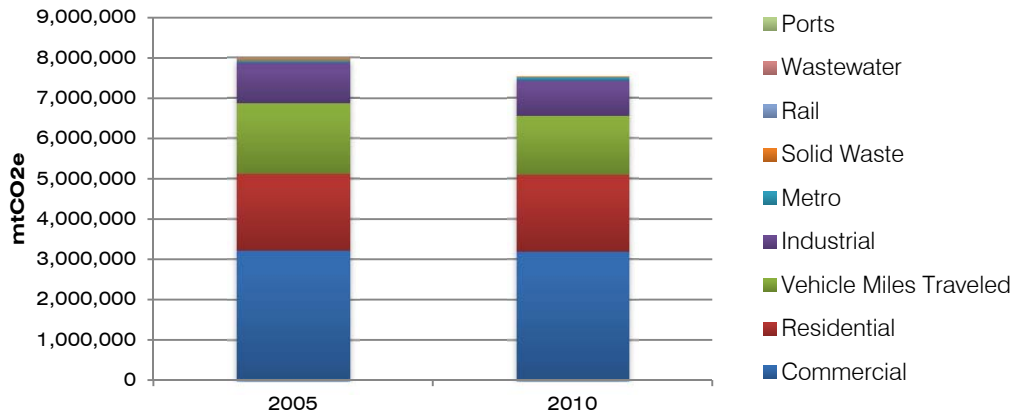
Waste generated by Lambert-St. Louis International Airport is discussed in the Lambert Field section of this report. Other City operations generated an estimated 5,333 mtCO2e of GHG emissions. About 77% were from decomposition of paper waste, and 20% from food waste. (Note: waste information was not available from the St. Louis Metropolitan Police Department, and has not been included in the total.)

PART III: CY 2005 & 2010 COMPARISON & FORECAST

COMPARISON OF CY 2005 AND CY 2010 EMISSIONS

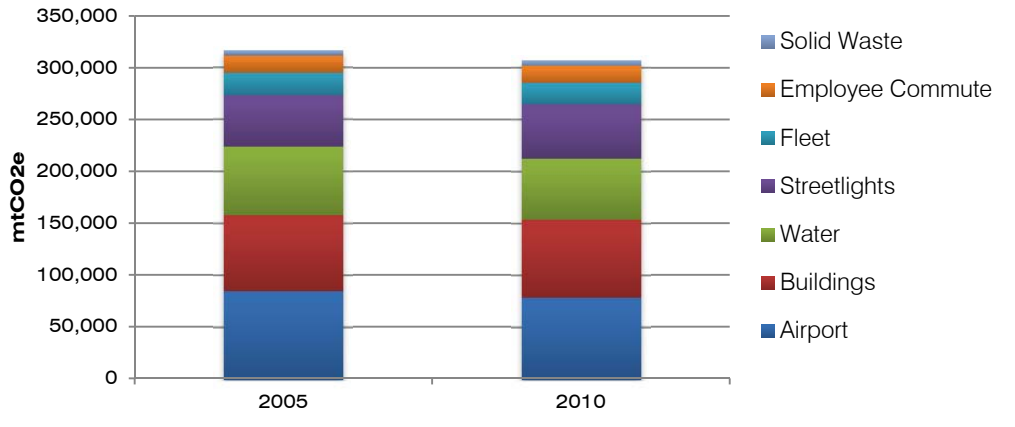
Between 2005 and 2010, total community GHG emissions decreased by 446,607 mtCO2e, or 6% against an overall decrease in population of about 2% and a decrease in per capita emissions from 22.7 mtCO2e per capita to 23.6 mtCO2e per capita, or about 4%. The community decreases were driven by reductions in emissions from Vehicle Miles Traveled (17%), industrial emissions (11%), and commercial emissions (1%), and partially offset by an increase in residential emissions (1%). There were also changes in wastewater, solid waste, and port emissions. These sectors represent a small portion of overall emissions and did not drive the change in overall emissions, despite the fact that their changes were large on a percentage basis.

Figure 24: Community Emissions, 2005-2010



Between 2005 and 2010, City government emissions decreased by 8,970 mtCO2e, or 3%. The decrease was primarily driven by decreases in water delivery emissions (12%), an airport emissions (8%), buildings and facilities (3%), and fleet emissions (5%). They were partially offset by increases in streetlight emissions (6%), and solid waste emissions (26%). Emissions from employee commute did not change significantly.

Figure 25: Government Emissions, 2005-2010

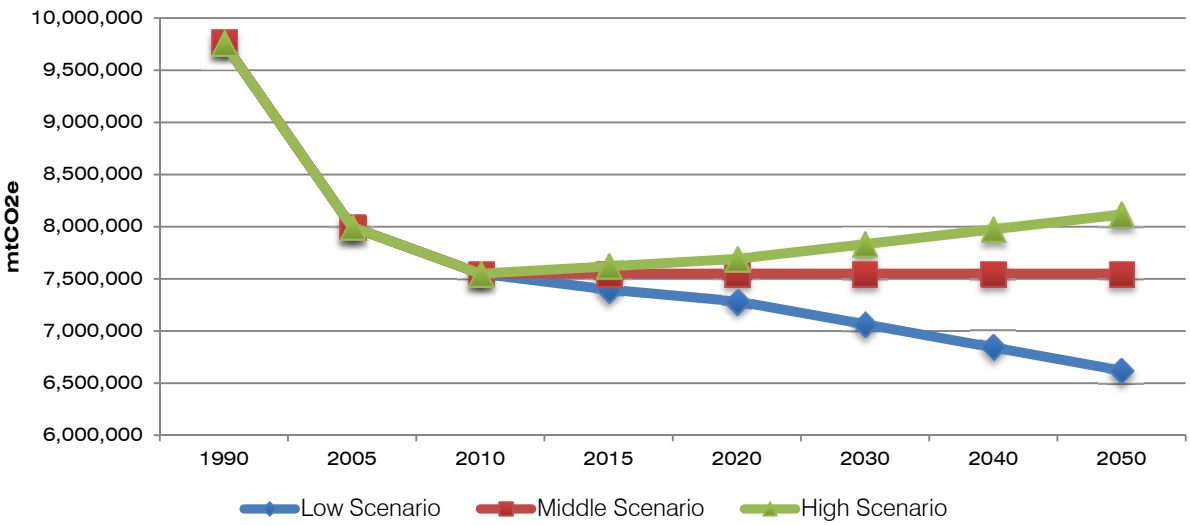


GREENHOUSE GAS EMISSIONS FORECAST

From the baseline of GHG data, the City is able to forecast likely results based on the premise that no action is taken to mitigate or abate GHG emissions. While the reality is many factors (such as total economic activity, energy mix, and Corporate Average Fuel Economy standards) are likely to drive GHG emissions, this forecast uses population trends to outline community source emission scenarios. Governmental emissions, however, are driven more by specific policies that vary from year-to-year, such as budget, staffing, and specific operating practices. These factors are difficult to estimate, so the forecast is limited to the community as a whole.

Three population change scenarios were provided by the St. Louis Planning and Urban Design Agency. One scenario involved a declining population over time, one involved a constant population, and one involved population growth. Using these three scenarios a "business as usual" forecast of emissions was created, extending to the year 2050. In addition, using census data, population data was used to "backcast" GHG emissions to the year 1990, the baseline year referenced in the U.S. Mayor's Climate Protection Agreement, which commits signatories to support reducing GHG emissions 7% below 1990 levels by the end of 2012.[19]

Figure 26: Community Emissions Forecast and Backcast



The population in 1990 was 396,685, in 2005 was 352,572, and in 2010 was 319,294, a 19.5% decrease from 1990-2010. Total community emissions in 1990 were backcast at 9,761,896 mtCO2e; total community emissions in 2010 were 7,549,862 mtCO2e representing a 22.7% decrease from 1990 levels.

[19] *U.S. Mayors Climate Protection Agreement,* http://www.usmayors.org/climaterotection/agreement.htm

APPENDIX

City of St Louis Greenhouse Gas Inventory – General Methodology
Community Emissions Inventory – Detailed Methodology
Government Operations Emissions Inventory – Detailed Methodology
2005 Government Employee Commuter Survey Detail

City of St Louis Greenhouse Gas Inventory – General Methodology

The City of St. Louis greenhouse gas emissions inventory was completed for the years 2005 and 2010 using local data sources whenever available for energy use, fuel consumption and waste generation. The government operations portion of this greenhouse gas emissions inventory follows the recommended or alternate methods outlined in the Local Governments Operations Protocol (LGOP)[20], which serves as a national standard for quantifying and reporting greenhouse emissions from local government operations. Operational control was utilized to define the government's organizational boundary, as opposed to financial control. This included autonomous departments with government-appointed board members. No similar standard to the LGOP was available for the community side of this inventory at the time this work was conducted. The synthesis of community-related information was guided using processes developed by ICLEI for their Cities for Climate Protection Program.

GHGs are emitted from hundreds of thousands sources in the City of St. Louis, many of which are mobile. Emissions are not directly monitored, nor could they be. Like all GHG inventories, the present study estimated GHG emissions by calculating them from other factors that could be measured, such as how much electricity and natural gas were consumed, how much people drove, including the types of vehicles and fuels used, and how much waste was generated. These measurements were converted to GHG emissions using standardized tools and databases.

ICLEI provided the working team an Excel-based Master Data Workbook to aid with the data organization. Data was then entered into ICLEI's emissions-calculating software, Clean Air-Climate Protection (2009) version 3.0 (CACP). CACP is the primary tool used by local governments in the United States to conduct greenhouse gas emissions inventories. Prior to data entry into CACP, some coefficients used by the program to calculate emissions from other factors must be manually entered. This inventory used a list of published electricity emissions factors by EPA's Emission and Generation Resource Integrated Database (eGRID) for region SERC Midwest for 2005[21], and the North American Electric Reliability Corporation (NERC) electricity factors for criteria air pollutants for 2005 for the region represented by map number 04[22].

Files are stored at the Office of the Mayor with the Director of Sustainability.

[20] *Local Government Operations Protocol,* Version 1.1. (ICLEI-Local Governments for Sustainability, 2010.) Downloaded from www.icleiusa.org.
[21] "eGRID2007 Version 1.1 (Year 2005)" *Local Government Operations Protocol* Version 1.1. (ICLEI-Local Governments for Sustainability, 2010), Table G.8.
[22] Source: North American Electric Reliability Corporation (NERC). Emissions factors for inventory years 2005-present are based on estimates for 2005 factors from a 2000 NERC study.

Community Emissions Inventory – Detailed Methodology

Residential, Commercial, and Industrial Sector Facilities

Energy consumption information for residential, commercial and industrial sectors within the City of St. Louis for 2005 was obtained primarily from the three major energy suppliers in the St. Louis area: Ameren Corporation, Laclede Gas Company, and Trigen-St. Louis Energy Corporation.

Ameren provided annual electricity consumption data by month in kWh for residential, commercial and industrial sectors within the City limits of St. Louis. Ameren was only able to provide data through the year 2007 as they are not required to maintain records exceeding three years. The City's population was higher in 2005 than in 2007 by a factor of 0.0052, so an adjustment was made to the kWh of electricity by the same factor for each sector prior to entering into CACP.

Laclede Gas provided natural gas consumption data by month for the year 2005 in amount of therms for the residential, commercial and industrial consumers for 2005, allowing for direct entry into CACP.

Trigen provided data for natural gas, and a small amount of fuel oils, consumed while producing steam and some electricity through a combination of gas turbines and heat recovery boilers. They served mostly the commercial sector and none of the residential sector. The amounts of each fuel were entered directly into CACP.

Energy consumption data for propane, kerosene and fuel oils were not available to be collected directly, so the team followed ICLEI's recommended practices. Adjusted sales of kerosene, distillate fuel, and residual fuel by sector for the State of Missouri are reported by the U.S. Energy Information Administration. [23][24][25] The number of Missouri and City of St. Louis households using these fuels to is reported in the American Community Survey. [26] For each of these fuels, total Missouri consumption was divided by the number of Missouri households using the fuel, to yield the average Missouri household consumption. The household average was then multiplied by the number of households in St. Louis using the fuel to yield the community total. The calculated total amount of each fuel consumed was entered into the CACP program to calculate the associated GHG emissions.

To estimate the total amount of kerosene and distillate fuel used by the residential sector, the number of households (within the City) was multiplied by the average rate of fuel consumption for households for the state of Missouri.

To estimate the total amount of kerosene, distillate fuel, and residual fuel used by the industrial sector, the number of people employed in industrial occupations (within the City) were multiplied by the average rate of fuel consumption for industrial occupations for the state of Missouri. The same calculation was used to estimate the total amount of kerosene, distillate fuel, and residual fuel used by the commercial sector (within the City), only using commercial sector-related occupations and average fuel consumption rates.

[23] "Adjusted Sales of Residual Fuel Oil by End Use, Missouri 2004-09." Downloaded from www.eia.gov.
[24] "Adjusted Sales of Distillate Fuel Oil by End Use, Missouri 2004-09." Downloaded from www.eia.gov.
[25] "Adjusted Sales of Kerosene by End Use, Missouri 2004-09." Downloaded from www.eia.gov.
[26] "2005-2009 American Community Survey 5-year estimates." Downloaded from www.eia.gov.

Vehicle Miles Traveled (VMT)

Emissions associated with vehicles on roadways within the City of St. Louis in 2005 do not include off-road vehicles or construction equipment. Emissions estimates were based on VMT data provided by the Missouri Department of Transportation's Planning division's 2005 report, "Daily VMT by County by Functional Class". VMT was entered directly into CACP. The VMT data did not include the types of vehicles, however. To adjust for the varying emissions of different vehicle types, a mix based on national averages was provided by ICLEI and entered into the CACP calculation.

Public transit provider, Bi-State Development Agency dba Metro Transit (Metrolink, Metrobus, and Call-A-Ride), provided total gasoline and diesel use for 2005 for all vans and buses, and natural gas and electric for buildings and other facilities. Metro estimated 65% of their total gasoline consumption occurred in the City, as well as 50% of diesel fuel for transit buses and 26% of diesel fuel for transit vans occurred in the City. Fuel amounts were entered directly into CACP.

Solid Waste

Emissions from waste are an estimate of methane generation that will result from the anaerobic decomposition of all organic waste sent to landfill in the base year, 2005. It is important to note that emissions are attributed to the year in which the waste was generated, even though the emissions themselves will occur over a 100+ year timeframe in which the waste is expected to decompose. Attributing all future emissions to the year in which the waste was generated incorporates all emissions from actions taken during the inventory year into that year's greenhouse gas release. This facilitates comparisons of the impacts of actions taken between inventory years and simplifies the analysis of the impact of actions taken to reduce waste generation or divert it from landfills.

The Streets Department Deputy Refuse Commissioner provided the tons of waste sent to landfills and the amount recycled for the City in 2005. The characterization of the waste stream sent to landfill was based on the "The 2006-2007 Missouri Municipal Solid Waste Composition Study" detailing the average sort results of St. Louis (South) transfer station during Fall 2006 and Spring 2007. The waste characterization is important as some types of waste (e.g. paper, plant debris, food scraps, and so on) generate methane within the anaerobic environment of a landfill and others do not (e.g. metal, glass, and so on).

Table A-1: Waste Characterization

	Percent by Weight
Paper Products	36.55
Food Waste	16.75
Plant Debris	…
Wood/Textile	5.85
All Other Waste	40.85

Note: per MDNR instruction, yard waste not included in survey.

Recycling programs are reflected in the emissions calculations as reduced total tonnage of waste going to landfills. The model, however, does not capture the emissions from production-related energy use associated with the transformation of recycled materials as part of the inventory.

Wastewater

Metropolitan St. Louis Sewer District provided the average daily amount of nitrogen in treated effluent discharged from the wastewater treatment plant (the nitrogen load). Given the average daily nitrogen load and the average number of customers served (residential, commercial, and industrial), Equations 10.8 and 10.9 in the LGOP were used to compute the estimated process and fugitive emissions from wastewater treatment.

Ports

Emissions from approximately 19 miles of port zone within the City of St. Louis were based on an estimated amount of fuel consumed per ton of freight transported. The tons of freight were provided by the October 2005 Missouri Department of Transportation's Missouri Statewide Freight Study by Wilbur Smith, HNTB.

Rail

Distillate fuel oil consumption by heavy rail was provided by the U.S. Energy Information Administration27. To estimate the total amount of fuel used within the City, the number of rail miles (70.79 miles) within the City of St. Louis were multiplied by the average fuel use per rail mile in Missouri. The amount of fuel was then entered into CACP.

Government Operations Emissions Inventory – Detailed Methodology

Airport Facilities and Operations

Emissions from Lambert-St. Louis International Airport facilities were determined based on electric (kWh) and natural gas (therms) consumption per meter or building, which were entered directly into CACP. The alternate method as described in the LGOP by equation 6.3428 was used for calculating refrigerant fugitive emissions.

Emissions from Airport vehicles and off-road equipment were determined based on direct measurement of fuel use primarily from fuel card purchases of gasoline, B-20 bio-diesel and compressed natural gas (CNG). The gallons of fuel were associated with vehicle types when entered into CACP to better determine emissions based not only on the fuel but the efficiency of the vehicle type.

Buildings and Facilities

Emissions from City government buildings and facilities were determined based on monthly billing records for each meter or building. Units provided for electricity (kWh) and natural gas (therms) allowed for direct entry into CACP. Prior to entering units provided for steam, conversion from thousand pounds condensate (mlbs) to MBtu was required per the Energy Star conversion table29.

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[27] "Adjusted Sales of distillate fuel by end use, Missouri 2004-09." Downloaded from www.eia.gov.

[28] " Calculating emissions of each type of HFC," *Local Government Operations Protocol*, Version 1.1. (ICLEI-Local Governments for Sustainability, 2010.), Eq.6.34, 61. Downloaded from www.icleiusa.org.

[29]http://www.energystar.gov/ia/business/tools_resources/target_finder/help/Energy_Units_Conversion_Table.htm.

For calculating refrigerant fugitive emissions, the recommended method, as described in the LGOP by equation 6.31,30 was used. According to the Montreal Protocol R-22 is scheduled to be phased out between 2010 and 2020 so no coefficient was provided in the LGOP. ICLEI confirmed the global warming potential (coefficient) for R-22 to be 1780.

Water Delivery Facilities

Emissions from water delivery facilities were determined based on electric (kWh) and natural gas (therms) consumption per facility which were entered directly into CACP. No refrigerants were reported or estimated.

Streetlights

Emissions from City public lighting, including traffic signals and street lights, were determined based on a summary report by month in kWh from the electric utility, Ameren, for public lighting. The total kWh hours were entered into CACP as no divisions were made between lighting types.

Vehicle Fleet and Mobile Equipment

Emissions from City vehicles and off-road equipment were determined based on direct measurement of fuel use primarily from fuel card purchases of gasoline, diesel and compressed natural gas (CNG). The gallons of fuel were associated with vehicle types when entered into CACP to better determine emissions based not only on the fuel but the efficiency of the vehicle type.

Vehicle type information for the St. Louis Metropolitan Police Department gasoline consumption was not available for the 2005 inventory, so an assumption was made that all gasoline was consumed in passenger vehicles.

Airport vehicles were included in the section for Airport facilities and operations.

Government Generated Solid Waste

The Streets Department Deputy Refuse Commissioner provided the tons of waste sent to landfills and the amount recycled for the City government in 2005. The characterization of the waste stream sent to landfill was based on the "The 2006-2007 Missouri Municipal Solid Waste Composition Study" detailing the average sort results of St. Louis (South) transfer station during Fall 2006 and Spring 2007 (see Table A-1). The waste characterization is important as some types of waste (e.g. paper, plant debris, food scraps, and so on) generate methane within the anaerobic environment of a landfill and others do not (e.g. metal, glass, and so on).

Recycling programs are reflected in the emissions calculations as reduced total tonnage of waste going to landfills. The model, however, does not capture the upstream emissions from production-related energy use associated with the transformation of recycled materials as part of the inventory.

Employee Commute

The methodology for estimating the employee commute emissions portion of the inventory is based solely on estimated vehicles miles traveled based on estimated miles between employees' work and home zip codes. This information was developed primarily through an online City Employee Commute Survey developed specifically for the purposes of this inventory and conducted in April and May of 2011. Base

[30] " Calculating emissions of each type of HFC using mass balance method," *Local Government Operations Protocol,* Version 1.1. (ICLEI-Local Governments for Sustainability, 2010): Eq.6.31, 59. Downloaded from www.icleiusa.org.

numbers for 2005 and 2010 were established using employee populations for those years as provided by the City's Budget Division and proportioning the results compared to the 2011 employee population: 2005: 7,096; 2010: 7,102; 2011: 6,947.

The daily one-way vehicles-miles-traveled per employee was calculated using MS Access with a summary table of 33 work zip codes created from a list of work and home zip codes of employees. The complete table was then geocoded using employee zip codes and the summary table of work zip codes, in both cases using a zip code centroid file. The placement of the centroids were approximate, because the zip code boundaries themselves weren't fixed. Once the locations were on the map, they were projected in the North America Equidistant Conic projection (assigning them 3D characteristics that help measure distances more accurately). Once the locations were projected, a script was run to measure the straight line distance from each employee zip code to each work zip code. This distance table was put back into the MS Access database and joined with the complete table via the work zip code, and then filtered based on whether the work zip code from the distance table and the work zip code from the table matched. This table was then exported to MS-Excel, each total daily VMT was multiplied by two (indicating a round trip), and this value was multiplied by the number of annual work days (i.e. 262). [31]

CO_2e emissions from employees' commutes were calculated by converting vehicle miles traveled per year by annual fuel consumption by fuel type (i.e. gasoline). The VMT data calculated were converted to fuel consumption estimates using fuel economy for single-occupancy vehicles.[32]

Due to the method by which CO_2e emissions from employee commutes in 2005 were estimated, emission results from this sector are likely lower than in reality. The reported emissions for this sector are based on VMT "as the crow flies" rather than actual VMT.

Community Emissions Forecast and Backcast – Detailed Methodology

Population counts for the years 1990, 2005, and 2010 were taken from the U.S. Census. The St. Louis Planning and Urban Design Agency provided estimates of the population in the City of St. Louis for the years 2015, 2020, 2030, 2040, and 2050, based on three scenarios: a shrinking population scenario (low growth), a constant population scenario (medium growth), and a growing population scenario (high growth). To backcast emissions to 1990, the percentage change in population between 1990 and 2005 was calculated. This percentage change was then applied to GHG emissions for 2005. To forecast emissions in 2015, 2020, 2030, and 2050, the percentage change in population between each year and 2010 was calculated. For each year, the respective percentage change was applied to emissions in 2010.

[31] Please note that due to the out-of-state location of two employees' home zip codes, the vehicle miles traveled to/from work were omitted from the above calculations.

[32] Fuel efficiency estimates for single-occupancy vehicles was taken from CACP2009.

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- All Contributing City of St. Louis Staff and Departments
- Ameren Corporation
- East-West Gateway Council of Governments
- Laclede Gas Company
- Metro Transit
- Metropolitan St Louis Sewer District (MSD)
- Trigen-St. Louis Energy Corporation / Veolia Energy

The following organizations were responsible for the preparation and synthesis of the material in this report:

- HOK
- St. Louis Community College
- ICLEI - Local Governments for Sustainability

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