City of Creve Coeur, Missouri

Updated Greenhouse Gas Emissions Inventory for 2014

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Credits and Acknowledgements

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Lastly, I would like to personally thank Emily Andrews and John May for their continued guidance and support in this process.

Sincerely,

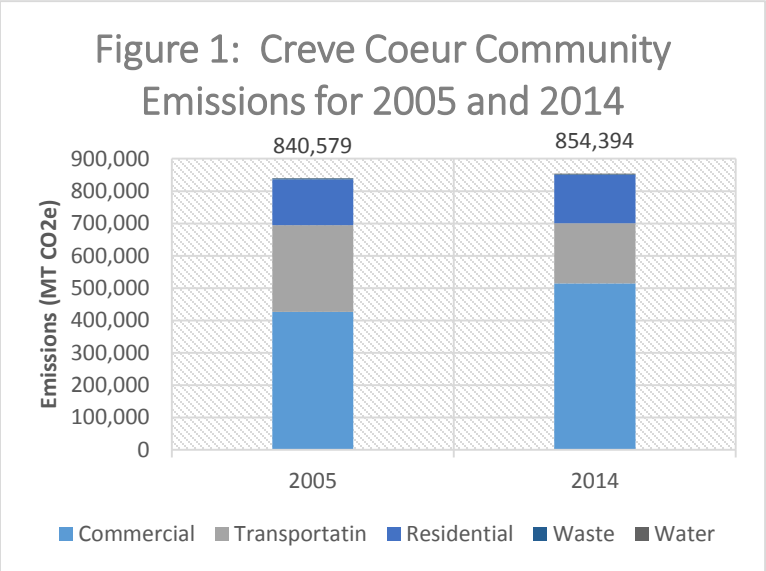
Luis Garcia
Regional Environmental Intern

EXECUTIVE SUMMARY:

On August 15, 2008 an initial greenhouse gas (GHG) inventory was completed for the City of Creve Coeur detailing GHG emissions by source and sector for the community and government operations. This GHG inventory established 2005 as the baseline year on which all other GHG emissions for Creve Coeur will be compared. The 2008 inventory, using emission data from 2005, was a first step in Creve Coeur's attempt to address climate change in its community. The City of Creve Coeur has since continued its commitment to limit wasteful and costly greenhouse gas emissions, implement energy conservation strategies and safeguard the environment for present and future citizens. This report is a small component of this commitment. In addition to the monitoring of current GHG emissions for the community and local government, this report will help assess the efficacy of reduction strategies that have been implemented since the original 2008 inventory. Similar to the 2008 inventory this report will tally emissions for the community as a whole as well as report emissions that are a result of government operations. The methods used in 2015 were similar to 2008 and permit direct comparison.

COMMUNITY EMISSIONS:

In 2014, Creve Coeur's total Community emissions were 854,394 metric tons (MT) carbon dioxide equivalent (CO_2e). Emissions from the Commercial energy consumption accounted for over half (60.2%) of the GHG emissions for the community. Transportation was the cause for the second highest emissions (21.8%). The Residential energy consumption was responsible for 17.5% of GHG emissions. Water and Wastewater (0.3%), and Solid Waste (0.2%) contributed a small percentage of overall emissions. Greenhouse gas emissions were 1.6% greater in 2014 compared to those in 2005. Though total emissions saw an increase, the Transportation and Waste sectors saw decreases in their emissions.



The majority of Community emissions, which is the combination of government operations, residential and commercial emissions, come from electricity (Table 1). The Commercial sector was the greatest consumer of electrical energy with 541,233,399 kWh emitting 446,914 metric ton of CO_2e. This amounts to 52.3% of all emissions.

Community Emissions		
Source	**2014 GHG emissions (Percentage of CO_2e)**	**2014 GHG emissions (MT CO_2e)**
Electricity	66%	565,220
Gasoline	19%	165,941
Natural Gas	12%	100,784
Diesel	3%	21,409

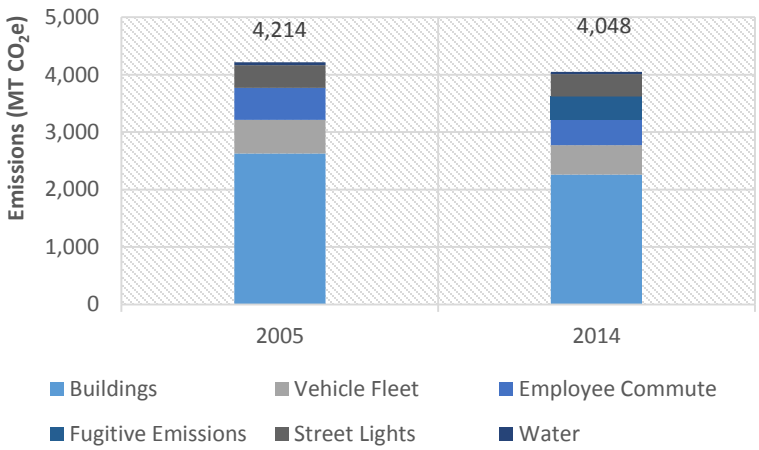
Table 1: 2014 GHG Emissions by Source

Compared to 2005, Commercial consumption of electricity and natural gas has increased 20% and 34%, respectively. Since 2005, Creve Coeur has seen an addition of approximately 2 million square feet of commercial floor space. This 16% increase in floor space can help account for part, but not all, of the 20% and 34% increase in electricity and natural gas use respectively, for the Commercial sector.

GOVERNMENT EMISSIONS:

In 2014, emission from the City of Creve Coeur's government operations were 4,048 metric tons of CO_2e. This represents a 4% decrease from 2005. Purchased energy (electricity and natural gas) for government buildings and facilities was responsible for the largest percentage of emissions with 55.9%. Next, with 12.6%, were emissions that were the result of burning gasoline and diesel by the city's vehicle fleet. Emissions from full-time government employees commuting to work accounted for 10.8% of government emissions. Fugitive emissions from leaked coolant used at the Dielmann Recreation Complex's Ice Arena accounted for 10%. Electricity used to power the city's streetlights and traffic signals was responsible for 9.7% of emissions. Lastly, electricity used to power the city's fountains and irrigation was responsible for 1% of emissions.

Figure 2: Government Operations' Emissions 2005 and 2014



While emissions from government operations in total were down 4% from 2005, this comparison is skewed because refrigerant was purchased for the ice arena in 2014, but not in 2005. Refrigerant is an extremely powerful greenhouse gas. Comparing only emission sources that were included in the 2005 inventory, the government operations have actually seen a 20% decrease in emissions.

Though government operations make up only 0.5% of Creve Coeur's total GHG emissions, many lessons can be learned from the government's dedication to energy efficiency. With the cost of local utilities projected to increase in the coming years, energy efficiency is becoming increasingly important. Local government operations saw a decrease in emissions in most sectors, excluding electricity for streetlights and traffic signals. Even though the government saw an increase in their utilities bills compared to 2005, these increases would have been more significant without some of the energy efficiency practices that the government has implemented. Creve Coeur's government avoided a total of $53,125 in utility charges in 2014 due to these efficiency practices.

CONCLUSION:

The 2005 greenhouse gas inventory forecast that, without making efforts to reduce greenhouse gas emissions, they would increase 9% by 2015. Adding the increase in commercial space that occurred, a 9% increase would have resulted in community emissions of 928,925 MT CO_2e. While Creve Coeur did not meet its target of reducing community GHG emissions by 20%, it did avoid 75,531 MT CO_2e of forecast emissions in 2014. By avoiding these emissions, Creve Coeur prevented $2,794,647 worth of damage that would have been caused by the carbon emissions[1]. Likewise, the energy efficiency actions implemented by the city government avoids $40,131 in annual utility costs at 2014 utility rates. This updated inventory allows the community to the re-evaluate its reduction strategies. Future reduction strategies for GHG emissions should be targeted to sectors that produce the largest emissions. There are many strategies still available to the community. Now is the time to celebrate successes and re-energize the community's investment in future energy conservation.

[1] Based on the per ton social cost of carbon as determined by the U.S. Government, Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (May 2013)

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INTRODUCTION:

BACKGROUND:

On April 14th, 2008, at the request of the Recycling, Environment and Beautification Committee, the City Council of the City of Creve Coeur unanimously passed a resolution requesting Mayor Harold Dielmann to sign the U.S. Mayors' Climate Protection Agreement, authorizing the City to conduct an inventory of greenhouse gases (GHG). Mayor Dielmann publicly signed the U.S. Mayors' Climate Protection Agreement on April 28, 2008. On August 15, 2008 an initial Greenhouse Gas Emissions Inventory for Creve Coeur was completed using 2005 as the baseline year. This inventory was performed with the assistance and consultation of ICLEI-Local Governments for Sustainability, using the process developed for their Cities for Climate Protection Campaign. The inventory utilized computer software developed specifically for this purpose: the Clean Air and Climate Protection Software (CACP) and emissions data from 2005. That report represented the completion of the first step of five in a process intended to guide cities through the creation and execution of an action plan to reduce GHG emissions and energy use.

This report is a continuation of this process and Creve Coeur's commitment to energy efficiency and conservation. Its purpose is twofold: It is an updated inventory of GHG emissions for the city government and community, and to monitor and assess the efficacy of reductions strategies that Creve Coeur's city government and community have implemented since the original inventory. The 2005 inventory used 2015 as the "forecast" year and emissions were forecasted under a "business as usual" scenario. GHG emissions were forecasted to rise 9% by 2015. It is logical then to re-evaluate GHG emissions at this time to compare projected emissions to actual emissions. Data used is from calendar year 2014 and not 2015 for various reasons. The city of Creve Coeur is currently in the process of updating its comprehensive plan and the results of this report will help to inform that process. Additionally, Creve Coeur participated in the Environment Protection Agency's (EPA) Pure Power Challenge in 2013, and this report will help to assess the results of participating in this challenge.

Since the initial inventory, Creve Coeur has continued its commitment to environmental stewardship. For example, in 2011 Creve Coeur became the second Green Power Community in Missouri and the fifth in the Midwest. As an EPA Green Power Community, Creve Coeur committed to acquire 3% of its electrical energy from renewable sources. The city government completed a Comprehensive Energy Audit for its government operations in 2013, and Creve Coeur won the Community Renewable Energy Project of the Year from Ameren Missouri's Pure Power Program in 2014. Also, in 2014 the city began its participation in the 25x20 Energy Benchmarking Campaign.

The city government has been participating in the previously mentioned programs and has seen some major projects aimed at reducing its GHG emissions. These include a lighting retrofit at all government buildings, more efficient heating systems at the Government Center and Public Works garage, white paint coating on the Government Center roof, LED lighting along part of Olive Boulevard, and the installation of a solar photovoltaic system at the Dielmann Recreational Complex. During the writing of

this report, the city also implemented a new trash service contract aimed increasing the amount of recycling in the community.

THE IMPORTANCE OF QUANTIFYING GHG EMISSIONS:

On August 3, 2015, the President of the United States unveiled the Clean Power Plan. This plan is aimed at reducing the carbon emissions from the power sector, nationwide. This will be accomplished by investing in renewable energy and cutting cost to homes and businesses by improving energy efficiency[2].

The evidence that humans are influencing the climate system is overwhelming. Findings conclude that more than half of the observed global temperature change from 1951 to 2010 was a result of human activities increasing GHG concentrations. The amount of GHG emission due to anthropogenic activities has continued to increase since 1970 with a larger increase seen between 2000 and 2010, despite more emission mitigation policies. Current science links an almost linear relationship between CO_2e emissions and projected global temperature change to the end of the century. To avoid the worst effects of climate change, emissions need to be reduced 40-75% by 2050, and to near zero by the year 2100[3].

This increased warming could have many adverse effects in our region. The number of heat waves and days with a temperature greater than 100 degrees Fahrenheit are expected to increase. Extreme hot weather is the leading cause of weather related deaths in the U.S., with the young and old being most at risk. A less extreme but operationally important aspect is that hotter temperatures also reduce worker productivity, especially for those working outside. Hotter summers may lead to poor air quality. Poor air quality is linked to many respiratory illnesses including asthma, bronchitis and emphysema, with children being the most susceptible. The Midwest is also forecast to see more intense rain fall with greater time intervals between rain falls. This could lead to increased flooding that could damage many residents. Warmer, wetter summers coupled with milder winters likely means an increased number of disease vectors mainly, ticks and mosquitos. These vectors carry diseases such as West Nile virus, St. Louis encephalitis virus and Lyme disease[4].

If the threats associated with global climate change are to be reduced or avoided, then a careful inventory of GHG emissions must be the first step in addressing this concern. Creve Coeur accomplished this step in 2008 with its baseline GHG inventory. This first step, however, should then be followed with periodic monitoring and evaluation of progress. This report is aimed toward assisting the Creve Coeur community evaluate its progress and decide which programs and activities would best reduce wasteful

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[2] http://www.epa.gov/airquality/cpp/cpp-key-topics.pdf

[3] Climate Change 2014 Synthesis Report Summary for Policymakers, IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

[4] http://nca2014.globalchange.gov/

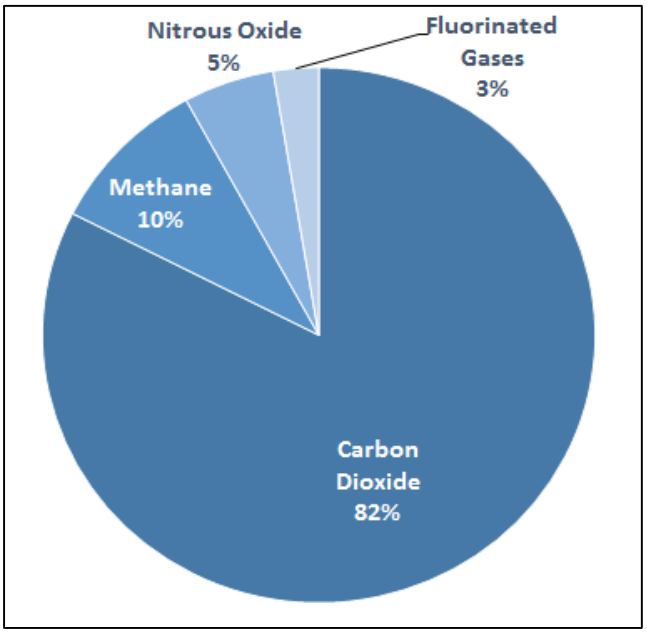
and unnecessary energy consumption and GHG emissions, thereby helping protect the economic longevity and personal health of its community.

METHODOLOGY:

MEASURING GREENHOUSE GASES

Emissions of greenhouse gases at community and government scale cannot be directly measured in a cost effective manner. For this reason GHG emissions are estimated using proxy data. Electricity and natural gas consumption are used to estimate emissions from commercial buildings, homes and industry. Vehicle miles travelled (VMT) are used to estimate emissions from motor vehicles. Emissions from burning coal for electrical generation and natural gas for heating were estimated from usage data provided from Ameren Missouri and Laclede Gas. Emissions from vehicle miles travelled within Creve Coeur include whether Creve Coeur was the origination or destination of the trip or simply passed through.

Figure 3: U.S. GHG Emissions in 2013



Greenhouse gasses are a diverse group of gasses that all share the trait of trapping radiant heat close to the surface of the Earth and are a major factor in global climate change. They include methane (CH_4), nitrous oxide (NO_x) and carbon dioxide (CO_2) among others. The capacity to which each gas can trap heat varies, and is referred to as its global warming potential (GWP). As CO_2 is the most prevalent GHG emitted (Figure 3), it is given a global warming potential of 1, and the global warming potential of all other gasses are compared to CO_2 (Table 2). In order to create a standard for comparison, the global warming effect of all gases are converted to the amount of CO_2 that would be required to have the equivalent effect, and the result is expressed in a single unit known as carbon dioxide equivalent (CO_2e). This procedure allows the effect of different gases to be directly compared, and it allows for the effects of all gases to be summed to a single comprehensive total.

Greenhouse Gas	Global Warming Potential (GWP)
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous Oxide (N_2O)	310
Hydrofluorocarbons (HFCs)	43-11,700

Table 2: Global Warming Potential for Four Common Greenhouse Gases

INVENTORY PROTOCOLS

This report uses the ICLEI ClearPath tool to inventory GHG emissions reported by their carbon dioxide equivalent (CO_2e). ICLEI-Local Governments for Sustainability is a membership organization that works to help local governments achieve reductions in greenhouse gas emissions and adapt to changes that may impact them due to climate change. The 2005 GHG inventory used the Clean Air and Climate Protection (CACP) software to calculate greenhouse gas emissions. ClearPath is an update of the CACP software, therefore results that were calculated from the CACP software for CO_2e emissions can be directly compared to emissions from the ClearPath software.

Similar to the baseline inventory, two separate inventories were compiled; one for government operations for the City of Creve Coeur and another for the community as a whole. All efforts were made to keep data sources and analysis constant from the initial inventory. There was some divergence from the baseline inventory data, specifically regarding Commercial and Industrial energy usage. In the 2008 inventory, reporting 2005 emission, there are separate Commercial and Industrial sectors. In this report, energy usage from these two sectors is combined in the Commercial sector. This was a result of Ameren Missouri no longer differentiating between the industrial and commercial rate classes. To reflect this change in this report, data from the Commercial and Industrial sectors have been combined into the Commercial sector for both inventories.

COMMUNITY AND GOVERNMENT SECTORS

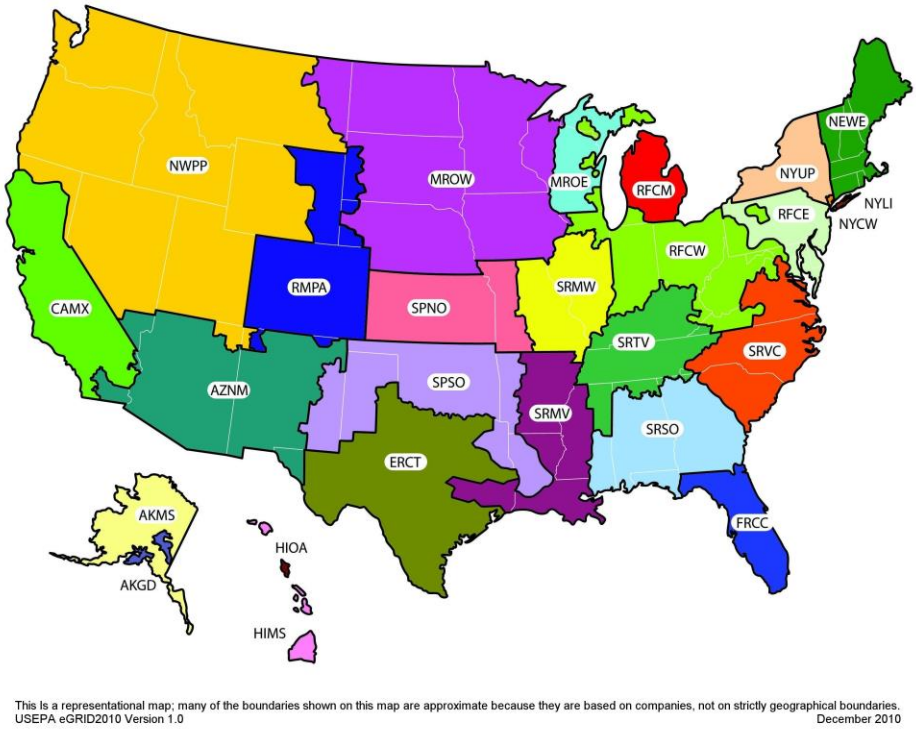
The community inventory involved compiling GHG emissions data from five major sectors. These were: Commercial, Residential, Transportation, Waste and Water. All data collected was for calendar year 2014. Commercial and Residential GHG emissions were estimated using electricity and natural gas usage, with data for each sector being provided by local utilities. Transportation emissions were calculated from vehicle miles travelled within Creve Coeur. This information was acquired from the East West Gateway Council of Governments (EWGCG). EWGCG tabulated vehicle miles travelled occurring within Creve Coeur city limits and supplied this total number to be used in this report. Solid waste creates GHG emissions in two ways. Greenhouse gasses are initially released from the vehicles used in collecting and transporting the waste. Secondly, greenhouse gasses are emitted from the decomposition or incineration of the solid waste. GHG emissions from both activities were accounted for in this report. GHG emission from the collection and transportation were estimated using miles traveled by the waste hauling trucks and fuel data supplied by the collection. Emissions from decomposition were projected from the amount of solid waste collected. Supplying water to the community results in the release of GHGs from the electricity required to deliver the water. The calculation of electricity required to deliver water total gallons consumed by the City of Creve Coeur was obtained in addition to total water consumption and associated electricity usage for the St. Louis region. The percentage of Creve Coeur water consumption was applied to total electricity usage to calculate electricity consumption for water delivery.

Local government emissions were calculated from data furnished by the City of Creve Coeur. These emissions were reported for five sectors: Buildings, Vehicle Fleet, Employee Commute, Streetlights and Water. All data was for calendar year 2014, except for vehicle fleet data, which was only available for the 2014 fiscal year (1/1/13-6/30/14), and employee commute, which was computed using current employee driving distances (July, 2015). Building emissions, similar to the community, were estimated using energy consumption, which was taken from utility bills. Vehicle fleet emissions were calculated using vehicle miles travelled and fuel use. GHG emissions that resulted from an employee commuting to work were determined by the distance the employee travels to work and average vehicle fuel efficiency. The distance was estimated using an employee survey. Streetlight emissions are a result of the electricity required to run the lights. This data came from the city government's utility bills. Similarly, water related emissions are a result of the electricity needed to pump and transport the water.

FACTOR SETS

Emissions are tabulated and accounted for in every major sector of the community and government operations. This includes primary emissions (emissions that occurred within the political boundaries of Creve Coeur) and secondary emissions (emissions occurring outside the political boundaries of Creve Coeur, but caused by activities within the political boundaries or Creve Coeur, e.g. electricity usage). Because greenhouse gases are estimated from proxy data (e.g. electricity consumption, natural gas consumption), greenhouse gas intensity factor sets must be used to equate the proxy data to a carbon dioxide equivalent. These emission factors can be universal, such as the case with burning of fuel oil and waste decomposition, or they can be varied as is the case with electricity generation.

Figure 4: NERC Regional Map



Electricity generation emissions vary by where the electricity is produced. Figure 4 illustrates different

electricity generation regions in the United States. Between these regions, different combinations of fuel sources are used to generate electricity, and therefore the amount of greenhouse gas emissions produced by production of a unit of electricity varies.

Between 2008 and 2014, Creve Coeur was transferred into the Southeast Electric Reliability Corporation (SERC) Midwest (SRMW) region. Thus, in this inventory, SRMW factor sets were used to report emissions from electricity consumption. The initial inventory used different factor sets. To permit direct comparison between the two inventories, wherever such comparisons are made, the 2008 electrical emissions have been adjusted using the SRMW factor sets.

2014 COMMUNITY GHG EMISSIONS:

COMMUNITY EMISSIONS:

Greenhouse Gas emissions are reported in units of carbon dioxide equivalent (CO_2e) for each sector of the community. These sectors include Residential, Commercial, Transportation, Water and Solid Waste. In 2014, the Creve Coeur community emitted 854,394 metric tons (MT) of CO_2e. The U.S. Census Bureau estimated Creve Coeur's population at 17,868 for 2014. This would amount to a per capita emission of 47.2 MT CO_2e.

Community GHG emissions are shown by sector and percentage of total in Table 3. Figure 5 illustrates the percentage of emissions by sector. As in 2005, Commercial, Residential and Transportation make up the majority of emissions, accounting for over 99% of emissions, leaving Water and Waste to account for less than 1% of GHG emissions for the community.

In 2014, the Commercial sector accounted for over half (60.2%) of all GHG emissions. As in 2005, the next largest emitter of GHG was the Transportation sector, which was responsible for 21.8% of the community's total emissions. Residential emissions (17.5%) were third. Water and Wastewater and Solid Waste sectors, with 0.3% and 0.2% respectively, were minor contributors to the communities overall GHG emissions.

In 2013, Creve Coeur participated in the Green Power Challenge, resulting in the purchase of renewable energy credits in 2014, which offset greenhouse gas emissions, but not energy consumption. This program will be discussed below.

Table 3: Total Community GHG Emissions by Sector (2014)

Sector	GHG Emissions (Percentage of CO_2e)	GHG Emissions (MT CO_2e)
Commercial Energy	60.2%	514,412
Transportation and Mobile Sources	21.8%	186,467
Residential Energy	17.5%	149,162
Water and Wastewater	0.3%	2,430
Solid Waste	0.2%	1,923
Total	**100.0%**	**854,394**
Pure Power RECs		-10,979
Total Net Emissions		**843,415**

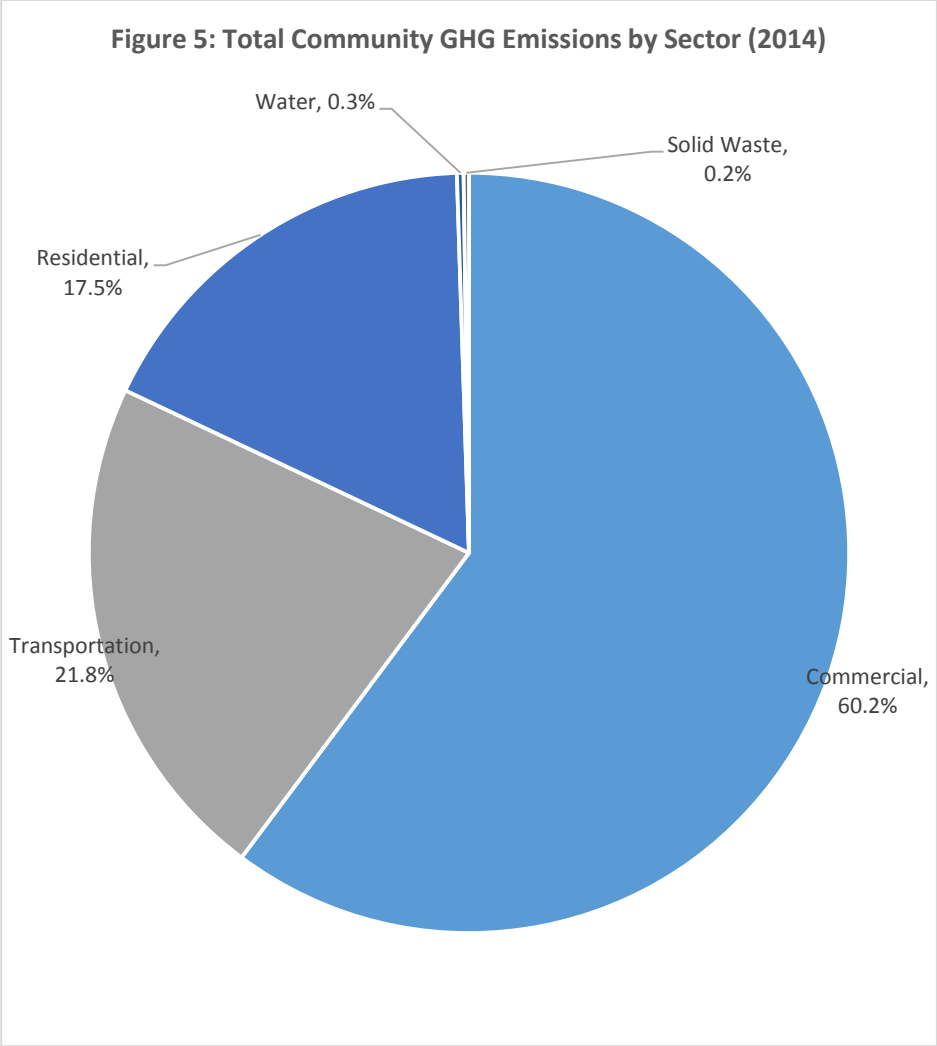


Figure 5: Total Community GHG Emissions by Sector (2014)
Water, 0.3%
Solid Waste, 0.2%
Residential, 17.5%
Transportation, 21.8%
Commercial, 60.2%

COMMERCIAL AND RESIDENTIAL BUILDINGS:

The Commercial and Residential sectors combined represent the built environment and account for 77.7% of all GHG emission for Creve Coeur (Table 3). These emissions are the result of providing energy to buildings in the form of electricity or natural gas. Table 5 shows the emissions from the Commercial and Residential sector broken down by energy source. The greatest emissions from providing energy to buildings are due to electricity usage. Close to 80% of both electricity usage and emissions that result from electricity comes from the Commercial sector. The Commercial sector used 400,925,413 more kilowatt-hours and emitted 331,038 metric tons of CO_2e more than the Residential sector. The Commercial sector is also responsible for 66% of natural gas usage and its associated emissions. This makes the Commercial sector a critical target for reducing GHG emissions within the community.

The Residential sector comprises the emissions generated to provide energy to Creve Coeur residents. As stated previously, the 2014 population was estimated to be 17,868 living in 7,550 households (2010 data for households). Using this figure the per capita emissions for residential energy (electricity and natural gas) were 8 metric tons of CO_2e, while the household emissions were 19 metric tons of CO_2e.

Table 4: 2014 Buildings Energy Usage and GHG Emissions by Source

Source and Sector	2014 Energy Usage	2014 Emissions (MT CO_2e)
Commercial		
Electricity (kWh)	541,233,399	446,914
Natural Gas (therms)	12,708,807	67,498
Residential		
Electricity (kWh)	140,307,986	115,876
Natural Gas (therms)	6,261,959	33,286
Subtotal electricity	**681,541,385**	**562,790**
Subtotal natural gas	**18,960,766**	**100,784**

TRANSPORTATION:

In recent years Creve Coeur has seen a decrease in vehicle traffic within its municipal boundary. However, while emissions from transportation are significantly smaller than those arising from the built environment, it is still the second largest source of emissions for the community. The Transportation sector was responsible for 20.8% or 186,467 metric tons of CO_2e emissions for Creve Coeur in 2014 (Table 3). This percentage is slightly smaller than the national trend where the Transportation sector accounts for 27% of GHG emissions. The majority of these emissions are the result of burning gasoline (Table 5). National fuel efficiency standards are reducing emissions from motor vehicles, but local policies encouraging the use of efficient vehicles could also encourage the use of fuel efficient vehicles.

SOLID WASTE AND WATER:

While many environmental benefits are to be realized by limiting solid waste and water use, these sectors represent a very small (less than 1%) portion of overall greenhouse gas emissions. Creve Coeur may wish to reduce its generation of solid waste and its water consumption for other reasons, but the City is unlikely to realize substantial reductions in energy consumption or GHG emissions by focusing on these sectors.

COMPARISON 2005 AND 2014:

Overall GHG emissions for the Creve Coeur community have increased by less than 1% from 2005. Table 5 offers a comparison of 2005 emissions of CO_2e with those of 2014. In contrast, on a per capita measure, emissions have decreased from 49.7 MT of CO_2e in 2005 to 47.2 MT of CO_2e in 2014. In 2005, the Commercial sector was responsible for 426,256 metric tons of CO_2e or 50.7% of all community emissions; in 2014, the Commercial sector was responsible for 514,412 metric tons of CO_2e or 60.2% of emissions. This represented a greater than 20% increase in emissions for this sector. While the 2005 inventory included Industrial emissions, these were down more than 95% compared to 2014. In 2005 industrial energy accounted for 6% of emission it now accounts for less than 1% of emissions. This was the result of the electrical utility no longer separating Industrial and Commercial electricity usage. This results in the Commercial sector having an inflated value and the Industrial sector has a deflated value compared to 2005. In 2013, Creve Coeur participated in the Green Power Challenge, resulting in the purchase of renewable energy credits in 2014, which offset greenhouse gas emissions, but not energy consumption. This program will be discussed below.

Table 5: Emissions by Sector for 2005 and 2014

Sector	2005 Emissions (MT CO_2e)	2014 Emissions (MT CO_2e)	% Difference
Commercial	426,256	514,412	+21%
Transportation	268,089	186,467	-30%
Residential	141,815	149,162	+5%
Waste	2,686	1,923	-28%
Water	1,733	2,430	+40%
Total	**840,579**	**854,394**	**1.6%**
Pure Power RECs	--	-10,979	
Total Net Emissions	**840,579**	**843,415**	**+0.3%**

COMMERCIAL AND RESIDENTIAL BUILDINGS:

Table 6 shows a more complete picture of building emissions by source and a comparison of Commercial and Residential energy use for 2005 and 2014. For 2014, commercial buildings used 91,035,622 kWh of electricity more than in 2005, an increase of more than 20%. Natural gas use also saw a total increase of more than 3 million therms, approximately a 20% increase. The Residential sector also saw moderate increases in energy use. Residential electricity use rose 7% and natural gas use rose 3% from 2005. In total, Residential energy accounted only 9% of the total energy use increase from 2005. This leaves the Commercial sector attributing to the other 91% of the increase. A major factor contributing to this energy use increase in the Commercial sector was the addition of 2 million ft^2 of commercial floor space since 2005, a 16% increase of commercial floor space from 2005.

Table 6: Utility energy use for 2005 and 2014 by source and sector

Source and Sector	2005	2014
Commercial		
Electricity (kWh)	450,197,777	541,233,399
Natural Gas (therms)	9,458,253	12,708,807
Residential		
Electricity (kWh)	131,080,309	140,307,986
Natural Gas (therms)	6,093,453	6,261,959
Subtotal electricity usage	**581,278,086**	**681,541,385**
Subtotal natural gas usage	**15,551,706**	**18,960,766**

TRANSPORTATION:

The Transportation sector has seen a decrease in emissions of 30% or 81,622 MT of CO_2e from 2005. Both emissions from gasoline and diesel fuel have seen a decrease from 2005 levels (Table 7). The emissions shown in Table 7 are different than the emissions from the Transportation sector in Table 6 because Table 7 includes emissions from all fuel use for transportation including the transportation of waste. The decreases in gasoline and diesel emissions shown here can be attributed to two major factors. The amount of vehicle traffic through Creve Coeur has decreased since 2005. Some of the roads have seen a decrease of 15% from 2005. In addition, national fuel efficiency standards have become stricter since 2005 which has resulted in less fuel burned per mile and lower emissions.

Table 7: GHG emissions by source for 2005 and 2014

Source	2005 GHG emissions (MT CO_2e)	2014 GHG emissions (MT CO_2e)	Percentage Difference
Gasoline	221,713	165,941	-25%
Diesel	46,377	21,409	-54%
Total	268,090	187,350	-30%

GREEN POWER COMMUNITY:

Electricity usage was responsible for 565,220 metric tons of CO_2e emissions. This corresponds to 66% of all community emissions by source (Table 8) and is by far the largest single contributor to community GHG emissions. Eighty percent of the electricity in Missouri comes from coal-burning power plants, 10% from nuclear power and 4% from power plants burning natural gas. In 2014, only 1% of electricity produced in Missouri was from non-carbon emitting, renewable sources[5].

Table 8: Total Community GHG Emissions by Source (2014)

Source	2014 GHG emissions (%CO_2e)	2014 GHG emissions (MT CO_2e)
Gross Electricity		565,220
RECs†		*-10,979*
Net Electricity	66%	554,241
Gasoline	19%	165,941
Natural Gas	12%	100,784
Diesel	3%	21,409
Net Total		**843,415**

† CO_2e emissions from RECs was supplied by Ameren Pure Power

In December 2011, the Creve Coeur City Council approved Creve Coeur's participation in the Environmental Protection Agency's Green Power Community program. As part of this commitment a portion of the energy supplied to the Creve Coeur community must come from renewable resources. The supply of renewable energy is tracked through the purchase of renewable energy credits (RECs).

RECs are the only instrument available to track renewable energy use. This is because once it is fed into the grid, electricity produced from renewable sources (wind, solar, etc.) cannot be distinguished from that produced from conventional sources (coal, natural gas, etc.). Therefore, an organization wanting to use renewable energy must purchase RECs, in essence allowing the organization to "own" this renewable energy. Since the electrical energy produced by these renewable sources (wind, solar, etc.) does not produce any carbon or GHG emissions, the purchase of these RECs ultimately reduces the emissions that Creve Coeur is responsible for. In 2014, the Creve Coeur community purchased 15,922,570 kWh worth of renewable energy, equivalent to 10,979 metric tons of CO_2e. Table 9 shows net GHG emissions after the CO_2e offset by RECs has been deducted from overall community emissions.

[5] http://www.eia.gov/electricity/data/browser/

It is important to note that these RECs do not deduct from the amount of energy used, as Creve Coeur is still using this electricity, it simply gets to offset the emissions from this electricity.

Table 9: GHG emissions with RECs included

	2005	2014	Percentage Increase from 2005
GHG Emissions (MT CO_2e)	840,579	854,394	1.6%
RECs		-10,979	
Net GHG emissions (MT CO_2e)	840,579	843,415	0.3%

CONCLUSION AND SUGGESTIONS:

While Creve Coeur has not met its goal of reducing community wide GHG emissions by 20% by 2015, this is not the only figure that is important to consider. The 2005 GHG inventory projected an increase in community wide GHG emissions of 9% by 2015, and this has not been the case (Table 9). This 9% increase was projected using a "business-as-usual" scenario. Under this "business-as-usual" stipulation, there would be no change in energy use trends. In reality, Creve Coeur has seen many changes to its community and has taken many steps to reduce its energy consumption and subsequent GHG emissions. The Commercial sector alone has seen a 2 million ft^2. increase from 2005. Table 10 calculates the emissions that would have occurred under the "business as usual" scenario, including the additional commercial floor space, and calculates the emissions avoided. Under a "business-as-usual" projections Creve Coeur had the potential emissions increase of 10.5% from 2005, this represents 88,346 metric tons of CO_2e. This works to further illustrate the effect of the energy conservation practices that the community has adopted.

Table 10: Potential GHG emissions as a result of new commercial floor space

	Emissions (MT CO_2e)	Percentage increase from 2005
2005 Emission	840,579	
Effect of adding 2 million sq. ft.	141,042	17%
Projected 9% increase *(including effect of 2 million sq. ft.)*	88,346	10.5%
Updated projected 2014 emissions	928,925	
Measured 2014 emissions	854,394	
Emissions avoided	75,531	

A 2013 interagency report by the US Government estimated that each metric ton of CO_2 emitted in 2013 would cause $37 of damage, including effects on human health, property damage from flooding and loss of ecosystem services, among others. With Creve Coeur avoiding 75,531 metric tons of CO_2e in 2014, this equates to globally avoided damages of $2,794,647[6].

An in-depth discussion of how Creve Coeur might continue its efforts to reduce energy consumption is beyond the scope of this report. Thus, this report's first recommendation is that Creve Coeur update and

[6] Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 (May 2013)

revise its energy conservation and climate action plan, and consolidate it into its new comprehensive plan update.

Beyond that, Creve Coeur has seen how the effects of its conservation efforts can be reversed by other community events, such as new development. As noted above, the best scientific opinion estimates that, to prevent the worst effects of climate change, greenhouse gas emissions must be reduced by 40-75% by 2050, and to near zero by 2100. It is difficult to imagine how Creve Coeur might achieve such very large reductions without access to clean energy. The City might wish to consider how to best encourage and facilitate the transition of its energy mix to clean energy.

The Commercial sector is the single largest emitter of GHGs and could potentially show the greatest decease in emissions. As the old adage goes: you can't manage what you don't measure. A pivotal first step to curbing GHG emissions in this sector could be to increase energy use awareness. The City of Creve Coeur already participates in the 25x20 Voluntary Energy Benchmarking Campaign. A potential strategy would be to encourage commercial property owners and managers to participate in the 25x20 Energy Benchmarking campaign as well[7]. The EPA estimates that buildings that consistently monitor their energy usage can achieve 2-10% in energy savings through better energy management[8].

A more intensive step would be to encourage businesses to participate in the Green Business Challenge, a collaborative program by the St. Louis Regional Chamber and Missouri Botanical Garden. This program is designed for businesses of all types to improve their sustainable practices using the Challenge Scorecard. The challenge allows businesses to explore what other companies are doing in the region and also includes an Apprentice Track to help new members.

Residential GHG emissions are primarily the result of electrical energy use. Strategies could focus on reducing electricity use in and around the home. The first step, similar to the commercial sector, might be to increase energy use awareness for homeowners.

[7] St. Louis High Performance Building Initiative, http://stlhighperformbldg.org; www.25x20.org

[8] EPA Energy Star Portfolio, http://www.energystar.gov

2014 GOVERNMENT OPERATION GHG EMISSIONS:

LOCAL GOVERNMENT EMISSIONS:

This inventory assessed emissions in six sectors of local government operations, the same ones included in the 2005 inventory:

1. Buildings
2. Vehicle Fleet
3. Employee commute
4. Fugitive emissions
5. Streetlights and Traffic Signals
6. Water

The Buildings sector includes emissions from all facilities and buildings the city operates. Vehicle Fleet refers to emissions from the city's various cars, trucks and equipment, which are operated by several departments such as Police and Public Works. The Employee Commute sector accounts for the GHG emissions produced by motor vehicles used by full-time employees in their daily commute. Fugitive emissions are a result of coolant leaking from chillers used in government operations. Streetlights and Traffic Signals refers to emissions from the electricity supplied to these lights and includes only the streetlights and traffic signals for which the City pays. For instance, streetlights paid for by subdivisions or by Missouri Department of Transportation (I-270) are not included. Water refers to GHG emissions from the energy used to power the City's various fountains, irrigation systems, and pumps.

In 2014, the City of Creve Coeur's government operations emitted an estimated 4,048 metric tons of CO_2e (Table 11). The total cost of energy consumed (electricity, natural gas, gasoline and diesel) for 2014 was approximately $510,072. This is greater than 15% of government operation expenditures[9]. This makes energy efficiency and conservation an integral part of reducing government operations expenses. Figure 6 illustrates the percentage of emissions by sector and associated cost. Emissions from buildings, streetlights and water account 66.6% from government operations, but the cost associated with these emissions is $374,262 or 73 % of total cost. The majority of this expense ($331,418) was the paid to cover electricity costs. Figure 6 further illustrates this trend showing emissions and cost by source. Electricity was responsible for the majority of costs and emissions associated with energy in 2014. The City purchased renewable energy credits as part of the Green Power Community Challenge in 2014, and these are shown as offsets to greenhouse gas emissions in Table 11. Lastly, Figure 7 (p. 22) shows that government operations emissions are relatively small compared to total community emissions.

[9] http://www.creve-coeur.org/documentcenter/view/4967

Table 11: Government Operations GHG emissions for 2014

Sector	%CO_2e	CO_2e (MT)	Cost ($)	Cost (%)
Buildings and Facilities	55.9%	2,262	$239,043	46.9%
Vehicle Fleet	12.6%	512	$138,366	27.1%
Employee Commute	10.8%	437	$0	0.0%
Fugitive Emissions	10.0%	407	$3,000	0.6%
Street Lights and Traffic Signals	9.7%	392	$124,107	24.3%
Water	1.0%	38	$5,556	1.1%
Total	**100.0%**	**4,048**	**$510,072**	**100.0%**
Renewable Energy Credits		-273		
Total Net Emissions		**3,775**		

Figure 6: Government Operations GHG emissions and cost by source, 2014

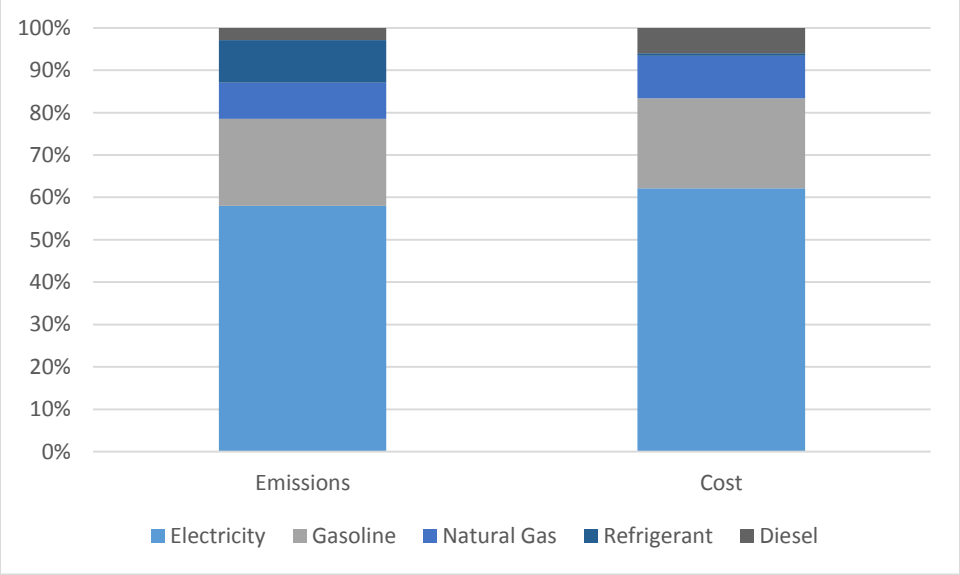
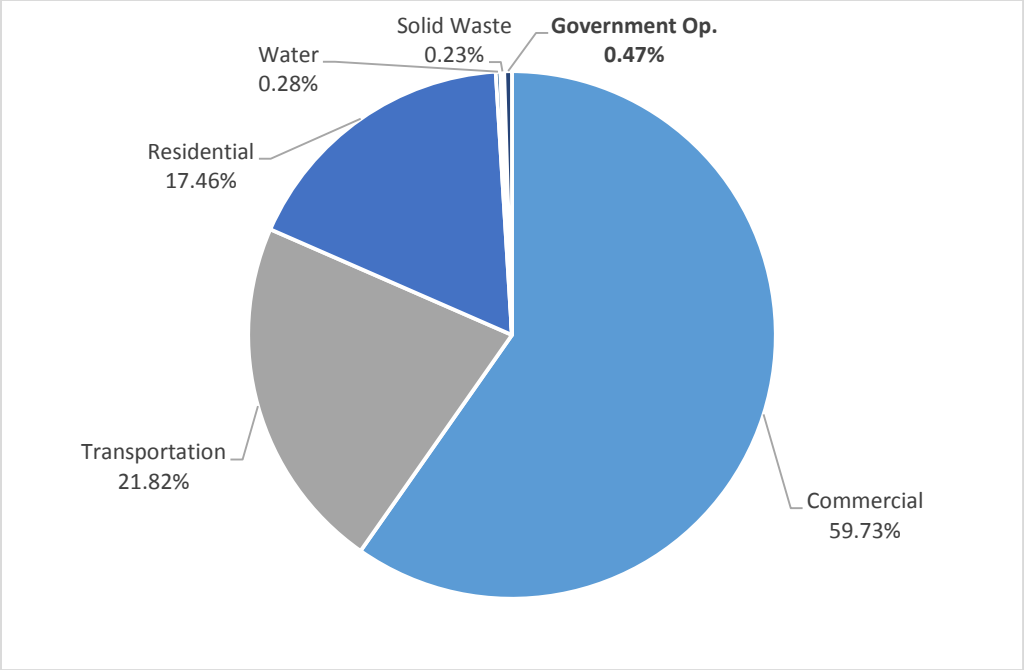


Figure 7: Government operations in relation to total community GHG emissions for 2014



BUILDINGS AND FACILITIES:

GHG emissions from buildings and facilities came primarily from energy use in 2014 and were 2,263 MT of CO_2e (Table 12). The Dielmann Recreation Complex, which houses an ice arena, golf shop and maintenance shop, is the largest user of electricity and natural gas. The Dielmann Recreation Complex has seen major renovations aimed at curbing energy use and the associated GHG emissions. The ice arena refrigeration system, used to keep the ice frozen, was found to be inefficient and was serviced in 2011. A photovoltaic (PV) solar system was installed on the roof and was tied to Golf Shop electrical system in the summer of 2014. In 2014, the PV system produced 9,223 kWh of electricity; this is equivalent to the offset of 6 MT of CO_2e[10] and a savings of $911.69[11]. The large use of natural gas is due to dehumidifiers used to keep fog off of the ice.

The Government Center is the second largest emitter of GHG by government owned buildings. Together with Dielmann Recreation Complex they are responsible for 85.9% of building energy use, 90.7% of building emissions and 88.4% of all building energy expenses (Tables 12 and 13). The Government Center also saw important renovations that helped reduce energy use since the 2005 GHG inventory. A lighting retrofit was conducted to convert lighting to more efficient compact fluorescent lamps and install motion sensors in some meeting rooms[12]. This was made possible by a grant through the American Reinvestment and Recovery Act and was completed in 2012. Two major renovations of the Government Center heating systems occurred in 2013. In addition, a heat-reflective white roof coating was installed on the Government Center in the summer of 2011.

[10] http://www.epa.gov/cleanenergy/energy-resources/refs.html

[11] Avg. cost of $0.09885 per kWh for 2014

[12] Kellum, Spencer. City of Creve Coeur Greenhouse Gas Inventory 2005. Regional Environmental Internship Program, 2008

Table 12: Government buildings and facilities energy use and emissions for 2014

Building	Electricity (kWh)	Percentage	Natural Gas (therms)	Percentage	2014 GHG Emissions (MT CO_2e)	Percentage
Dielmann Rec Complex	1,182,426*	50.9	42,063	65.0	1,201	53.1
Government Center	971,280	41.8	9,103	14.1	850	37.6
Public Works Garage	108,300	4.7	11,509	17.8	150	6.6
Leaf Site	2,689	1.0	1,994	3.1	13	0.6
Minor Facilities	59,355	2.6	0	0.0	49	2.2
Total	**2,324,050**		**64,669**		**2,263**	

* This kWh is omitting power produced from the PV system

Table 13: Utility costs per building for 2014

Building	Electricity Cost	Natural Gas Cost	Total
Dielmann Rec Complex	$98,325	$31,670	**$129,995**
Government Center	$73,358	$8,046	**$81,404**
Public Works Garage	$10,052	$9,779	**$19,831**
Leaf Site	$386	$2,053	**$2,453**
Minor Facilities	$5,375	$0	**$5,375**
Total	**$187,496**	**$51,548**	**$239,054**

The Public Works Garage, the third largest emitter of GHGs, also saw many changes starting in 2011. The roof and walls of the building were re-insulated in 2011. Also, the vents for the heating system were located next to exhaust vents, effectively ejecting the warm air as it was released. The heating vents were moved closer to the floor to help alleviate this problem. Two radiant heat lamps were also installed above the garage bay doors. These help to quickly heat the area that sees the greatest mixing of indoor and outdoor air.

The Leaf Site is, as the name implies, a dumping ground for leaves that are collected by the Public Works department from residents' homes. The leaf sites have seen marked expansion since 2005, with an additional building being acquired in 2012. Minor facilities refers to small buildings or structures

primarily located in parks, the most well-known being the Tappmeyer House in Millennium Park, and the main energy use associated with these facilities is electricity used for lighting.

VEHICLE FLEET:

Table 14: Fuel oil emissions for 2014

Department	Emissions (MT CO_2e)	Fuel use (Gallons)	Cost ($)
Public Works			
Gas	89	10,160	24,847
Diesel	117	11,500	30,480
Police			
Gas	306	33,992	80,039
Total	**512**	**55,652**	**135,366**

In 2014 the City of Creve Coeur's Vehicle Fleet emitted 512 MT of CO_2e. This accounted for 14% of total municipal emissions (Table 11). The Public Works Department has recently started converting its fleet to vehicles with diesel engines from vehicles with gasoline engines. Diesel comprised approximately 20% of fuel purchased and Vehicle Fleet emissions for 2014 (Table 14). The benefits offered by diesel are twofold; diesel engines offer better fuel economy compared to gasoline engines of comparable size. Plus, they maintain a greater torque at low rates per minutes (RPMs), allowing diesels to pull heavy machinery better.

Table 15: VMTs by department

Department	Vehicle Miles Travelled
Public Works	115,357
Police	389,072

The Police Department is responsible for 60% of the GHG emissions and the cost of the city's vehicle fleet. Police vehicles also travel over 3 times as far as do those of the Public Works department (Table 15). This equates to an average of 1,066 miles travelled daily. While, the Police Department has recently acquired newer vehicles, with over half the fleet vehicles being less 2 years old. The city could realize greater savings converting to more fuel efficient vehicles.

EMPLOYEE COMMUTE:

Employee commute was the third largest contributor to government GHG emissions with 437 metric tons of CO_2e. In 2014, the average City of Creve Coeur employee was travelling approximately 40 miles in daily work commute. This number assumes an average yearly work calendar of 230 days. The average gasoline price in the St. Louis region is $2.30 (July, 2015)[13]. Relatively far daily commutes in concert with low fuel prices and inadequate public transportation options ensures that the preferred commute option for employees will be single driver vehicle travel.

FUGITIVE EMISSIONS:

Fugitive emissions are emissions that result from coolants (ex. Hydrofluorocarbons (HFCs) and Hydrochlorofluorocarbons (HCFCs)) leaking from refrigeration units. These are an important group to consider as many of these chemicals have global warming potentials greater than 1,000 times that of

[13] http://fuelgaugereport.aaa.com/states/missouri/missouri-metro/

CO_2. For Creve Coeur, these emissions primarily represented refrigerant (R-22) loss from the icing system at the ice arena. Such loss can occur suddenly, as when a pipe breaks, or as a slow leak over time, which is characteristic of all such systems. It is not possible to directly measure Creve Coeur's fugitive emissions in 2014, so they were estimated using refrigerant purchases during the year. Fugitive emissions accounted for 407 metric tons of CO_2e emissions, the fourth largest source of emissions for government operations (Table 11).

STREETLIGHTS:

In 2014, Creve Coeur's Street and Stop Lights emitted 392 MT of CO_2e and cost $124,107. This is the fifth largest emitter of GHGs but the third largest energy expense for government operations. The reason for the large expense is that the city purchases what is sometimes referred to a 'turn-key' service from Ameren Missouri for the majority of these lights. This includes the Olive Boulevard service that is responsible for 62% of GHG emissions and 85% of the cost. A turn-key service indicates that Ameren Missouri owns, operates and maintains the lights, with Creve Coeur paying for the service. Some of the costs, therefore, represent rental and maintenance fees, not the cost of electricity. This arrangement limits the control that the city has on the type of lights that are installed where this service is used. It is worth noting that the city has installed light-emitting diode (LED) lights in many new subdivisions and along part of Olive Boulevard median, where the city has sole control over lighting. LED lighting is the most energy efficient type of lighting currently available, and they last longer, reducing maintenance costs.

WATER:

Water emissions are a result of the electricity consumed to pump the water to its end location. This sector, in the government operations side of the inventory, does not include water for residential use or water pumped into government buildings. That is counted as part of the community emissions. Rather, this sector refers to water that is pumped to city fountains or used for irrigation.

RENEWABLE ENERGY CREDITS (RECS):

The City of Creve Coeur also participated in the Ameren Pure Power Program[14] in 2014. Similar to the community commitment, the City of Creve Coeur has committed to purchasing "blocks" of renewable energy certificates (RECs)[15] which support renewable energy production. Each REC that is purchased represents 1,000 kWh produced by renewable energy sources (e.g. wind, solar, etc.). In 2014, Creve Coeur purchased 33 Pure Power Blocks per month for a total of 396 blocks. This is equivalent to 396,000 kWh of electricity from renewable energy sources or 273 MT of CO_2e emissions. Similar to the community, this reduces the GHG emissions for 2014 from 3641 to 3368 (Table 16) but does not impact the energy use from government operations.

Table 16: Emissions from Government Operations with RECs

	2014	2005	% Difference
GHG Emissions (MT CO_2e)	3,641	4,214	-14%
RECs	273		
Net GHG emissions (MT CO_2e)	3,368	4,214	-20%

[14] https://ameren.com/missouri/environment/pure-power

[15] https://ameren.com/missouri/environment/pure-power/renewable-energy-certificates

COMPARISON 2005 AND 2014:

Although municipal operations account for a small fraction of overall GHG emissions in Creve Coeur (<0.5%), the local government is leading by example in energy efficiency and emissions reductions. Creve Coeur has been able to reduce GHG emissions by 573 MT of CO_2e which is a 14% decrease from 2005 (Table 17, Figure 8). These reductions do not take into account Fugitive emissions as these were not included in the 2005 inventory and do not allow for a direct comparison. The remainder of these comparisons will omit fugitive emissions and focus on emissions that were reported for 2005.

GHG emissions have been reduced in all sectors except streetlights (Table 17, Figure 8). This reduction in GHG emissions has been coupled with a 7% increase in energy costs. The disconnect between emissions decrease and cost increase is the result of overall cost increases for fuel and energy since 2005[16]. The majority of emissions for Creve Coeur government operation come from electricity usage. An even greater reduction was observed when RECs were deducted from 2014 GHG emissions. In total this amounts to a 20% reduction in GHG emissions from 2005 (Table 16 and 17).

Table 17: Comparison of GHG emissions and cost by sector, 2005 and 2014

Sector	2014 CO_2e (MT)	2005 CO_2e (MT)	Difference	Percentage Difference	2014 Cost ($)	2005 Cost ($)	Difference	Percentage Difference
Buildings and Facilities	2,262	2,627	-365	-14%	$239,043	$233,693	$5,350	2%
Vehicle Fleet	512	587	-75	-13%	$138,366	$120,019	$18,347	15%
Employee Commute	437	556	-119	-21%	$0	$0	$0	
Street Lights and Traffic Signals	392	394	-2	-0.5%	$124,107	$117,783	$6,324	5%
Water	38	50	-12	-24%	$5,556	$4,555	$1,001	22%
Total (fugitive emissions omitted)	**3,641**	**4,214**	**-573**	**-14%**	**$507,072**	**$476,050**	**$31,022**	**7%**
Renewable Energy Credits	273	-------						
Net (fugitive emissions omitted)	**3,368**	**4,214**	**-846**	**-20%**				

[16] http://www.eia.gov/electricity/data/browser/#/topic/7?agg=2,0,1&geo=g&freq=M

Figure 8: Government Operations Emissions
2005 and 2014*
*Fugitive Emissions omitted

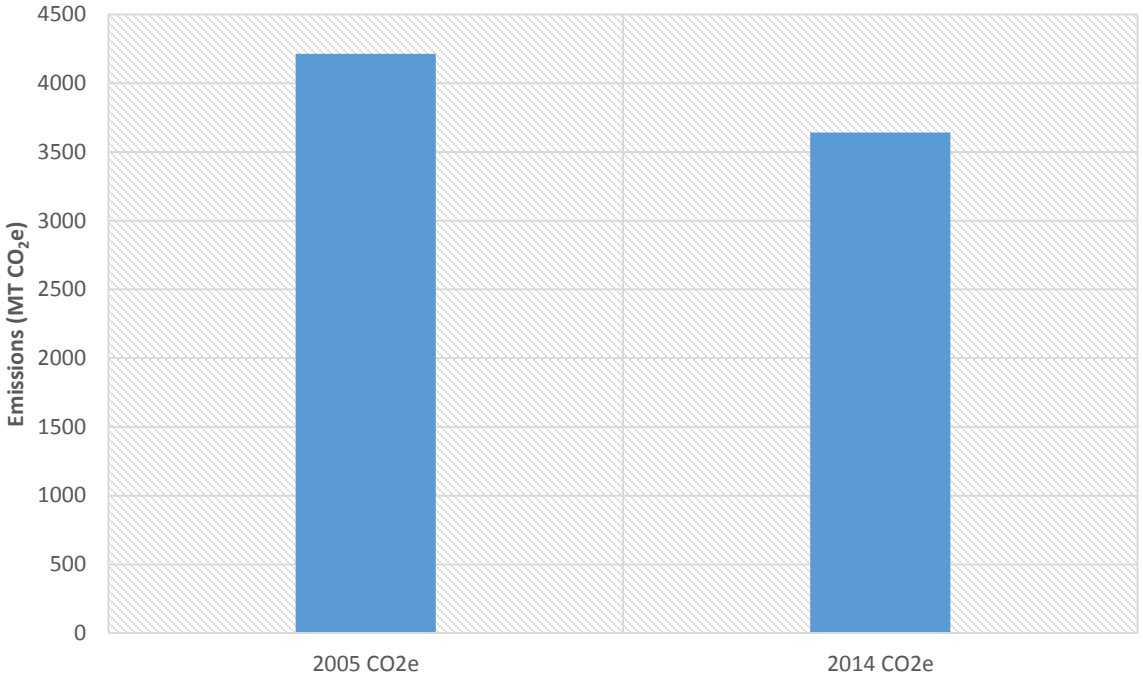
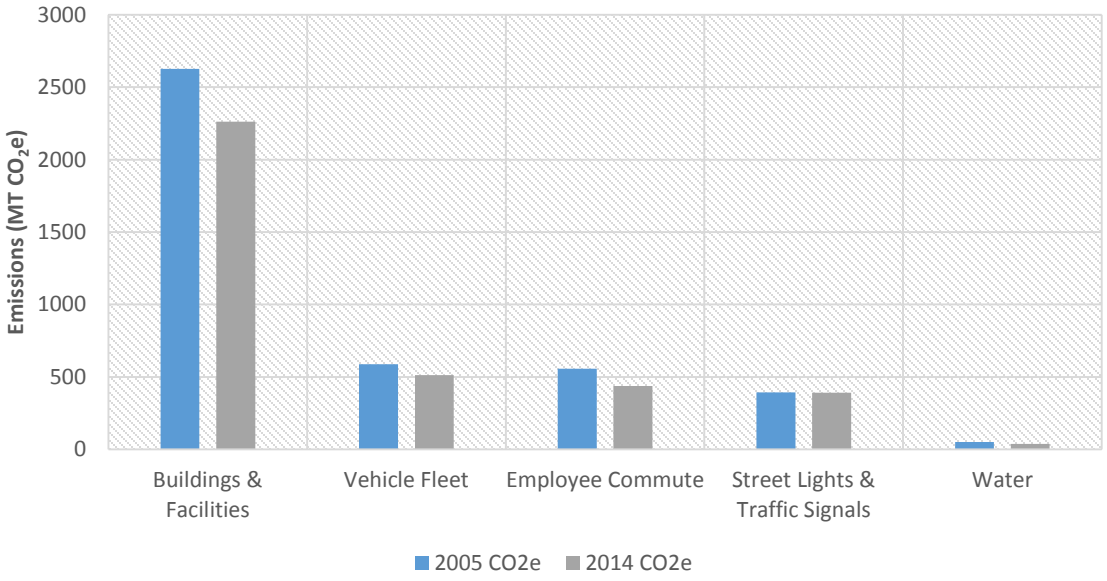


Figure 9: Government Emissions by sector
2005 and 2014 by sector*
*Fugitive Emissions Omitted



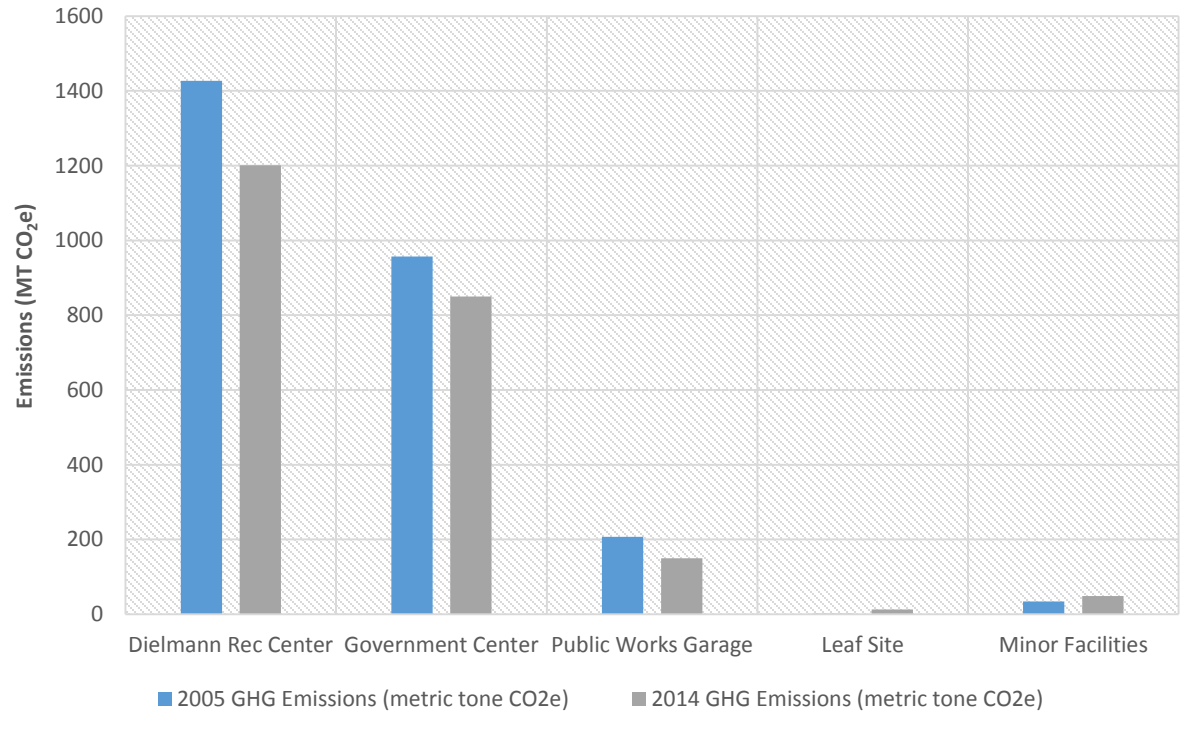
BUILDINGS AND FACILITIES:

Since 2005, Government building and facilities have seen a 13.9% reduction in emissions representing 364 metric of CO_2e (Table 18) (fugitive omissions omitted). Similar to 2005 the major contributing buildings to these emissions were the Dielmann Recreation Center, the Government Center and the Public Works Garage. All three buildings have decreased emissions, as can be seen in table 18 and as illustrated in figure 10.

Table 18: Comparison of GHG emissions by government buildings for 2005 and 2014

Building	2005 GHG Emissions (MT CO_2e)	2014 GHG Emissions (MT CO_2e)	Difference (MT CO_2e)	% Difference
Dielmann Recreation Complex	1,427	1,201	-226	-15.8%
Government Center	957	850	-107	-11.2%
Public Works Garage	207	150	-57	-27.5%
Leaf Site	2	13	11	550.0%
Minor Facilities	34	49	15	44.1%
Total	**2,627**	**2,263**	**-364**	**-13.9%**

Figure 10: Government Buildings GHG emissions 2005 and 2014



The previously mentioned reductions in emissions can be tied to a decrease in the consumption of electricity and natural gas, as shown in Tables 19 and 20. The decrease in energy usage is a result of multiple factors, mentioned in the previous section, mostly involving building improvements or renovations. The Dielmann Recreation Complex continues to be the largest user of electricity and natural gas. Since 2005, it has seen two major renovations that have reduced electricity use in subsequent years. The ice arena refrigeration system overhaul and the photovoltaic solar system installation have attributed to a 15.8% reduction in GHG emissions from 2005.

The Government Center has also seen a reduction in its consumption of natural gas (Table 20). This is primarily a result of a new boiler system installed in 2013.

The Public Works garage has seen a reduction in natural gas use but an increase in electricity usage. Renovations were discussed in the Buildings and Facilities section, the addition of the heat lamps might help account for the increase electricity usage. The Leaf Site has seen major expansion since 2005 with a new building accounting for the increase in both electricity and natural gas usage. Minor facilities have seen a major increase in energy consumption from 2005. This is largely due to increased usage of the Tappmeyer House, a historic home in Creve Coeur's Millennium Park.

These increases in efficiency have helped to moderate the energy costs associated with Creve Coeur Government Buildings. Not only did Creve Coeur use less electricity in 2014, but compared to 2005 the price of electricity has increased 46%. Without its conservation efforts, Creve Coeur's electricity costs for its buildings would have been approximately $21,446 more than they were. Note that this represents an annual cost savings that Creve Coeur will reap every year so long as it continues to conserve electricity.

Natural gas, conversely, has seen a decrease in price since 2005. However, by reducing natural gas consumption, Creve Coeur avoided $18,685 in 2014 costs. This, too, is an annual savings that Creve Coeur will reap every year so long as it continues to conserve natural gas.

Combined the government of Creve Coeur avoided $40,131 in utility bills in 2014.

In 2009 and 2010, an informal analysis of energy use for the three government buildings (Dielmann Recreation Complex, Government Center and Public Works Garage) was completed. This analysis shows that the energy use for these three buildings was lowest in 2009 for electricity and 2010 for natural gas. Since then, energy use has increased slightly. This further helps underline Creve Coeur's need to continue and expand its energy conservation strategies targeted at building energy use.

Table 19: Comparison of electricity usage and cost by building for 2014 and 2005.

Building	2014 Electricity Use (kWh)	2005 Electricity Use (kWh)	Electricity use difference (kWh)	Percentage Difference	2014 Electricity Cost ($)	2005 Electricity Cost ($)	Electricity cost difference ($)	Percentage Difference
Dielmann Rec Complex	1,182,426	1,458,570	-276,144	-18.9%	$98,325	$78,556	$19,769	25%
Ice Arena	*933,180*	*1,170,360*	-237,180	*-20.3%*	*$74,234*	*$59,565*	*$14,669*	*25%*
Golf Shop	*224,340 **	*267,720*	-43,380	*-16.2%*	*$22,194*	*$17,795*	*$4,399*	*25%*
Golf Maintenance Building	*24,906*	*20,490*	4,416	*21.6%*	*$1,897*	*$1,196*	*$701*	*59%*
Government Center	971,280	995,040	-23,760	-2.4%	$73,358	$55,153	$18,205	33%
Public Works Garage	108,300	99,408	8,892	8.9%	$10,052	$6,159	$3,893	63%
Leaf Site	2,689	194	2,495	1286.1%	$386	$27	$359	1330%
Minor Facilities	59,355	35,914	23,441	65.3%	$5,375	$2,429	$2,946	121%
Total	**2,324,050**	**2,589,126**	**-265,076**	**-10.2%**	**$187,496**	**$142,324**	**$45,172**	**32%**

** On 8/21/2014, PV system came on-line.*

Table 20: Comparison of natural gas usage and cost by building for 2014 and 2005.

Building	2014 Natural Gas Use (therms)	2005 Natural Gas Use (therms)	Natural Gas use difference from 2005 (therms)	2014 Natural Gas Cost ($)	2005 Natural Gas Cost ($)	Natural Gas cost difference from 2005 ($)	Percentage Difference
Dielmann Rec Complex	42,063	39,547	2,516	$31,670	$40,295	-$8,625	6.4%
Government Center	9,103	23,660	-14,557	$8,046	$24,734	-$16,688	-61.5%
Public Works Garage	11,509	23,593	-12,084	$9,779	$25,057	-$15,278	-51.2%
Leaf Site	1,994	251	1,743	$2,053	$397	$1,656	694.4%
Minor Facilities	0	740	-740	$0	$886	-$886	-100.0%
Total	**64,669**	**87,791**	**-23,122**	**$51,548**	**$91,369**	**-$39,821**	**-43.6%**

VEHICLE FLEET:

In 2005, the Vehicle Fleet emissions were broken out by each individual department's fuel usage, which was then used to calculate their GHG emissions. In 2014, this separation was not available, all fuel use data was either categorized as Police or Public Works. To be able to better compare findings, the 2005 Emissions from non-police departments have been included under Public Works. The data is shown in Table 21.

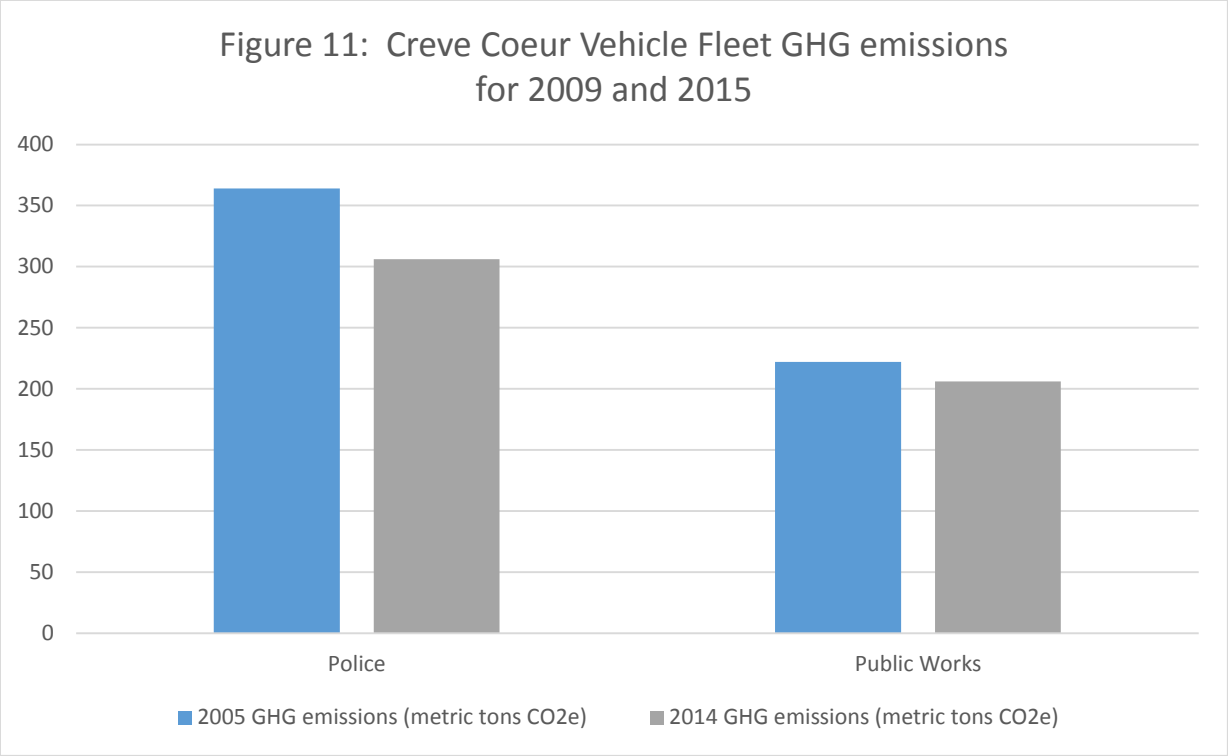
As in 2005, the largest emitter of GHGs in Creve Coeur's Vehicle Fleet is the Police Department (Table 21). The Police Department daily operations encompass patrolling Creve Coeur's city limits daily, and they require vehicles able to carry a large amount of equipment and conduct pursuit operations. Despite these constraints, both departments have been able to reduce GHG emissions, with a combined reduction of 12.6% (Table 21 and Figure 11). Since 2005, more than 75% of Public Works vehicles and all of the police vehicles have been replaced. For Public Works, the lower emissions are likely a result of much of the fleet being replaced by more fuel efficient and lower emitting diesel vehicles. The decrease in emissions from the Police Department most likely comes from a switch to smaller, more fuel efficient patrol cars. Similar to electricity costs, the cost of gasoline has increased since 2005 with the city from an average of $2.00/gallon in 2005 to $2.50/gallon in 2014[17], with diesel seeing similar increases[18]. By reducing the fuel consumed by its vehicle fleet, Creve Coeur avoided approximately $12,997 in fuel costs in 2014. As with electricity and natural gas, this is an annual savings that will accrue to Creve Coeur every year, so long as the city continues to conserve.

Table 21: Comparison of Vehicle Fleet emission and fuel usage for 2005 and 2014

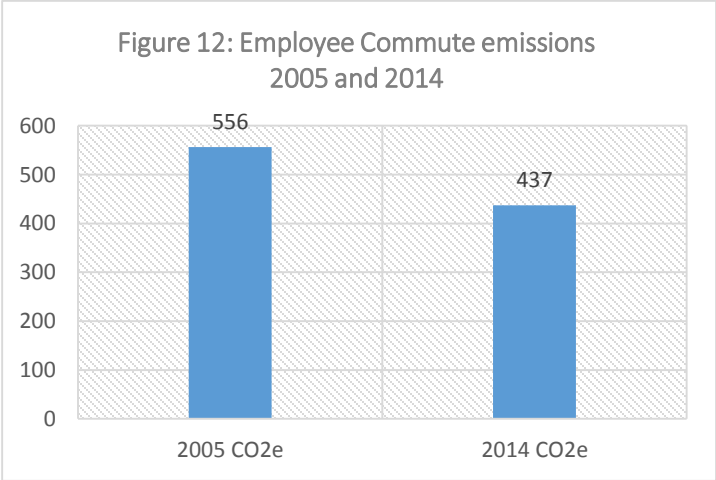
Department	2005 GHG emissions (MT CO_2e)	2014 GHG emissions (MT CO_2e)	Percentage Difference GHG emissions	2005 Fuel Use (gallons)	2014 Fuel Use (gallons)	Percentage Difference Fuel Use
Police	364	306	-15.9%	37,500	33,992	9.4%
Public Works	222	206	-7.2%	23,045	21,610	6.2%
Total	**586**	**512**	**-12.6%**	**60,545**	**55,602**	

[17] Vehicle fleet data is from FY 2014-2015 which includes data from 2015, which had greatly reduced costs per fuel

[18] http://fuelgaugereport.aaa.com/



EMPLOYEE COMMUTE:



Employee commute was the third largest contributor to government GHG emissions, similar to 2005. This sector, however, saw the greatest decrease (21%) from 2005. The GHG emissions for 2005 and 2014 are illustrated in Figure 12. The difference in emissions, similar to Vehicle Fleet, can be partly attributed to the steady increase of fuel efficiency for passenger vehicles since the 1990's. The current average fuel efficiency is over 33 miles per gallon (mpg) for new cars and 25 mpg for new light trucks[19]. Another consideration is the number of full time employees commuting to work. In 2005 that number was 117, while in 2014 that number was 107. The per-employee emission of GHGs was 4.8 MT of CO_2e in 2005.

[19]https://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_04_23.html

This has been decreased to 4.1 MT of CO_2e in 2014. Improving energy efficiency and increased use of hybrid and electric passenger vehicles should further reduce these emissions in the future.

STREETLIGHTS:

The five largest GHG emitting sets of streetlights are shown in Table 17 for 2005 and 2014. As in 2005, Creve Coeur does not own many of these streetlights. This applies to the Olive Boulevard Service, which is also responsible for the largest percentage of emissions (Table 22). All lights have seen a decrease in emissions, though the Olive Blvd Service and N. New Ballas Traffic Signals have seen an increase in cost. This is likely the result of a conversion to LED light as old signals are replaced.

Table 22: GHG emissions from Streetlights for 2005 and 2014

2005 Street Lights and Traffic Signals	2005 (MT CO_2e)	2005 Cost ($)	2014 Street Lights and Traffic Signals	2014 (MT CO_2e)	2014 Cost ($)
Total	**394**	**$117,783**	**Total**	**392**	**$124,107**
Olive Blvd Service	285	$109,345	Olive Blvd Service	278	$109,694
N New Ballas Traffic Signal	26	$2,022	N New Ballas Traffic Signal	17	$2,102
Rue de la Banque	19	$787	Rue de la Banque	10	$713
I-270 Overpass Light	18	$787	I-270 Overpass Light	8	$558
Magna Carta Traffic Signal	11	$938	Magna Carta Traffic Signal	4	$636
Sub-total	**322**	**$113,879**	**Sub-total**	**317**	**$113,703**
% of total	**91.7%**		**% of total**	**80.9%**	

WATER:

The amount of GHG emissions from water have been reduced 24% from 2005 but the city has seen a 22% increase in cost (Table 23). This was again caused by the increase in cost of electricity from 2005 and is forecast to steadily increase in the coming years.

Table 23: GHG emissions and cost from Water for 2005 and 2014

Sector	2005 CO2e (MT)	2014 CO2e (MT)	Emissions Difference (MT)	Percentage Emissions Reduction	2005 Cost ($)	2014 Cost ($)	Cost Difference ($)	Percentage Cost Increase
Water	50	38	-12	-24%	$4,555	$5,556	$1,001	22.0%

CONCLUSION AND SUGGESTIONS:

The City of Creve Coeur has been able to reduce GHG emissions that result from government operations by 604 MT of CO_2e which is a 20% decrease from 2005. At the same time, Creve Coeur is paying 7% more in fuel and energy costs compared to 2005 (Table 17). This difference can be seen in every sector of government operations. The price for electricity and natural gas is projected to steadily increase in coming years.[20] At this rate, the local government must continually reduce their emissions to avoid a future increase in their energy expenses.

Similar to the community inventory, the largest portion of emission for the local government comes from buildings (62.1%). While Creve Coeur has made progress in reducing energy consumption and GHG emissions from buildings, energy efficiency in this sector remains the city's largest opportunity. Some possible opportunities include participation in the Green City Challenge, which, similar to the Green Business Challenge, focuses on reducing energy use in everyday operations. Unlike the Green Business Challenge, it has an added focus on engaging constituents, both residents and businesses, to support the city's efforts. Part of the Green City Challenge would involve re-forming a city staff green team, which was also a recommendation in the 2010 Climate Action Plan for Creve Coeur. A city green team would consist of representatives from different departments meeting regularly to discuss and coordinate energy conservation and greenhouse gas reduction efforts. If the local government is to increase its reductions in GHG emissions, these efforts must be concentrated and directly overseen by a group or individuals responsible for implementation and execution. As with community emissions, more detailed and comprehensive strategies will be outline in the Climate Action Plan.

[20] http://www.eia.gov/beta/aeo/#/?id=3-AEO2015

Appendix A: ICLEI Procedures

ICLEI-Local Governments for Sustainability provided Government and Community excel worksheets to help track and catalogue the data. The original data, whether excel spreadsheet, PDF or other, was also saved within these excel worksheets. The contact information was also recorded for the person/s that provided the information.

Energy use data was originally input into a Master Data Workbook, supplied by ICLEI, to help in collection and tabulation. Amounts that were tabulated in this workbook were then entered into ClearPath software. ClearPath converted these inputs using appropriate factor sets, into CO_2e.

Appendix B: Common Acronyms and Definitions

CACP CACP is a management tool that tracks emissions and reductions of greenhouse gases associated with electricity, fuel use, and waste disposal.

ICLEI Local Government s for Sustainability is a membership organization that works to help local governments achieve reductions in greenhouse gas emissions and adapt to changes that may impact them due to climate change. ICLEI's members consist of local governments, more than 1,000 of which were active members in 2013.

GHG Greenhouse Gas. Any of several gases (carbon dioxide, water vapor, methane, nitrous oxide, ozone, hydrofluorocarbons) that, when released into the atmosphere, have the effect of trapping heat

GWP Global Warming Potential. This is the unit of measurement of heat trapping effects of gas relative to carbon dioxide.

CO_2e Carbon Dioxide Equivalent. When a greenhouse gas is released into the atmosphere, its warming effect is described by referring to the number of tons of carbon dioxide that would have to be released to create the equivalent warming effect.

MT Metric Ton. A metric ton is equal to 1,000 kilograms. It is approximately 2,204 pounds.

kWh Kilowatt hour, equal to 1,000 watts. A kWh is equal to 3,412 BTUs.

therm A unit of heat energy most commonly used in reference to natural gas and is approximately equal to burning 100 cubic feet of natural gas. A therm is equal to 100,000 BTU

VMT Vehicle Miles Traveled

REC Renewable Energy Credit. A certificate that demonstrates an individual or organization has purchased 1 megawatt-hour of renewable energy.