City of Creve Coeur, Missouri

Baseline Greenhouse Gas Emissions Inventory for 2005

(August 15th, 2008)

Prepared By:

Spencer Kellum, Intern

Saint Louis University

city of CREVE COEUR

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August 15, 2008

Mayor & City Council
Creve Coeur Government Center
300 N. New Ballas Road
Creve Coeur, MO 63141

Honorable Mayor and City Council Members,

On Wednesday, August 13, 2008, the Recycling, Environment and Beautification Committee, by unanimous vote, approved this greenhouse gas inventory report. We are honored to provide it to the Mayor and City Council.

Sincerely,

Susan Baseley
Chairperson, REB

Credits and Acknowledgements

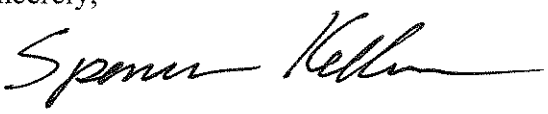
Many people were involved in the completion of this report. In particular, I would like to thank the City of Creve Coeur staff: Frank Dudenheoffer (Maintenance Attendant), Lieutenant William Funkhouser (Commander - Community Policing Division), Robert Gunn (Director of Public Works), Jim Heines (Assistant Director of Public Works), Nancy O'Loughlin (Executive Office Associate), and Connie Parish (Department of Public Works Office Associate).

Also, I would like to express my appreciation for the assistance that Amy Malick (Midwest Regional Director, ICLEI) provided.

This inventory and report is the result of the collaboration of numerous sources. These sources include: Allied Waste Services, AmerenUE, Crawford Bunte Brammeier Traffic and Transportation Engineers, Laclede Natural Gas Company, Missouri American Water Company, St. Louis County Department of Highways and Traffic, 3Degrees, and the City of Creve Coeur's archives. 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.

I would also like to thank the members of the Recycling, Environment and Beautification Committee and the Cool Cities Subcommittee, whose help in the creation of this report was invaluable. Also, I would like to personally thank Jaysen Christensen, David Kirschner and John May for their continued guidance and support in the process.

Sincerely,



Spencer Kellum, Intern

Saint Louis University

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Executive Summary

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 US Mayors' Climate Protection Agreement and 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. This report represents the completion of the Greenhouse Gas Emissions Inventory.

This Greenhouse Gas Emissions 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). This report represents 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 Greenhouse Gas Emissions Inventory was conducted during the summer of 2008 and inventoried emissions released throughout 2005 for use as a baseline. The inventory was separated into two "sides": one side for municipal operations and the other for the entire community within Creve Coeur City limits. The emissions from municipal operations are a subset of total community emissions and are included in the community emission data. They are reported separately in order to provide information that can be used to develop appropriate policy for both municipal operations and for the community as a whole.

This report provides the data that is necessary to guide the design of a GHG abatement action plan. For major reductions in GHG emissions to occur, the sectors of the community which use large quantities of carbon-intensive fuels have to be addressed. This report identifies those sectors. This report also identifies the sectors that use costly fuel sources. It is important to note that programs to realize costs savings require analyses that go beyond the limits of this report, especially analyses of the costs of implementation.

By completing this Greenhouse Gas Emissions Inventory, Creve Coeur has vaulted to a position of leadership in the St. Louis area concerning efforts to understand and mitigate the effects of climate change. To make the most of this leadership role, the author recommends that, using the information provided in this report, the City of Creve Coeur establish a GHG reduction target, as well as develop and implement an action plan to achieve this reduction goal.

Major Findings

Community Emissions and Energy Use

- In 2005, the entire Creve Coeur community emitted 794,963 metric tons of CO_2e. The three major emitters are highlighted below.

Table 1: Major Community GHG Emissions by Sector, 2005

Sector	GHG Emissions (%CO_2e)	GHG Emissions (metric tons CO_2e)
Commercial	42%	336,012
Transportation	34%	268,089
Residential	17%	132,320

- GHG emissions are forecasted to rise 9% by 2015, to 868,363 metric tons of CO_2e.
- Commercial buildings produced the most GHG in the community, at 42%.
- Electricity use constituted 28% of total energy, though it produced 55% of total GHG emissions.
- Per capita residential electricity use was 7,956 kWh in 2007, compared to 5,410 kWh, 4,680 kWh, and 4,720 kWh for three other metropolitan St. Louis cities.[1]
- Gasoline used for Transportation cost the community over $52 million and produced 28% of GHG emissions.

Government Emissions and Energy Use

The City of Creve Coeur government operations generated 3,973 metric tons of CO_2e in 2005. Further analysis of municipal data suggested that inefficient equipment choice and building design may be causing unnecessary energy waste, resulting in increased GHG emissions and energy costs. The three major emitters, and the percentage of total energy costs, are shown below.

Table 2: Major Government GHG Emissions by Sector, 2005

Sector	GHG Emissions (%CO_2e)	GHG Emissions (metric tons CO_2e)	Cost (%)
Buildings	61%	2,431	49.1%
Vehicle Fleet	15%	587	25.2%
Employee Commute	14%	556	N/A

- The City's buildings and facilities accounted for more than 60% of GHG emissions and approximately half of energy purchase costs ($233,693).
- The Public Works Garage used more natural gas in January than either the Government Center or Golf Shop/Ice Arena, despite being a much smaller facility.
- The City's vehicle fleet accounted for 15% of GHG emissions, 22% of total energy use, and 25% of total energy costs ($120,019).
- The energy required to operate the Golf Shop/Ice Arena generated over 100 metric tons of CO_2e each month May through August and cost approximately $11,000 per month.
- Streetlights represent only 9% of City GHG emissions, but 25% of City energy costs ($117,783).
- The daily commute of City employees contributed 14% of GHG emissions and is estimated to have cost each employee an average of $1,100.

[1] The data from 2007, which the provider requested to be kept anonymous, was the only data available for the four cities used for comparison.

Introduction

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 US Mayors' Climate Protection Agreement. This resolution puts the City of Creve Coeur in a position to provide the necessary leadership and awareness needed to effectively cut GHG emissions. Through smart tactics, such as increasing energy efficiency in its buildings, vehicle fleet and streetlights, waste reduction efforts, switching to renewable energy sources, efficiently using land, creating high density communities, establishing green space, planting trees, smart transit planning, and creating transportation alternatives, the City of Creve Coeur has the opportunity to reduce GHG emissions, while improving quality of life. Potential benefits of reducing GHG emissions include lower energy bills, decreased traffic congestion, improved air quality and an increased livability of Creve Coeur.

The purpose of this inventory is to identify and quantify GHG emissions as a first step towards reducing them. This inventory establishes the baseline GHG emission level for the community as a whole, as well as for government operations. The baseline level of GHG emissions is then used to project emissions in a future year, 2015, called the "forecast year." By comparing future levels of GHG emissions against the results of the forecast year, the City will be able to measure the success of reduction efforts

All data in this report is from 2005, with the exception of some traffic volume data from 2004 and 2006. The year 2005 was chosen as the base year because of readily available data. Also, many cities have chosen 2005 as a base year, making comparisons between Creve Coeur and other cities possible.

The Report

The Cities for Climate Protection Campaign has outlined a five step process for reducing GHG emissions. They are:

Step 1: Conduct a baseline emissions inventory and forecast.

Step 2: Adopt an emissions reduction target for the forecast year.

Step 3: Develop a Local Action Plan.

Step 4: Implement policies and measures.

Step 5: Monitor and verify results.

This report was completed with the help of ICLEI-Local Governments for Sustainability and using their Clean Air and Climate Protection Software (CACP). The report was created through the use of two individual inventories within the CACP Software, which are called "sides" - one for emissions of the Creve Coeur community as a whole and one for emissions from municipal operations. The government inventory is considered a subset of the community inventory and is included therein. They are presented separately to facilitate the development of appropriate policy and GHG emissions reductions plans in both contexts.

In a city such as Creve Coeur, it is not possible to actually measure the emissions from all sources in a given year. This inventory represents an approximation of emissions based on energy use data across various sectors. This method was chosen because it was the most

accurate within the limits of cost effectiveness. It is the most commonly used method by cities across the nation and world.

While obtaining detailed and accurate data was the highest priority throughout this inventory, some data limitations were encountered. In these situations, certain assumptions were required to complete small portions of the inventory. These assumptions are noted throughout the text. It is also important to note that the numbers in the tables may not add up to equal exactly the total displayed at the bottom. This occurred because of rounding with the CACP software. The totals are only off by one or less, and this is well within the limits of what would be expected due to rounding.

Climate experts have estimated that stabilizing climate change may require reductions in GHG emissions of 50-85%.[2] The prospect of needing to make such large reductions presents Creve Coeur with a significant challenge. A program to achieve such reductions is beyond the scope of this report. Throughout the text, however, suggestions for possible GHG reduction measures are made as examples of initiatives the City could pursue. These suggestions originate from inefficiencies the author noticed while performing this inventory and are included to guide the creation of the Local Action Plan.

A glossary of terms is provided on page 40.

[2] Intergovernmental Panel on Climate Change, http://ipcc-wg1.ucar.edu/wg1/wg1-report.html

2005 Community Emissions Inventory

Data Organization

The community GHG emissions inventory report is organized into six sectors:

1. Commercial
2. Residential
3. Industrial
4. Transportation
5. Waste
6. Other

For the Commercial, Residential, and Industrial sectors, natural gas and electricity use data were used to approximate GHG emissions. The Transportation sector estimates emissions created by vehicles using roads within the Creve Coeur city limits, whether the trip originated or terminated in Creve Coeur, or simply passed through. They were estimated using various traffic volume studies. From traffic volume, the CACP Software was used to approximate total vehicle miles traveled and GHG emissions. Emissions from the Waste sector focused primarily on methane generated from the decomposition of landfill waste. The estimations were based on the size and composition of the Creve Coeur waste stream. The Other sector represents the electricity used to provide the Creve Coeur community with water.[3]

Community Summary

In 2005, the Creve Coeur community emitted approximately 795,000 metric tons of CO_2e. (See the Glossary for an explanation of CO_2e.) For each sector, percentage of total GHG emissions, amount of GHG emissions, and energy use is shown in Table 3. The percent of total GHG emissions is illustrated in Figure 1. The Commercial, Transportation and Residential sectors were the three largest, together accounting for over 92% of all GHG emissions. The Industrial, Waste and Other sectors together accounted for less than 8%.

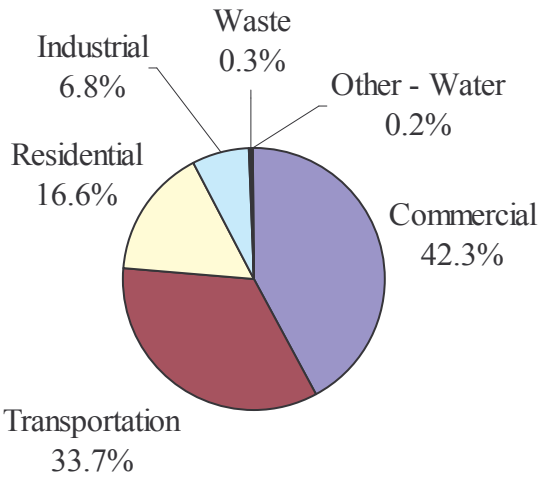
Even though the Commercial sector was the largest emitter of GHG, it used only two thirds as much energy as the Transportation sector. The Residential sector used half as much energy as the Commercial. Therefore, the amount of GHG released per unit of energy was highest in the Commercial sector, second in Residential, and third in Transportation. A partial explanation for this is that most of the emissions in the Commercial and Residential sectors come from electricity use. Most of the electricity in this region is generated at coal-fired power plants. Coal is, in comparison to other fuels, a carbon intensive fuel[4] and is dirty when incinerated to produce energy.

[3] See Appendix 1 for detailed description of water data.
[4] Source: http://www.uraniumsa.org/esd/energy_comparison_table.pdf

Table 3: Total Community GHG Emissions by Sector, 2005

Sector	GHG Emissions (%CO_2e)	GHG Emissions (metric tons CO_2e)	Energy Equivalent (MMBtu)
Commercial	42.3%	336,012	2,217,716
Transportation	33.7%	268,089	3,444,668
Residential	16.6%	132,320	1,056,718
Industrial	6.8%	54,299	265,269
Waste	0.3%	2,686	-
Other - Water	0.2%	1,558	-
Total	**100.0%**	**794,963**	**6,984,371**

Figure 1: Total Community GHG Emissions by Sector, 2005



The emissions and energy use from each major energy source are depicted in Table 4. Electricity is the largest, with over half of the total community GHG emissions. Gasoline and Diesel, which are transportation fuels, combine to total 33.7% of community GHG emissions. Natural Gas contributed 11.0%. The last four energy sources are waste materials that emit carbon dioxide and methane as they decompose in a landfill. Refer to the Waste sector description for a detailed explanation of these last four energy sources.

Table 4: Total Community GHG Emissions by Energy Source, 2005

Energy Source	GHG Emissions (%CO_2e)	GHG Emissions (metric tons CO_2e)	Energy Equivalent (MMBtu)
Electricity	55.0%	437,024	1,984,533
Gasoline	27.9%	221,713	2,855,683
Natural Gas	11.0%	87,164	1,555,171
Diesel	5.8%	46,377	588,985
Paper Products	0.3%	2,224	-
Food Waste	0.1%	634	-
Wood/Textiles	0.0%	-25	-
Plant Debris	0.0%	-148	-
Total	**100.0%**	**794,963**	**6,984,371**

Energy use is broken down for the Commercial, Residential and Industrial sectors by fuel type in Table 5. Creve Coeur used 581,278,086 kWh of electricity throughout 2005. To get an idea of how Creve Coeur compares to other St. Louis metropolitan cities, residential per capita electricity was calculated using 2007 data. (The data from 2007 was the only data available for the four cities used for comparison.) Creve Coeur's per capita residential electricity use was 7,956 kWh. Three[5] other metropolitan St. Louis cities' per capita electricity use were much less: 5,410 kWh, 4,680 kWh, and 4,720 kWh.

Using a current average of $0.0639[6] per kWh, residential electricity use in 2005 is estimated to have cost almost $8.4 million.[7] A similar calculation for the Commercial and Industrial sectors would be unreliable because pricing rates for these sectors are more variable than Residential rates. An analysis of monthly electricity usage could possibly help the City identify the end uses from which electricity demand originates. Unfortunately, such an analysis could not be performed because the necessary data was not available.

Table 5: Total Community Energy Use by Sector, 2005

Sector	Electricity (kWh)	Natural Gas (therms)
Commercial	379,674,500	9,218,985
Residential	131,080,309	6,093,453
Industrial	70,523,277	239,268
Total	**581,278,086**	**15,551,706**

[5] The data provider requested the cities be kept anonymous.
[6] Cost per kWh computed from residential rates at https://www2.ameren.com/business/Rates/ratesBundledElecFullSrvMO.aspx
((0.0792 * 4) + (0.0562 * 8)) / 12 = $0.0639
[7] $0.0639 * 131,080,309 kWh = $8,371,662.40

Monthly Natural Gas Use Trends

The monthly natural gas use for the community as a whole is displayed in Figure 2. The curve is expected, with higher usage in the winter months than summer, because of the role natural gas plays as fuel for space heating. However, over 500,000 therms per month are still used in the summer. One possible explanation for the observed summer usage is the continued use of natural gas for water heating and cooking throughout the summer. Residential and Commercial monthly natural gas use is depicted in Figure 3. As expected, the two sectors tend to follow trends similar to each other and to the community as a whole.

Figure 2: Community Monthly Natural Gas Use, 2005

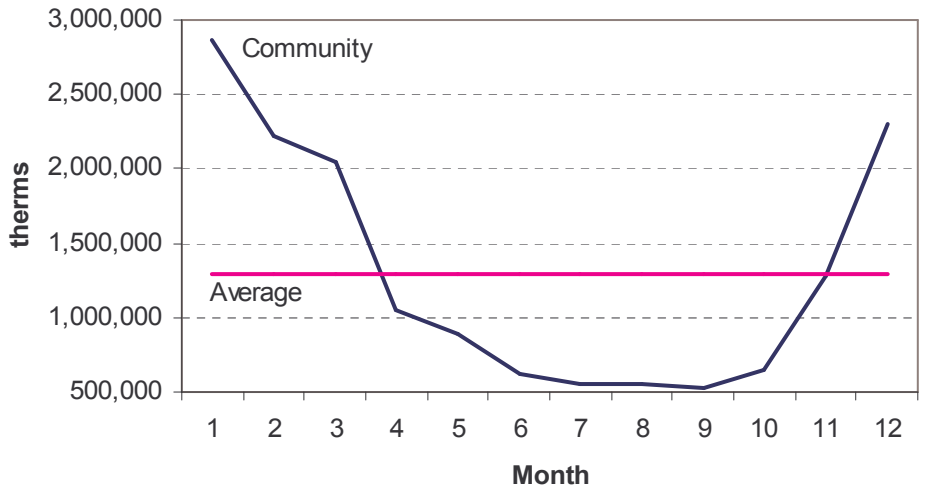
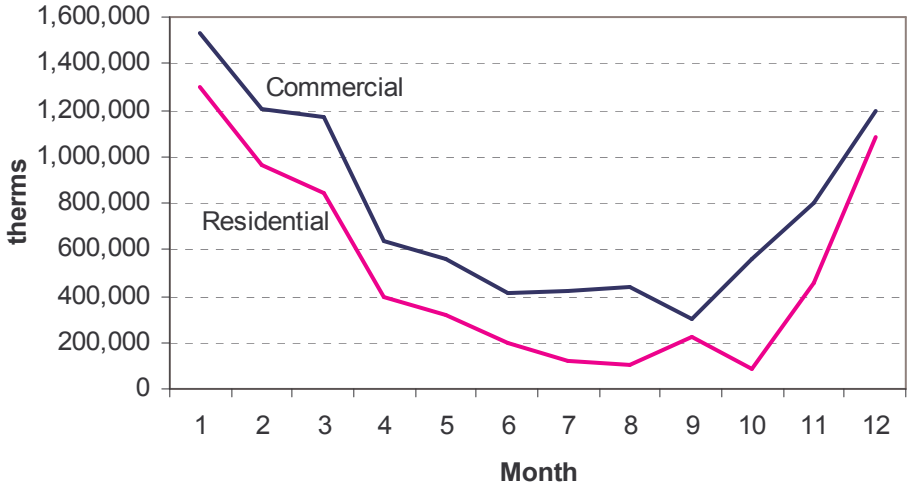


Figure 3: Residential and Commercial Monthly Natural Gas Use, 2005



Local Action Plan Suggestions

1. Community

The keys to successfully cutting GHG emissions are the education and motivation of community members. Rising fuel costs have started to provide some motivation for change, but the City can help build a positive framework for change by educating the community. A public education and outreach campaign could be developed that instructs community members in real world solutions, such as techniques for retrofitting energy efficient technology in homes and businesses. To be truly successful, sustainability has to become integrated into the Creve Coeur culture, and educating community members is an important first step.

To address community emissions, the City needs to develop programs that inspire the public to change the way energy is used. It is important that these programs fall under one advertising campaign. "Creve Coeur: Cool City!" has already been informally adopted as the slogan and should continue serving this purpose. This slogan could be combined with a suitable logo containing a declaration of the reduction target. An example of this, based on a hypothetical reduction target, is depicted below. (The crest is green.) A comprehensive campaign would allow residents and businesses to associate reduction measures with the overall movement, which would help integrate sustainability into the psyche of Creve Coeur. This would also convey the sense that the Cool Cities initiative is unified in working towards the stated goal.

The City could develop an online GHG footprint calculator and provide a set of choices for local GHG reduction measures, such as an urban tree program, that residents and businesses can fund through GHG offset credits.

Also, the City could encourage residents and businesses to participate in Pure Power, which is AmerenUE's voluntary renewable energy program. Participants pay an additional $0.015 per kWh, or $15 per block of 1000 kWh, to fund renewable energy projects.

Commercial

To curb emissions from the Commercial sector, the City could help promote AmerenUE's Commercial Energy Audit/Upgrade Rebates program to area businesses.

This program "reimburses participants up to $1,000 for initial energy audits…and up to 33% - with a cap of $5,000 per customer – for the cost of implementing energy efficiency recommendations that resulted from the audits."[8]

Residential

Residents could also be encouraged to increase the energy efficiency of their homes. This could be done through the development of a program that residents can commit to by signing a pledge. This program could be supported by local advertisements, ranging from public service announcements on local radio stations, to "Creve Coeur: Cool City!" car window stickers that recognizes an individual's commitment to climate protection. A brochure with tips to cut energy use and GHG emissions could be made available throughout the city. A similar program could be developed for all sectors of the community.

The Change a Light Campaign, administered by the Midwest Energy Efficiency Alliance (MEEA), and supported by AmerenUE, offers Missouri residential electric customers a $2 rebate on compact fluorescent bulbs (CFLs) at participating hardware stores. This campaign is similar to Kansas City's Million Lights Campaign, which surpassed its goal of replacing one million incandescent light bulbs with CFLs. Creve Coeur could model a campaign similar to Kansas City's and utilize the rebates offered through the Change a Light Campaign. This program can be applied community wide, but the rebate could not.

[8] http://www.ameren.com/Community/ADC_07CommunityConnectionsBrochure.pdf

Transportation

The Transportation sector estimates emissions created by vehicles using roads within the Creve Coeur city limits, whether the trip originated or terminated in Creve Coeur, or simply passed through. The Transportation sector emissions are shown in Table 6. Emissions from the Transportation sector were 33.7% of the community total in 2005. Data from 2004, 2005 and 2006 was used to ensure there were enough data points to accurately represent traffic in Creve Coeur. Traffic data obtained from roads that are not technically in Creve Coeur were included when the counting site was located just outside City limits and the vehicles being counted are either entering or leaving Creve Coeur.

The length of each type of road (collector/local, arterial and highway) within City limits is also shown in Table 6. The Highway road type refers to the two miles of Interstate 270 that pass through Creve Coeur. Olive Boulevard, New Ballas Road and Ladue Road are examples of Arterial roads. Roads such as Mason, Schuetz and Schulte are considered to be Collector/Local roads.

Table 6: Relative GHG Emissions by Road Type, 2005

Road Type	GHG Emissions (%CO_2e)	GHG Emissions (metric tons CO_2e)	US Gallons Gas Equivalent	Energy Equivalent (MMBtu)	Miles of Road Type
Collector/Local	54.0%	144,750	14,807,752	1,859,893	99.2
Highway	27.0%	72,438	7,410,256	930,748	2.0
Arterial	19.0%	50,901	5,207,105	654,026	10.7
Total	**100.0%**	**268,089**	**27,425,112**	**3,444,668**	-

In 2005, the official census population estimate of Creve Coeur's night time population was 16,920.[9] The Creve Coeur Olivette Chamber of Commerce estimates the daytime population to be about 50,000.[10] The day and night population difference is roughly 33,000, meaning that there is a net population gain throughout the day. Most of this population gain is due to the workforce commuting to Creve Coeur for the day. Without a comprehensive public transportation system that links people with the places they need to go, the Transportation sector will continue to be a significant contributor of GHGs.

The community used an estimated 22,736,000[11] gallons of gasoline commuting in 2005. Using a 2005 average gasoline price of $2.27[12] per gallon, this cost the drivers in the community roughly $51,610,000.[13] At a mid-2008 price of $4.00 per gallon of gasoline, this equates to nearly $91,000,000.[14] The majority of money spent on gasoline leaves the region, denying the local economy a significant revenue source.

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[9] Source: Population Division, U.S. Census Bureau , Table 4: Annual Estimates of the Population for Incorporated Places in Missouri, Listed Alphabetically: April 1, 2000 to July 1, 2007 (SUB-EST2007-04-29), Release Date: July 10, 2008

[10] Estimate found at http://www.ccochamber.com/development.shtml

[11] Note that this does not include Diesel fuel.

[12] Computed from the US Department of Energy's energy statistics located at http://www.eia.doe.gov/emeu/steo/pub/xls/Fig2.xls. An average of monthly retail gas prices for 2005 was calculated and utilized.

[13] $2.27 * 22,735,845 Gallons = $51,610,368.15

[14] $4.00 * 22,735,845 Gallons = $90,943,380.00

Local Action Plan Suggestions

2. Transportation

To help curb GHG emissions from the Transportation sector, the City could pass a "no-idling" ordinance in Creve Coeur. This ordinance would cut down on unnecessary fuel waste. Idling for longer than ten seconds uses more fuel and produces more GHG than restarting the engine.[15] Signs could be placed at common idling locations, such as schools, to remind residents of the ordinance.

The City could also initiate a program to encourage residents to reduce the number of vehicle trips they make, and to use more fuel efficient vehicles. Dense, walkable cities with vital town centers are more energy efficient than sprawled suburban designs.

Waste [16]

The Waste sector accounted for 0.3% of total community emissions. The GHG emissions associated with each waste category is shown in Table 7. In 2005, Creve Coeur produced 5,627 tons of waste and diverted an additional 1,238 tons of recyclables. The emissions associated with this sector come from the biological breakdown of organic materials in a landfill. This produces methane, which is a GHG that is 21 times more potent than carbon dioxide.[17] Creve Coeur's waste stream produces such small amounts of methane that the effect of the increased potency is small when compared to total emissions.

This inventory addresses the most common organic materials in a typical waste stream: paper products, food waste, plant debris and wood/textiles. (The majority of the remaining waste does not decompose and does not emit GHG.) Methane can be captured at the landfill site and used as fuel to generate electricity. Creve Coeur's waste goes to the landfill in Roxana, Illinois, which does capture some of the methane produced. However, data regarding the amount captured was not available, so the inventory was conducted assuming no methane was recovered.

When wood, textiles, and plant debris are landfilled, the effect is considered a net reduction in GHG emissions because their emissions are partially sequestered in the landfill. Please see Appendix 1 for a detailed discussion.

[15] http://www.oee.nrcan.gc.ca/transportation/idling/wastes.cfm?attr=8

[16] It should be noted that the inventory was conducted assuming that plant debris collected by the City was landfilled. During the writing of this report it was noticed that this is not the case. Because the Waste sector is such a small portion of total GHG emissions, 0.3%, the effects of this assumption are very small.

[17] http://www.epa.gov/methane/scientific.html

Table 7: Relative GHG Emissions by Waste Composition, 2005

Waste Type	(%CO_2e)	GHG Emissions (metric tons CO_2e)	Percentage of Total Waste
Paper Products	82.8%	2,224	36.0%
Food Waste	23.6%	634	11.0%
Plant Debris	-5.5%	-148	18.0%
Wood/Textiles	-0.9%	-25	2.0%
All Other Waste	0.0%	0	33.0%
Total	**100.0%**	**2,686**	**100.0%**

While the effects of recycling do not explicitly show up in this inventory, it does save the virgin material required for the production of new products. Also, recycling keeps paper products from reaching the landfill where they would have produced GHG. Any increases in recycling quantities from 2005 levels should be counted as a GHG reduction measure. The use of commingled 60 gallon toters, planned to go into operation in 2009, is predicted by the recycling company to increase per capita recycling volume.

Reducing waste is an important environmental strategy for Creve Coeur for a number of reasons: landfill space is limited and increasingly expensive and less waste reduces the risk of toxic compounds leaching into the groundwater. However, because waste is such a small fraction of Creve Coeur's GHG emissions, waste reduction is not a likely place to find large future GHG reductions.

Local Action Plan Suggestions

3. Waste

Many cities have adopted a "pay as you throw" policy,[18] also known as a variable-rate waste program. In such a program, citizens are charged based on the amount of garbage they produce (measured by number of trash bags or size of trash can), while recycling is provided free of charge. This creates an incentive to recycle and keeps the taxpayer from subsidizing the wastefulness of others.

The cost savings for the City would be significant. Currently, the City pays $3.82 monthly for recycling service at each of the 5,520 residential households. The City pays a monthly waste removal fee of $13.92 for each household. In May of 2008 alone, the City paid $76,838.40 for waste service, compared to $21,086.40 for recycling service over the same period. If a pay as you throw program were in place, citizens could be given composting bins, paid for with money normally spent providing waste service, which would divert organic waste from the landfill where it would normally produce GHG.

[18] http://americancityandcounty.com/mag/government_payasyouthrow_payoff/

Other: Water

The GHG emissions from the Water sector constituted 0.2% of total community emissions. The emissions from the Water sector are calculated from the energy Missouri American Water Company used to pump and treat Creve Coeur's water. This data was included in the Other sector because the water facility is normally expected to be located with the city boundaries. Theoretically, water facility energy use should be included in the community energy data from the utilities. Creve Coeur's situation is different because our water is provided by the St. Louis County Central Plant in Maryland Heights, which is outside the City of Creve Coeur, and therefore, not included in the community electric data from AmerenUE.

The St. Louis County Central Plant serves a population of 660,000 and consumed 81,000,000 kWh of electricity. The 2005 U.S. Census Bureau's annual population estimate of 16,920[19] was used to estimate Creve Coeur's portion of total electricity used, and from that emissions were estimated. This calculation resulted in an emissions estimate of 1,558 metric tons of CO_2e in 2005 or 0.2% of total GHG emissions. The decision to use residential rather than daytime population for this calculation almost certainly results in an underestimation of the GHGs emitted by this sector. Since the GHG emissions resulting from water treatment and pumping tend to be small, the error is not felt to be substantive. The rationale for the decision is described in Appendix 1.

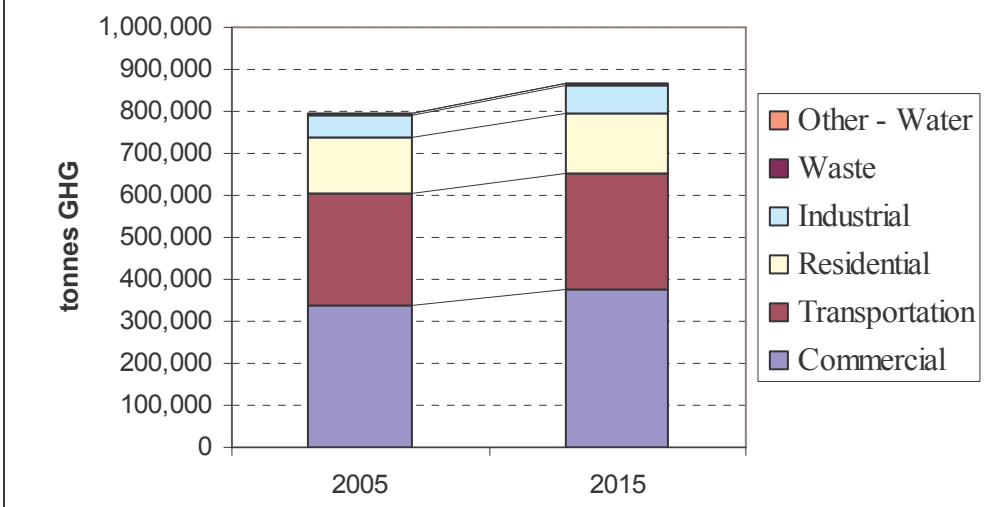
[19] Source: Population Division, U.S. Census Bureau , Table 4: Annual Estimates of the Population for Incorporated Places in Missouri, Listed Alphabetically: April 1, 2000 to July 1, 2007 (SUB-EST2007-04-29), Release Date: July 10, 2008

2015 Community Emissions Forecast

Under a business as usual scenario, the City of Creve Coeur's community GHG emissions will increase over the next seven years. Unless abatement action is taken, GHG emissions are expected to rise 9% by 2015, to 868,363 metric tons of CO_2e. The projected growth in each sector's emissions is shown in Figures 4 and 5. Various reduction target options and the GHG emission reductions required to meet these targets are shown in Table 8. The reduction target options pursue a specific reduction percentage from the forecast emissions in 2015.

The forecast year was conducted using an energy use growth forecast tool from ICLEI, based on data from the U.S. Department of Energy, Energy Information Administration. This tool used a local Creve Coeur population growth rate of 0.37%[20] per year, which was calculated from the U.S. Census Bureau's annual population estimates from 2000 to 2007.

Figure 4: Creve Coeur GHG Emissions for Forecast Year 2015



[20] ((16,933-16,500) / 7) / 16933 = 0.003653 or 0.37%

Figure 5: Forecasted Change in Emissions by Sector, 2005-2015

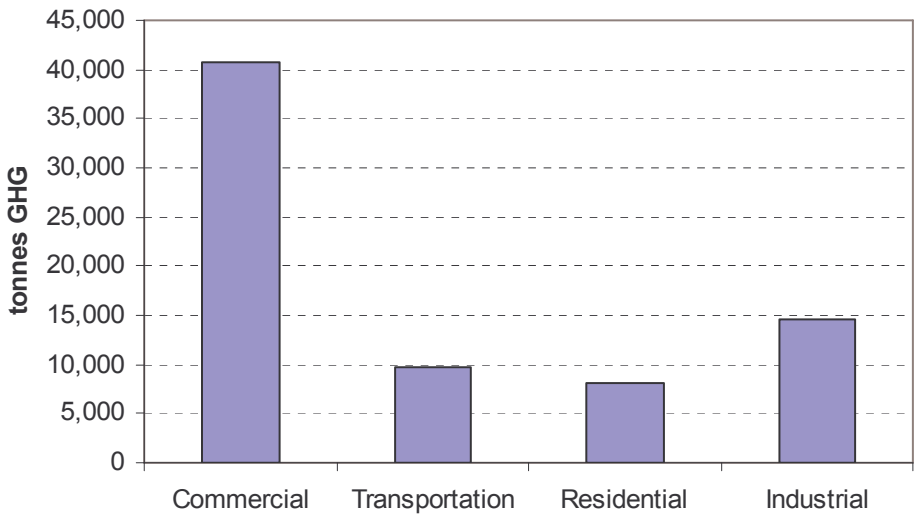


Table 8: GHG Emissions Reductions for Forecast Year 2015

Reduction %	Target Emissions Level (CO_2e)	Emissions Reductions Required (CO_2e)
10%	781,527	86,836
15%	738,109	130,254
20%	694,690	173,673
25%	651,272	217,091
30%	607,854	260,509
50%	434,182	434,182

2005 Government Operations Emissions Inventory

Introduction

Over the course of 2005, the City of Creve Coeur's municipal operations produced 3,973 metric tons of CO_2e. The City paid over $476,000 for electricity, natural gas and fuel for its buildings, vehicle fleet, streetlights, and irrigation systems. While the City itself is responsible for only a small portion of the community's total emissions, the City has the unique opportunity to lead the entire community by example and to pioneer practices and technologies that the City wishes to encourage throughout the community. As the City strives to become the community leader in emissions reduction efforts, it will also benefit from the associated energy and maintenance cost savings. Decreasing municipal costs can free up funds which can be used to support other services, or to finance further emission reduction efforts.

Data Organization

The government side of the inventory is organized into five sectors:

1. Buildings
2. Vehicle Fleet
3. Employee Commute
4. Streetlights and Traffic Signals
5. Water

The Buildings sector includes all facilities and buildings the City operates. Vehicle Fleet refers to the City's various cars and trucks, which are operated by several departments such as the Police and Public Works Departments. The Employee Commute sector accounts for the GHG emissions produced by motor vehicles used by fulltime employees in their daily commute. The Streetlights and Traffic Signals sector includes only the streetlights and traffic signals for which the City pays. For instance, streetlights paid for by subdivisions or by MoDOT (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.

The results of the government inventory will first be broken down by sector. This method is used to identify which sectors are large emitters, where the potential for large reductions is greatest. Another way the data will be shown is energy cost by sector. Organizing data by energy costs will draw attention to sectors that use expensive fuels or large amounts of fuel. This will show which sectors offer the highest potential for financial savings. In some cases, the data is broken down further into monthly energy use trends. Monthly data will show seasonal differences, as well as identify any irregular, and potentially inefficient, energy use trends.

Government Operations Summary

Government emissions, energy use, and energy cost are broken down by sector in Table 9 and depicted in Figures 6 and 7. The GHG emissions from the electricity and natural gas used in the City's buildings were more than four times the amount of the next largest source, which was fuel, primarily gasoline, used in the City's vehicle fleet. The daily commute of fulltime City employees generated almost as much GHG as the Vehicle Fleet, but fuel was paid for individually; therefore, the City had no direct fuel costs for this sector. City-controlled streetlights contributed a smaller portion of emissions, but were nearly a quarter of total energy

costs. The City's fountains and irrigation systems contributed very little compared to other sectors.

Table 9: Total Government GHG Emissions by Sector, 2005

Sector	(%CO_2e)	GHG Emissions (metric tons CO_2e)	Energy Equivalent (MMBtu)	Cost ($)	Cost (%)
Buildings	61.2%	2,431	17,616	$233,693	49.1%
Vehicle Fleet	14.8%	587	7,604	$120,019	25.2%
Employee Commute	14.0%	556	7,164	$0	0.0%
Streetlights	8.9%	353	1,611	$117,783	24.7%
Water	1.1%	45	204	$4,555	1.0%
Total	**100.0%**	**3,973**	**34,079**	**$476,049**	**100.0%**

Figure 6: Total Government GHG Emissions by Sector, 2005

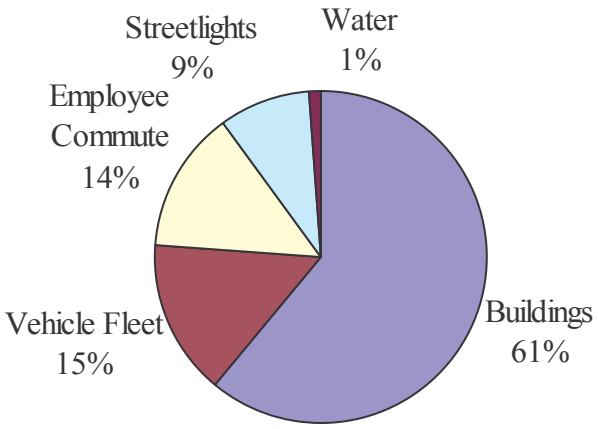
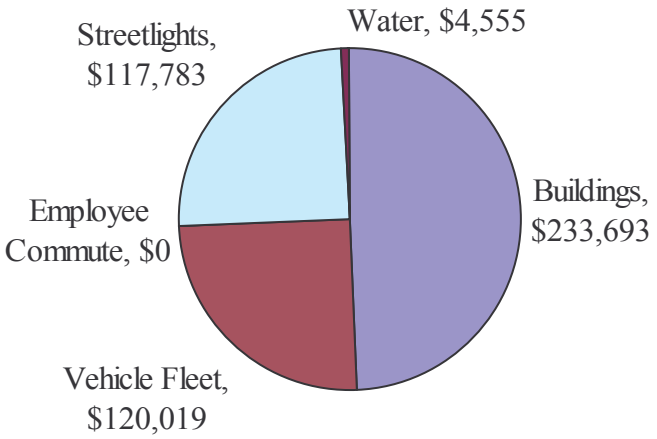


Figure 7: Government Energy Costs by Sector, 2005



Buildings

Municipal buildings generated 61.2% of total government GHG emissions. Relative emissions contributions for each individual building are depicted in Table 10 and illustrated in Figure 8. The top two contributors were the Ice Arena and the Government Center. Combined, these two buildings were responsible for 74.4% of emissions from City buildings. Four facilities were responsible for 98% of Buildings emissions and 60% of total municipal emissions. Therefore, focusing on these four sites has the greatest potential to yield large municipal emissions reductions. It is important to note that the Ice Arena and Golf Shop are in the same building; together that one building was responsible for 53.4% of Building emissions.

Figure 8: Building Sector Relative GHG Emissions, 2005

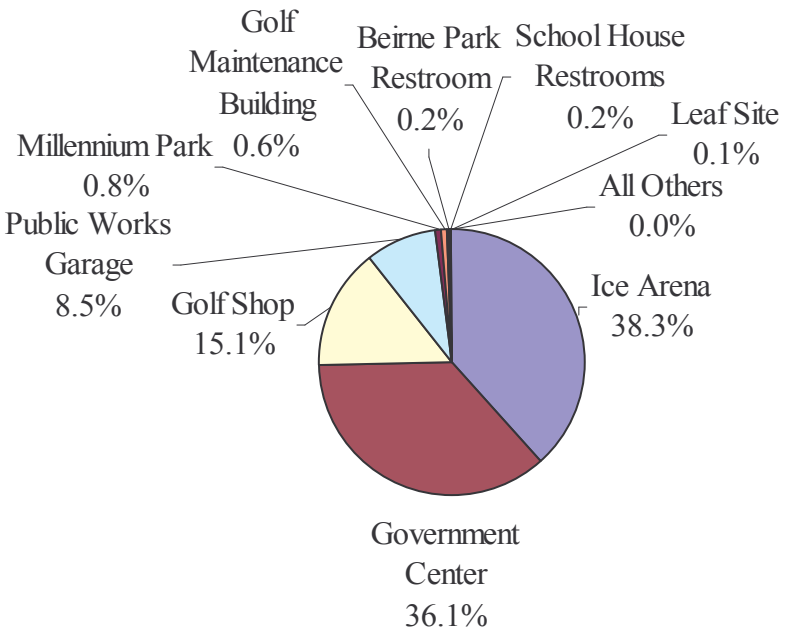


Table 10: Buildings GHG Emissions, 2005 [21]

Building	(%CO_2e)	GHG Emissions (metric tons CO_2e)	Electricity Use (kWh)	Electricity Cost ($)	Natural Gas Use (therms)	Natural Gas Cost ($)	Energy Equivalent (MMBtu)
Ice Arena	38.3%	932	1,170,360	$59,565	9,887	$10,074	4,983
Government Center	36.1%	878	995,040	$55,153	23,660	$24,734	5,762
Golf Shop	15.1%	367	267,720	$17,795	29,660	$30,221	3,880
Public Works Garage	8.5%	207	99,408	$6,159	23,593	$25,057	2,699
Millennium Park	0.8%	20	27,209	$1,236	-	-	93
Golf Maintenance Building	0.6%	15	20,490	$1,196	-	-	70
Beirne Park Restroom	0.2%	5	1,472	$148	740	$886	79
School House Restrooms	0.2%	5	6,692	$546	-	-	23
Leaf Site	0.1%	2	194	$27	251	$397	26
Conway Park Restrooms	0.0%	0	381	$118	-	-	1
Tappmeyer House	0.0%	0	79	$98	-	-	0
School House Cabin Lighting	0.0%	0	65	$97	-	-	0
Malcolm Terrace Park	0.0%	0	12	$93	-	-	0
Conway Park Cabins	0.0%	0	5	$93	-	-	0
Total	**100.0%**	**2,431**	**2,589,127**	**$142,324**	**87,791**	**$91,369**	**17,616**

[21] Data obtained from AmerenUE and Laclede Gas utility bills from Creve Coeur City archives.

Local Action Plan Suggestions

4. Buildings

Often, significant emissions and energy cost reductions can be attained through lighting efficiency upgrades. Another common strategy involves hiring an outside energy consultant (see below) to review each building and develop recommendations for improving building efficiency in a systematic manner. Given the large fraction of GHG emissions and energy costs attributable to specific City buildings, these two strategies may offer significant reductions in both.

The City of Creve Coeur can achieve significant financial benefits by hiring a professional energy consultant,[22] such as Energy Solutions, Inc. (ESI), to perform an analysis of, and develop a comprehensive strategy for, the City buildings. ESI has done numerous projects, such as the Monsanto Center, 11 of University City School District schools and administrative buildings, and the Donald Danforth Plant Science Center. According to the ESI website,[23] "clients consistently realize 30%, 40%, even 50% savings on their utility bills." The cost of natural gas and electricity for the Government Center in 2005 was nearly $80,000. A 30% savings would be approximately $24,000 annually.

The City could choose to enroll in AmerenUE's Pure Power program, which provides funding to renewable energy projects. By enrolling, the City would agree to pay an additional $0.015 per kWh each month or purchase blocks of 1,000 kWh for $15 each. The City of Clayton was the first St. Louis metropolitan city to enroll in Pure Power and did so in July, 2008. Clayton is paying $495 extra each month to support renewable energy. To fully cover the 83,000 kWh the Government Center uses in an average month, the City would have to pay an additional $1243 each month. The cost could, and should, be brought down with efficiency upgrades prior to enrolling.

[22] Other local companies:

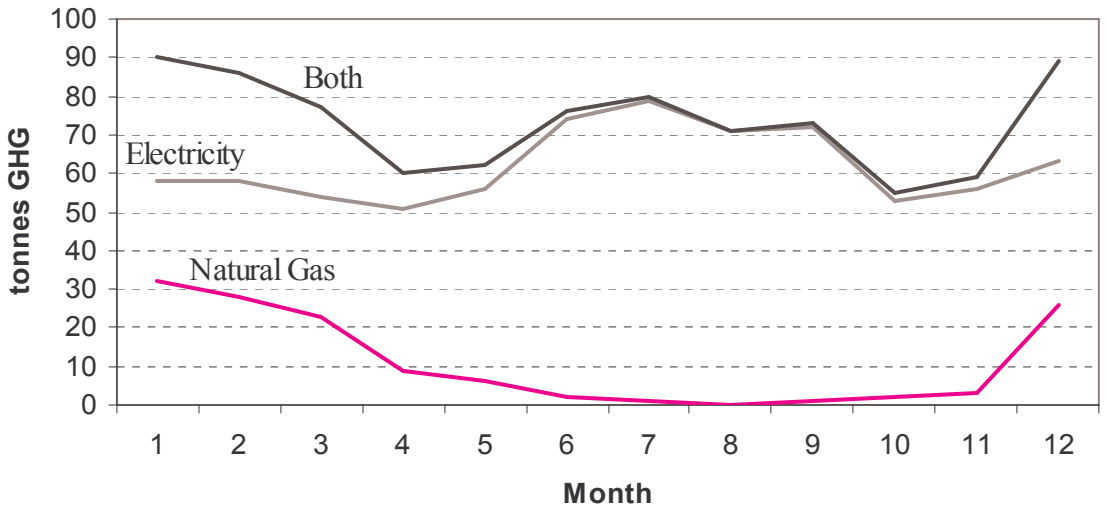
1) Vertegy Consultants. Phone: (314) 733-2666. http://www.vertegyconsultants.com/
2) Sage Homebuilders, Renovation Division. Phone: (314) 576-5550. http://www.sagestl.com/index2.html

[23] http://www.energysolutions-stl.com/

Monthly Building Energy Use Trends

The following figures are focused on the top four GHG emitters: the Government Center, Golf Shop/Ice Arena, and Public Works Garage. The monthly trend of energy use and GHG production over the year 2005 is highlighted in each figure. A summary of GHG emissions for the three buildings is shown in Figure 9.

Figure 9: Monthly GHG Emissions For Select Buildings, 2005



Government Center

The monthly trend of energy use for the Government Center is shown in Figure 10. One might expect a curve like this, with electricity spiking in the hot summer months due to air conditioning, while the cold winter months have increased natural gas usage. The monthly GHG emissions for each energy source are depicted in Figure 11. By displaying the data in this manner, it is clear that electricity use is the main source of GHG. The cost of the energy used in the Government Center is displayed in Figure 12.

Figure 10: Government Center Monthly Energy Use, 2005

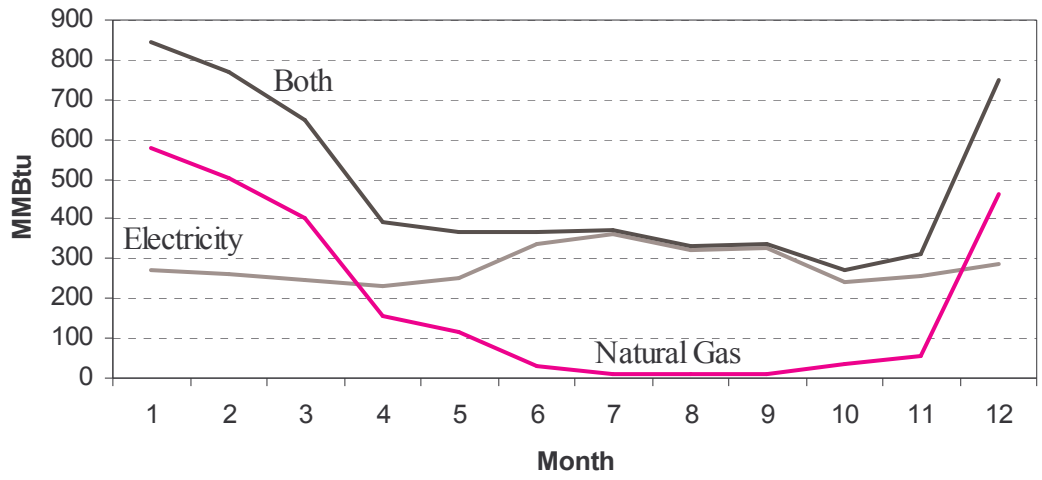


Figure 11: Government Center Monthly GHG Emissions by Energy Source, 2005

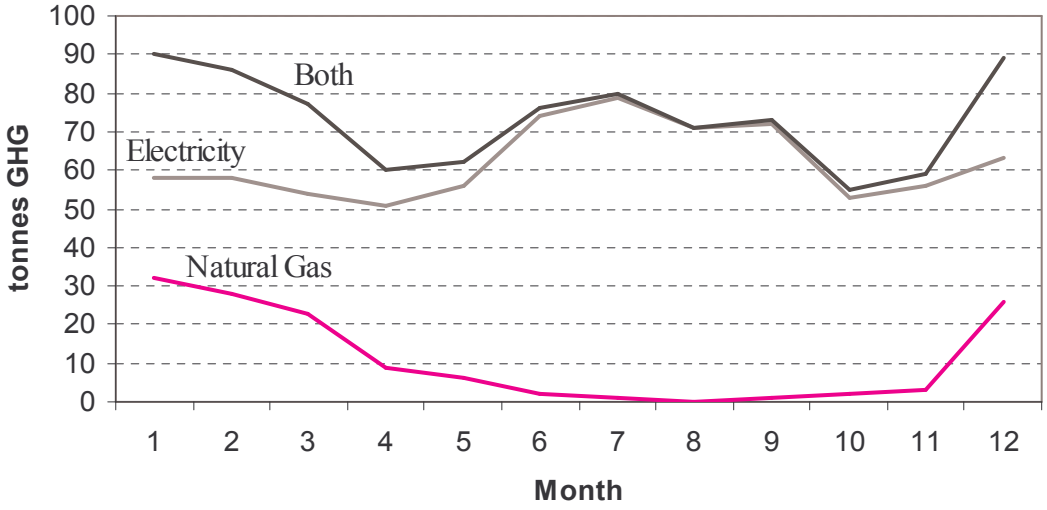
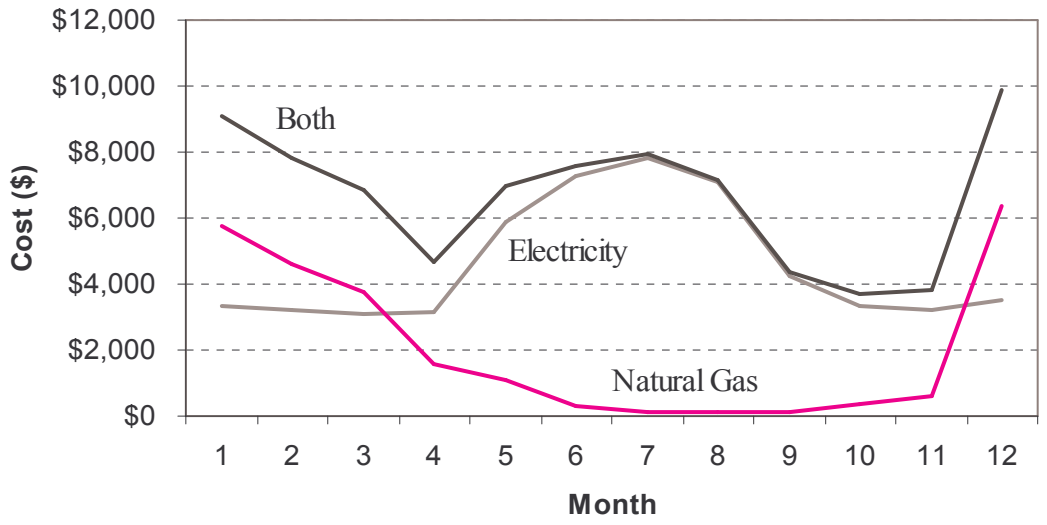


Figure 12: Government Center Monthly Cost by Energy Source, 2005



Local Action Plan Suggestions

5. Government Center

An improvement in HVAC system efficiency would decrease emissions from both electricity and natural gas use. The installation of window film[24] on all windows in the Government Center would increase the efficiency of the windows. This would decrease solar heat gain in the summer, which would reduce the cooling load on the HVAC system. Conversely, it would reduce heat loss in the winter.

The skylights in the atrium of the Government Center allow a significant amount of heat in during the summer because of the southern orientation of the windows. These windows receive direct sunlight throughout the year. Replacing these skylights with low-emissivity skylights,[25] which suppress heat flow across the window, will decrease solar heat gain and reduce the amount of energy used to cool the building. Minimally, these windows should be covered with a highly reflective film.

Increasing light bulb efficiency is a popular reduction technique. Since 2003, the 40-watt overhead lights in the Government Center have been replaced with 34-watt bulbs as they burn out. According to maintenance staff, roughly 80% of the lights have been upgraded as of mid-2008. Greater efficiency could be gained through upgrading to T5 or T8 fluorescent bulbs.

Installing occupancy sensors to control lights in rooms that are sporadically used would

[24] Local company:
1) Dalo Glass Tinting. 6258 Lemay Ferry Rd, St. Louis, MO 63129. Phone: (314) 416-7400. http://www.daloglasstinting.com/

[25] Local companies:
1) St. Louis Skylights. Chesterfield. Phone: (636) 536-2000 http://www.stlouisskylights.com/
2) Premier Skylights, LLC. Maryland Heights. Phone: (314) 298-8500 http://www.premierskylights.com

save energy from being wasted when the room is unoccupied. In the Government Center, several meeting rooms have seen this retrofit. This could be expanded into the restrooms and other fitting locations.

Another suggestion would be to paint the roof membrane with a reflective, white coating, which would reflect sunlight. This would cool the building and help reduce summer energy use by easing the load on the cooling system. A black roof can be up to 40^{0}F warmer than the surrounding air, whereas the temperature difference with a white roof is only 10^{0}F. This practice can also increase the life of the roof because it decreases the wear on the roof by lessening the expansion and contraction occurring because of heating and cooling throughout the day. There is a slight increase in winter heating costs, but this is outweighed by the benefits in the summer.

Golf Shop/Ice Arena

The monthly trend of energy use for the Ice Arena and Golf Shop is depicted in Figure 13. They are combined because they are in the same building. Again, the expected trends are present, with higher natural gas use in the winter months. As at the Government Center, electricity use produces the most GHG, which is shown in Figure 14. The cost of the energy used is shown in Figure 15. It is important to notice that energy, mainly electricity, in the summer months cost the City approximately $11,000 each month.

Figure 13: Golf Shop/Ice Arena Monthly Energy Use, 2005

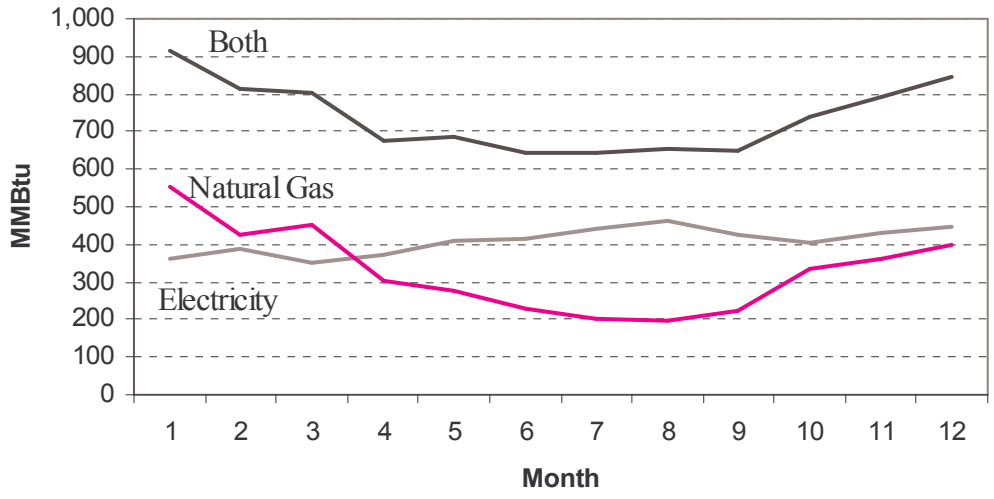


Figure 14: Golf Shop/Ice Arena Monthly GHG Emissions by Energy Source, 2005

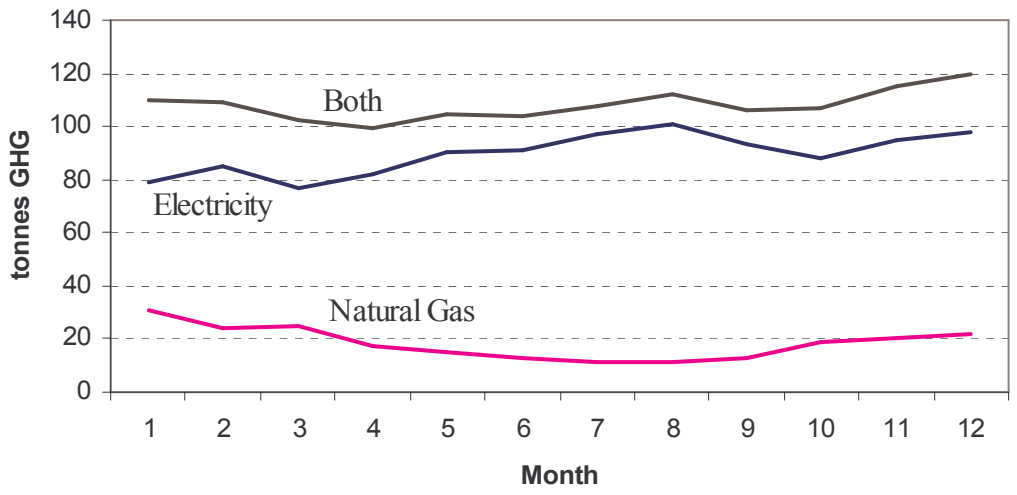
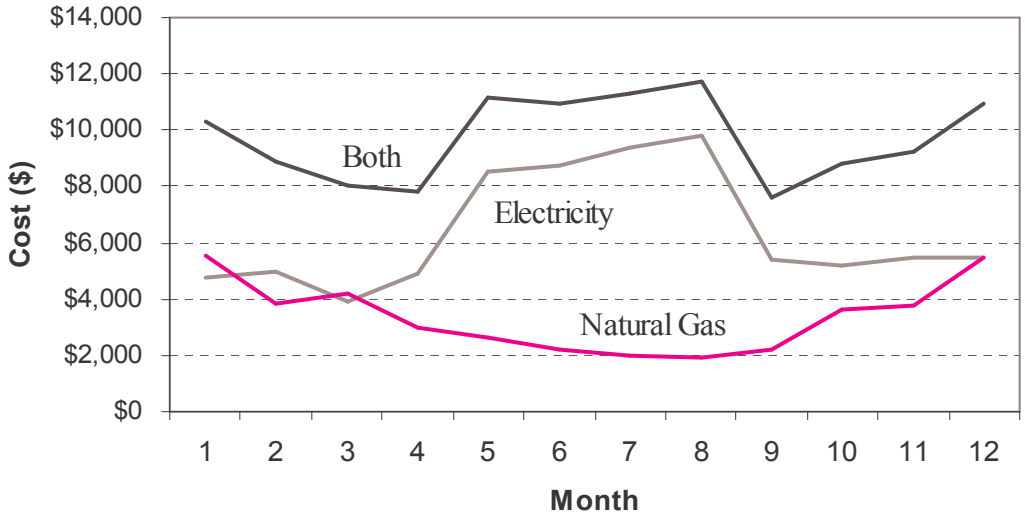


Figure 15: Golf Shop/Ice Arena Monthly Cost by Energy Source, 2005



Local Action Plan Suggestions

6. Golf Shop/Ice Arena

Many of the ideas suggested for the Government Center could be applied to the Golf Shop/Ice Arena to achieve similar benefits. To pursue further reductions, the City could explore not fully operating the facility in the summer months. One possibility would be to simply close the ice rink during the summer. Another might be to explore an agreement to share summer ice service with other cities that operate ice rinks, for

instance Brentwood. An arrangement could be worked out by which both city's residents could be serviced. With only one rink open, both cities' energy costs and GHG emissions might be reduced.

The Golf Shop/Ice Arena is the most expensive building the City of Creve Coeur operates and is the leading GHG emitter. If the City were to find a way to close the ice rink, it would reduce energy costs and emissions an average of $9,700 and 108 metric tons of CO_2e per month based on 2005 usage and costs. A summer shut down over June, July and August of 2005 could have achieved reduction of roughly $33,000 and 320 metric tons of CO_2e.

Public Works Garage

The monthly trend of energy use in the Public Works Garage is displayed in Figure 16 and the monthly trend of GHG emissions is shown in Figure 17. The cost of energy per month tends to mirror natural gas, as shown in Figure 18. Looking first to natural gas use, the trend appears as one would expect, with higher usage in the winter. Note the sheer quantity of energy the Public Works Garage consumed in relation to its size. In the month of January alone, the Public Works Garage used more energy from natural gas than either the Government Center or the Golf Shop/Ice Arena, both of which are much larger buildings.

The problem lies in the lack of adequate insulation and in a heating system that sits on the roof. This heating system blows hot air into the open two-story interior space, without any means to distribute air down. Therefore, the hot air accumulates in the uninsulated top where it escapes from the building easily and does not reach the lower level where employees actually are.

The inefficiencies of this building can also be seen in the electricity use trend. The City's other buildings have a clear spike in electricity use during the summer because of air conditioning, but in Figure 16 the spike is not seen with such clarity. Instead, electricity use appears to be constant throughout the year, regardless of the season. This occurs because the building lacks a thermostat, meaning the heating system fan runs continuously instead of turning on when needed. Hence, the electricity usage does not decrease during the winter months. The City has already recognized this problem, and improvements to insulation and HVAC are planned and will be completed during 2008-09 fiscal year.

Figure 16: Public Works Garage Monthly Energy Use, 2005 [26]

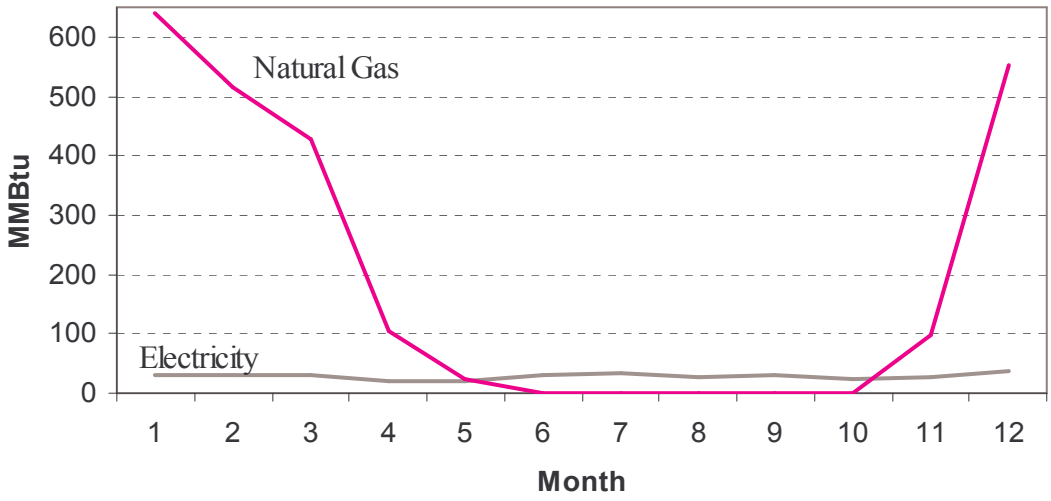
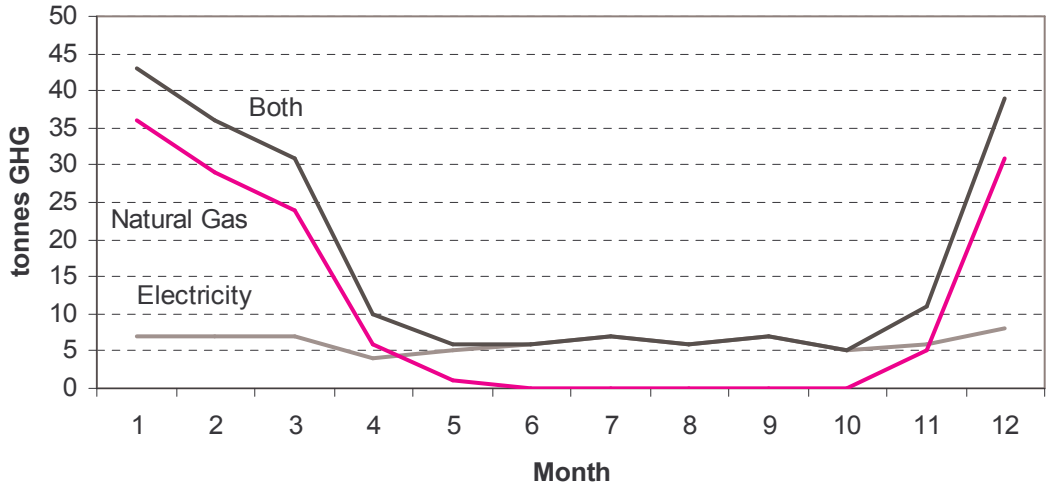
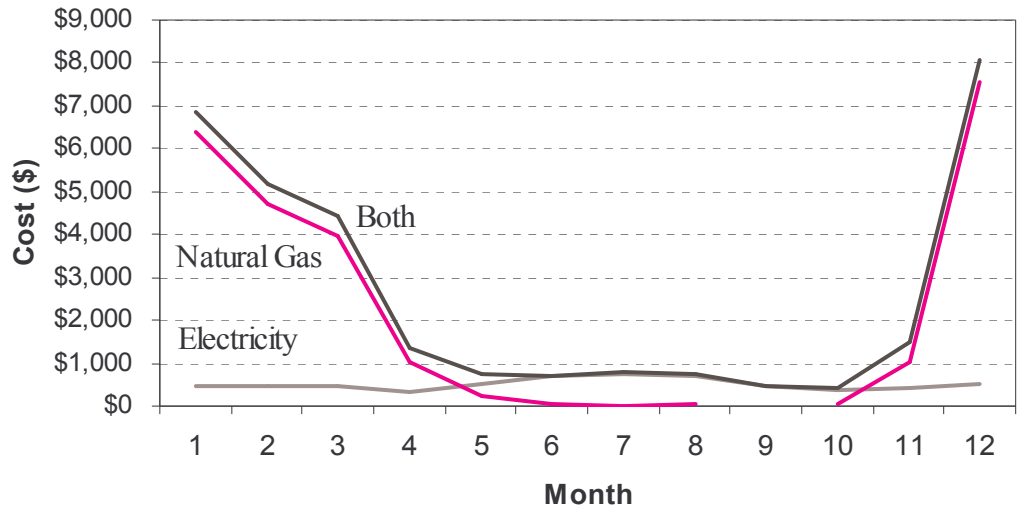


Figure 17: Public Works Garage Monthly GHG Emissions by Energy Source, 2005



[26] The "Both" line was left off this graph because it essentially mirrors the "Natural Gas" line.

Figure 18: Public Works Garage Monthly Cost by Energy Source, 2005



Local Action Plan Suggestions

7. Public Works Garage

An investment in a few basic measures, some as simple as insulation, ducts to carry heated air to the lower levels of the building, and thermostats, would decrease energy use and improve interior comfort. Because the City has already planned to make some of these changes, the GHG emissions are expected to decrease. It may be worthwhile to have an energy consultant evaluate the building as well. (See Government Center Local Action Plan Suggestions for companies.)

Vehicle Fleet

The City of Creve Coeur's Vehicle Fleet was responsible for the emission of 587 metric tons of CO_2e. This was 14.8% of total municipal emissions and was the second largest municipal emitter. Each department's emissions are depicted in Table 11. The Police Department had the largest Vehicle Fleet emissions, 62.1%, and a gasoline cost of over $73,000. The Street Department was responsible for 30.7% of Vehicle Fleet GHG emissions.

Given the quantity of fuel the City uses, even small increases in fuel efficiency have the potential for considerable cost savings. The City paid an average of approximately $2.00 per gallon in 2005, while today's (mid-2008) retail price is nearly $4.00 per gallon. The City does pay less per gallon than the retail price, because the City buys in bulk. That being said, assuming the City pays $0.50 less per gallon than the retail price and using the quantity of fuel used in 2005, the City will pay an additional $92,000[27] for gasoline in 2008.

[27] $3.50*60,545 = $211,907.50, $211,907.50 - $120,019.00 = $91,888.50

Table 11: Vehicle Fleet GHG Emissions, 2005 [28, 29]

Department	(%CO_2e)	GHG Emissions (metric tons CO_2e)	Gasoline Use (gallons)	Gasoline Cost ($)	Energy Equivalent (MMBtu)
Police Department	62.1%	364	37,500	$73,856	4,710
Street Department	30.7%	180	18,693	$38,693	2,348
Parks Department	5.8%	34	3,499	$5,810	439
Health and Welfare	1.4%	8	853	$1,660	107
Total	**100.0%**	**587**	**60,545**	**$120,019**	**7,604**

Local Action Plan Suggestions

8. Vehicle Fleet

Some cities have attempted to address rising fuel costs by changing their vehicle purchasing policies. Where trucks and SUVs are required, if possible, they are replaced by more fuel efficient models (for instance, large SUVs are replaced with Ford Escape hybrids). Where SUVs are not required, they are replaced by more fuel efficient cars. When feasible, larger, more powerful cars are replaced with smaller hybrids. Another option the City could explore is the replacement of traditional police vehicles with Segways or electric golf carts.

A bicycle police patrol is another common strategy used by many cities.[30] As the leading user of gasoline in the City's Vehicle Fleet, the Police Department could cut its fuel use by expanding its bicycle patrol. With the mobility a bicycle provides, officers could access difficult areas easier, and response time to accidents during rush hour may decrease because bicycles would not be delayed by traffic. The health of police officers may improve because of the increased exercise, which holds the potential to lower health costs. A bicycle patrol does have its limits. Bicycles can only be used an average of nine months out the year, but increased use during the summer months, when gasoline is historically more expensive, could yield significant fuel cost savings. The City could show it's commitment to the US Mayors' Climate Protection Agreement, while demonstrating that bicycling is a viable commuting option, by expanding the bicycle patrol.

[28] Data obtained from Monthly Gas Reports from Creve Coeur City archives.
[29] Refer to Appendix 2 for detailed description of Vehicle Fleet calculation method and auto classification.
[30] http://www.cnn.com/2008/US/05/26/bikes.cops.ap/index.html

Employee Commute

The daily commute of the City's 117 fulltime employees was the third largest contributor to government GHG emissions, at 14%. Over the course of 2005, day-to-day commuting of City employees to and from work emitted 556 metric tons of CO_2e. Approximately 57,000 gallons of gasoline were consumed, at a cost paid for by individual employees. This cost is significant. Assuming an average retail gasoline price of $2.27[31] per gallon, the total cost to City employees was roughly $129,500.[32] The average price per employee was approximately $1,100.

Local Action Plan Suggestions

9. Employee Commute

Emissions reductions could be achieved through the establishment of an expanded 4-day work week, with longer hours and Fridays off. In an effort to reduce the state's emissions 20% by 2015, Utah recently implemented this policy for most state workers.[33] Other jurisdictions have implemented this policy part-time during the summer. If the City of Creve Coeur was to implement this policy for its employees year-round, approximately 11,400 gallons of gasoline could be saved annually. This translates into a reduction of 111 metric tonnes CO_2e. In 2005, this could have saved City employees a collective $26,000. In the summer of 2008, with retail gas prices at $4.00 per gallon, the same reduction would yield a $46,000 savings.

Emissions reductions could also be achieved though increased use of public transportation or car-pooling. Another method would be to promote the use of alternate forms of transportation, such as bicycling.

[31] Computed from the US Department of Energy's energy statistics located at http://www.eia.doe.gov/steo#US_Petroleum_Markets . An average of monthly retail gas prices for 2005 was calculated and utilized.
[32] 57,035* $2.27= $129,469.45
[33] http://www.usatoday.com/news/nation/2008-06-30-four-day_N.htm?se=yahoorefer

Streetlights and Traffic Signals

The Streetlights and Traffic Signals sector contributed 8.9% of the total and was the fourth largest emitter of GHGs. In 2005, the cost to the City to operate its streetlights was nearly $118,000. The relative emissions contributions of various streetlight groups are shown in Table 12 and Figures 19 and 20. These numbers only represent the streetlights the City directly pays for, and does not include streetlights paid for by other sources. (These are included in the community inventory.)

The Streetlights and Traffic Signals sector is a bit more complicated than some of the other government sectors. A majority of lights in Creve Coeur are operated by AmerenUE and the City pays a flat rate for the service of the light, regardless of kWh used. In reviewing Table 12, it is important to note that AmerenUE charges the City different meter rates for different sets of lights, and the groups also contain different numbers of lights. Some, such as the Olive Boulevard Streetlight Service, have many lights associated with the single entry. Others, like the Conway Rd Traffic Signal, have only a few.

Table 12: Streetlights Relative GHG Emissions, 2005 [34]

Service Description	(%CO_2e)	GHG Emissions (metric tons CO_2e)	Electricity Use (kWh)	Electricity Cost ($)	Energy Equivalent (MMBtu)
Olive Blvd Streetlight Service	72.5%	256	341,460	$109,345	1,165
N New Ballas Traffic Signal 1	6.5%	23	31,166	$2,022	106
Rue de la Banque Streetlights	4.8%	17	23,061	$787	79
I-270 Overpass Lights	4.5%	16	21,519	$787	73
Magna Carta Traffic Signal	2.8%	10	12,987	$938	44
N New Ballas Traffic Signal 3	2.5%	9	11,607	$848	40
N New Ballas Traffic Signal 2	2.3%	8	11,053	$807	38
Ladue Traffic Signal	1.7%	6	8,274	$731	28
Ladue Traffic Signal 2	1.1%	4	4,870	$437	17
Conway Rd Traffic Signal	0.8%	3	4,569	$401	16
Langdon Way Ct Streetlights	0.3%	1	1,439	$588	5
Ladue and Mosley Lighting	0.0%	0	0	$93	0
Total	**100.0%**	**353**	**472,005**	**$117,783**	**1,611**

[34] Data obtained from AmerenUE utility bills from Creve Coeur City archives.

Figure 19: Streetlight and Traffic Signal GHG Emissions, Government Operations, 2005

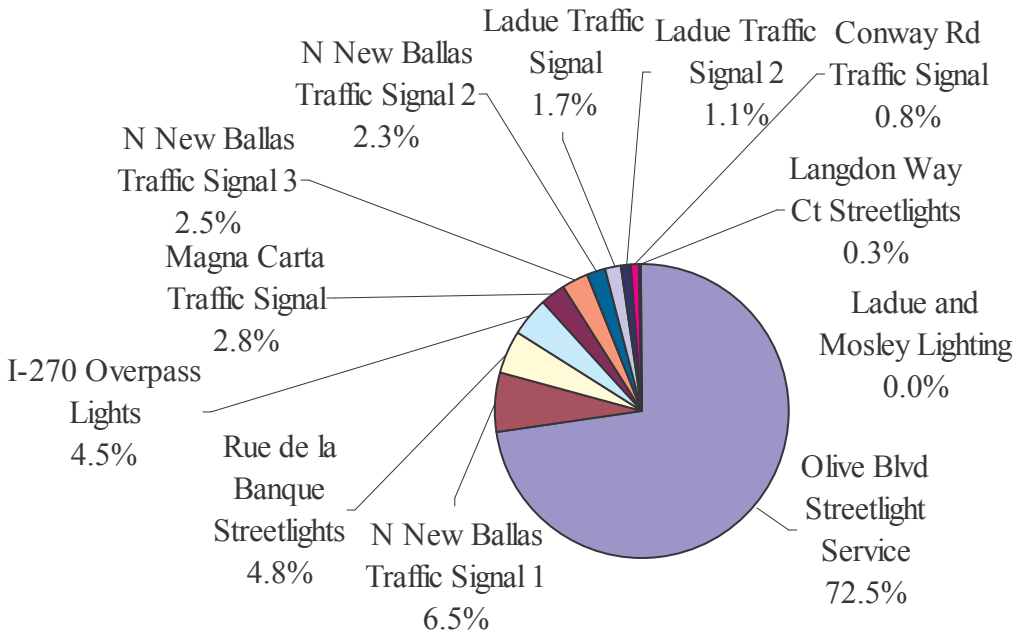
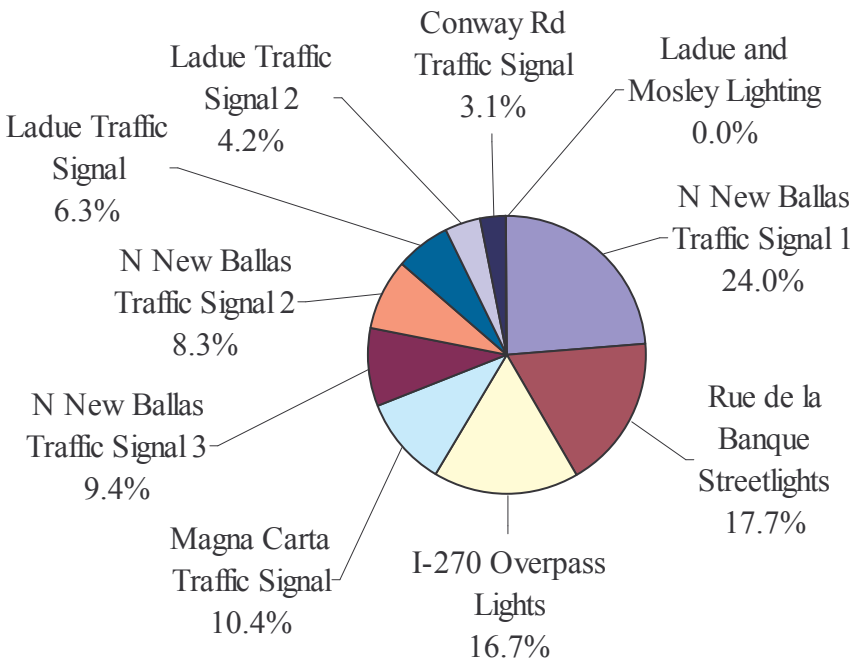


Figure 20: Streetlight and Traffic Signal Emissions, Government Operations, 2005

(Without Olive Blvd Streetlight Service or Langdon Way Ct Streetlights)



AmerenUE Owned Lights

The streetlights that AmerenUE owns and operates on the City's behalf are separated from the rest in Table 13. The two entries that fall into this category are the Olive Boulevard Streetlight Service and Langdon Way Court Streetlights (which represents three lights on Langdon Way Court). The City pays a flat monthly rate for each of the 595 lights in these categories, seemingly based on lumens or pole type. Of the 595 lights, 442 are already using reasonably efficient High Pressure Sodium Lamps (HPS), though they could be more efficient using various lights such as: Low Pressure Sodium Lamps, Induction Lighting or Light Emitting Diodes. Fifty-three of the 595 lights still use Mercury Vapor Lamps (MV) which are fairly inefficient and could be upgraded for significant energy savings. For the remaining 100 lights the City is charged based on pole type, and for these, the type of lamp is unknown. Because these streetlights are operated by AmerenUE, the City does not have direct control, and must work within programs offered by the utility. Currently, AmerenUE does not offer lighting more efficient than sodium vapor bulbs. However, AmerenUE will convert lights for a fee, currently $100 per lamp.[35]

[35] Located at https://www2.ameren.com/business/Rates/ratesBundledElecFullSrvMO.aspx

Table 13: AmerenUE Owned Lights, 2005

Entry	High Pressure Sodium Lamps			Mercury Vapor Lamps			Unknown Lamps	
	#	Light Type	Lumens	#	Light Type	Lumens	#	Pole Type
Olive Blvd. Streetlight Service	33	Enclosed	9,500	3	Open Btm	6,800	18	Wood
	1	Open Btm	9,500	35	Post Top	6,800	46	Steel
	294	Post Top	9,500	1	Open Btm	3,300	36	Concrete
	111	Enclosed	25,500	4	Enclosed	20,000	-	-
	-	-	-	10	Enclosed	6,800	-	-
Langdon Way Ct Streetlights	3	Post Top	9,500	-	-	-	-	-
Total Quantity	**442**	**-**	**-**	**53**	**-**	**-**	**100**	-

Local Action Plan Suggestions

10. Streetlights and Traffic Signals

Significant emissions reductions and cost savings could be realized for each entry through upgrading to more efficient light sources. While options for changing the light sources of Olive Boulevard Streetlight Service are limited to programs available through AmerenUE, there are a number of lights that are in the City's control, which makes changing lights more straightforward. The New Ballas Road and Ladue Road traffic signals could be switched to light emitting diode (LED) traffic signals, which use significantly less energy. Additionally, the Rue de la Banque Streetlights and I-270 Overpass Lights are within the City's control and could be changed. The I-270 Overpass Lights were changed to more efficient lights in the past, but citizens complained about the color and they were switched back. New efficient lighting options have become available in the last two years that may make such a change more viable.

Water

The Water sector does not represent water used by the City, as water-related emissions could only be calculated on a community basis, and the government's contribution was included in that. Rather, the emissions in this sector represent emissions from the energy required to operate the City's various pumps and irrigation systems. They only contributed 1.1% of total government emissions, with a total of 45 metric tons of CO_2e. The relative emissions of specific fountains and irrigation sensors are depicted in Table 14 below.

Water conservation is an important environmental strategy, but does not necessarily yield direct GHG savings. While the St. Louis region enjoys abundant water in the surrounding rivers, protecting the quality and availability of this water ensures this will be the case in the future.

Table 14: Water Relative GHG Emissions, 2005 [36]

Site	(%CO_2e)	GHG Emissions (metric tons CO_2e)	Electricity Use (kWh)	Electricity Cost ($)	Energy Equivalent (MMBtu)
Conway Park Fountain	44.4%	20	26,343	$1,804	90
Fountain Park	40.0%	18	24,575	$1,718	84
I-270 Sprinkler System	11.1%	5	6,044	$411	21
Beacon Hill Sprinkler & Ladue Irrg. Tree	4.4%	2	2,912	$279	10
New Ballas Irrg Tree	0.0%	0	0	$93	0
New Ballas Irrg Tree 2	0.0%	0	0	$93	0
New Ballas Irrg Tree 3	0.0%	0	0	$93	0
Olive W Median Sprinkler	0.0%	0	0	$33	0
Olive/I-270 Sprinkler	0.0%	0	0	$32	0
Total	**100.0%**	**45**	**59,874**	**$4,555**	**204**

Local Action Plan Suggestions

11. Water

One of the easiest ways to decrease water use is to replace faucets and toilets with those that conserve water. Traditional faucets use 3 to 7 gallons per minute, but low flow faucets can use as little as 1.5 gallons per minute.[37] Faucets can also be controlled by sensors that turn water on and off as needed. No flow (waterless) urinals eliminate the water needed to flush liquid waste. A cartridge containing a liquid sealant forms a barrier between the open air and the drain pipe, which stops odor problems. Dual-flush toilets use a lower volume of water by giving a choice: a smaller volume of water per flush for liquid waste and a larger volume for solid wastes. In addition, a simple plaque stating how much water the toilet or faucet is expected to save can serve as a powerful advertising tool for sustainability.

An additional step would be to equip the irrigation systems with rain sensors, which stop the system from running when it is raining. The I-270 Sprinkler System is the only irrigation system currently equipped with sensors, but the rest could be.

[36] Data obtained from AmerenUE utility bills from Creve Coeur City archives.
[37] http://asumag.com/mag/university_slowing_flow/

Conclusion

By signing the US Mayors' Climate Protection Agreement, the City of Creve Coeur made a formal commitment to reduce its greenhouse gas emissions. This report marks the completion of the first step in the reduction process: the establishment of a baseline and forecast GHG emission level, against which future inventories can be compared.

In the base year 2005, the Creve Coeur community emitted 794,963 metric tons of CO_2e as a whole. The majority of emissions came from the Commercial and Transportation sectors with a combined emission of over 600,000 metric tons of CO_2e. The City of Creve Coeur government operations were responsible for 3,973 metric tons of CO_2e. Unless abatement steps are undertaken, GHG emissions are estimated to increase to 868,363 metric tons in 2015.

In its effort to reduce emissions, the City of Creve Coeur would be well served to follow the methodology put forth by ICLEI. Following the program outlined in their Cities For Climate Protection Campaign, the next step would involve adopting an emissions reduction target, documenting measures that have already been taken, and developing a Local Action Plan to choose and implement additional measures.

When considering reduction measures and developing a Local Action Plan, all the potential benefits should be considered: improved air quality, increased productivity, improved safety, strengthened community interaction, lower utility costs, better health, decreased oil consumption, increased exercise, lower public service costs, a stronger local economy, decreased greenhouse emissions and many more. In general, reduction strategies should focus on energy efficiency, renewable energy sources, decreased vehicle fuel consumption, alternative transportation methods, smart community design, waste reduction, increased green space and other sustainable strategies. Specific suggestions related to specific community and government sectors have been included under those headings throughout the text and could prove to be useful. By implementing appropriate reduction strategies, the City of Creve Coeur can guide the community to achieve many of the above benefits and create a more livable Creve Coeur.

Glossary

Anaerobic – Without oxygen. Waste is decomposed by various strains of bacteria. Some of them operate only in the absence of oxygen. These are called anaerobic bacteria, and they are responsible for the methane that is produced when waste decomposes in a landfill.

CO_2e – Carbon Dioxide Equivalent. When a greenhouse gas is released into the atmosphere, its warming effect is described by referring to the number of tons of carbon dioxide that would have to be released to create the equivalent warming effect. This is its CO_2e. Explanation: a number of gases have the effect of trapping heat when they are released into the Earth's atmosphere. The trapped heat causes the Earth to warm, causing global warming. Different gases are more or less potent at trapping heat, and this characteristic is called their *warming potential.* The warming effect of a given greenhouse gas depends both on its warming potential and on the amount of the gas released. Because a standard unit is needed by which the effect of different gases can be compared, and because *carbon dioxide* is the most common greenhouse gas, the effects of other gases are converted to how many metric tons of carbon dioxide would be required to have an equivalent warming effect. This is CO_2e.

Greenhouse Gas – Any of several gases (carbon dioxide, water vapor, methane, nitrous oxide, ozone, chlorofluorocarbons) that, when released into the atmosphere, have the effect of trapping heat. Different gases are more or less effective at trapping heat, and this characteristic is known as their warming potential.

kWh – Kilowatt hour, equal to 1,000 watts. A kWh is commonly used by electric utilities to represent the amount of delivered energy and appears on most electricity bills in the US.

Lumen – For the purposes of this report this is a measure of visible light emitted from a light source.

Metric Ton or Tonne – A metric ton is equal to 1,000 kilograms. It is the most commonly used unit for expressing greenhouse gas emissions. Using a "metric ton" over the US customary "ton" allows for the accurate comparison of emissions in other countries. It is also represented as "tonne." It is approximately 2,204 lbs.

MMBtu – BTU stands for British thermal unit. MMBtu is used to represent one million BTU. This unit of measure is used to describe energy content. Each type of fuel contains a different amount of energy. Therefore, the energy content of each individual fuel is made equal by relating it to the number of BTU per unit fuel.

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.

APPENDIX 1: Detailed 2005 Community Inventory Notes

These notes are provided to document the procedures that were used to complete the inventory, so that future inventories can use similar procedures, thereby providing results that can be appropriately compared to the results of this inventory.

Residential, Commercial, Industrial

NOTES:

Total 2005 electricity use data for Creve Coeur was provided by Mike Focht (Key Account Executive, AmerenUE - Business & Community Relations). The data was divided into four sectors: Residential, Commercial, Industrial (RCI) and Street & Highway. (Street & Highway refers to traffic lights, sign lights, etc) Each sector was broken down further into Regular, Annexations, Dusk to Dawn and Dusk to Dawn Annexations. Dusk to Dawn refers to streetlights that are pole mounted and controlled by sensors that turn them on and off.

The Regular and Annexation data was added together for Residential, Commercial, and Industrial individually and entered into the CACP Software. Dusk to Dawn and Dusk to Dawn Annexations were added together for the Residential, Commercial and Industrial sectors individually and to account for part of the energy used by streetlights. These were included as separate entries in the community inventory under the correct sector.

The Street and Highway sector had to be handled differently. The Street and Highway sector data is representative of all streetlighting in Creve Coeur, excluding the lighting accounted for by Dusk to Dawn/Dusk to Dawn Annexations. There is no Streetlight sector in the CACP Software on the community side, which would be an appropriate place for Street and Highway data. Furthermore, there was no method for breaking the Street and Highway sector data up accurately between RCI sectors. To complete the streetlight information, the total Street and Highway data was split up equally between Residential, Commercial and Industrial sectors and put into the CACP Software as a separate entry. It cannot be accurately included in the government inventory because the data includes streetlights outside government control.

It is important to note that there was no associated lighting (Dusk to Dawn/Dusk to Dawn Annex) reported by AmerenUE for the Industrial sector. After looking at the 2006 and 2007 data it seems apparent that the Industrial lighting data was added to the Commercial and Residential sectors' data. In 2006 and 2007, the electricity used by the Industrial sector was much more than the either the Residential or Commercial sectors. The inventory was conducted without changing the numbers provided from AmerenUE, but any future inventory should make note of this.

Natural Gas usage was provided by George Csolak (Director of Corporate Communications, Laclede Natural Gas Company). Data came broken down into each sector (Residential, Commercial and Industrial) for each month. Each sector's yearly summation was calculated and included under Regular/Annexations.

Transportation

NOTES:

Data was provided by various sources. The Vehicle Miles Traveled (VMT) Calculator was utilized to calculate transportation data. Data from 2004, 2005 and 2006 was used for the

Transportation sector to ensure that each road type had enough data points to accurately represent daily traffic. Road classification was based on the East West Gateway Coordinating Council's map of roadway functional classification found at http://www.ewgateway.org/trans/funcclass/funcclass.htm. Jim Heines (Assistant Director of Public Works, City of Creve Coeur) provided a summary of mileage of roads within Creve Coeur. Road mileage was added together based on the above road classification and used in the VMT Calculator. Jurisdictional boundaries were based on the City of Creve Coeur Planning Department's Ward Maps found at http://www.creve-coeur.org/maps/index.htm

Brian Rensing (Traffic Engineer, Crawford, Bunte, Brammeier (CBB)) sent 2004 directional data for the following:

Conway Rd. - West of New Ballas Rd. (Collector)

Dautel Ln. - North of Olive Blvd. (Collector)

Graeser Rd. - South of Olive Blvd. (Collector)

Olive Blvd. (340) – West of Dautel Ln. (Arterial)

Olive Blvd. (340) – East of Deaver Lane (Arterial)

New Ballas Rd. – North of Conway Rd. (Arterial)

All the roads included from CBB were directional, meaning that one direction of traffic was counted per entry. To obtain an Average Annual Daily Traffic (AADT) for the road, all the days for each direction were averaged together, and then the two directions were added together to get a total AADT.

Lt. William Funkhouser (Commander - Community Policing Division, Creve Coeur Police Department) provided a summary of Traffic Volume counts prepared by St. Louis County Department of Highways and Traffic. Data was provided in the form of Average Weekday Traffic (AWT), but the CACP Software needs the data in Average Annual Daily Traffic (AADT). Kevin Sharp (St. Louis County Department of Highways and Traffic) provided the full traffic count reports. These reports provided daily totals for week intervals, which were averaged to obtain AADT. The data points supplied by this source were:

Baur Blvd. – East of Lindbergh Blvd. (Arterial)

Baur Blvd. – West of Warson Rd. (Arterial)

Conway Rd. – East of Mason Rd. (Collector)

Craig Rd. – South of New Ballas Rd. Extension (Arterial)

Fee Fee Rd. – North of Olive Blvd. (Arterial)

Mason Rd. – North of Conway Rd. (Collector)

Mason Rd. – South of Conway Rd. (Collector)

Mason Rd. – North of Ladue Rd. (Collector)

Mason Rd. – South of Ladue Rd. (Collector)

Mason Rd. – South of Olive Blvd. (Collector)

Ross Ave. – North of Olive Blvd. (Collector)

Schuetz Rd. – West of Lindbergh Blvd. (Collector)

Schulte Rd. – North of Olive Blvd. (Collector)

MoDOT traffic information was obtained from the website at http://www.modot.org/safety/TrafficVolumeMaps2005.htm. The data points provided by this source were:

Interstate 270 – North of Interstate 64 (Highway)

Olive (340) – West of I-270 (Arterial)

Olive (340) – East of I-270 (Arterial) **

Lindbergh Blvd. (67) – South of Olive Blvd. (Arterial) **

Ladue (AB) – West of I-270 (Arterial)

** - For these two points, truck counts were provided, in addition to normal traffic counts. The CACP Software already includes truck traffic estimates; if truck counts were added into the software separately then truck traffic would be double counted. Therefore, truck counts were added into the AADT for these two points to avoid potentially inflating the effect of truck traffic. Also, including separate truck counts for only two data points would have changed the uniformity of data.

Waste

NOTES:

Annual waste tonnage was provided by Jim Heines (Assistant Director of Public Works, City of Creve Coeur). The CACP Software required the percentage of the total waste stream for five categories of waste: paper products, food waste, plant debris, wood/textile and all other. To determine the stream composition, the default CACP stream percentages had to be edited and are described below. The annual waste tonnage data was divided into three categories: Trash, Recycle, and Yard Waste. The recycled material (1,237.51 tons) was left out of the inventory because the effects of recycling are accounted for by not contributing to total GHG emissions. Any increases in recycling from 2005 levels should be counted as a reduction measure.

The stream composition was determined as follows. Yard Waste was the only portion of the waste stream that was measured, so the ratio that Yard Waste was of the Total Waste (excluding Recycled) was used as the percentage for Plant Debris (=18%). The other categories were based off of this calculation. The difference between the default and calculated Plant Debris was 8%; therefore, 2% was subtracted from each of the other four categories to make the total equal 100%. The calculated waste stream percentages were then applied to the Total Waste tonnage to estimate the quantity of each waste category.

It should be noted that the inventory was conducted assuming plant debris collected by the City was landfilled. During the writing of this report it was noticed that this is not the case. Because the Waste sector is such a small portion of total GHG emissions, 0.3%, the effects of this assumption are very small.

Tony Lamantia (Municipal Account Representative, Allied Waste Services) provided final location of Creve Coeur's waste (Roxana, Illinois).

Detailed Discussion of Emissions Factors

The formula below was used within the CACP Software to determine GHG emissions for each waste type. Factor A is the emissions factor, while Factor B is the sequestration factor. By looking down to the Default Waste Coefficients, one can see how Plant Debris and Wood/Textiles yield a net reduction in emissions. In both, by adding Factors A and B together, in the manner shown in the formula, a negative number is reached. That number, multiplied by (1-R), and then by Wt, will yield a negative number for CO_2e.

$$CO_2e = Wt * [(1-R) A + B]$$

Where "Wt" is the quantity of waste type "t", and "R" is the methane recovery factor and is only applied in the case of landfill waste. A and B are emissions factors and are defined below.

Factor A: CO_2e emissions of methane per tonne of waste at the disposal site

Factor B: CO_2e sequestered at the disposal site, in tonnes per tonne of waste

Table 15: Analysis Module Default Waste Coefficients (tonnes CO_2e/tonne)

Waste Type "t"	Disposal Type	A	B
Paper Products	Managed Landfill	1.34	-0.91
Food Waste	Managed Landfill	0.77	-0.09
Plant Debris	Managed Landfill	0.44	-0.84
Wood/Textiles	Managed Landfill	0.39	-0.84
All Other Waste	Managed Landfill	0	0

Other

NOTES:

The water data was collected as a yearly summation of the electricity used by the St. Louis County Central Plant in Maryland Heights. It was provided by Bob Feurman (Director, Production, Missouri American Water Company). The Central Plant serves a population of 660,000 and consumed 81,000,000 kWh of electricity. The 2005 U.S. Census Bureau's annual population estimate of 16,920 was used to estimate Creve Coeur's portion of emissions. This resulted in an emissions calculation of 1,558 metric tons of CO_2e.

Residential population was used for this calculation instead of total daytime population for two reasons. First, data regarding residential vs. commercial water use was not available. Second, the author had no way of estimating the relative water use of residents vs. daytime workers. Thus, the relative effects of such water uses as bathing, washing clothes and dishes, operating swimming pools, and watering turf and gardens, could not be apportioned.

81,000,000 kWh at Central Plant * (16,920 population of CC/660,000 pop served by Central Plant) = 2,080,472 kWh for CC

APPENDIX 2: Detailed 2015 Community Forecast Notes

NOTES:

The forecast year was conducted using an energy use growth forecast tool from ICLEI, provided by Eli Yewdall (Program Associate, ICLEI). It utilized a calculated population growth rate of 0.37%*, which was based off of the U.S. Census Bureau's annual population estimates from 2000 to 2007. The calculated growth rates are displayed in the table below.

* ((16,933-16,500) / 7 years) / 16,933 = 0.003653 or 0.37%

Table 16: Energy Use Growth Rates

	Total Electricity	Natural Gas	Motor Gasoline	Distillate Fuel Oil (Diesel)	Other
Residential	0.62%	0.57%	-	-	-
Commercial	1.14%	1.33%	-	-	-
Industrial	2.40%	3.82%	-	-	-
Transportation	-	-	0.66%	1.48%	-
Waste	-	-	-	-	0.37%
Other	1.14%	-	-	-	-

APPENDIX 3: Detailed 2005 Government Inventory Notes

Buildings

NOTES:

Data on electricity use came from AmerenUE monthly utility bills located in Creve Coeur City archives. Data on natural gas use came from Laclede Gas monthly utility bills, also located in City archives. Monthly electricity and natural gas usage, with costs, were added together separately for each government building.

Vehicle Fleet

NOTES:

Data came from monthly gas usage reports located in Creve Coeur City archives. Gas usage data was missing for January, February and March. This was addressed by taking the average of 2004 and 2006 data to fill the missing 2005 data.

The monthly gas price was missing from the gas reports for the months 1-3, 5 and 6. This was addressed by taking the average of the months that were reported, 4 and 7-12, to come up with an average of $1.98. Note that this number is a broad estimate.

Vehicle classification was based on the descriptions provided in the CACP Software help files. The Gas Can and Leaf Vacuum entries used a significant amount of fuel that could not be left out of an accurate GHG inventory, so the issue of which category to place them had to be resolved. An accurate GHG inventory does not require vehicle type to be identified, but the determination of Criteria Air Pollutants (CAP) does. This report did not utilize the results concerning CAPs; however, vehicle type was specified to identify which vehicles produce the most GHG. Therefore, the Gas Can and Leaf Vacuum entries were included as Auto – Compact/Subcompact to ensure the GHG emissions were counted.

Vehicle Classification

Parks Department	*Vehicle*
Heavy Truck	1 Ton Dump Truck
Light Truck/SUV/Pickup	F-250, 1 Ton Pickup, Ford Pickup, Dodge Ram
Auto - Compact/Subcompact	Gas Cans
Health and Welfare	*Vehicle*
Light Truck/SUV/Pickup	Chevy Silverado
Police Department	*Vehicle*
Auto - Compact/Subcompact	Tempo
Auto – Mid-Size	Lumina
Auto – Full-Size	Crown Victoria, Impala
Light Truck/SUV/Pickup	F-250, Econoline, Cherokee
Street Department	*Vehicle*

Heavy Truck	1 Ton Dump Truck, 2 Ton Dump Truck
Light Truck/SUV/Pickup	Chevy Pickup
Auto – Compact/Subcompact	Gas Cans, Leaf Vacuum

Employee Commute

NOTES:

Emissions from the Employee Commute sector was calculated using the home addresses of 2005 fulltime employees, provided by Nancy O'Loughlin (Executive Office Assistant, City of Creve Coeur). Commute distance was found by plugging addresses into Google Maps and finding the distance from the employee's home to the Government Center, at 300 N New Ballas Rd. The daily roundtrip mileage for all fulltime employees was multiplied by 260 to simulate a year's worth of government employee mileage. This represents 52, five-day weeks, assuming all 117 employees drive alone. The total mileage was entered into the CACP Software in the passenger vehicle category. A small number of addresses were not recognized by Google Maps. In this situation, the mileage was taken from the nearest town or zip code. Please note that the Employee Commute sector only represents fulltime staff. Part time staff were excluded from the government inventory, but are accounted for in the community Transportation sector.

Streetlights and Traffic Signals

NOTES:

Data for the Streetlights and Traffic Signals sector came from AmerenUE utility bills found in Creve Coeur City archives. The same method of adding the monthly electricity usage and associated costs together to get a yearly total was used. Separating the lighting into streetlights or traffic signals was helped by Connie Parish, (Department of Public Works Office Associate, City of Creve Coeur) who clarified utility bill line items with Mike Focht (Key Account Executive, AmerenUE - Business & Community Relations). Note that entries for government Streetlights and Traffic Signals were only those that the City of Creve Coeur received an electric bill for. Data on other lighting, paid for by other sources, was provided in the community electricity data from AmerenUE and is accounted for in the community inventory.

Line Item Addresses Taken From AmerenUE Utility Bill

Conway Traffic Signal	12199 Conway Rd.
Langdon Way Court Streetlights	10975 Langdon Way Ct.
I-270 Overpass Lights	12197 Olive Othr
Kingsbridge Subdivision Streetlight	10701 Kingsbridge Est. Dr.
Ladue Traffic Signal	Ladue Rd, Traffic Signal
Ladue Traffic Signal 2	10700 Ladue Rd.
Ladue and Mosley Lighting	X, Nec Ladue & Mosley
Magna Carta Traffic Signal	498 Magna Carta Dr.
N New Ballas Traffic Signal 1	900 N New Ballas Rd.

N New Ballas Traffic Signal 2	500 N New Ballas Rd.
N New Ballas Traffic Signal 3	552 N New Ballas Rd.
Olive Boulevard Streetlight Service	11631 Olive Blvd.
Rue de la Banque Streetlight Service	11901 Olive Blvd.

Water

NOTES:

Data on the Water sector came from AmerenUE utility bills found in Creve Coeur City archives. The same method of adding each month's electric usage and associated costs together to get a yearly total was used. Government operated irrigation sensors and fountains are the only municipal sources of GHG emissions for the Water sector.