Greenhouse Gas Emissions Inventory Update

For the City and Community of:
Lawrence, KS

2002- 2012

City *of* Lawrence

INTRODUCTION

What is a Greenhouse Gas Inventory?

A greenhouse gas inventory is an accounting of greenhouse gases (GHGs) emitted to or removed from the atmosphere over a period of time. Policymakers use inventories to establish a baseline for tracking emissions trends, developing mitigation strategies and policies, and assessing progress. An inventory is usually the first step taken by entities that want to reduce their GHG emissions. An inventory can help local governments:

- Identify the sectors, sources, and activities within their jurisdiction that are responsible for greenhouse gas emissions.
- Understand emissions trends.
- Quantify the benefits of activities that reduce emissions.
- Establish a basis for developing a local action plan.
- Track progress in reducing emissions.
- Set goals and targets for future reductions.

BACKGROUND

Greenhouse Gas Emissions & Climate Change Impacts

The United Nations Intergovernmental Panel on Climate Change (IPCC), a global consortium of scientists, has determined that the warming of our climate system is "unequivocal" and that the evidence indicates with 95 percent certainty that human activity is the principal cause of global warming. Climate change has disruptive and uncertain consequences for agriculture, water supply, transportation, energy, ecosystems, and national security that affect citizens on a global and local scale. In addition to impacts on global ecosystems, these climate fluctuations may stunt economic growth and have adverse consequences for human health.

At the local level, these changes potentially impact the services cities will need to provide for citizens. Infrastructure surrounding water provision, distribution and security will be paramount. Preparation for and response to extreme weather events will increase. Health risks due to increased temperatures and heat waves will affect citizens, and cities will need to account for growing energy demands. Recognizing a need for action, and the potential impact that climate change has globally, as well as locally in Lawrence, former Lawrence Mayor Dennis "Boog" Highberger signed on to the U.S. Conference of Mayors Climate Protection Agreement on behalf of the City of Lawrence, Kansas in March 2006.

Under the Mayors Climate Protection Agreement, participating cities commit to:

1. Strive to meet or beat the Kyoto Protocol targets in their own communities, through actions ranging from anti-sprawl land-use policies to bike path development to public information campaigns;
2. Urge their state governments and the federal government to enact policies and programs to meet or beat the greenhouse gas emissions reduction target suggested for the United States in the Kyoto Protocol—7% reduction from 1990 levels by 2012; and
3. Encourage the U.S. Congress to pass the bipartisan greenhouse gas reduction legislation, which would establish a national emissions trading system.

City of Lawrence GHG Mitigation Initiatives

In order to advance these goals, the Mayor's Task Force on Climate Protection (also known as the Climate Protection Task Force, or CPTF) was appointed in February 2008 to create a Climate Protection Plan for the City of Lawrence. The Climate Protection Task Force first undertook a greenhouse gas emissions inventory to establish a baseline of city GHG emissions. The initial inventory was prepared in 2008 and assessed 1990-2005 emissions data. In 2005, the City of Lawrence's GHG emissions reflected patterns of energy consumption similar to cities across the Unites States. The 2005 measurement of GHG emissions was 1,661,047 metric tons of CO_2 equivalents, and per capita emissions were 18.76 tons of CO_2e/person.

Based upon the major findings of the GHG emissions baseline in 2008, Lawrence Mayor Michael Dever and the CPTF developed the following climate change mitigation goal for the City of Lawrence: An 80% reduction in greenhouse gas emissions measured in carbon dioxide equivalent (CDE) by 2050, using baseline data from 2005. CPTF suggested the following timeline for achieving incremental reductions goals:

- 30% reductions by 2020
- 50% reductions by 2030
- 70% reductions by 2040
- 80% reductions by 2050

The Climate Protection Task Force also **recommended seven actions that the City of Lawrence should pursue to reduce both municipal and community greenhouse gas emissions**:

1. Provide dedicated staffing and adequate funding to support climate protection and sustainability initiatives.
2. Strengthen energy conservation policies and building standards.
3. Incorporate the goal of reducing greenhouse gas emissions into land use planning.
4. Develop transportation policies and programs to consume less energy and reduce emissions.
5. Establish outreach and education programs on emissions reduction issues.
6. Expand source reduction and waste reduction programs and initiatives.
7. Exercise leadership by prioritizing efforts to reduce greenhouse gas emissions in municipal operations.

In May 2010, the City of Lawrence and Douglas County created a shared Sustainability Coordinator position housed within the two local governments. The Sustainability Coordinator works with City departments, County departments, and citizens to achieve the community's sustainability and GHG reduction goals.

2002-2012 Update to City GHG Emissions Inventory

The initial GHG emissions inventory was conducted in 2008, utilizing 2005 data. As conditions in both the City of Lawrence operations and the broader community have changed over time, an update of the GHG emissions inventory is necessary to understand changes in the sources of GHG emissions and the results of our mitigation efforts.

In addition, the International Council for Local Environment Initiative (ICLEI) released a new software tool (ClearPath) to assist cities with their GHG emissions inventories. This cloud-based software is much improved over the previous software used for the 2005 inventory, allowing us to further understand the various sources of emissions, and to plan effective mitigation efforts. ClearPath is an easy tool for local governments to measure, plan for, and reduce energy and greenhouse gas emissions.

This 2002-2012 GHG inventory update represents Lawrence's efforts to continue to monitor greenhouse gas emissions and evaluate the effectiveness of the mitigation strategies previously undertaken. The inventory was conducted by the Sustainability Coordinator with much input from various city departments. The City's Sustainability Advisory Board also reviewed the data and provided recommendations for updating the original strategies in the 2008 Climate Protection Plan (see Appendix A).

STUDY METHODOLOGY

ClearPath is an online greenhouse gas emissions management tool that inventories and forecasts emissions and reductions associated with major categories of GHG emissions (i.e. energy use, fuel use, transportation, and waste disposal). ClearPath calculates total greenhouse gas emissions from the local government operations and the community as a whole. This inventory can be used to compare results from previous years and help to identify areas for improvement and progress. Establishing and regularly updating an emissions inventory assists cities as they quantify the effects of existing emissions reduction measures. ICLEI is a trusted source of greenhouse gas emissions management software used by a number of local governments, including peer cities such as Iowa City, Iowa, Lincoln, Nebraska, and Columbia, Missouri.

The greenhouse gas inventory tool provides two modules, a Community Analysis and a Government Analysis. Each module in ClearPath is broken down into specific segments:

Community Analysis:

- Residential energy use
- Commercial energy use
- Industrial energy use
- Transportation/mobile sources
- Solid waste

Government Analysis:

- Buildings/facilities
- Street lights/traffic signals
- Vehicle fleets
- Transit fleets
- Water and wastewater treatment
- Employee commute

For the community greenhouse gas inventory, community-wide data is collected for local electricity and natural gas consumption across residential, commercial, and industrial sectors; annual vehicle miles traveled (VMT) within the city limits of Lawrence; and annual landfill contributions. The government module allows governing bodies to quantify the greenhouse gas contributions associated with operating city owned buildings, city fleets, streetlights, transit operations, water and wastewater treatment, and the impact of employee commutes.

Data was collected from energy utilities such as Westar Energy and Black Hills Energy to compile the energy consumption numbers. Hamm Landfill and departments throughout the City of Lawrence assisted in the gathering of vehicular data, water usage, and landfill contribution. Each category converts inputs into equivalent annual tons of CO_2. The ClearPath software analyzes point-of-use emissions (not life cycle emissions) and only accounts for the emissions created or as a result of actions taking place within the city limits. For example, even though a cubic foot of natural gas consumed a significant amount of energy to reach Lawrence, the only emissions accounted for in this survey are those associated with converting the cubic foot of natural gas into energy while within the city limits of Lawrence.

RESULTS

Community Analysis (2002-2012)

The City of Lawrence's community-wide greenhouse gas emissions were calculated for 10 years, from 2002 to 2012. Over the past ten years, the levels of community-wide GHG emissions have remained relatively steady.

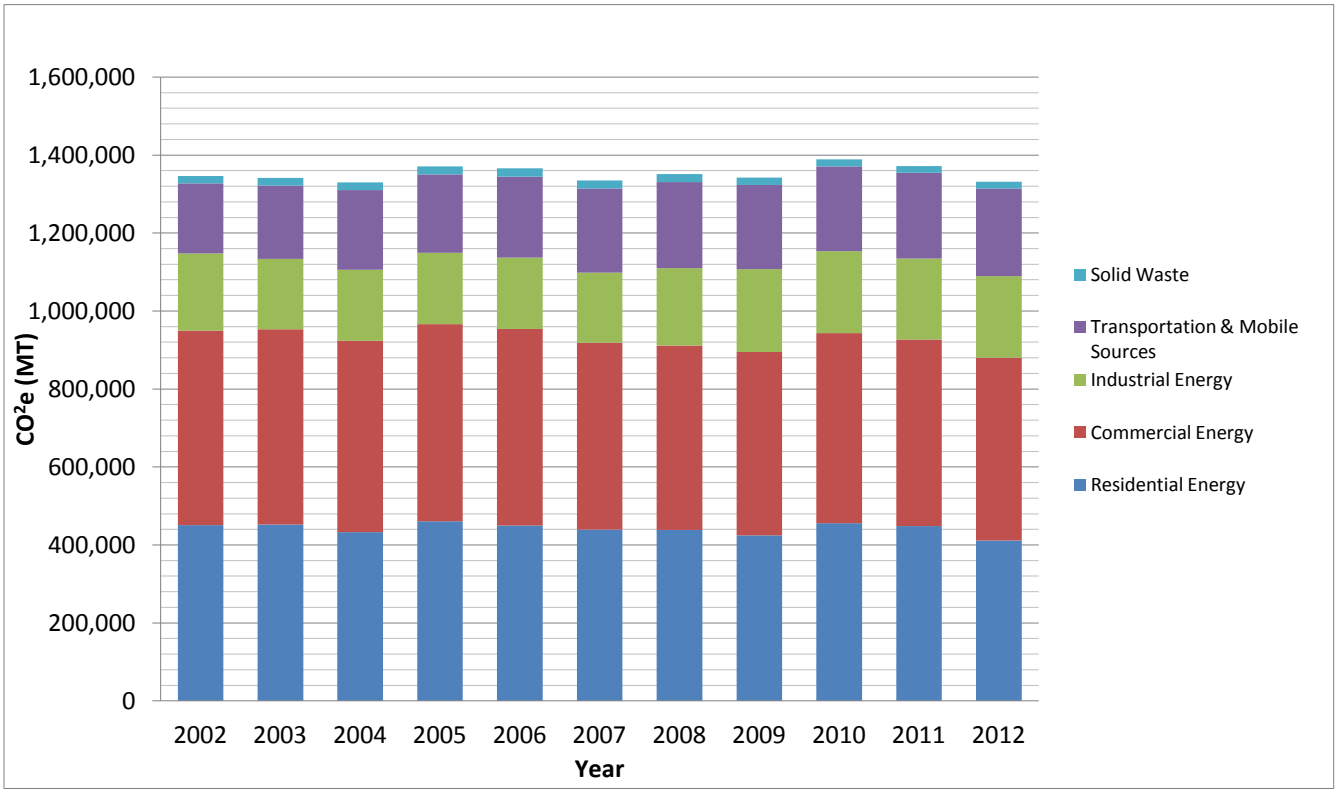
A few notable fluctuations include a decrease in solid waste emissions of 20,216 CO_2e(MT), to 16,864 CO_se(MT), between 2008 and 2012. This decrease may have been driven by a combination of recent community-wide recycling efforts and a decrease in construction waste due to decreased building activity during the economic downturn. Another notable trend is the gradual increase in transportation-related emissions over the ten year period, increasing from 178,179 CO_2e(MT) to 223,941 CO_2e(MT).

Energy-related emissions in residential, commercial, and industrial sectors remained relatively consistent, with annual variations attributable to community and government efforts (i.e. conservation campaigns, building code revisions) but also to elements beyond local control (i.e. weather conditions, technology improvements, and the economic downturn).

Table 1. Community GHG Emissions by Sector (2002-2012) in tons of CO_2e.

Year	Residential Energy	Commercial Energy	Industrial Energy	Transportation & Mobile Sources	Solid Waste Disposal	Total:
2002	450,740	499,282	197,541	178,179	19,217	1,344,959
2003	452,232	501,367	180,303	186,312	19,485	1,339,699
2004	432,803	491,200	181,669	199,947	20,295	1,325,914
2005	461,106	504,835	183,728	199,076	20,191	1,368,936
2006	450,299	503,756	183,160	205,571	21,192	1,363,978
2007	439,388	479,541	179,628	214,219	20,523	1,333,299
2008	438,304	472,914	198,841	219,379	20,216	1,349,654
2009	424,513	470,187	212,889	214,033	18,883	1,340,505
2010	455,983	487,516	209,690	216,324	17,889	1,387,402
2011	448,748	478,437	207,115	219,196	17,393	1,370,889
2012	411,712	468,708	208,579	223,941	16,864	1,329,804

Chart 1. Community GHG Emissions by Sector (2002-2012) in tons of CO_2e.



In the ten year period from 2002-2012, the City added 10,634 residents. It is important and encouraging to note that despite this significant increase in population, the community's total emissions have stayed flat. Table 2 shows per capita greenhouse gas emissions from 2002-2012. In that ten year period, per capita emissions declined by approximately 2 metric tons of CO2 per person, a 12.32% decrease.

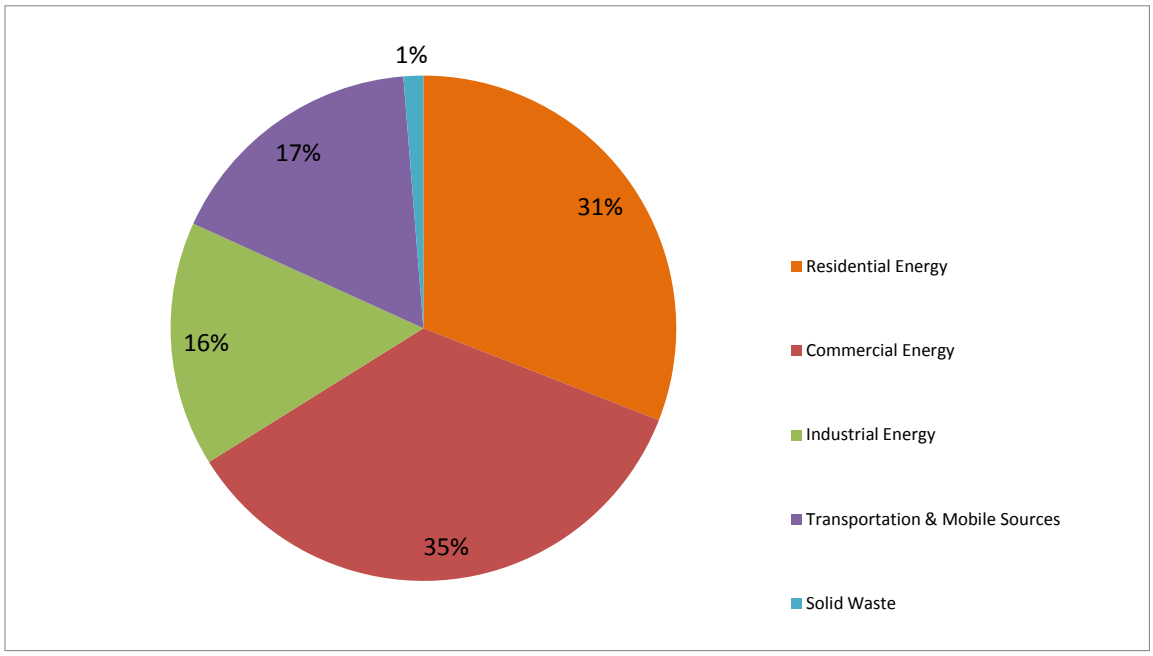
Table 2. Per Capita GHG Emissions (2002-2012) in tons of CO_2e.

Year:	Total Emissions:	Population:	Per capita emissions:
2002	1,344,959	83,310	16.14
2003	1,339,699	84,844	15.79
2004	1,325,914	86,448	15.34
2005	1,368,936	88,664	15.44
2006	1,363,978	89,110	15.31
2007	1,333,299	90,311	14.76
2008	1,349,654	90,866	14.85
2009	1,340,505	91,464	14.66
2010	1,387,402	92,727	14.96
2011	1,370,889	93,116	14.72
2012	1,329,804	93,944	14.16

The total amount of CO_2e emitted by the City of Lawrence community in 2012 was 1,329,804 metric tons. A breakdown of CO_2e emissions by sector (Chart 2) shows that commercial energy (35%), residential energy (31%), and industrial energy (16%) are three of the four largest contributors to released greenhouse gases.

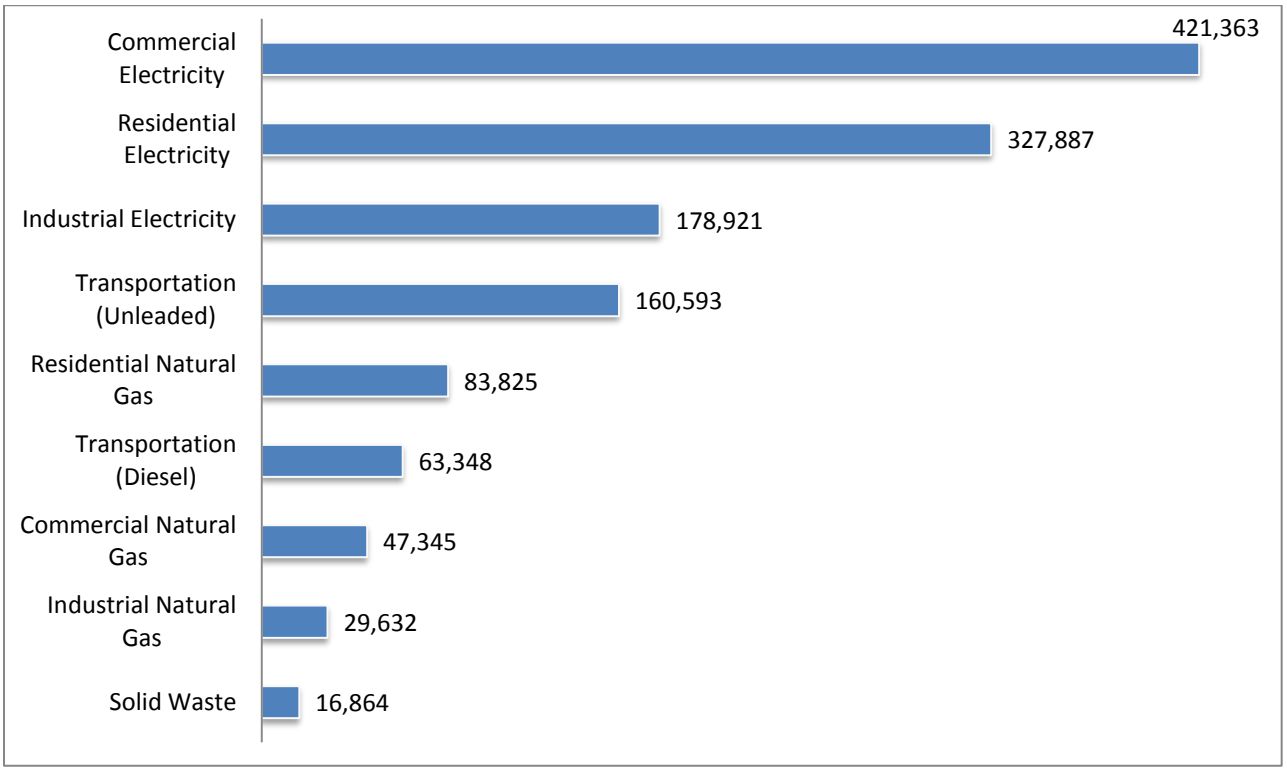
Transportation is also a significant contributor to community-wide emissions (17%). The largest transportation source of emissions is vehicles using unleaded gasoline. In 2012 there were 93,944 people living in the City of Lawrence and a total of 422,050,595 vehicle miles driven. Emissions from solid waste only account for 1% of community-wide GHG emissions.

Chart 2. Contributions to Community GHG Emissions by Sector (2012).



Electricity use specifically contributes more greenhouse gas emissions than natural gas. The majority of energy provided from Westar Energy is produced from burning coal, the most carbon-intensive of fuel sources. Therefore, electricity usage drives community emissions in the residential, commercial, and industrial energy sectors.

Chart 3. Community GHG Emissions by Source (2012) in tons of CO_2e.



Community Analysis (2002-2012): Per Capita Comparisons

Over the past ten years, Lawrence has seen a population growth increase from 83,310 residents in 2002 to 93,994 in 2012. Therefore, it is helpful to look at emissions trends by sector on a per capita basis. In the following charts, per capita analysis was conducted on the energy, transportation, and waste emissions sectors. GHG emissions per capita decreased from 2002-2012 in both the energy sector (per residential account and per business account) and in the solid waste sector. GHG emissions per capita increased from 2002-2012 in transportation.

Chart 4: GHG Emissions from Energy Used per Household (residential accounts)

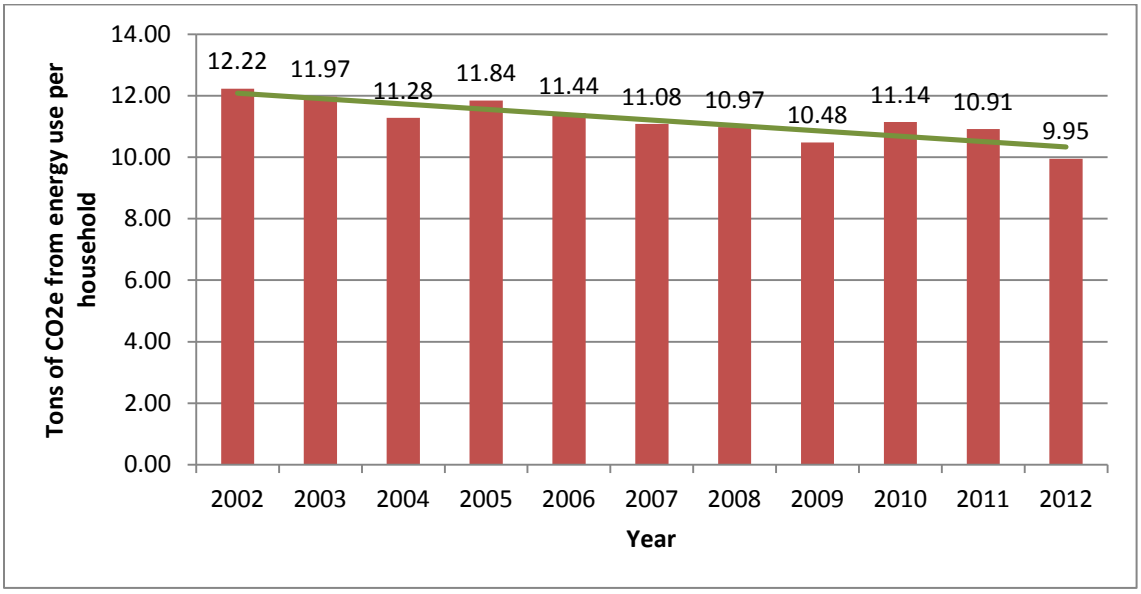


Chart 5: GHG Emissions from Energy Used per Business (commercial accounts)

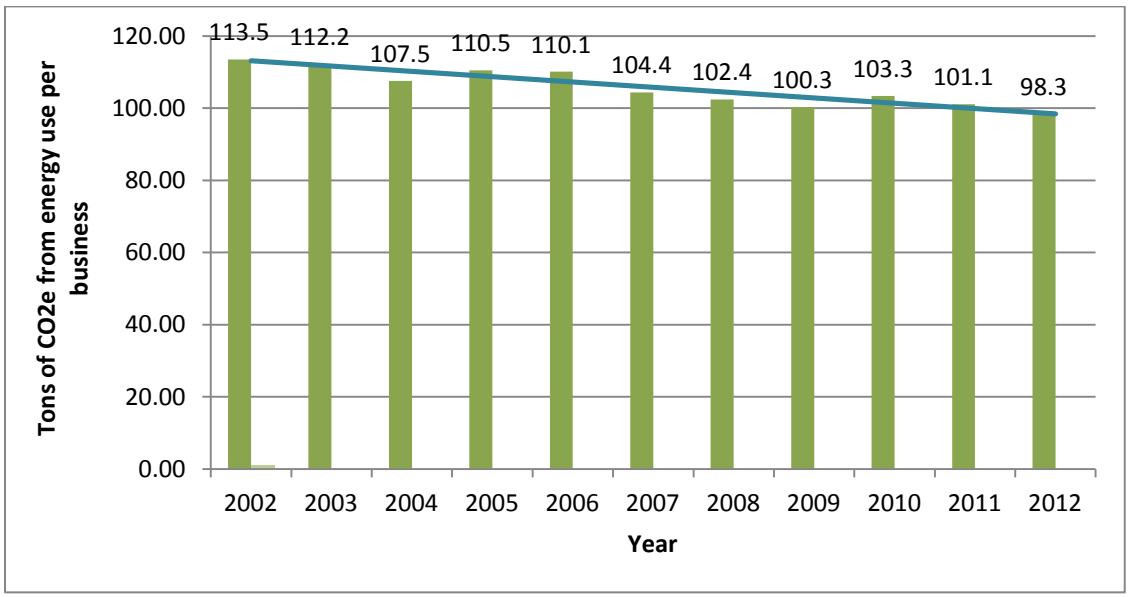


Chart 6: GHG Emissions from Solid Waste Generated per Person

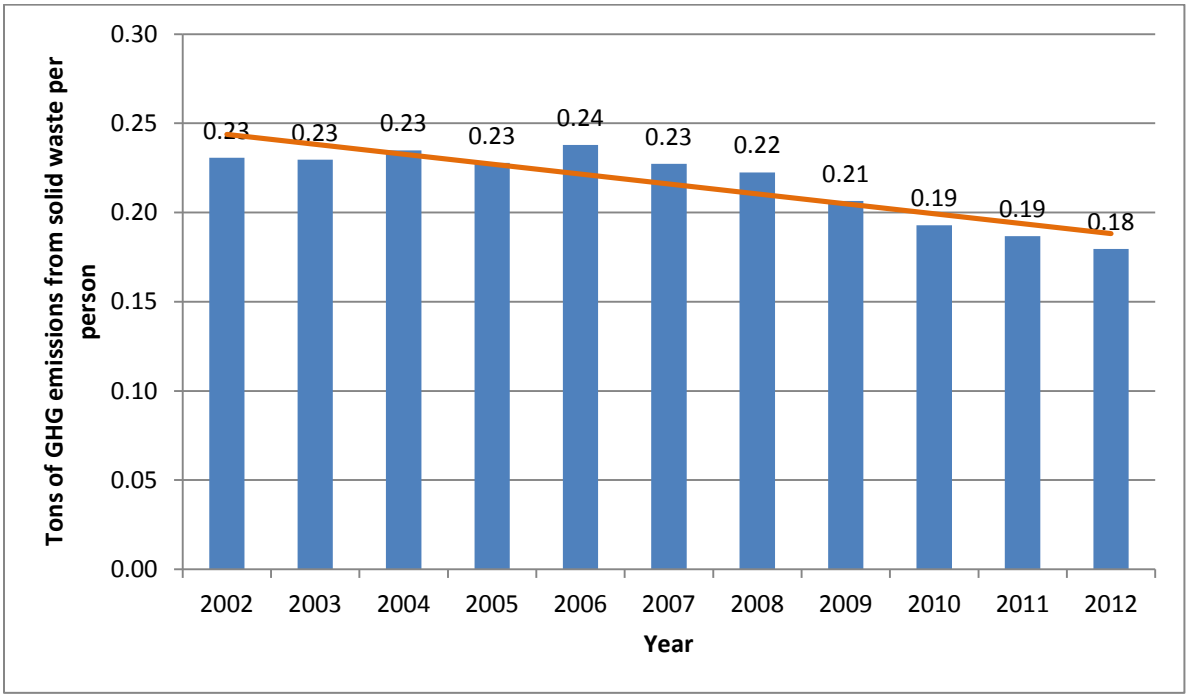
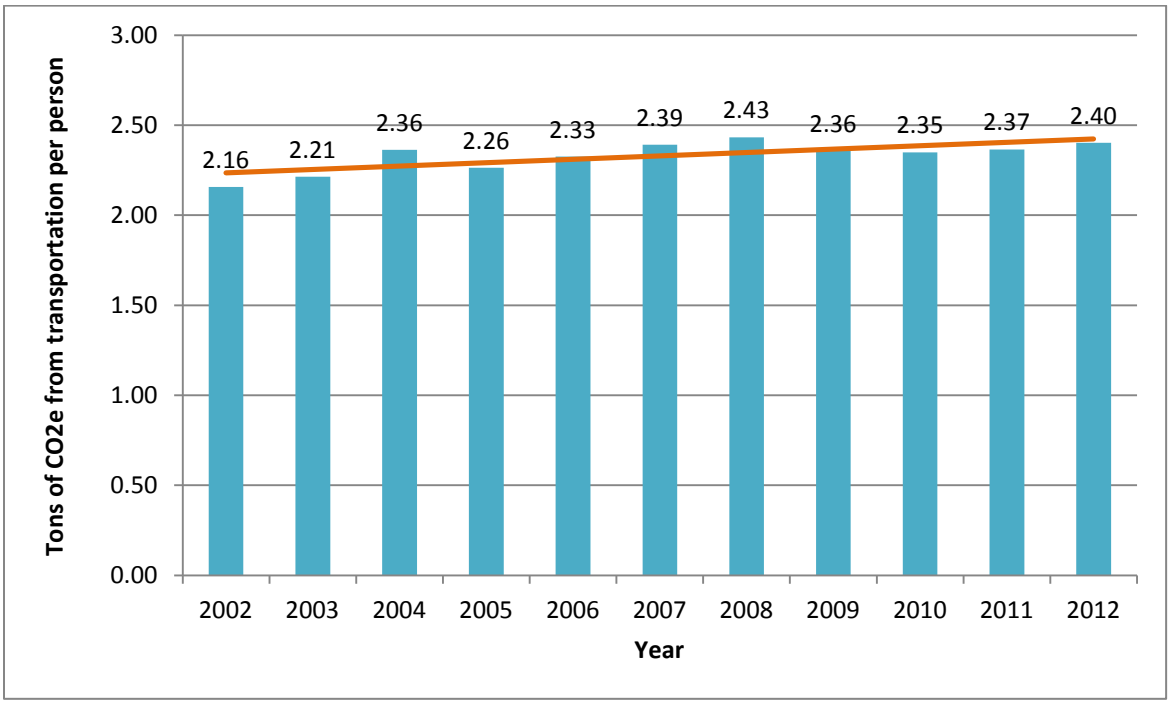


Chart 7: GHG Emissions from Transportation Sources per Person

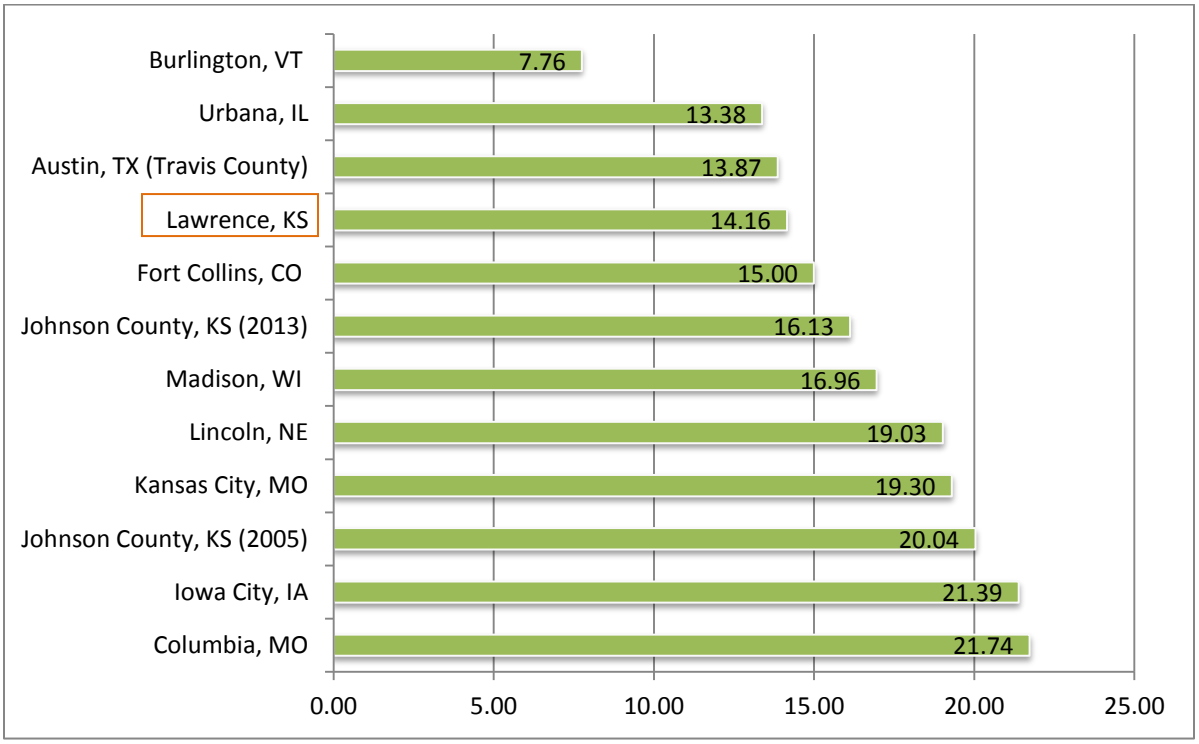


Community Analysis (2002-2012): Comparisons with Peer Communities

A comparison of CO_2e emitted per person was drawn between the City of Lawrence, surrounding cities, and communities of similar population size. The twelve cities included in this comparison differ in many ways, including alternative transportation availability, municipally-owned or investor-owned utilities, electricity generation sources (i.e. coal or renewable energy), and size of industrial base.

In 2012, Lawrence residents were responsible for 14.16 tons of CO_2e per person, putting it well under the 2010 national average which was 19 tons per person. Notably, Burlington, VT, as represented in Chart 8 below, has significantly lower emissions levels (7.76 CO_2e) than the other communities compared, which may be explained by that city's use of hydropower, an emissions-free source of electricity generation.

Chart 8. Community GHG Emissions Compared to Peer Cities.



Government analysis

The City of Lawrence's government greenhouse gas emissions were calculated for the same ten year period from 2002 to 2012. City greenhouse gas emissions are also relatively flat, with highest emissions reached in 2004 (65,236 MT CO_2e). Since 2008, City greenhouse gas emissions have been on a steady decline. The largest contributors of GHG emissions in the government inventory are GHG emissions from energy use in government buildings and facilities, and GHG emissions from the treatment of wastewater.

There has been a steady decrease in GHG emissions from energy use in government buildings and facilities from 2007 to present (declining from a peak of 34,005 MT CO_2e in 2006). This decrease may be attributable to recent efforts towards energy conservation and energy efficiency in maintenance departments throughout City facilities. Decreases in GHG emissions were also noted in the streetlights and traffic signals category, likely due to conversions of City traffic signals to more energy efficient LED technologies over this same time period.

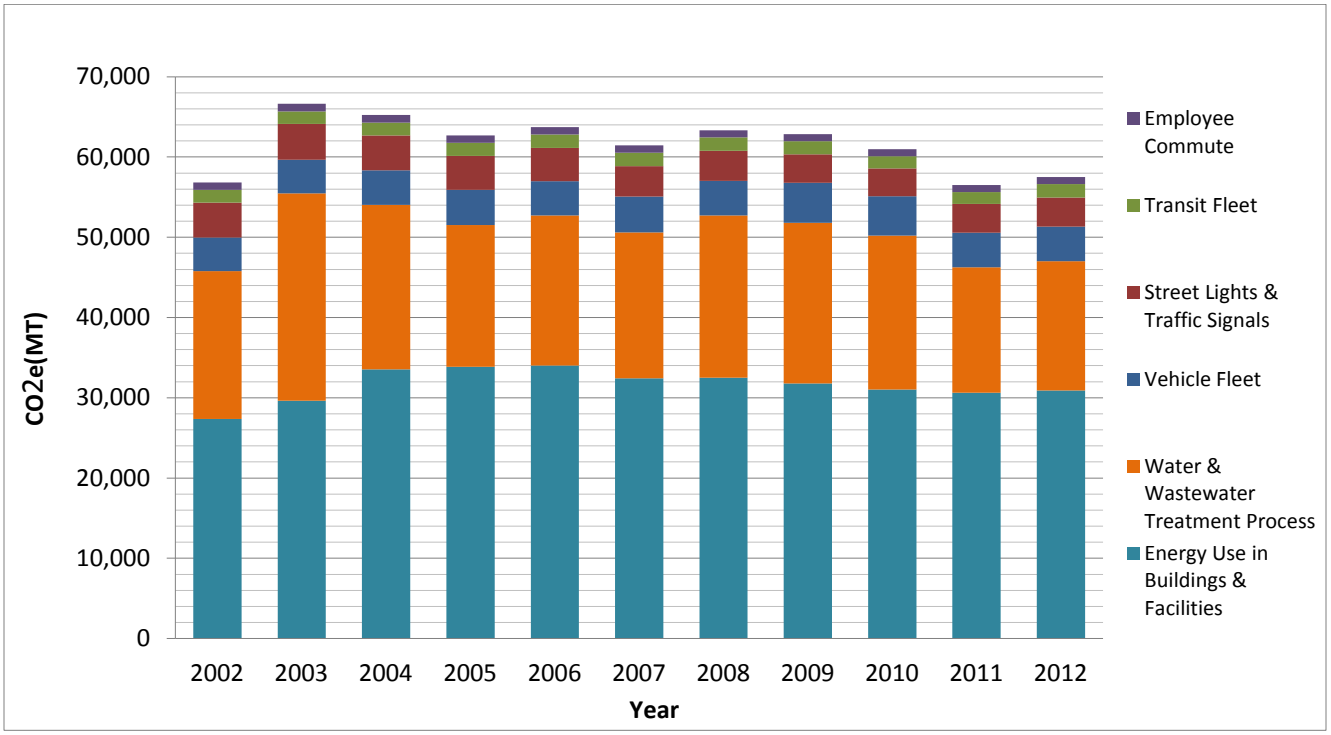
GHG emissions from the treatment of wastewater have fluctuated over the ten year period, primarily influenced by system demand and changes to the treatment process. The GHG emissions at our wastewater plant are driven by biological processes that break down waste in the wastewater plant treatment basins. The actual energy used in our water and wastewater treatment plants is captured in the "Energy Use in Buildings & Facilities" category.

Vehicle fleet emissions have increased slightly over time, while transit fleet emissions have remained relatively constant. Employee commutes also impact GHG emissions, and have decreased over the ten year period.

Table 3. Government GHG Emissions by Sector (2002-2012) in tons of CO_2e.

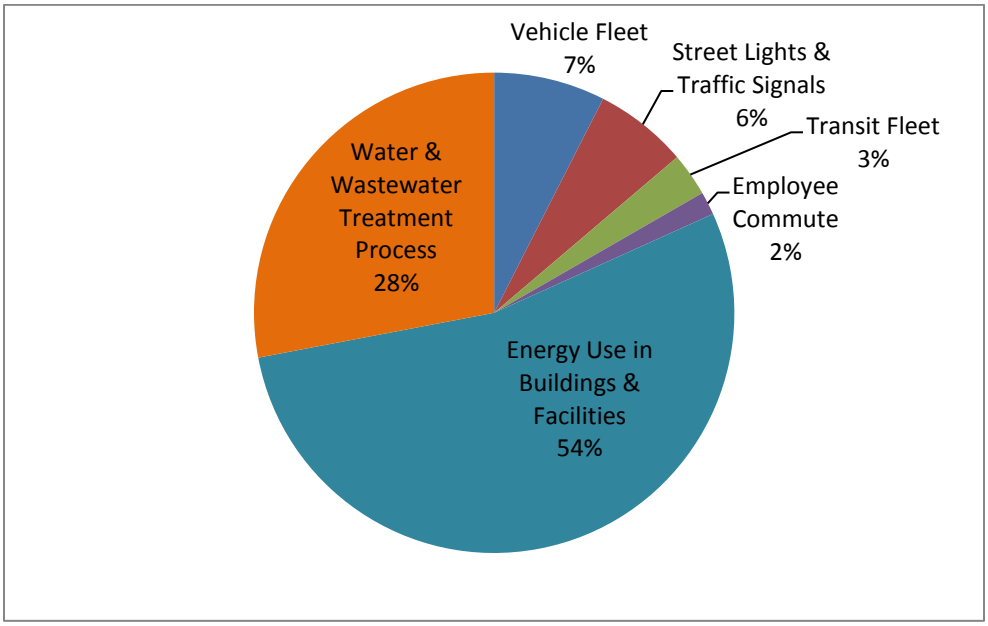
Year	Vehicle Fleet	Street Lights & Traffic Signals	Transit Fleet	Employee Commute	Energy Use in Buildings & Facilities	Water & Wastewater Treatment Process	Total:
2002	4,187	4,353	1,558	948	27,376	18,418	56,840
2003	4,192	4,455	1,553	955	29,619	25,860	66,634
2004	4,329	4,324	1,617	944	33,559	20,463	65,236
2005	4,380	4,203	1,633	933	33,860	17,681	62,690
2006	4,267	4,174	1,662	917	34,005	18,705	63,730
2007	4,462	3,787	1,690	911	32,428	18,169	61,447
2008	4,308	3,735	1,660	883	32,485	20,248	63,319
2009	4,980	3,584	1,604	885	31,779	20,012	62,844
2010	4,892	3,460	1,515	886	31,034	19,185	60,972
2011	4,301	3,616	1,462	892	30,617	15,637	56,525
2012	4,311	3,616	1,671	895	30,916	16,097	57,506

Chart 9. Government GHG Emissions by Sector (2002-2012) in tons of CO_2e.



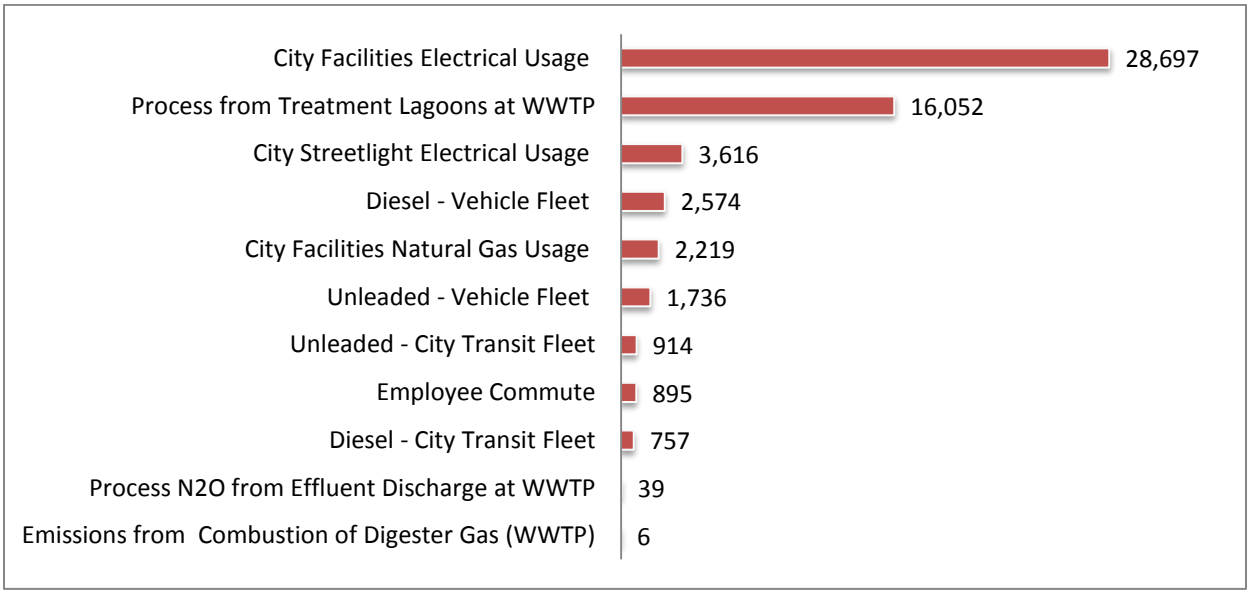
The 2012 government GHG emissions by sector shows that buildings and facilities contribute to 54% of the CO_2e emissions for the City of Lawrence operations in 2012. The City operates approximately 45 major buildings and facilities – ranging from water treatment plants to City Hall to recreation centers. Water and wastewater treament processes account for the second highest emissions at 28%.

Chart 10. Contributions to Government GHG Emissions by Sector (2012).



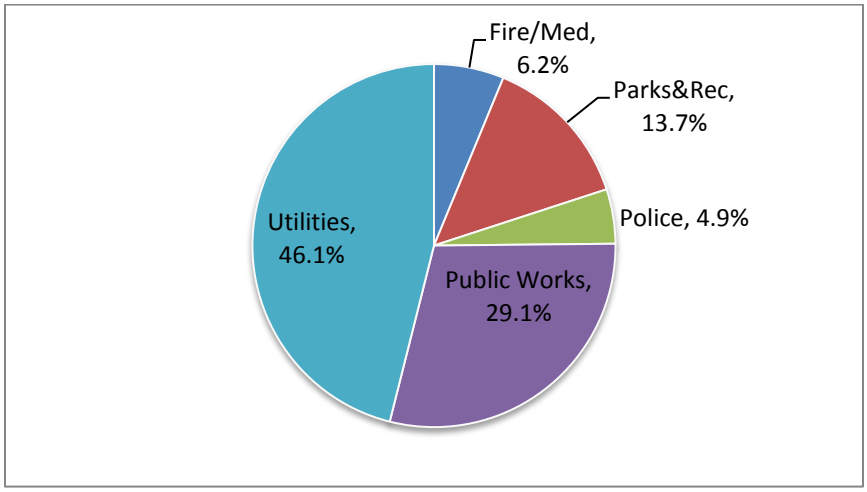
A breakdown of government emissions by source shows that the largest contributor to government greenhouse gas emissions in 2012 was electrical usage in city facilities at 28,697 CO_2e(MT). In 2012, 16,052 MT of CO2e were emitted at the wastewater treatment plant through the biological process of wastewater treatment.

Chart 11. 2012 Government GHG Emissions by Source in tons of CO_2e.



An analysis of government GHG emissions by department highlights City departments' contributions to overall city GHG emissions. The City's Utilities Department, which is responsible for treatment of all city water and wastewater, is the largest contributing department, driven primarily by high electricity demands at their plants. Public Works and Parks and Recreation also contribute significant emissions to the overall City total, as both departments manage fleets and several City buildings. A detailed department-by-department breakdown of GHG emissions is provided in Appendix B.

Chart 11. Government GHG Emissions by Department (2012) in tons of CO_2e.



CONCLUSION

Following the tide of overwhelming international consensus that human-induced climate change has negative effects on our natural resources and citizens, the City of Lawrence recognizes the impacts that climate change has on the broader Lawrence community and our City's own operations and services. The signing of the Mayors Climate Protection Agreement in 2006 and the adoption of the Climate Protection Plan in 2009 were both critical leadership actions the City took to address our climate change risks. The City's first GHG emissions inventory conducted in 2008 set a baseline for our community and government emissions, and led the Climate Protection Task Force to establish a goal of 80% reduction of GHG emissions by 2050. This update is critical for assisting the City in measuring our progress on our GHG reduction initiatives.

The data shows that despite an increase in population of 10,000 people, community GHG emissions have remained relatively flat. Not only has this been good news from an environmental standpoint, it has also been good news for residents, businesses, and the City financially, as a kilowatt-hour of electricity cost 6.7 cents in 2002 and increased to 10.7 cents in 2012. At the same time a gallon of gas was $1.39 in 2002 and increased to $3.68 by 2012.

The stabilization of emissions could be due to multiple factors including; community education campaigns aimed at emissions reductions, policy changes to improve energy requirements in building codes, and internal efforts to improve the energy efficiency of city buildings and operations. In addition, there have been multiple factors outside of our community control including innovations in technology to improve efficiency (i.e. LED lighting) and the economic downturn which led to decreased energy use and decreased construction activity.

Per capita emissions are declining in the focus areas prioritized in recent years by the city and community – namely energy efficiency and solid waste. However, emissions levels are increasing in the transportation sector as more Lawrence residents equals more single occupant vehicles on the roads.

In order to reach the City's goal of 80% GHG emissions reduction by 2050, more aggressive measures are required. As the coal-dependent fuel mix at Westar Energy continues to drive Lawrence's emissions, energy conservation, efficiency, and renewable energy remain key elements in reducing overall emissions in our community and government buildings. This was a priority in the 2008 Climate Protection Plan, and remains a key focus still. More work remains to be done to reduce transportation-related emissions, both through land use planning and improvements to vehicle efficiency. Also of importance to reducing greenhouse gas emissions is water conservation and efficiency which, although not addressed in the original Climate Protection Plan report, have a significant potential to reduce water usage, which saves energy and protects City infrastructure.

Appendix A. Climate Protection Plan Priorities (revised 9.17.14)

In 2008, the Climate Protection Task Force utilized the 2005 GHG emissions inventory baseline to prioritize the actions that Lawrence should take to reduce our greenhouse gas emissions. At their September 2014 meeting, the City Sustainability Advisory Board discussed the results of the GHG emissions inventory update, and re-prioritized the recommended mitigation actions. The Sustainability Advisory Board re-prioritized the recommendations to reflect an increased focus on land use and transportation planning, to reduce vehicle miles traveled (VMT) within the city of Lawrence. Energy efficiency and conservation remains a high priority (#3) given that the majority of the city's GHG emissions are related to energy use in our residential, commercial, and industrial facilities.

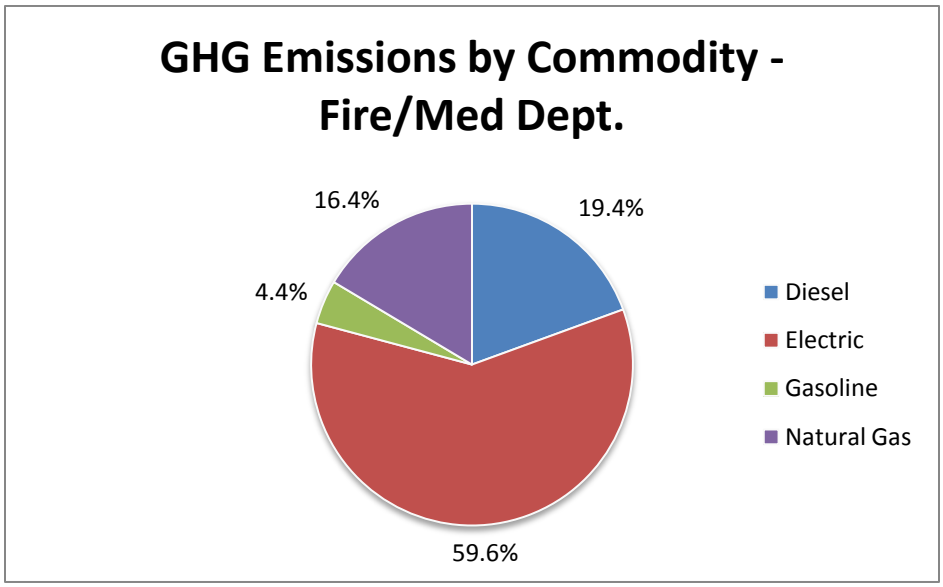
The Sustainability Advisory Board also added a new priority (#4) to emphasize the interconnectedness of water, energy, and emissions. As the City of Lawrence is the water and wastewater utility for our citizens, we have an opportunity to encourage water conservation which reduces water use, saves energy, and protects our water system infrastructure.

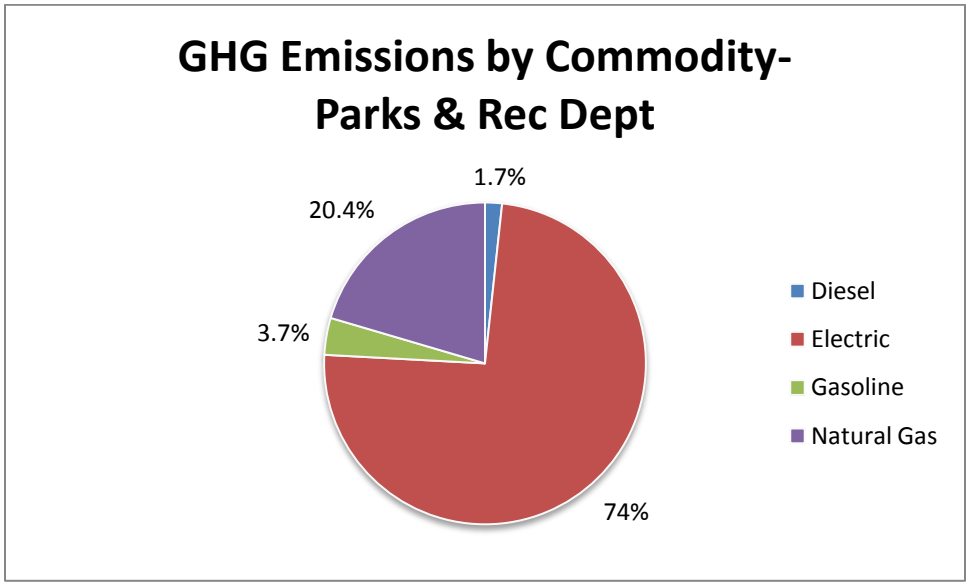
Although the Sustainability Advisory Board did prioritize the recommendations, they recognize that reducing our GHG emissions as a city will take efforts in all of the following areas:

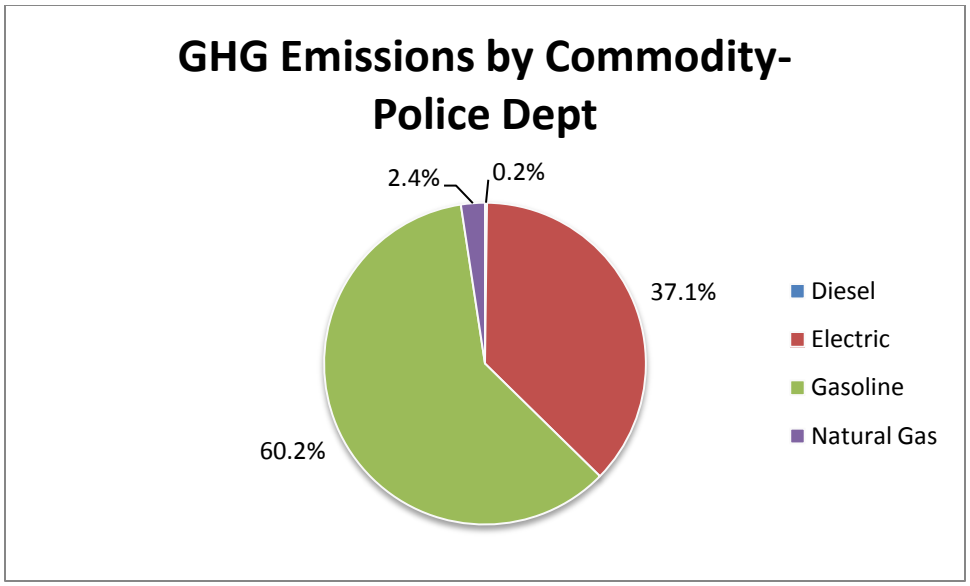
1. Incorporate the goal of reducing greenhouse gas emissions into land use planning.
2. Develop transportation policies and programs to consume less energy and reduce emissions.
3. Strengthen energy conservation policies and building standards.
4. Develop water conservation policies and programs to consume less water, reducing energy usage and infrastructure costs.
5. Expand source reduction and waste reduction programs and initiatives.
6. Exercise leadership by prioritizing efforts to reduce greenhouse gas emissions in municipal operations.
7. Provide dedicated staffing and adequate funding to support climate protection and sustainability initiatives.
8. Establish outreach and education programs on emission reduction issues.

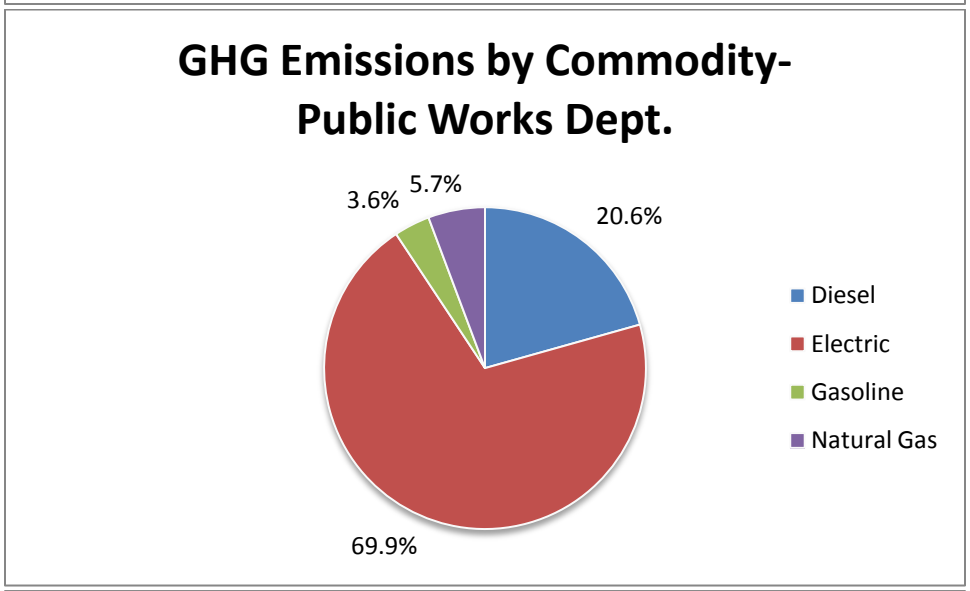
Appendix B. Department-by-Department Report of GHG Emissions Sources

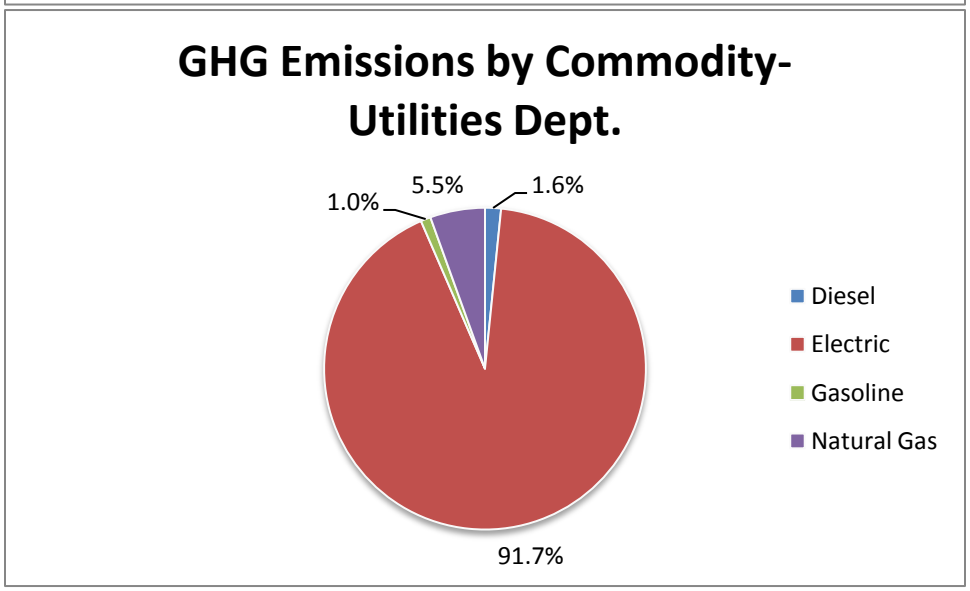
Each City department varies widely in the services and operations they provide. City department GHG emissions contributions depend upon their particular mix of buildings and facilities (electricity and natural gas), and fleet vehicles (diesel and unleaded). This data was collected utilizing the City's EnergyCAP energy usage tracking software, therefore, the categories differ slightly from the ClearPath tracking tool. EnergyCAP tracks City usage of four fuel commodities – electricity, natural gas, unleaded gasoline, and diesel fuel. Data is shown for the five departments with the largest impact on citywide GHG emissions.






GHG Emissions by Commodity- Police Dept
2.4%
0.2%
37.1%
60.2%
Diesel
Electric
Gasoline
Natural Gas


GHG Emissions by Commodity- Public Works Dept.
3.6%
5.7%
20.6%
69.9%
Diesel
Electric
Gasoline
Natural Gas


GHG Emissions by Commodity- Utilities Dept.
1.0%
5.5%
1.6%
91.7%
Diesel
Electric
Gasoline
Natural Gas

Appendix C. Douglas County Greenhouse Gas Emissions from Key Facilities

Douglas County tracks energy use of seven major facilities using EnergySTAR Portfolio Manager software. This software tracks electricity and natural gas used to fuel County-owned buildings. The County has not yet incorporated tracking of GHG emissions from gasoline or diesel fuel usage.