



**WORK SESSION MEETING
AGENDA
CITY OF CREVE COEUR
CITY COUNCIL
300 NORTH NEW BALLAS RD
DECEMBER 14, 2015
6:00 PM**

CALL TO ORDER

ROLL CALL

DISCUSSION ITEMS

1. Greenhouse Gas Inventory and Phase II Climate Action Plan

Summary: Intern Luis Garcia will be presenting the new Greenhouse Gas Emissions Inventory and the Phase II Climate Action Plan. The Energy and Environment Committee has reviewed the inventory and draft plan.

Pursuant to Section 610.022 RSMo., the City Council could, at any time during the meeting, vote to close the public meeting and move to closed session to discuss matters relating to litigation, legal actions and/or communications from the City Attorney as provided under Section 610.021(1) RSMo. and/or personnel matters under Section 610.021(13) RSMo. And/or employee matters under Section 610.021(3) RSMo. and/or real estate matters under Section 610.021(2) or other matters as permitted by Chapter 610.

Posted: _____ posted 12/10/2015
Deborah Ryan, MPCC
City Clerk



City Council
300 North New Ballas Rd
Creve-Coeur, MO 63141

SCHEDULED

Meeting: 12/14/15 06:00 PM
Department: City Council
Category: Report
Prepared By: Andrea Muskopf
Department Head: Debbie Ryan

STAFF REPORT

Greenhouse Gas Inventory and Phase II Climate Action Plan

Intern Luis Garcia will be presenting the new Greenhouse Gas Emissions Inventory and the Phase II Climate Action Plan. The Energy and Environment Committee has reviewed the inventory and draft plan.



City of Creve Coeur, Missouri

Phase 2 Climate Action Plan 2015

LUIS GARCIA
USGBC-MISSOURI GATEWAY CHAPTER
REIP INTERN, 2015



Acknowledgements:

This project could not have been completed without the help and support of many people. I would like to thank the City of Creve Coeur staff especially; Andrea Muskopf (Human Resources Assistant), Mark Perkins (City Manager), Sharon Stott (Asst. to the City Administrator), Jim Heines (Director of Public Works), Jason Valvero (Director of Parks and Recreation), Sgt. Jeffrey Hartman (Admin & Support Services), Debbie Loso (Finance Manager), Matt Wohlberg (City Engineer), and Steve Unser (Chief Building Official). I would also like to thank the members of the Energy and Environment Committee, whose help in the creation of this report was invaluable.

I would also like to offer a great deal of to John May and Emily Andrews, for their patience, tutelage and willingness to answer my many questions.

Finally, I would like to offer my appreciation to the citizens of Creve Coeur for their continued dedication to build a more sustainable community.

Sincerely,

Luis Garcia
Regional Environmental Intern
U.S. Green Building Council- Missouri Gateway Chapter

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Introduction:

The City of Creve Coeur has been a leader of clean energy and efficiency among local St. Louis communities. On April 14th, 2008, the City Council of the City of Creve Coeur unanimously passed a resolution endorsing the U.S. Mayors' Climate Protection Agreement. As part of this agreement the City is striving to meet or beat the greenhouse gas emission targets outlined by the Kyoto Protocol¹ and incorporate the following 12 strategies:

1. Inventory global warming emissions in City operations and in the community, set reduction targets, and create an action plan.
2. Adopt and enforce land-use policies that reduce sprawl, preserve open space, and create compact, walkable urban communities.
3. Promote transportation options such as bicycle trails, commute trip reduction programs, and incentivize carpooling and public transit.
4. Increase the use of clean, alternative energy by, for example, investing in "green tags"², advocating for the development of renewable energy resources, recovering landfill methane for energy production, and supporting the use of waste to energy technology.
5. Make energy efficiency a priority through building code improvements, retrofitting city facilities with energy efficient lighting, and urging employees to conserve energy and save money.
6. Purchase only Energy Star³ equipment and appliances for City use.
7. Practice and promote sustainable building practices using the U.S. Green Building Council's LEED program or a similar system.
8. Make changes to the city's vehicle fleet including increasing the average fuel efficiency of municipal fleet vehicles, reduce the number of vehicles in fleet, launch an employee education program including anti-idling messages, and, if possible, convert diesel vehicles to bio-diesel.
9. Support and encourage Metropolitan St. Louis Sewer District (MSD) to evaluate opportunities to increase pump efficiency in water and wastewater systems, and recover wastewater treatment methane for energy production.
10. Increase recycling rates in City operations and in the community.

¹ The Kyoto Protocol is an international agreement that aims at reducing carbon emissions by setting reduction targets for its parties.

² "Green tags" or as they are also commonly referred to Renewable Energy Credits (RECs) represent the ownership of the environmental benefits associated with renewable power generation

³ Energy Star is a voluntary program from the EPA aimed at assisting individuals and businesses save money and protect the environment through energy efficiency

11. Maintain healthy urban forests and promote tree planting to increase shading and to absorb carbon dioxide (CO₂).

12. Help educate the public, schools, other jurisdictions, professional associations, and businesses about reducing global warming pollution.

Along with being a signatory of the U.S. Mayors' Climate Protection Agreement, the City also conducted a Phase I Greenhouse Gas (GHG) Inventory and Climate Action Plan (CAP) in 2008. The 2008 CAP outlined several strategies aimed at curbing Creve Coeur's GHG emissions. In this initial plan much of the emphasis was placed on municipal operations. The strategies included performing an energy audit of government buildings, upgrading HVAC systems for government buildings, and organizing a staff green team. These strategies have resulted in the City of Creve Coeur seeing a marked reduction in energy usage and associated GHG emissions. Additionally, electricity and natural gas payments combined were essentially unchanged from 2005 and 2014, in spite of increasing utility rates.

The CAP envisioned a three phase program, starting with easily achieved strategies focused on government operations, then gradually expanding to include more ambitious strategies that involved the community at large. Thus, the Phase 1 plan was intended to familiarize the local government with reducing its own emissions, and to have a smaller impact on the community at large. The Phase 1 CAP set an ambitious goal of reducing GHG emissions by 20% by 2015 and by 50% by 2050. The City of Creve Coeur, Missouri Updated Greenhouse Gas Emissions Inventory for 2014 found that emissions from government operations have, indeed, been reduced by 20% from 2005 levels. In the community at large, however, construction added two million square feet of commercial space under roof between 2005 and 2014, making apples-to-apples comparisons impossible. However, adjusting for the additional construction, compared to business as usual projections for 2015, GHG emissions from the community at large have been reduced by 9%. Even though overall GHG emissions increased by 2,836 metric tons (mt) of CO₂e from 2005, a per capita decrease was seen from 49.7 mt of CO₂e in 2005 to 47.2 mt of CO₂e in 2014.

Thus, the initial GHG emission reduction goal was met for city government operations, but not for the community at large. The best scientific information indicates that to avoid the worst effects of climate change, GHG emissions must be reduced 40-70% by mid-century.⁴ Because technological progress is likely to make further reductions easier for Creve Coeur, the largest reductions should be loaded toward the end of the time period. Thus, this report recommends that Creve Coeur adopt new goals of reducing GHG emissions 10% by 2025, 20% by 2035, and 50% by 2050, all compared to 2015 GHG emissions. This amounts to an annual reduction of 8,544 mt of CO₂e per year by 2025, and 13,670 mt of CO₂e between 2025 and 2050.

⁴ *Fifth Assessment Report*, Intergovernmental Panel on Climate Change, published in 2014.

Climate Change:

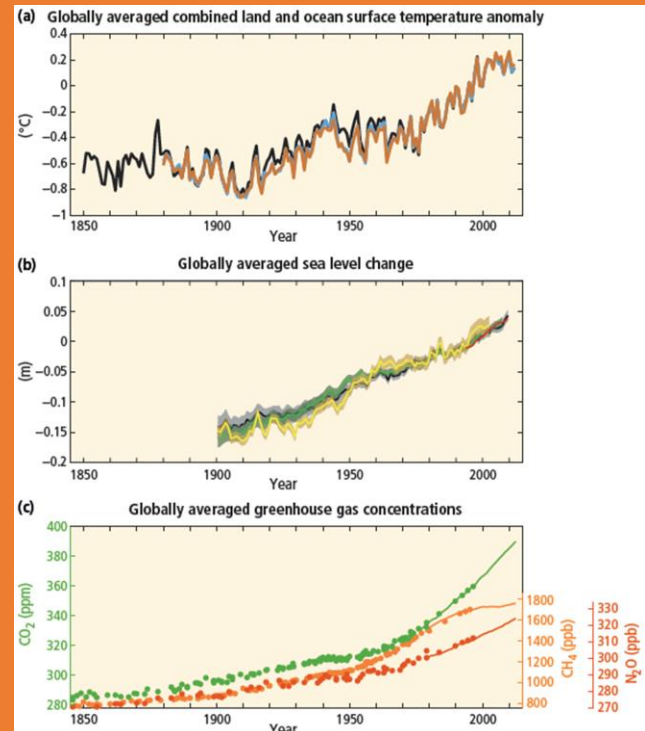
Human activities are causing vast and lasting changes to the Earth's atmosphere. Though scientific consensus is overwhelming many citizens are still skeptical of the immediate need for strategies to reduce greenhouse gas emissions that could help stem the alterations to the atmosphere and consequent climate change. However, if communities wait to take action until the worst effects of climate change are visible, it will be too late.

A report by the Risky Business Project identified the St. Louis Area as the Midwestern metropolitan area facing the highest climate risk due to its high summer temperatures and humidity levels. Some of the economic effects that could be experienced include increased energy costs and declines in labor productivity (Kate Gordon, 2015).

Increased demand for electricity will further tax an already aging and over-taxed electrical grid. Without improvements to the grid or alteration to the distribution of electrical energy, power outages may become more frequent and prolonged (Neumann and Price, 2009).

The human contribution to climate change is caused primarily by the emission of greenhouse gases from burning fossil fuel to create energy. Many strategies to reduce GHG emissions do so by reducing energy consumption or by substituting renewable energy for energy from fossil fuel. They are investments in our future. Sometimes the investment is expected to reduce or avoid future energy costs. Other times they are anticipated to generate returns related to the City's leadership position and ability to attract "the best and the brightest" to live and work here. And at times they are anticipated to generate returns related to health, welfare, social values, and quality of life. The City of Creve Coeur, Missouri, Updated Greenhouse Gas Emissions Inventory for 2014 estimated that the City's efforts to reduce GHG emissions were already saving \$2.8 million annually in avoided damages that would have been caused by the carbon emissions⁵.

Figure 1: Correlation of atmospheric gases and Earth's temperature



⁵ 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)

Forecast:

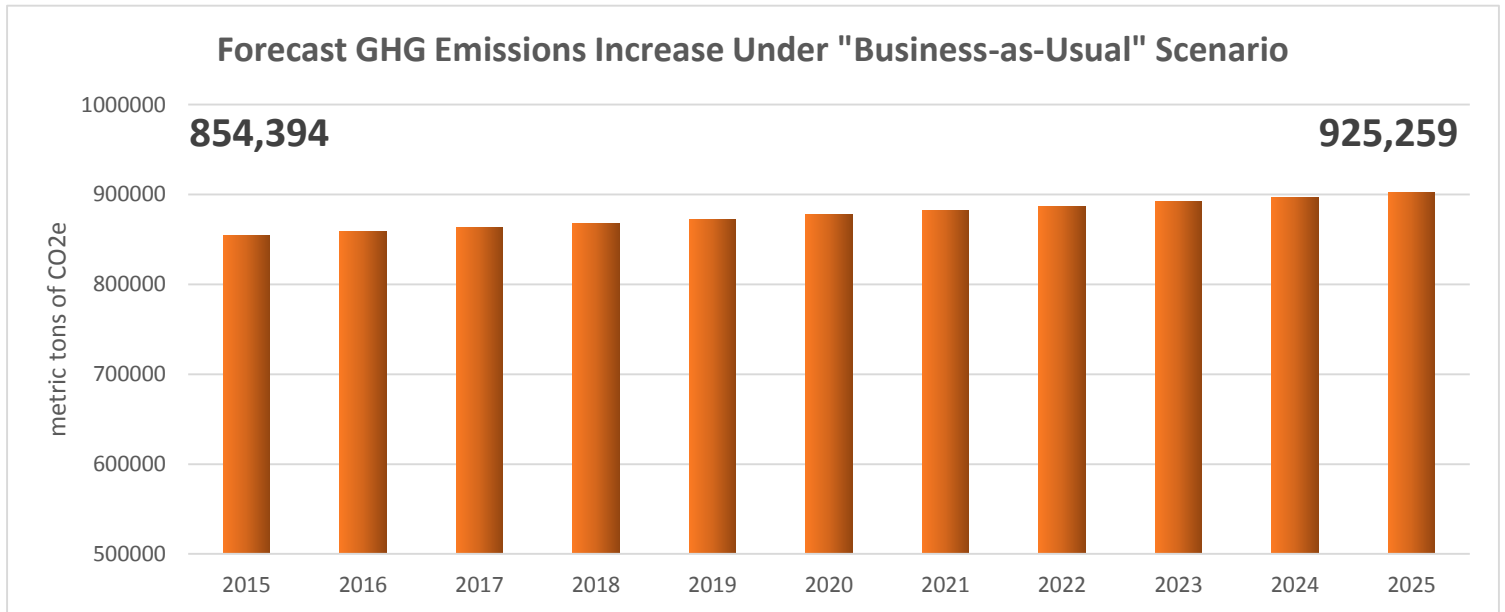


Figure 2: Forecast GHG emissions for Creve Coeur by 2025

Greenhouse gas emissions are expected to increase at the same rate as does population. Creve Coeur's annual rate of population increase is expected to be 0.08%. Thus, emissions are forecasted to increase by 70,865 metric tons of CO₂e in the next 10 years (Figure 2). This is equivalent to adding 1,500 cars to road each year. Looking further out this "business-as-usual" scenario would result in 1,002,059 mt of CO₂e emissions by 2035 and 1,126,815 mt of CO₂e emissions by 2050. This is equivalent to burning approximately 1,500 railroad cars full of coal.

GOALS:

The following recommended goals are an update and expansion of the goals set forth in the original Climate Action Plan.

1. Increase energy efficiency in the community as a whole and in government operations;
2. Increase the use of renewable energy in the community as a whole and in government operations;
3. Increase the use of alternative transportation in the community as a whole and in government operations;
4. Provide and encourage education on climate change, and on strategies to reduce energy consumption and GHG emissions.
5. Reduce waste in the community at large and in government operations;
6. Encourage the development of plans and strategies to cope with and adapt to the changes that will occur as a result of climate change.

Energy Efficiency:

Community Strategies:

Commercial buildings are the single largest emitters of greenhouse gases in Creve Coeur (52% of all GHG). If emissions are to be reduced by any meaningful amount, then reducing their consumption of energy from fossil fuel must be priority.

Strategies:

Encourage participation in the national building benchmarking challenge:

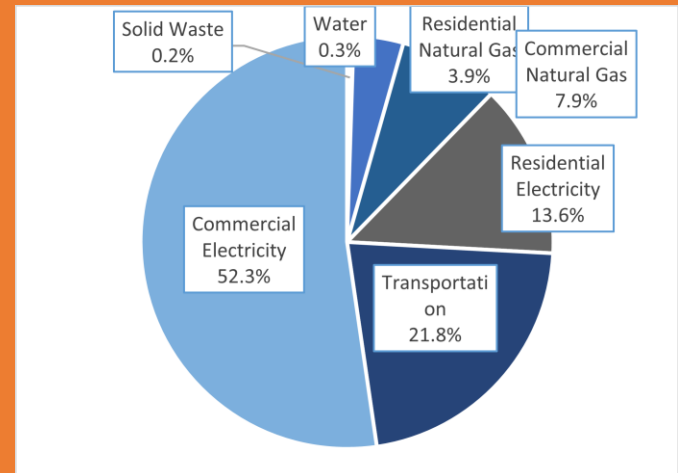
The past few years have seen a surge of governments, particularly of large cities, requiring large private buildings in their community to benchmark energy consumption. This benchmarking is typically done with a tool such as the ENERGY STAR Portfolio Manager, which

allows building energy consumption to be tracked over time and compared to the energy consumption of other similar buildings around the country. Benchmarking allows for better management of building operations and maintenance and allows building managers to more effectively consider energy efficiency when making their capital improvement plans. The Environmental Protection Agency (EPA) estimates that buildings that participate in energy benchmarking save 2.4% in annual energy through improved energy use.

Commercial building upgrades & retrofits: This report recommends that the City of Creve Coeur encourage commercial buildings to make energy efficiency retrofits and upgrades using two basic approaches. One is educational, and will be discussed below. The other involves incentives. Development of a program of incentives is beyond the scope of this plan, but could include zoning and building code trade-offs, permitting fee reductions or rebates, and expedited permit processing.

Develop a program to encourage energy audits in small commercial and residential buildings. Energy audits identify building systems that involve the greatest energy waste as well as building systems that can be upgraded or retrofitted economically. They are the essential first step of any retrofit or upgrade project. Three levels of energy audits have been identified. In increasing comprehensiveness they are walkthrough, general, and investment grade. Investment grade audits tend to identify the largest energy saving opportunities. In a large commercial building, an investment grade energy audit is a significant project. Most commercial building retrofits should begin with an investment grade energy audit, which should be incentivized by the City of Creve Coeur as part of the upgrade and retrofit incentive program discussed above.

Figure 3: GHG emissions percentage by sector



The largest single emitter of green-house gases in Creve Coeur is commercial electricity use.

Economically justifying comprehensive energy audits in small commercial and residential buildings may be more difficult. For this reason, this plan recommends development of a program of incentives to encourage them. The specifics of such a program are beyond the scope of this report. They could include, however, developing a referral list of state certified energy auditors, aggregating audits for buildings in Creve Coeur and contracting with approved energy auditors to provide the audits at a discounted price, zoning or building code trade-offs for buildings that obtain an audit and carry out the recommendations, or even development of an Energy Conservation Audit and Disclosure ordinance mandating that building sellers must conduct an energy audit and disclose it to the buyer.

Developing financial incentives for energy efficiency and clean energy: Properly conceived and executed energy efficiency and clean energy projects have a moderate return on investment. While it is larger than the return on most bond investments, the immediate cost of the project coupled with its moderate return over time may not be sufficient to capture the interest of building owners. To help businesses and residents invest in energy efficiency, the City of Creve Coeur could adopt any of a series of financial programs to encourage energy efficiency:

- Clean energy financing programs.** The returns on energy efficiency and clean energy programs are moderate, but reliable. They are ideal candidates for financing programs in which the cost of the financing is paid out of the energy savings they achieve. Because returns are moderate, the payoff period of such loans can be five years or more, making it advantageous for the financing program to attach to the property rather than the individual if the property is sold. A variety of clean energy financing schemes exist, including financing by energy service companies, bank loans, and Property Assessed Clean Energy (PACE) programs. A PACE program is a program in which energy efficiency and clean energy projects are bundled together by a PACE authority. The authority sells a bond in the aggregated amount. The proceeds from the sale of the bond are distributed to the property owners in the form of loans to do the energy efficiency and clean energy projects. The property owners pay off the loans from their energy savings, keeping any additional savings for themselves. However, unlike a traditional loan, which attaches to the individual, the PACE loan attaches to the property and is paid as a form of property tax. This means it runs with the property should the property be sold before it is paid off. Properly designed PACE projects provide sufficient savings to pay the debt service on the loan and provide a return to the property owner. After the loan is paid off, all savings accrue to the property owner.

In order to be economic, energy financing programs must aggregate a sufficient number of projects to make the process efficient. Creve Coeur is not a large enough city to aggregate sufficient projects. Thus, it would need to participate in financing programs operated by others. Each program has its own specific advantages. Exploring which is the best fit for Creve Coeur is beyond the scope of this plan. However, participating in one or the other would be one way the City could help make energy efficiency and clean energy projects affordable.

Alternatively, there are various forms of private funding for energy efficiency projects through private third party financing companies that are available for building owners. These companies often work through contractors that arrange financing for the customer and the contractor or financing company is paid over time through the energy savings.

- **Fee reductions:** The City of Creve Coeur collects a variety of permitting fees related to properties. Though not a large fraction of building or project costs, on some projects the fees can aggregate to a significant sum. The City could develop a program of permitting fee reductions for projects that include energy efficiency and clean energy projects. The City could include expedited processing as part of the program.
- **Zoning incentives.** It is common for cities to negotiate zoning incentives with property developers in order to secure goals related to public welfare that may not be directly covered by zoning or building codes. The City of Creve Coeur could use zoning incentives to secure energy efficiency or clean energy features in new construction and significant renovations. The City of Creve Coeur is currently looking at incorporating zoning incentives into its updated Comprehensive Plan.

Table 1: Ordinances for Energy Efficiency Financing:

• PACE • Building benchmarking • Tax break/penalty to comply • Fee reduction • Expedited processing • Zoning incentives	15-25% reduction in energy use resulting in a reduction of 10,000 to 17,000 mt of CO₂e ⁶⁷
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Updating the IECC code: The lifespan of a typical building is 50-60 years. Inefficient building construction leads to higher energy bills over the life of the building resulting in decades of increased costs that far exceed the cost of energy efficient construction. Because the building stock transforms slowly, the IECC building codes will not result in an immediate large reduction in building-related GHG emissions or energy consumption. However, if kept up to date, they will ensure that future construction will produce energy efficient buildings, and large energy and GHG reductions will be achieved over time. The City of Creve Coeur should review and adopt updated versions of the IECC as part of its regular code updating process.

Leaders in the Community:

Much “buy in” will be required from the commercial sector to realize these emission reductions. Strategies to educate the community and encourage participation will be discussed under "Education" below. However, many commercial entities within Creve Coeur are already taking a closer look at their energy expenditures and realizing the savings available from energy efficient practices. Though by no means comprehensive, examples might include:

The Danforth Plant Sciences Center- HVAC and boiler upgrade

⁶ Estimated reductions based on average energy efficiency projects from a variety of energy efficiency resource site (ex: EPA, ACEEE, MEEA), as well as data from local energy efficiency contractors

⁷ Reductions based on 10% participation by Creve Coeur community

- The Danforth Plant Sciences Center has implemented energy efficiency measures including conversion of water boiler system and recalibrating HVAC airflow system
- These changes have resulted in approximately 50% decrease in energy usage

Missouri Baptist University- Lighting conversion to LED

- The university converted 1,542 fluorescent fixtures to high efficiency LEDs
- The return on investment of this lighting retrofit is expected to be less than one year

Government Strategies:

The City of Creve Coeur has been a leader in implementing energy efficient practices in their buildings.

For several years the City implemented energy efficiency strategies on an ad hoc basis. In 2013 the City procured an energy audit and has used its recommendations to guide its energy efficiency efforts since then.

These practices have reduced emissions by 14% and saved the city \$40,000 in utility costs for 2014. These changes not only resulted in annual savings, they also created a more sustainable environment for current and future citizens of Creve Coeur.

At this point, the City has initiated numerous energy efficiency strategies. The next steps for the City should focus on periodically monitoring city operations and promoting energy efficiency strategies within the community.

Require "Green" certification of new buildings: Buildings that are energy efficient result in greater energy savings over the life of the building. Energy efficient buildings also help utilities better handle demand during peak hours. In addition to energy efficiency, "green" buildings provide a healthier, more comfortable working environment. At the time of this writing, the City is considering a new Police Department building and either a new Government Center or a renovation of the existing Government Center. Two types of green certification are available. The first involves the overall environmental impact of the building. A variety of green building certification schemes exist, however the U.S. Green Building Council's (USGBC) Leadership in Energy & Environmental Design (LEED) program is the best-known green building certification system, with more than 13.8 billion square feet of building space certified. The second kind of certification involves energy efficiency. The U.S. Department of Energy's Energy Star certification is available to buildings that achieve a certain level of energy efficiency, with more than 25,000 properties certified. The City of Creve Coeur could adopt a policy requiring both certifications for new government buildings and for significant renovations of existing buildings.

Building Benchmarking coupled with periodic reports to City Council: Benchmarking would allow the city to better manage building energy use and better target energy inefficiencies. The past few years have seen a surge of governments, both state and local, requiring regular benchmarking of energy performance in their own buildings. The most commonly used tool is the U.S. Department of Energy's ENERGY STAR Portfolio Manager which allow for tracking of energy consumption over time and for comparisons of performance to other similar buildings around the country. Tracking with Portfolio Manager is required to achieve ENERGY STAR certification, discussed above.

Table 2: Government Building benchmarking (Assumes a 2.4% reduction in improved annual energy use)			
Estimated total potential annual emissions reductions (mt of CO2e)			53
Buildings	Government Center	Dielmann Rec Complex	Public Works Garage
Emissions Reductions (mt of CO2e)	20	29	4

Renewable Energy:

Community Strategies:

The access to renewable energy sources is key to creating a sustainable and carbon neutral society. Energy efficiency is the most cost effective strategy for reducing GHG emissions. However, in today's world, humans require energy to support our lives and our economy. Thus, it will not be possible for Creve Coeur to achieve the deep reductions in GHG emissions that are needed without access to renewable energy.

The City of Creve Coeur has been an EPA Green Power Partner since 2013. As part of this commitment the Creve Coeur community at large committed to purchasing at least 3% of its electrical energy from renewable sources. This amounted to approximately 15 million kWh from renewable energy for 2014. Most of this energy was acquired by purchasing Green-e certified renewable energy credits through Ameren Missouri. The city has also granted building permits for rooftop solar array installation amounting to 872 kW of annual solar energy production in Creve Coeur.

Because commercial buildings are the largest consumers of electrical energy, encouraging them to source energy from renewable sources should be a primary focus.

Strategies:

Purchase additional renewable energy credits: Currently the Creve Coeur community is sourcing 3.2% of its electrical energy from renewable energy sources. Increasing the purchase of credits would result in an immediate offsetting of carbon emissions. Purchasing renewable energy credits is among the easiest strategies for increasing consumption of renewable energy. Creve Coeur should continue its participation in the Green Energy Challenge, and should periodically engage in public events and educational campaigns that promote the use of renewable energy.

Table 3: Increase in renewable energy credits (RECs) purchased by community			
Percent increase in RECs purchase	50%	100%	150%
Percent of total energy purchased	4.8%	6.4%	11.0%
Annual kWh	23,085,192	30,780,256	38,475,320
Estimated annual emissions reductions (mt of CO2e)	7,000	18,000	27,000

Solarize Campaign: Purchasing renewable energy credits may be the easiest renewable energy strategy, but it adds cost to the energy bill without providing a payback, except by avoiding future damage from GHG emissions. In addition, it does not provide a physical asset that can be seen by the public to serve

as a symbol of the city's commitment to renewable energy. For those reasons, Creve Coeur may want to develop renewable energy assets that provide a payback and have a physical presence inside the city.

Solar energy is the type of renewable energy best suited to the St. Louis area. The city of Creve Coeur should review its codes and ordinances to ensure that building owners who want to install solar energy systems, whether residential or commercial, are not constrained from doing so by zoning restrictions, outdated building codes, or neighborhood covenants. The city should encourage commercial buildings to consider rooftop solar as they provide a greater area with minimal shading.

However, a national study found that only 22-27% of residential roofs are suitable for PV arrays. One option would be to establish a larger community installation, often called a "solar garden," which would sell some or all of its power to Creve Coeur residents. As Missouri is a regulated market for utilities a third party cannot at this time install and sell energy from a solar garden that supplies solar power to its customers. For this reason the most likely scenario would be for the local utility (i.e. Ameren Missouri) to install and operate the array. Ameren Missouri has made just such an installation at the O'Fallon Renewable Energy Center in O'Fallon, MO. To develop a solar garden, the city would need to locate a suitable tract of land and work with community partners to build the solar garden and sell its power to Creve Coeur residents. The table below estimates the emission reductions of a 1MW array.

Table 4: Solarize Campaign	
Estimated total potential annual emissions reductions (mt of CO ₂ e)	900⁸

Leaders in the Community:

Several members of the Creve Coeur community have made significant commitments to renewable energy:

DeSmet Jesuit Academy- 100kW PV array

- In July of 2014 four 25kW arrays were installed on the roof of the DeSmet Jesuit Academy
- This is the largest single solar array in Creve Coeur

Monsanto- RECs in community

- Monsanto contributes the largest percentage of renewable energy credits (RECs) within Creve Coeur

Government Strategies:

As part of the Green Power Challenge, the City itself purchased 396,000 kWh of renewable energy in 2014. This amounts to 14% of the total electrical energy used for city operations.

⁸ Electricity generation and subsequent emissions were calculated using the PVWatts® calculator from the National Renewable Energy Laboratory

In addition, the city also placed a 25kW array on the roof of the Dielmann Recreation Complex. Since coming online in August of 2014 the solar array has generated approximately 35,000 kWh of electricity for the city.

Strategies:

Installation of additional solar power on city facilities: The City of Creve Coeur has installed a trial 25kWh array on the Dielmann Recreation Center. The city should establish a goal of procuring 30% of its electricity from renewable energy by 2035. This does not have to come completely from on-site installations but could also be purchased from the larger community solar discussed in the Community Strategies section. The city is considering constructing a new police building and renovating the city government center. Incorporating solar arrays into the designs for those buildings would be a natural step in implementing this strategy.

Table 5: Emissions avoided from additional renewable energy procurement	
Two 25 kWh solar arrays on new/renovated government buildings	48 mt of CO ₂ e
30% of electricity for municipal operations coming from renewable sources	690 mt of CO ₂ e

10% RECs increase: Currently the City of Creve Coeur purchases 15% of its electrical energy in the form of renewable energy credits. Increasing the purchase of RECs from 15% to 25% would result in immediate offsetting of carbon emissions (Table5).

Table 6: Increase purchase of RECs offsetting Government electricity	
Current RECs (kWh)	396,000
Current RECs % of Government electricity	15%
Potential increase in RECs purchase	25%
Estimated annual emissions reductions (mt of CO ₂ e)	455

Alternative Transportation:

Community Strategies:

Emissions from automobiles account for 22% of Creve Coeur's greenhouse emissions. Strategies that encourage alternative modes of transportation (walking, bicycling, mass transit) would not only reduce GHG emissions, they would bring other benefits to the citizens of Creve Coeur, such as safer roads, increased air quality and better health.

Strategies:

Pedestrian connectivity: The 2002 Comprehensive Plan calls for the city to design and create a comprehensive community wide network of off-street and on-street connections for pedestrians. The plan also calls for the city to require new development to include public amenities, including pedestrian connections and bicycle facilities. These efforts should be continued and given a high priority.

Bikeway plan: The 2002 Comprehensive Plan calls for the city to develop a Bikeway Plan as part of the Pedestrian Plan. The city should work with a local partner (for instance, Trailnet) to develop such a plan and implement it.

Multi-modal streets: The 2002 Comprehensive Plan calls for the city to promote the design of multi-modal streets that provide safe and efficient mobility for automobiles, bicycles, and pedestrians. In some locations, street modifications have been accomplished, for instance along Olive Boulevard west of I-270. The city should continue its efforts to create multi-modal streets. Since 2002, however, several street design ethics have gained national attention that not only promote safety for multiple transportation modes, but also address other concerns such as stormwater runoff. The most well-known of them is called "Complete Streets." The city should explore the adoption of Complete Streets or a similar design ethic as part of its comprehensive plan update (Table 7).

Table 7: Multi-modal streets program (based on 5% participation)			
Avg. vehicle fuel efficiency			23.8
Est. population of Creve Coeur			17,000
No. of weekly VMTs avoided	1	3	5
Total weekly gallons of gasoline avoided	36	100	180
Estimated annual emissions reductions (mt of CO ₂ e)	16	52	104

Carpooling program: Work with a local transportation or carpooling partner to develop a carpooling program for businesses in Creve Coeur (Table 8).

Table 8: Carpooling program (based on 5% participation)			
Avg. vehicle fuel efficiency			23.8
Est. commuting population of Creve Coeur			28,000
No. of daily commute VMTs avoided	4	10	20
Total daily gallons of gasoline avoided	235	588	1,776
Estimated annual emissions reductions (mt of CO ₂ e)	460	1,150	3,680

Leaders in the Community:

The Parkway School District has been a leader and staunch advocate for sustainability in the community for many years. The district could be included in all six of the goals set forth in this report. The district serves as an example of how large organizations can effectively implement sustainable practices.

Parkway School District has integrated CNG fuel into its bus fleet

- Currently Parkway Schools operate 30 CNG buses out of its 150 bus fleet
- The school district will continue to convert to CNG as older buses are replaced

Government Strategies:

Transportation-related emissions from government operations come from two main sources: emissions by vehicles in the city fleet (primarily police and public works) and emissions for vehicles used by employees in their daily commute. In both cases, reductions in energy consumption and GHG emissions are accompanied by reductions in energy costs. Further reductions can be accomplished by substituting alternative fuels for gasoline and diesel, by reducing vehicle miles traveled, and by continuing the transition from gas guzzling vehicles to fuel efficient vehicles.

Strategies:

Alternative fuel sources: CNG vehicles have several advantages over gasoline and diesel vehicles: CNG costs less per mile travelled, it emits 20-45% less smog producing pollutants, and 5-9% fewer GHG emissions. The city government has researched the feasibility of establishing compressed natural gas fuel stations within Creve Coeur. In addition the capital cost associated with building a CNG plant cannot be justified with the current usage of CNG in the community. However, future demand might become more favorable towards CNG, especially if local businesses express interest. In addition, if a fueling station could be established in cooperation with a consortium of nearby local governments, all of which contract to purchase fuel from the station, then affordability might improve.

The following table represents the savings that would be possible by converting the Public Works gasoline vehicles to compressed natural gas (Table 9). The difference in fuel consumption reflects the greater efficiency of CNG fuels⁹. At the time of this writing the price for CNG was \$1.99/gasoline gallon equivalent (GGE)¹⁰.

Table 9: Explore Alternative fuel sources for Public Works fleet vehicles			
	Annual Fuel Consumption	GHG emissions (mt of CO ₂ e)	Cost (\$)
Gasoline consumption	8,325 gallons	44	\$24,847
CNG equivalent	6,926 GGE	36	\$13,784

Employee Carpooling Campaign: The city government could develop an employee carpooling program. Such programs typically involve a central registry that connects potential users with each other. The city could follow up with a program of incentives or contests to reward and encourage participation. Table 10 illustrates the emissions reductions of half the city staff participating in a ride sharing programming.

Table 10: Promote employee carpooling/ride sharing	
Emissions reduction (mt of CO ₂ e)	218
Annual gallons of gasoline	24,530
Annual savings to employees	\$51,513

Anti-idling campaign: Engine idling consumes fuel and emits greenhouse gases. In addition, it emits other pollutants and increases engine wear and tear. Between 5-10% of vehicle fuel use occurs during idling, and hence, a similar proportion of GHG emissions. Most idling episodes are brief. However, some

⁹ Based on fuel conversion table by the California Energy Commission;
<http://energyalmanac.ca.gov/transportation/gge.html>

¹⁰ <http://www.cngprices.com/stations/CNG/Missouri/St-Louis/>

vehicles (trucks, construction equipment, etc.) may be allowed to idle for longer periods of time, increasing the fraction of fuel use and GHG emissions attributable to idling. The City of Creve Coeur should develop and conduct an anti-idling campaign for operators of its vehicle fleet. In addition to directly reducing GHG emissions, an anti-idling campaign would have the effect of demonstrating to its employees the city's commitment to reducing GHG emissions.

Reducing Waste:

While greenhouse gas emissions from waste and associated activities contributed little to overall emissions in Creve Coeur, promoting waste reduction is an essential element of sustainable communities.

Community Strategies:

Strategies:

Trash service: Under the current contract residents will pay for the valet component of the trash service. The city has already seen a significant drop in valet service from 40% to 18%. This results in fewer GHG emissions from idling trash trucks. Currently, the residents may choose from three sizes of trash totes. The city, in the future, might consider other programs aimed at reducing the amount of trash produced by residents such as composting (discussed below) or so-called “pay-as-you throw” programs.

Increase composting of local waste: Much of the refuse taken to the landfill is compostable waste. This should be encouraged not only for the local residents but also some of the businesses where food is a major waste product (ex: grocery stores and restaurants). As mentioned below the Parkway School District has successfully partnered with local composting organizations to collect and remove the waste. The city might want to explore options into large scale community composting. Many major cities have implemented curbside composting for residents, this might be easily incorporated into Creve Coeur’s successful yard waste program. The city yard waste sites might be ideal locations to consolidate organic waste from the community and partner with a composting organization to remove the compostable food waste.

Leaders in the Community:

Parkway School District

- 500 tons of waste is composted annually in partnership with Total Organics Recycling/St. Louis Composting
- Much of the tableware used in the schools is compostable

Government Operations:

Strategies:

Monitor current waste reduction: In July 2015, the City of Creve Coeur changed its waste service. This was done to decrease waste going to the landfill and increase recycling. The effectiveness of this effort should be evaluated as data becomes available. Included in this should be the effect of conversion from any of the trash pickup vehicles from diesel to CNG.

Implementation:

- Monitor effectiveness of new waste program (Green Team, EEC)
- Promote composting among residents and businesses that produce the largest quantity of compostable waste.

Education:

As Creve Coeur implements the various initiatives that will put this plan into effect, it will be necessary to inform the public about them. Thus, Creve Coeur will need an ongoing climate action public education campaign. The current government website offers information on a variety of environmentally friendly practices. This however, needs to be expanded upon with community outreach campaigns.

*Community Strategies***Strategies:**

Creve Coeur Sustainability Campaign: Beginning next year the City of Creve Coeur's Energy and Environment Committee will begin to offer informative meetings aimed at curbing energy inefficiency for residents and businesses. Information regarding cost effective strategies that range from simple to complex to reduce energy use and GHG emissions is widely needed to counter any misinformation.

Website update: Creve Coeur's website offers environmental tips and information on reducing GHG emissions on its website. The information on those pages is several years old and is no longer accurate. As part of the sustainability campaign discussed above, the city should update this information.

Leaders in the Community:

Dr. Joseph Martinich- 2016 Sustainability Campaign

- Starting in January of 2016 Creve Coeur resident Dr. Joseph Martinich, Founders Professor of Logistics and Operations Management at the University of Missouri- St. Louis, will conduct information sessions on a wide range of energy and waste reduction methods

Government Strategies:

Though often overlooked, strategies to organize city staff, educate them, motivate them, and reward them are among the most important strategies of all. The reason is that there are hundreds, if not thousands, of sustainability practices, and no planning process can identify or evaluate them all. Creve Coeur will have to rely on its staff to identify and implement strategies to reduce GHG emissions. Unless staff is organized around sustainability, educated, motivated, and rewarded, Creve Coeur is unlikely to achieve its GHG reduction goals.

Strategies:

Regular municipal green team meetings: A green team is team of city employees who meet to create, evaluate, coordinate, and implement sustainability strategies. The requirements of a successful green

team are that it be chaired by somebody who is held responsible for its success, that it have a clear mission, that its members be committed to improving the sustainability of government operations, and that members be in positions to actually influence city operations.

Many sustainability experts consider the establishment of a functioning green team to be the single most important sustainability strategy any organization can pursue. Creve Coeur established a green team a few years ago; it does not meet regularly, however. Creve Coeur should reinvigorate its green team, give it a clearly defined mission, and hold it responsible for meeting regularly and continuing to accomplish its mission.

Incentivize "green" practices: City employees are the city's greatest resource for developing green ideas. To tap this resource, Creve Coeur would need to develop a program through which green ideas can be submitted to the green team, and through which successful ideas can be acknowledged and incentivized.

"Green" recognition: Creve Coeur should develop a program to recognize employees that are practicing or promoting "green" policies during monthly administration meetings.

Review the green purchasing plan: In 2009, Creve Coeur became one of the first municipalities in the region to implement a green purchasing policy. At the time, the policy intentionally gave considerable leeway to purchasers in deciding whether to pursue a green purchase or a more standard purchase. Creve Coeur has now been implementing this green purchasing policy for six years, and it is an appropriate time to review it, determine its strengths and weaknesses, and determine where and how it needs to be amended.

Adaptation:

While it is of upmost importance to reduce the amount of greenhouse gases emitted into the atmosphere there is overwhelming consensus that we are beginning to see, and will for the foreseeable future continue to see, the effects of global climate change. For this reason, it is important for communities to implement strategies aimed at mitigating climate change's effects. It is only in recent years, however, that scientific information has begun to emerge in sufficient detail to allow for such planning in our region. For the Midwest, and the St. Louis area in particular, the direct effects include hotter summer days, warmer winters, more severe and acute rain events that could lead to flooding, and longer dry periods between the rains. Combined, these direct effects are likely to have some or all of the following secondary effects:

- a greater number of extremely hot days during summer, with an accompanying increase in heat-related illness and death, and a decrease in work productivity;
- a decrease in air quality, with an accompanying increase in respiratory illness;
- a decrease in water quality during hot periods due to low oxygenation and the growth of algae and other microorganisms;
- an increase in water demand during hot summer months;
- an increase in insect pests, including those that vector diseases;
- an increase in electricity demand during hot summer months, with an accompanying increase in electricity outages and interruptions;

- an increase in heat-related maintenance costs, such as equipment overheating and road buckling;
- a decrease in heating demand during the winter months;
- a decrease in cold-related maintenance costs such as pipe freezing and snow removal;
- possible changes in food availability.

Until these threats become clearer, and specifically how they will affect Creve Coeur, it is not possible for the city to take extensive action. However, a few general strategies can be pursued. Having a diverse plant community could help mitigate some of the effects of climate change. Plants also actively reduce the concentration of atmospheric carbon dioxide, a greenhouse gas. Plants also provide additional benefits to the community, these include: increasing property values, lower utility costs and increasing quality of life.

Community Strategies:

Strategies:

Strengthen the electrical grid: Modern life is heavily dependent on the energy grid. Weather events over the past few decades have taught us that when the grid goes down, our ability to function normally is seriously disrupted. Creve Coeur does not have control over the grid, and it is regulated at the state and national level. However, the city is in a position to speak for its residents and advocate for a strong, resilient grid. In addition, local renewable energy systems, such as rooftop solar and solar gardens, have the potential to provide some power should a catastrophic failure occur on the grid. Creve Coeur should advocate at the state level for a strong, resilient grid. It should encourage local renewable energy systems, and see that they are designed to function as partial backups in the event of a grid failure. This would include the advocacy for micro-grids that have the potential to operate independent of the grid.

Harden city infrastructure: Creve Coeur should convene a task force to study how climate change is likely to impact infrastructure owned by the city, and how it should be hardened.

Heat emergency plan: Creve Coeur should develop and keep updated an emergency plan to cope with heat emergencies. The plan should have such factors as establishing emergency cooling shelters, identifying those in need of emergency services, determining whether they need medical or cooling attention, and transporting them to medical facilities and/or cooling shelters.

Government Strategies:

One of the City of Creve Coeur's points of pride is the amount of green space. The City has been certified a Tree City USA by the Arbor Day foundation since 1997 and recently completed a tree inventory which will help maintain a diverse tree population. While Creve Coeur has made many strides in creating a verdant community many improvements are possible.

Strategies:

Urban ecosystems modelled after SITES: SITES is a rating system that assesses the design, construction and maintenance of landscapes. The goal with these landscapes is to create ecologically resilient communities. Among some of the benefits are a suite of ecosystem services including: flood mitigation, water quality improvement and erosion control.

The city is currently developing a residential storm water ordinance aimed at mitigating storm water. This involves a buffer zone along creeks where no disturbance is allowed. These locations would be ideal for diverse urban ecosystems. In addition, in city parks have implemented different plantings such as rain garden and swales that provide varied ecosystem services. While these practices are individually beneficial the city could move towards a more extensive and wide-reaching plan aimed at encouraging the implementation of SITES based ecosystems where applicable.

Provide native planting habitats for pollinators including the Monarch butterfly: This strategy works in conjunction with the previous one. High functioning urban ecosystems have the added benefit of providing habitat for fauna including native pollinators. Currently, native pollinators are facing marked declines in population and these declines are having, previously unforeseen, effects on plant communities. City committees and departments, including the Horticulture, Ecology, and Beautification Committee, the Stormwater Committee, and the Planning and Zoning Commission, the Public Works Department, the Community Development Department, and the Recreation Department should be charged with developing plans to adapt city infrastructure and property to the effects of climate change.

Conclusion:

Since 2008, when it completed the first greenhouse gas inventory in the St. Louis Region, Creve Coeur has been a sustainability leader. The completion of the Updated Greenhouse Gas Emissions Inventory for 2014 and the adoption of this climate action plan, Creve Coeur reaffirms that it remains a sustainability leader in the St. Louis Region. History shows that when the people of Creve Coeur unite and put their hearts and minds behind a task, they can accomplish great things. Climate change will require the city's best efforts, for its own welfare, and for the welfare of the world.

Community			Estimated Reductions
Building Benchmarking	Short (next year)	Initiate communications with major commercial partners, establish contact person within city staff	N/A
	Medium (1-5 yrs)	Establish infrastructure for collecting and monitoring building performance	
	Long (5 yrs +)	Explore feasibility of requiring benchmarking for all commercial buildings	
Energy Auditors List	Short (next year)	Task EEC member and staff to create a list of energy auditors	N/A
	Medium (1-5 yrs)	Promote energy auditors list to community	
	Long (5 yrs +)	Explore opportunities to incentivize residential energy efficiency	
Adopt new IECC standards	Short (next year)	City Council pass new IECC standards	N/A
	Medium (1-5 yrs)	Continue to monitor and upgrade as necessary	
	Long (5 yrs +)	Continue to monitor and upgrade as necessary	
Commercial Energy Efficiency Incentive Programs	Short (next year)	Explore energy efficiency ordinances centered on incentivizing energy efficiency upgrades for commercial buildings	10,000 – 17,000
	Medium (1-5 yrs)	Pass affordable financing ordinances for building energy efficiency programs	
	Long (5 yrs +)		
Government			
Require "Green" Certification	Short (next year)	Team EEC, city staff and USGBC to explore LEED certification for new city construction	N/A
	Medium (1-5 yrs)	Based on results of committee findings implement necessary steps	
	Long (5 yrs +)		
Building benchmarking with reports to City Council	Short (next year)	Assign city staff responsible for updating benchmarking info. and reports	53
	Medium (1-5 yrs)	Set goals for municipal buildings to reach energy star certification	
	Long (5 yrs +)	Adjust goals as needed to continually improve building performance	

Renewable Energy			Estimated
Community			Reductions
RECs increase	Short (next year)	Promote Green Power Community commitment to community	7,000
	Medium (1-5 yrs)	Explore collaboration and participation with large community organizations (business, hospitals, schools, etc.)	
	Long (5 yrs +)	Continue promotion of renewable energy	
Community Solar	Short (next year)	Explore public interest and feasibility of community solar campaign	900
	Medium (1-5 yrs)	Based on findings, task residents with building interest or support	
	Long (5 yrs +)	Create campaign aimed at utility (Ameren) owned community solar array	
Government			
RECs increase	Short (next year)	Increase RECs purchases of RECs from 15% to 25%	455
	Medium (1-5 yrs)	Move out into community to increase RECs purchases throughout community	
	Long (5 yrs +)	Use RECs purchasing as clear sign of Creve Coeur's commitment and interest in local renewable energy	
Additional solar on city buildings	Short (next year)	Complete thorough analysis of cost/benefit of solar installation on DRC	740
	Medium (1-5 yrs)	Consideration of solar installations on new/renovated buildings	
	Long (5 yrs +)	Explore options to increase renewable energy either within or outside of Creve Coeur	

Alternative Transportation			Estimated Reductions
Community			
Multi-modal Streets	Short (next year)	Comprehensive plan currently underway	104
	Medium (1-5 yrs)	With guidance from Comprehensive plan partner with community organizations (ex: Trailnet) to identify potential expansion of alternative transport	
	Long (5 yrs +)	Incorporate dense community building planning in key areas around Creve Coeur	
Carpool Campaign	Short (next year)	Communicate with major businesses within Creve Coeur	3,680
	Medium (1-5 yrs)	Work with business to develop plan to encourage carpooling by employees	
	Long (5 yrs +)	Evaluate effectiveness of plan and adjust as necessary	
Government			
Alternative Fuel Source	Short (next year)	Explore interest in community for fleet vehicle upgrade to CNG or other fuel source	8
	Medium (1-5 yrs)	Continue upgrading vehicle fleet to diesel and other fuel alternatives to gasoline	
	Long (5 yrs +)		
Employee Carpool	Short (next year)	Develop plan to encourage/incentivize employee carpooling	218
	Medium (1-5 yrs)	Evaluate effectiveness of plan and adjust as necessary	
	Long (5 yrs +)	Continue evaluation	
Anti-idling Campaign	Short (next year)	Develop campaign setting limits on idling time for city vehicles	N/A
	Medium (1-5 yrs)	Initiate campaign	
	Long (5 yrs +)	Evaluate fuel consumption savings	

Reducing Waste			Estimated Reductions
Community			
Increase Composting	Short (next year)	Communicate with major organic waste producers (restaurants, grocery stores, etc.) within city	TBD
	Medium (1-5 yrs)	Explore feasibility of partnering trash producers with composting companies in the region	
	Long (5 yrs +)	Consider expanding composting to other areas of the community	
Trash service paid by residents	Short (next year)	Continue monitoring trash conversion to curbside and size of trash totes used by residents	TBD
	Medium (1-5 yrs)	Explore/develop plan to move payment of trash services from city to residents	
	Long (5 yrs +)	Dependent on resident opinion	
Government			
Monitor Current waste reduction	Short (next year)	Continue monitoring trash conversion to curbside and size of trash totes used by residents	N/A
	Medium (1-5 yrs)	Explore options aimed at reducing trash and increasing recycling and composting	
	Long (5 yrs +)	Explore options aimed at reducing trash and increasing recycling and composting	

Education			Estimated
Community			Reductions
Sustainability Campaign	Short (next year)	First phase of the Creve Coeur Sustainable Living series	N/A
	Medium (1-5 yrs)	Monitor success/participation of campaign, adapt topics/presentation as needed	
	Long (5 yrs +)	Continue monitoring/adapting	
Website Update	Short (next year)	Task EEC with compiling current sustainability topics and information	N/A
	Medium (1-5 yrs)	Update sustainability section of website with new information	
	Long (5 yrs +)	Continue updating as needed	
Government			
Regular Green Team Meetings	Short (next year)	Set a team "leader" and team member from all departments, initial planning meeting to set goals and schedule (possible ideas follow)	N/A
	Medium (1-5 yrs)	Continue meetings adjusting goals as needed	
	Long (5 yrs +)	Evaluate success of goals	
Incentivize "green" practices	Short (next year)	Green Team develop "green" campaign	N/A
	Medium (1-5 yrs)	Launch "green" campaign	
	Long (5 yrs +)	Evaluate success and adapt as needed	
"Green" recognition	Short (next year)	Green Team explore recognition for staff that practice "green" habits	N/A
	Medium (1-5 yrs)	Implement recognition program	
	Long (5 yrs +)	Evaluate success and adapt as needed	
Review the green purchasing plan	Short (next year)	Green Team evaluate green practices in city operations	N/A
	Medium (1-5 yrs)	Report to city council success/improvement	
	Long (5 yrs +)	Continue evaluating purchase practices	

Adaptation			Estimated
Community			Reductions
Strengthen the electrical grid	Short (next year)	Explore along with community solar campaign	N/A
	Medium (1-5 yrs)	Develop strategies to campaign for electrical grid renovation to state government	
	Long (5 yrs +)	Continue conveying importance to state officials	
Heat emergency plan	Short (next year)	Identify target areas and population susceptible to high temperature	N/A
	Medium (1-5 yrs)	Determine whether Heat Emergency Plan is necessary for Creve Coeur	
	Long (5 yrs +)	Develop and implement plan	
Government			
Urban ecosystem based on SITES	Short (next year)	Explore integration with current city stormwater and comprehensive plans	N/A
	Medium (1-5 yrs)	Encourage SITES model to businesses and residents where applicable	
	Long (5 yrs +)	Evaluate effectiveness of SITES model and adapt as necessary	
Provide native planting for pollinators	Short (next year)	Provide education on benefits of diverse plantings	N/A
	Medium (1-5 yrs)	Expand native plantings on government grounds	
	Long (5 yrs +)	Collaborate with local agencies to help expand efforts	



City of Creve Coeur, Missouri

Updated Greenhouse Gas Emissions Inventory for 2014

LUIS GARCIA

USGBC-MISSOURI GATEWAY CHAPTER REIP INTERN

SEPTEMBER, 2015



Missouri
Gateway
CHAPTER

Credits and Acknowledgements

Many people were instrumental in the completion of this report. I would like to express my immense gratitude to the City of Creve Coeur staff: Andrea Muskopf (Human Resources Assistant), Mark Perkins (City Manager), Sharon Stott (Asst. to the City Administrator), Jim Heines (Director of Public Works), Jason Valvero (Director of Parks and Recreation), Sgt. Jeffrey Hartman (Admin & Support Services), Debbie Loso (Finance Manager), Matt Wohlberg (City Engineer), and Steve Unser (Chief Building Official). I would also like to thank the members of the Energy and Environment Committee, whose help in the creation of this report was invaluable

This inventory and report is the result of the collaboration of numerous sources. These sources include: Allied Waste Services, Ameren UE, East-West Gateway Council of Governments, Laclede Natural Gas Company, Missouri American Water Company, Republic Waste Services, and the City of Creve Coeur. I would like to express my gratitude to these sources and their representatives for the assistance and cooperation they provided, which made the completion of this report possible.

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

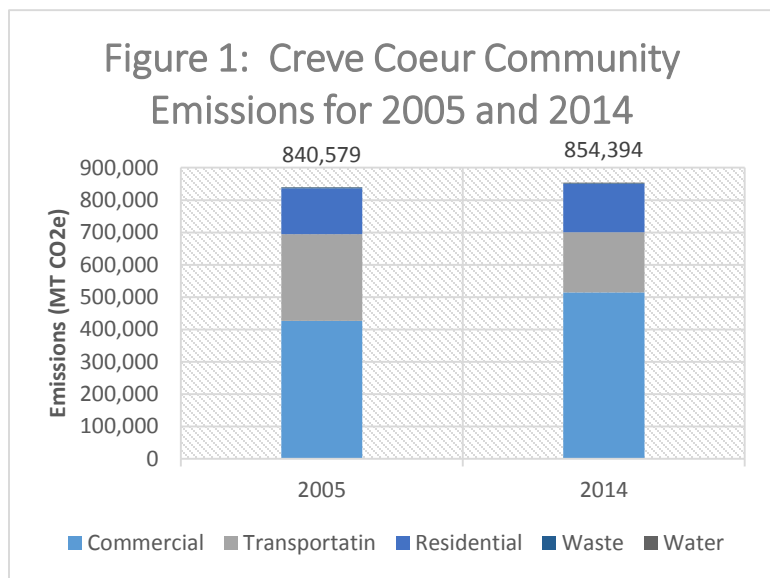
EXECUTIVE SUMMARY:

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 (CO₂e). 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 CO₂e. This amounts to 52.3% of all emissions.

Community Emissions		
Source	2014 GHG emissions (Percentage of CO ₂ e)	2014 GHG emissions (MT CO ₂ e)
Electricity	66%	565,220
Gasoline	19%	165,941
Natural Gas	12%	100,784
Diesel	3%	21,409

Table 1: 2014 GHG Emissions by Source

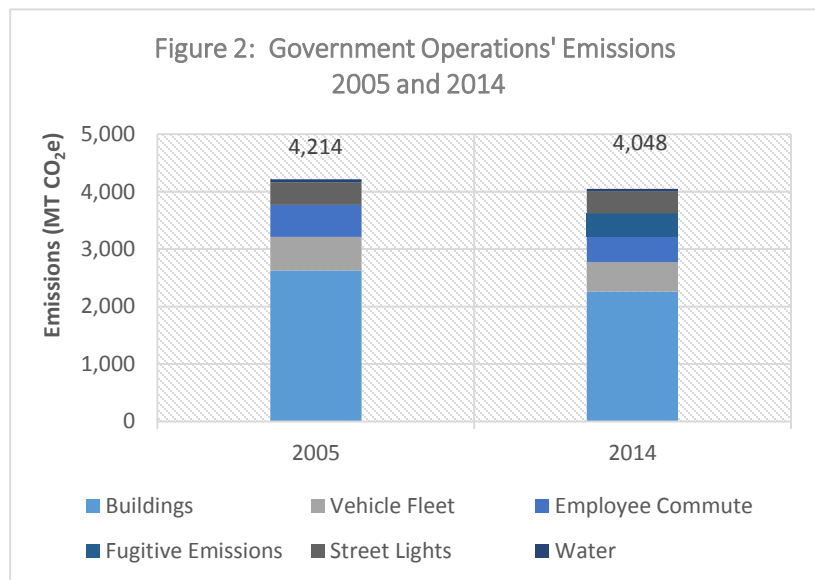
Compared to 2005, Commercial consumption of electricity and natural gas has increased 20% and 34%, respectively. Since 2005, Creve Coeur has seen an addition of approximately 2 million square feet of commercial floor space. This 16% increase in floor space can help account for part, but not all, of the 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 CO₂e. 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.

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 CO₂e. While Creve Coeur did not meet its target of reducing community GHG emissions by 20%, it did avoid 75,531 MT CO₂e 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 emissions¹. 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 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 efficiency².

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 CO₂e 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 2100³.

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 disease⁴.

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

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.

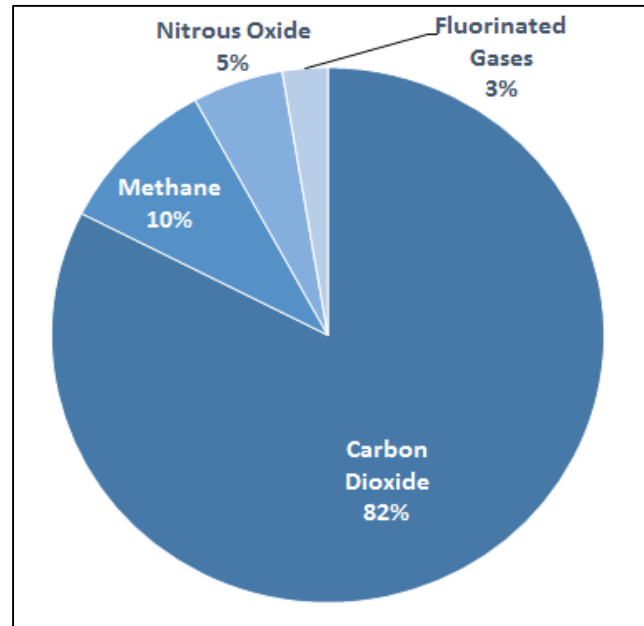
METHODOLOGY:

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.

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 (CH₄), nitrous oxide (NO_x) and carbon dioxide (CO₂) among others. The capacity to which each gas can trap heat varies, and is referred to as its global warming potential (GWP). As CO₂ 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 CO₂ (Table 2). In order to create a standard for comparison, the global warming effect of all gases are converted to the amount of CO₂ that would be required to have the equivalent effect, and the result is expressed in a single unit known as carbon dioxide equivalent (CO₂e). 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.

Figure 3: U.S. GHG Emissions in 2013



Greenhouse Gas	Global Warming Potential (GWP)
Carbon dioxide (CO ₂)	1
Methane (CH ₄)	21
Nitrous Oxide (N ₂ O)	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 (CO₂e). 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 CO₂e 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.

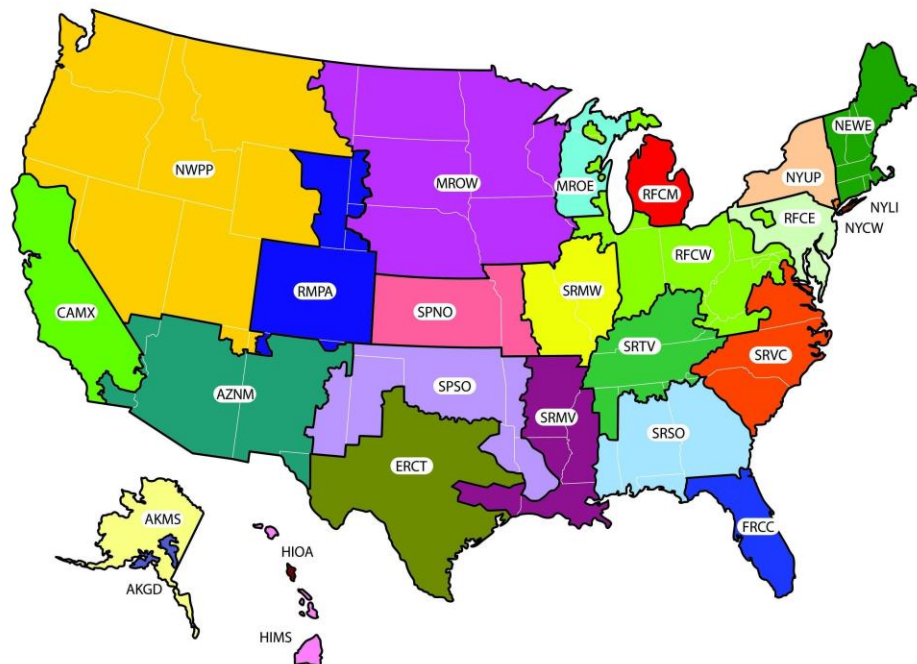
FACTOR SETS

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 of 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.

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

Figure 4: NERC Regional Map



This is a representational map; many of the boundaries shown on this map are approximate because they are based on companies, not on strictly geographical boundaries. USEPA eGRID2010 Version 1.0 December 2010

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 (CO₂e) 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 CO₂e. 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 CO₂e.

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.

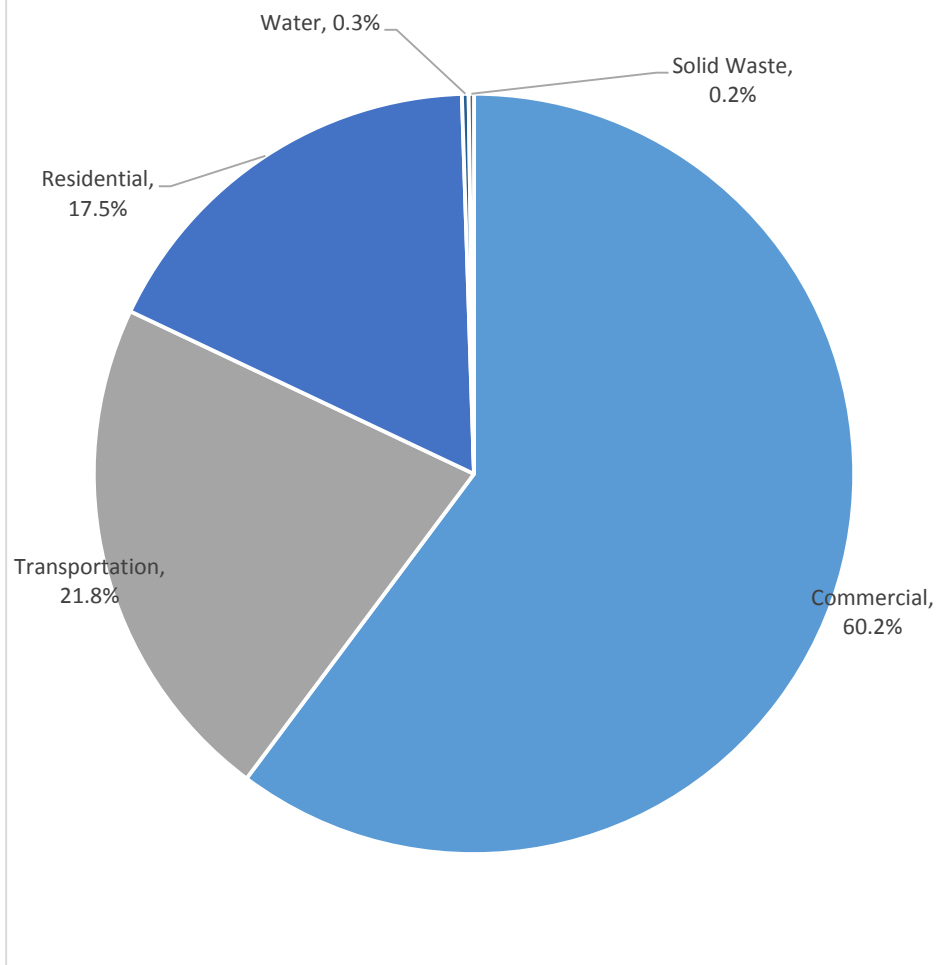
In 2014, the Commercial sector accounted for over half (60.2%) of all GHG emissions. As in 2005, the next largest emitter of GHG was the Transportation sector, which was responsible for 21.8% of the community's total emissions. Residential emissions (17.5%) were third. Water and Wastewater and Solid 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 ₂ e)	GHG Emissions (MT CO ₂ e)
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)



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 CO₂e 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 CO₂e, while the household emissions were 19 metric tons of CO₂e.

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

Source and Sector	2014 Energy Usage	2014 Emissions (MT CO ₂ e)
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 CO₂e 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 CO₂e with those of 2014. In contrast, on a per capita measure, emissions have decreased from 49.7 MT of CO₂e in 2005 to 47.2 MT of CO₂e in 2014. In 2005, the Commercial sector was responsible for 426,256 metric tons of CO₂e or 50.7% of all community emissions; in 2014, the Commercial sector was responsible for 514,412 metric tons of CO₂e 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 ₂ e)	2014 Emissions (MT CO ₂ e)	% 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 ft² 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 CO₂e 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 ₂ e)	2014 GHG emissions (MT CO ₂ e)	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 CO₂e 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 sources⁵.

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

Source	2014 GHG emissions (%CO ₂ e)	2014 GHG emissions (MT CO ₂ e)
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

[†] CO₂e 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 CO₂e. Table 9 shows net GHG emissions after the CO₂e 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 CO₂e)	840,579	854,394	1.6%
<i>RECs</i>		-10,979	
Net GHG emissions (MT CO₂e)	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 ft². 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 CO₂e. 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 ₂ e)	Percentage increase from 2005
2005 Emission	840,579	
Effect of adding 2 million sq. ft.	141,042	17%
Projected 9% increase <i>(including effect of 2 million sq. ft.)</i>	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 CO₂ 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 CO₂e in 2014, this equates to globally avoided damages of \$2,794,647⁶.

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 decrease 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 well⁷. The EPA estimates that buildings that consistently monitor their energy usage can achieve 2-10% in energy savings through better energy management⁸.

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 CO₂e (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 expenditures⁹. 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 ₂ e	CO ₂ e (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		

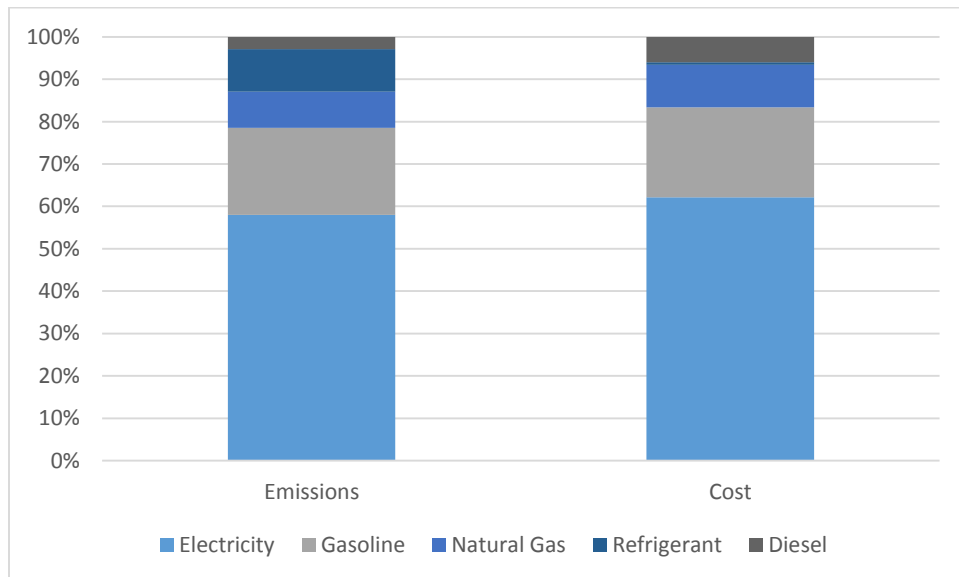
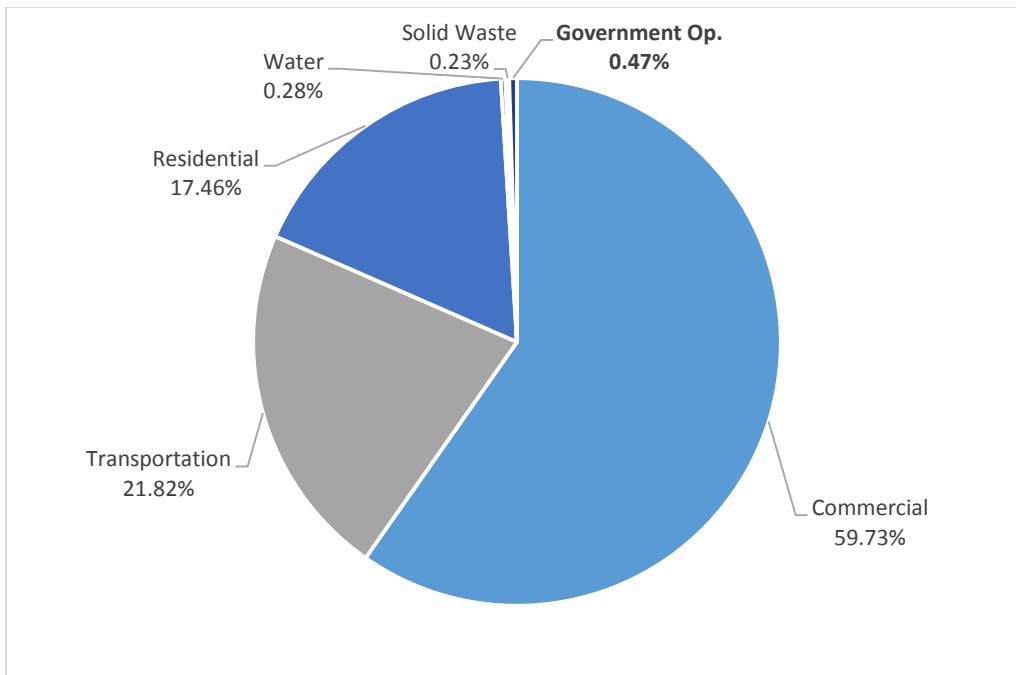
Figure 6: Government Operations GHG emissions and cost by source, 2014

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 CO₂e (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 CO₂e¹⁰ and a savings of \$911.69¹¹. 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 rooms¹². 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 ₂ e)	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:

In 2014 the City of Creve Coeur's Vehicle Fleet emitted 512 MT of CO₂e. 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

Table 14: Fuel oil emissions for 2014

Department	Emissions (MT CO ₂ e)	Fuel use (Gallons)	Cost (\$)
<i>Public Works</i>			
Gas	89	10,160	24,847
Diesel	117	11,500	30,480
<i>Police</i>			
Gas	306	33,992	80,039
Total	512	55,652	135,366

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

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.

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

EMPLOYEE COMMUTE:

Employee commute was the third largest contributor to government GHG emissions with 437 metric tons of CO₂e. 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/>

CO₂. 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 CO₂e 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 CO₂e 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 Program¹⁴ 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 CO₂e 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 CO₂e)	3,641	4,214	-14%
RECs	273		
Net GHG emissions (MT CO₂e)	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 CO₂e 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 2005¹⁶. 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 ₂ e (MT)	2005 CO ₂ e (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

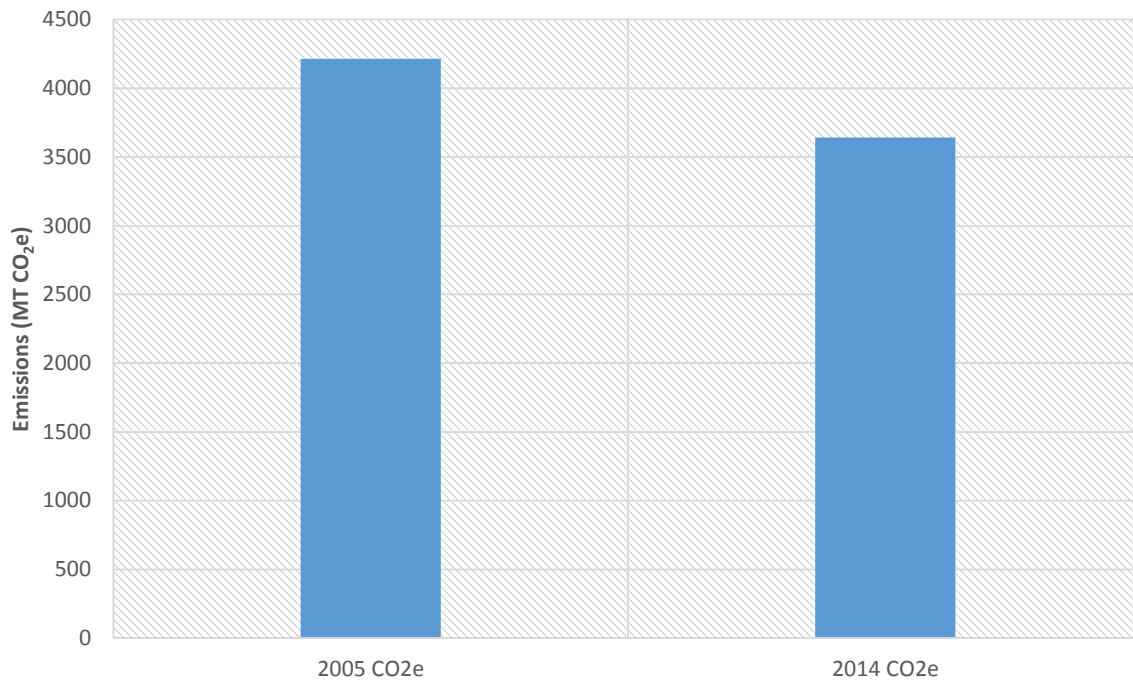
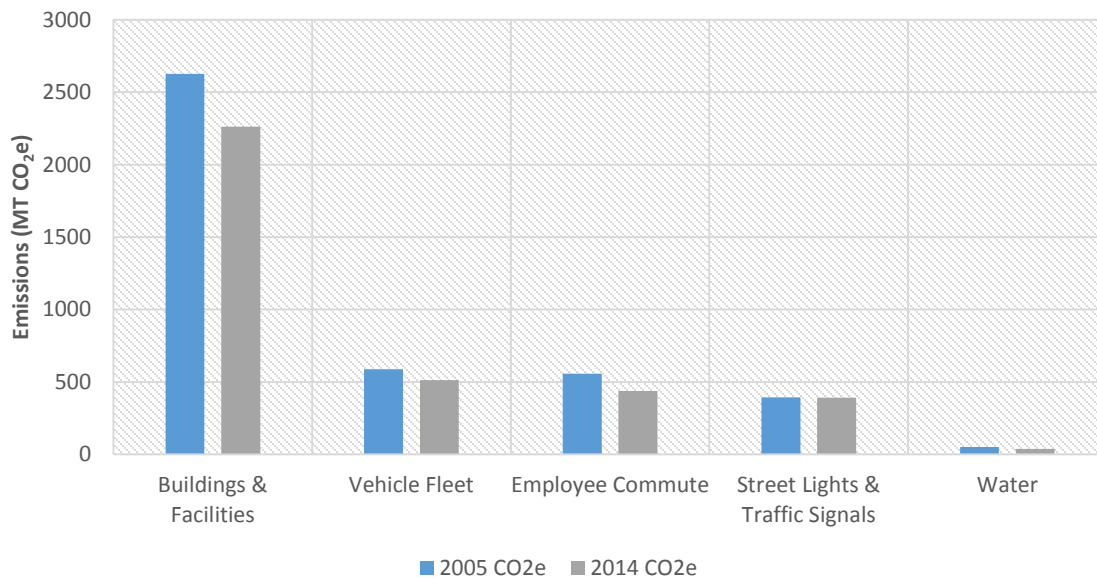


Figure 9: Government Emissions by sector
2005 and 2014 by sector*

*Fugitive Emissions Omitted



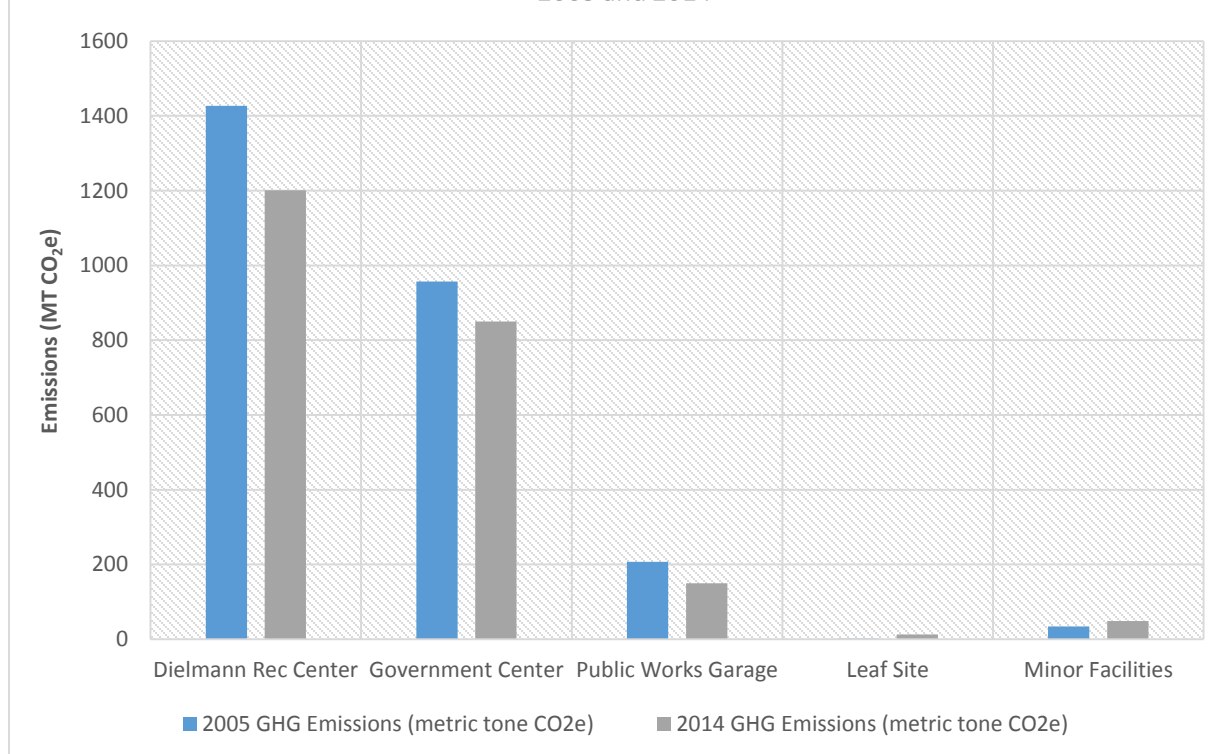
BUILDINGS AND FACILITIES:

Since 2005, Government building and facilities have seen a 13.9% reduction in emissions representing 364 metric of CO₂e (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 ₂ e)	2014 GHG Emissions (MT CO ₂ e)	Difference (MT CO ₂ e)	% 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 2014¹⁷, with diesel seeing similar increases¹⁸. 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.

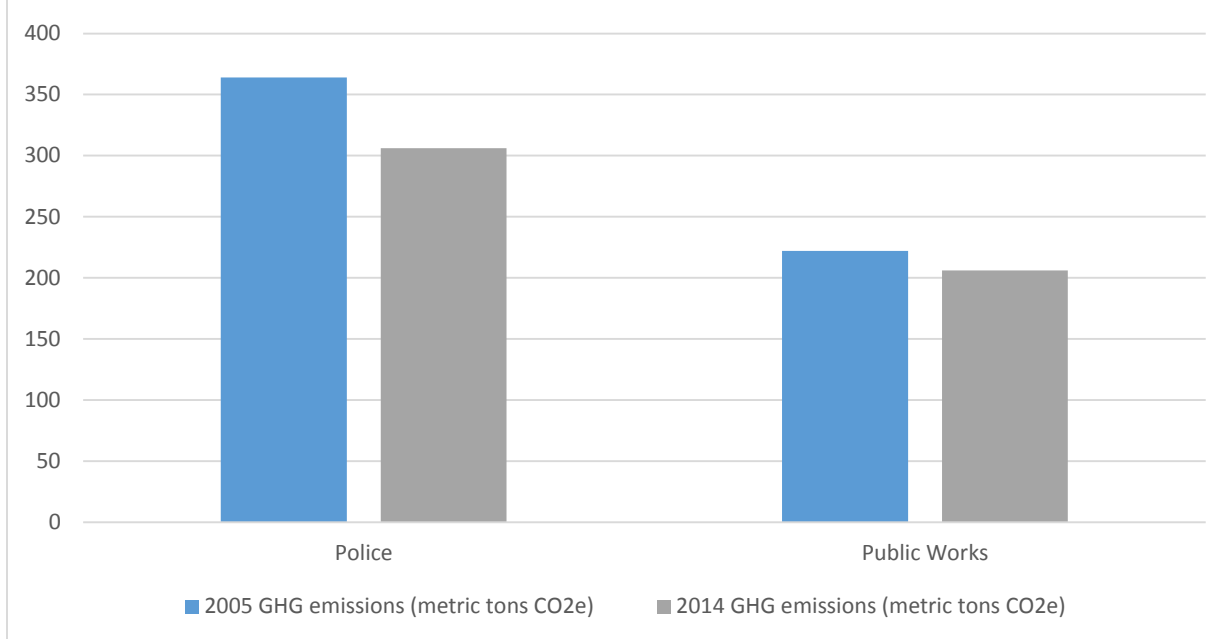
Table 21: Comparison of Vehicle Fleet emission and fuel usage for 2005 and 2014

Department	2005 GHG emissions (MT CO ₂ e)	2014 GHG emissions (MT CO ₂ e)	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/>

Figure 11: Creve Coeur Vehicle Fleet GHG emissions for 2009 and 2015

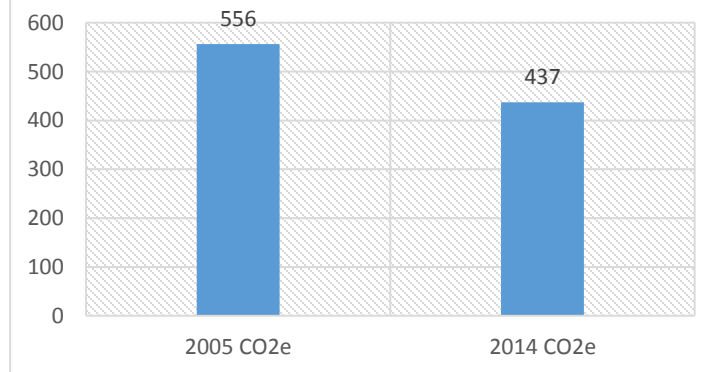


EMPLOYEE COMMUTE:

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 trucks¹⁹. 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 CO₂e in 2005.

Figure 12: Employee Commute emissions 2005 and 2014



¹⁹https://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 CO₂e 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 ₂ e)	2005 Cost (\$)	2014 Street Lights and Traffic Signals	2014 (MT CO ₂ e)	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 CO ₂ e (MT)	2014 CO ₂ e (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 CO₂e 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 CO₂e.

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 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. 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.

CO₂e 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.