CITY OF MADISON GREENHOUSE GAS EMISSIONS REPORT: 2007 BASELINE

MAY 13, 2010

WORKSHOP IN ENERGY ANALYSIS AND POLICY

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FOREWORD

Students in the Energy Analysis and Policy (EAP) Graduate Certificate program in the Gaylord Nelson Institute for Environmental Studies at the University of Wisconsin–Madison produced this report for the City of Madison Sustainability Committee. The students are enrolled in the Energy Analysis Seminar, the capstone course in their graduate certificate program. The seminar provides EAP students the opportunity to improve their analytical skills by applying them to an issue with a substantial energy component and to contribute useful knowledge and recommendations to their client.

EAP is an optional graduate-level certificate or Ph.D. minor that gives students the knowledge and skills needed to become leaders in industry, government, consulting, and key energy fields.

EAP's interdisciplinary curriculum considers technical, economic, political, and social factors that shape energy policy formulation and decision-making. It examines current topics in energy resources, energy market structures and practices, traditional public utilities, energy technology, energy and environmental linkages, energy and environmental policy, and energy services. The curriculum also acquaints students with relevant skills: quantitative reasoning, analysis of energy issues, pricing and life-cycle costing, business analysis, and environmental quality assessment.

Master's-degree students who complete the program receive EAP certificates in addition to their degrees. Doctoral students can count the program as a distributed minor.

The opinions and judgments presented in the report do not represent the views, official or unofficial, of the Nelson Institute or of the client for which the report was prepared.

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EXECUTIVE SUMMARY

In order to plan for a carbon-constrained future and efficiently develop mitigation and adaptation policy measures, city governments must establish a greenhouse gas (GHG) emissions baseline and periodically reinventory all GHG emissions. In the spring of 2010, the City of Madison worked with a team of graduate students from the University of Wisconsin's Nelson Institute for Environmental Studies certificate program in Energy Analysis and Policy to construct a carbon baseline report for the City's Government Operations. A baseline year of 2007 was chosen by staff members, constructed from the best available data collected by city agencies. To conduct the baseline a greenhouse gas modeling program known as Clean Air and Climate Protection Software 2009 available through the City of Madison's membership with International Council for Local Environmental Initiatives.

This report for the City of Madison outlines the results and the steps that were taken to establish a comprehensive and accurate inventory of emissions for carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4) for Government Operations in 2007. This report outlines the Local Government Operations Protocol, used to determine emissions resulting from City Operations. In addition, the report provides an explanation of the software used to determine the baseline, a list of the greenhouse gas emissions included in the inventory, an overview of the government operations sectors included in the study, and a summary of the methodology used for gathering and entering the data. Finally, the authors make recommendations to the city on how to better account for greenhouse gas emissions in the future.

The modeling software used for local governments accounting is divided into two categories: Local Government Operations and Community Emissions. The City of Madison felt that it would be most beneficial to begin with an inventory of emissions associated with Local Government Operations.

The results of the baseline inventory show that the city of Madison produced 94,723 tons CO_2 equivalent GHGs, at an estimated total cost of nearly $14 million for fuel and electricity. The "Buildings and Facilities" sector is responsible for the largest proportion of total GHGs (35 percent) – accounting for the heating, cooling and electricity use of Madison's buildings and facilities. Water delivery facilities operated by the city water utility produced the next highest level of GHG emissions, accounting for 23 percent. These two sectors present the greatest opportunity to reduce GHG emissions from city operated facilities. The next two largest contributors of GHGs from city operations come from the city's transit fleet and motor vehicle pool. Considered together these two sectors are in fact the second largest producers of GHG emissions and the largest source of energy costs. The remaining sectors contribute less than 15 percent of GHG emissions.

The authors recommend that the City of Madison next conduct a Community analysis baseline and create a schedule and implementation plan for regularly conducting GHG emissions inventories.

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (%)	CO2 (MMBtu)	Cost ($)
Buildings and Facilities	33,313	965	1,744	33,481	35.3	186,597	3,605,408
Water Delivery Facilities	21,373	700	683	21,489	22.7	82,904	2,329,753
Transit Fleet	14,809	94	97	14,825	15.7	183,698	3,199,043
Vehicle Fleet	11,371	518	982	11,462	12.1	142,466	2,665,828
Streetlights & Traffic Signs	9,130	239	618	9,173	9.7	62,986	1,145,835
Employee Commute	3,008	190	135	3,039	3.2	38,502	918,666
Solid Waste Facilities	798	12	35	800	0.8	3,492	59,942
Wastewater Facilities	451	15	14	454	0.5	1,680	48,821
Total	94,255	2,732	4,308	94,723	100	702,325	13,973,296

INTRODUCTION

Local governments around the United States are taking steps to reduce their Greenhouse Gas (GHG) emissions. The first step in this process is accounting: establishing an emissions baseline. The establishment of an inventory baseline for Government Operations will provide city staff with the necessary tools to monitor, verify, and compare over time the effectiveness of emissions reduction strategies implemented by the City of Madison.

The benefits of establishing a baseline for the city of Madison, Wisconsin, home to both the University of Wisconsin and the state's capitol, are four-fold: to reduce financial and environmental risk, to prepare for state or federal regulations requiring the establishment of a GHG emissions baseline, to address inefficiencies in energy use through more cost-effective accounting, and to expand upon the ethic of environmental leadership in the Midwest.

A baseline emissions inventory will help the City of Madison make future financial investments that reduce the city's GHG emissions moving forward. If a climate change bill is signed into federal or state law, voluntary reporting may be expected by state and federal regulators. A baseline inventory can help the city determine which sectors of government produce the highest GHG emissions and help evaluate how those emissions may be reduced most cost-effectively. A baseline will also help Madison City Operations set achievable targets for reducing GHG emissions, and offer cost-effective recommendations for meeting these targets. Finally, by conducting a baseline emissions report, Madison will join other localities, both in the United States and abroad, that have shown environmental leadership.

This report describes the GHG inventory protocol and methodology used to conduct a baseline inventory for the City of Madison. The results of the baseline are then presented, along with recommendations for improving the quality of future inventories, and outline the next steps the City should take in order to comprehensively evaluate, and develop policy measures to mitigate, Madison's GHG emissions.

ICLEI-LOCAL GOVERNMENTS FOR SUSTAINABILITY

The International Council for Local Governments Initiative, or ICLEI-Local Governments for Sustainability, is the leading local government organization for sustainability in the world. ICLEI was founded by a group of local governments who convened at the United Nations for a meeting of the World Congress of Local Governments for a Sustainable Future in 1990. By 2009, ICLEI has grown to a membership of over 1,000 cities in over 43 countries worldwide; of which, over 600 in the United States, and 78 in the Midwest, have joined. In 2003, ICLEI changed its name to include the phrase "Local Governments for Sustainability," to better reflect its expanded mission of addressing sustainability issues. The City Madison has been a member of ICLEI-Local Governments for Sustainability since 2006.

One of the benefits of membership for a city is access to the tools and support necessary for implementing, the Local Government Operations protocol using the GHG emissions modeling software called Clean Air and Climate Protection, which allows a city to conduct a GHG emissions inventory for both City Operations and Community Emissions. As stated in the ICLEI Annual Report, "you can't manage what you can't measure." This expression reflects the broad purpose of GHG accounting. To meet this goal, ICLEI has set out a five "Milestone" process to reduce emissions. This includes:

1. Conducting a comprehensive baseline GHG emissions baseline inventory and forecast for Government Operations and Community emissions
2. Adopting an emissions reduction target
3. Developing a formal local climate action plan
4. Implementing the plans, policies and measures
5. Monitoring progress, reporting results, and re-evaluating the plan

This report for the City of Madison Government Operations will complete one part of the first Milestone for the City of Madison. Approximately one-third of ICLEI-member cities in the US have completed the first Milestone using the CACP software, such as the cities of Boulder, CO, Washington D.C., Minneapolis, MN and Phoenix, AZ.

THE LOCAL GOVERNMENT OPERATIONS PROTOCOL

ICLEI's Local Government Operations Protocol (LGOP) is "designed to provide a standardized set of guidelines to assist local governments in quantifying and reporting GHG emissions associated with their government operations." LGOP is based on the Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard, which is an accounting system developed by the World Resources Institute and World Business Council for Sustainable Development. The Protocol was developed in partnership by the California Air Resources Board (ARB), the California Climate Action Registry (CCAR) and ICLEI-Local Governments for Sustainability in collaboration with the Climate Registry[1] and multiple other stakeholders.[2] This protocol is "the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions."[3]

According to the Protocol, the purpose of the LGOP is to:

- Enable local governments to develop emissions inventories following internationally recognized GHG accounting and reporting principles defined with attention to the unique context of local government operations;
- Advance the consistent, comparable, and relevant quantification of emissions and appropriate, transparent, and policy-relevant reporting of emissions;
- Enable measurement towards climate goals;
- Promote understanding of the role of local government operations in combating climate change; and
- Help to create harmonization between GHG inventories developed and reported to multiple programs.

Reductions in emissions are reported by comparing emissions inventories of the local government over time. Accurate and standardized internal methods of reporting are important to ensure that accurate time series comparisons can be made. It is important to note that the inventory is not intended to be used to compare emissions between local governments, but rather for internal policy formation and program evaluation. As different municipalities may have dramatic differences in the size and composition of the sectors that fall under their respective jurisdictional boundaries, fair and accurate comparisons are impossible.

ORGANIZING CITY INFORMATION FOR THE ICLEI CAPC MODEL SOFTWARE

ICLEI has developed modeling software program to comply with LGOP defined protocol standards for government and community GHG assessments. This Clean Air and Climate Protection (CACP) software, along with assumptions and methodology recommended by ICLEI to ensure uniform standards of accounting, provides the basic platform that has enabled the outcomes of this study. The following few sections discuss these elements.

[1] www.theclimateregistry.org
[2] Local Government Operations Protocol, 2008. Page 10
[3] http://www.ghgprotocol.org/calculation-tools/faq

For accurate, reliable, and consistent accounting to occur, the inputs and outputs of the model must be well defined. LGOP clearly defines a method of tracking sources of emissions to produce an accurate calculation for certain GHG emissions described below. To quantify these emissions, local government activities are categorized by organizational boundaries, scopes and sectors, which are also described in this section.

By defining sources of emissions by scope and establishing organizational boundaries, the LGOP ensures that a regional greenhouse gas inventory conducted in the future by a neighboring local government will not overlap or double count emissions from a neighboring municipal government with a pre-existing GHG baseline. As a result the CACP modeling software may not always produce comprehensive estimates of GHG emissions associated with a particular municipal area, particularly if significant emission sources belong to an adjoining municipality, the county, or the state. Rather, the LGOP methodology as implemented in the CACP software focuses on producing GHG emission estimates for sources that fall under the direct control of the municipality performing the inventory, allowing policy makers to focus on what can be changed rather than serve as a tool to cast blame across jurisdictional borders.

CACP was most recently updated in April of 2010.

CACP RECOGNIZED GHG EMISSIONS

LGOP recognizes the following six GHG emissions:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- hydrofluorocarbons (HFCs)
- perflorocarbons (PFCs)
- sulfur hexafluoride (SF_6)

The first three GHGs listed above (CO_2, CH_4, and N_2O), are the most important in terms of volume. Although CO_2 is the least potent of these three greenhouse gas emissions, it is by the far the most abundant emission resulting from fossil fuel combustion as a source of energy. CACP software employs standards created by the Intergovernmental Panel on Climate Change (IPCC) to convert all GHGs into a CO_2-equivalent (CO_2e). CH_4 is 21 times more potent than CO_2 in terms of its global warming potential based on radiative forcing that warms the globe over time, and is calculated as 21 units of CO_2e for every one unit of CH_4. N_2O is 310 times more potent than CO_2.

The second three GHGs listed above (HFCs, PFCs, and SF_6) are associated with refrigerants and industrial processes. The potency of HFCs, PFCs, and SF_6 is very high, but the total volume produced within energy systems is much lower than other GHGs. Although the CACP software allows users to record these HFCs, PFCs, and SF6 emissions, the city of Madison did not have refrigerant data on record in 2007, and was accountable for no industrial production. Therefore these estimates were not used in the study. If the city chooses to record these data in the future, it is recommended that estimates for refrigerant and industrial emissions be utilized in future GHG inventories, and that past estimates be either backcasted or held constant The resulting estimates should be added to the results of this study for the sake of consistency and verification of progress.

ORGANIZATIONAL BOUNDARIES

It is important to establish jurisdictional boundaries for determining GHG accountability. Under the LGOP protocol, local governments must choose to account for either emission sources over which they have operational control or financial control. The City of Madison chose to report its emissions based on operational control, which is what the Protocol recommends. Although the city in part finances low-income residential housing through its Community Development Authority, it is not accountable for the electricity and natural gas heating that community members use while living there. These emissions are better counted in a Madison community assessment.

The following are other examples of facilities that Madison does not operate, and for which no emissions were accounted:

- Municipal airports (Dane County operates the local airport)
- Municipal power plants (the city purchases power from local investor owned utilities)
- Municipal ports
- Other municipal metro systems (the city only operates buses)
- Industrial facilities (i.e. concrete production)

Additionally, the city does not maintain any active municipal landfills as Dane County and private firms operate the landfills around Madison. However, the City of Madison does operate equipment at closed landfill sites. As such the energy use and corresponding emissions from these sites are included in the inventory.

When completing the Community GHG assessment, the city should utilize this Government Operations emissions study to ensure there is no double counting or uncounted emissions for which either the city government or community are responsible. Likewise, should regional assessments be conducted, the city should provide this study and supplementary information to GHG accounting entities to avoid these same problems.

SCOPES

The LGOP carbon accounting methodology divides emissions into three group for accounting purposes, recognized by the CACP software as “scopes” of GHG emissions: direct, indirect, and other direct emissions.

- Scope 1: Direct emissions
    - Vehicle engine combustion
    - On-site natural gas combustion for heating buildings
    - Refrigerants leakage of refrigerators and air-conditioners
- Scope 2: Indirect emissions
    - Off-site electricity production (supplied by power plants)
    - Off-site heat or steam (supplied by combined heat and power plants)
- Scope 3: Other indirect emissions
    - Employee commute vehicle emissions
    - Employee waste production
    - Contracted services

SECTORS

Based on the LGOP scopes, the CACP modeling software specifies twelve government sectors for analysis. The software is structured so that all inputs must be entered into separate sectors. This allows analysts to break down emissions into distinct areas in order to use the resulting output to better target emissions reductions policy. Table 1 lists the government sectors defined by the software, indicating which sectors included in this baseline study.

Table 1: LGOP Sectors

Reported in Madison's Government Operations Baseline Study	*Not Owned by the City (Not Included in the Report)*
Buildings and other facilities	Refrigerants†
Streetlights and traffic signals	Power generation facilities
Vehicle fleet	Port facilities
Employee commute	Airport facilities
Transit fleet	Other industrial processes
Water delivery facilities	
Solid waste facilities	

† no data available for baseline year

METHODOLOGY

The following section briefly describes the methodology used in conducting the baseline inventory. A more detailed presentation of the steps taken to collect, prepare and enter the data used is found in Appendix A.

CHOOSING A BASE YEAR

City staff reviewed all sectors included in the report to determine what data exist, and determined the baseline year to be 2007, the earliest year with robust data available. Although the Protocol encourages the use of the earliest data available, this objective must be balanced with the accuracy of information available in earlier years. According to the LGOP, it is important to choose a base year which is not unusually hot or cold to reflect a normative GHG emissions report for the period.

COEFFICIENTS

Emissions factors are "calculated ratios relating GHG emissions to a proxy measure of activity in an emissions source."[4] When multiplied by the "activity data," or amount of use for a sector, the CACP software determines the amount of emissions associated with that sector of the local government. Emissions factors are established regionally, but several utilities, particularly in California, have established and verified their own, more specific coefficients. For the City of Madison Government Operations report, the Emissions Factors from the EPA's eGRID subregion 3 (Figure 1) and the North American Electric Reliability Corporation region 4 (NERC) (Figure 2) were used per ICLEI recommendations, and as directed in the Local Government Operations Protocol Appendix G. The eGRID emission factors account for CO2, N2O and CH4. NERC factors account for NOx, SOx, CO, VOC and PM10

Figure 1: EPA eGRID Subregions

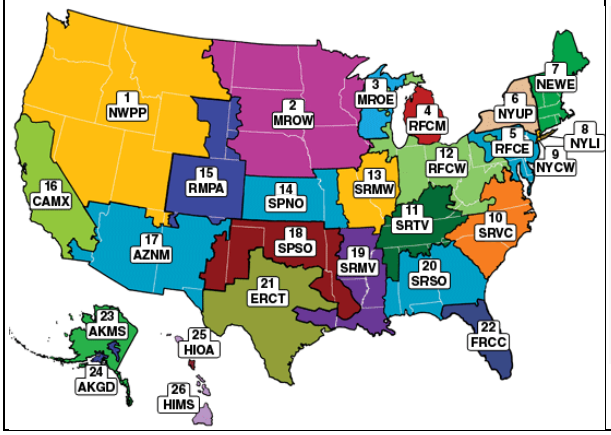


Figure 2: NERC Regions for Emissions Inventory

[4] Local Government Operations Protocol, 2008, page 27

DATA ENTRY

The City of Madison's Government Operations emissions baseline inventory consisted of two types of emissions: stationary sources and mobile sources. Stationary sources included buildings (heating, cooling, and electricity), streetlights, water delivery, wastewater facilities, and refrigerants. Mobile sources included the city's transit fleet, vehicle fleet and employee commute.

Energy use data was collected from various city agencies currently responsible for recording and reporting such information.Data on the amount of energy used by type and the costs associated with each energy source were cleaned and aggregated by analysis sector and imported into the CACP software using the copy and paste "assistant" functions available in the software so as to eliminate manual entry and minimize error.

GHG emissions from city employee generated solid waste was calculated using a per-employee waste coefficient as estimated by the state of California for solid waste generated by public administration employees.[5] This total amount was then converted to GHG emissions using the LGOP and CACP software.

[5] http://www.calrecycle.ca.gov/wastechar/DispRate.htm

GOVERNMENT OPERATIONS INVENTORY RESULTS

According to the data collected, in 2007 the City of Madison used over 57 million kWh of electricity, 12 million therms of natural gas and the equivalent of 5 million kWh of district steam to operate all city buildings, facilities, lights and other stationary equipment. In addition, the city used nearly 2 million gallons of diesel fuel and 395 thousand gallons of gasoline across the city's transit and agency vehicle fleet. An additional 309 thousand gallons of gasoline is estimated to have been produced by city employees commuting to and from work. All told the city's energy use came at an estimated cost of $13,973,296. Table 2 details City Government Operations energy use by sector. Through this energy consumption, the city generated an estimated GHG emissions equivalent to 94,723 tons of CO_2.

Table 2: Energy Use Summary

	Electricity (kWh)	Natural Gas (therms)	Steam (kWh)	Diesel (gal)	Gasoline (gal)
Buildings and Facilities	26,155,679	800,838	5,052,752		
Streetlights and Signals	7,587,453	370,905			
Water Delivery	23,023,014	43,274			
Wastewater	492,149				
Solid Waste Facilities	363,799	22,503			
Transit Fleet				1,315,125	10,642
Vehicle Fleet				681,838	385,685
Employee Commute					309,941
Total	*57,622,094*	*1,237,520*	*5,052,752*	*1,996,963*	*706,268*

The following section highlights the overall results from the GHG baseline inventory as well as sector level highlights. A full emissions report can be found in Appendix B. Additionally, the CACP software estimates criteria air pollutant (CAP) emissions from energy use. While not presented here, a summary of CAP emissions by sector is provided in Appendix B.

SUMMARY BY SECTOR

As shown in Figure 3 and Table 3, the Buildings and Facilities sector is responsible for the largest proportion of total GHGs (35 percent) – accounting for the heating, cooling and electricity use of Madison's buildings and facilities. Water delivery facilities operated by the city water utility produced the next highest level of GHG emissions, accounting for 23 percent. These two sectors present the greatest opportunity to reduce GHG emissions from city operated facilities. The next two largest contributors of GHGs from city operations come from the city's transit fleet and motor vehicle pool. Considered together these two sectors are in fact the second largest producers of GHG emissions and the largest source of energy costs. The remaining sectors contribute less than 15 percent of GHG emissions.

Owing to the different energy source types (electricity vs. natural gas vs. liquid fuels) total cost does not correlate strictly with total primary energy consumption. The Transit Fleet and Vehicle Fleet sectors have a higher relative cost when compared to the other sectors due to the relatively high cost of diesel and gasoline when considered on a dollar per unit of energy basis.

Figure 3: Summary by Sector - CO_2 Equivalent and Cost

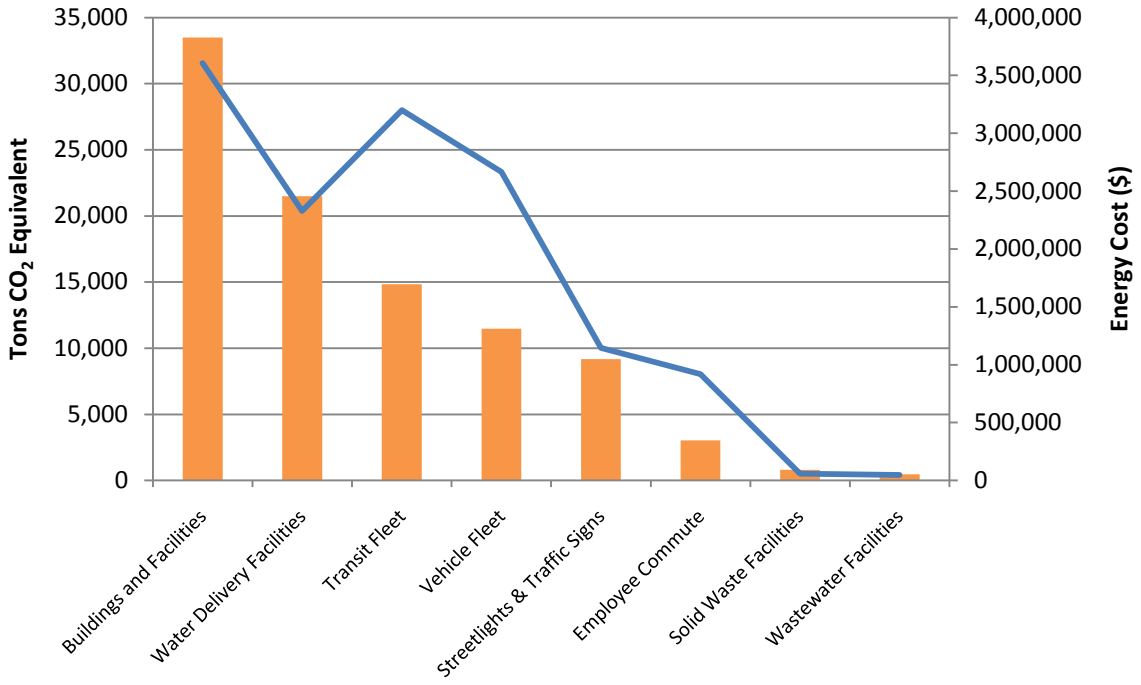


Table 3: Detailed Summary - By Sector

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (%)	CO2 (MMBtu)	Cost ($)
Buildings and Facilities	33,313	965	1,744	33,481	35.3	186,597	3,605,408
Water Delivery Facilities	21,373	700	683	21,489	22.7	82,904	2,329,753
Transit Fleet	14,809	94	97	14,825	15.7	183,698	3,199,043
Vehicle Fleet	11,371	518	982	11,462	12.1	142,466	2,665,828
Streetlights & Traffic Signs	9,130	239	618	9,173	9.7	62,986	1,145,835
Employee Commute	3,008	190	135	3,039	3.2	38,502	918,666
Solid Waste Facilities†	798	12	35	800	0.8	3,492	59,942
Wastewater Facilities	451	15	14	454	0.5	1,680	48,821
Total	94,255	2,732	4,308	94,723	100	702,325	13,973,296

†includes estimate of emissions from government employee generated solid waste

SUMMARY BY SOURCE

The vast majority of GHG emissions generated by City of Madison government operations in 2007 came from electricity and diesel fuel use, with these two energy sources responsible for almost 80 percent of total emission. The majority of electricity use came from powering the city's various buildings and facilities and running the water utility's water delivery pumps. Fully 65 percent of city's diesel fuel use came from transit fleet operations. These sectors hold the greatest potential for reducing GHG emissions from electricity and diesel fuel use.

Table 4: Summary by Source

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (%)	Energy (MMBtu)	Cost ($)
Electricity	57,495	1,903	1,729	57,808	61	213,907	6,217,345
Diesel	16,739	99	104	16,755	17.7	207,588	3,632,065
Natural Gas	7,238	27	1,364	7,257	7.7	123,752	972,414
Gasoline	6,782	413	367	6,850	7.2	86,807	1,864,800
Off Road Diesel	5,595	287	735	5,647	6	69,342	1,266,337
Off Road Gasoline	73	4	8	73	0.1	929	20,336
Total	93,922	2,733	4,307	94,390	100	702,325	13,973,297
Fuel costs include Buildings, Vehicle Fleet, Streetlights and Water/Sewage sectors only.							

SUMMARY OF ENERGY-RELATED COSTS

Energy is typically one of the largest operational costs for municipal governments aside from payroll expenses. In 2007, total energy use cost the City of Madison an estimated $13.97 million. More than half of the city's energy costs came from the Buildings and Facilities and Transit Fleet sectors. When considered on an energy source basis, Electricity purchases made up the largest proportion of city energy costs. Of note however is the fact that liquid fuel purchases (diesel and gasoline for on and off road use) make up a larger proportion of energy costs than electricity use.

Table 5: Energy Related Costs - By Sector

	Buildings and Facilities	Transit Fleet	Vehicle Fleet	Water Delivery Facilities	Streetlights & Traffic Signs	Employee Commute	Solid Waste Facilities	Wastewater Facilities	Total
Cost ($)	3,605,408	3,199,043	2,665,828	2,329,753	1,145,835	918,666	59,942	48,821	13,973,296
Cost (%)	26%	23%	19%	17%	8%	7%	0%	0%	

Table 6: Energy Related Costs - By Source

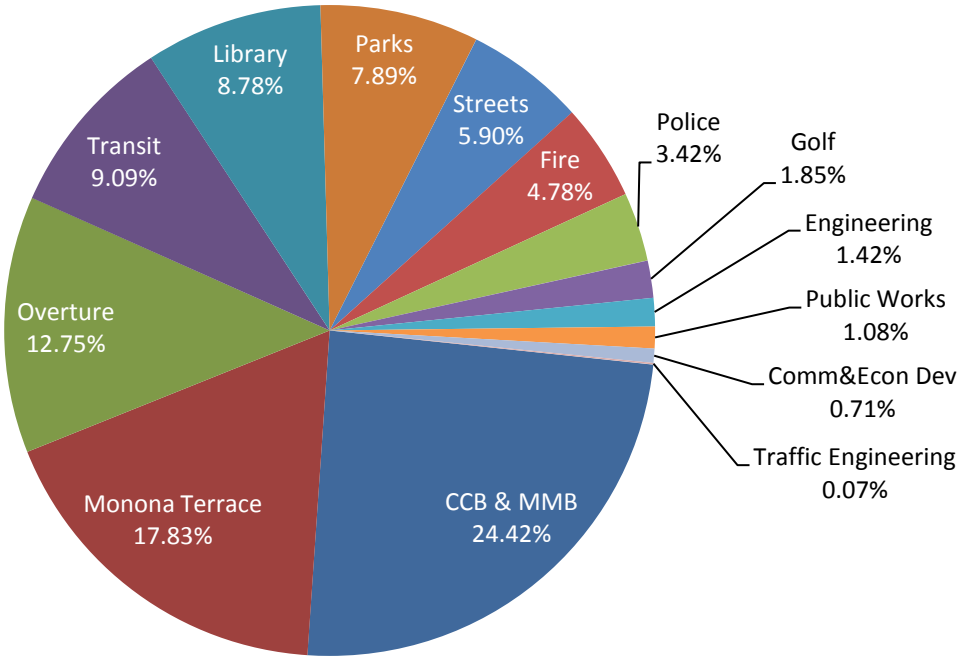
	Electricity	Diesel	Gasoline	Off Road Diesel	Natural Gas	Off Road Gasoline	Total
Cost ($)	6,217,345	3,632,065	1,864,800	1,266,337	972,414	20,336	13,973,297
Cost (%)	44%	26%	13%	9%	7%	0%	

DETAILED SECTOR ANALYSES

The following section presents the findings of the GHG baseline inventory on a per sector basis. Data is presented by agency where such a distinction was deemed appropriate.

BUILDINGS AND OTHER FACILITIES

Figure 4: Buildings and Facilities - By Agency



STREETLIGHTS AND TRAFFIC SIGNALS

Table 7: Streetlight and Signals Summary

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (% total)	CO2 (MMBtu)	Cost ($)
Streetlights & Traffic Signs	9,130	239	618	9,173	9.7	62,986	1,145,835

WATER DELIVERY FACILITIES

Table 8: Water Delivery Facilities Summary

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (% total)	CO2 (MMBtu)	Cost ($)
Water Delivery Facilities	21,373	700	683	21,489	22.7	82,904	2,329,753

TRANSIT FLEET

Table 9: Transit Fleet Summary

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (% total)	CO2 (MMBtu)	Cost ($)
Transit Fleet	14,809	94	97	14,825	15.7	183,698	3,199,043

Table 10: Transit Fleet Emissions - By Source

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (% total)	Energy (MMBtu)	Cost ($)
Diesel	14,706	87	93	14,720	15.5	182,376	3,170,204
Gasoline	103	6	5	104	0.1	1,322	28,839
Subtotal	14,809	94	97	14,825	15.7	183,698	3,199,043

VEHICLE FLEET EMISSIONS

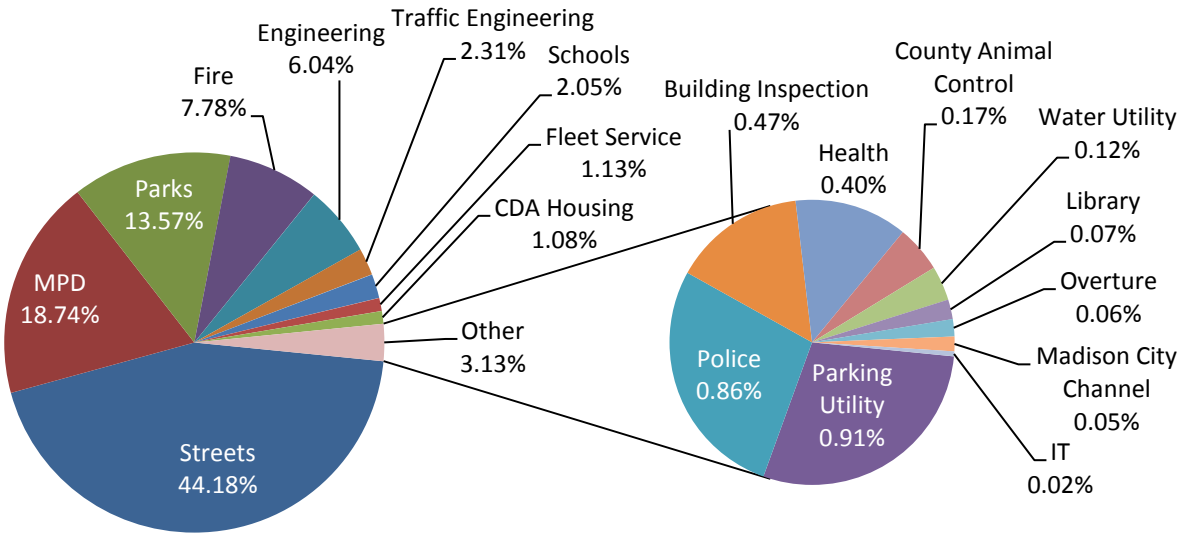
Table 11: Vehicle Fleet Emissions Summary

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (% total)	CO2 (MMBtu)	Cost ($)
Vehicle Fleet	11,371	518	982	11,462	12.1	142,466	2,665,828

Table 12: Vehicle Fleet Emissions - By Source

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (% total)	Energy (MMBtu)	Cost ($)
Diesel	2,033	12	11	2,035	2.1	25,212	461,860
Gasoline	3,688	217	230	3,724	3.9	47,205	922,599
Off Road Diesel	5,595	287	735	5,647	6	69,342	1,266,337
Off Road Gasoline	55	3	6	56	0.1	707	15,031
Subtotal	11,371	518	982	11,462	12.1	142,466	2,665,828

Figure 5: Vehicle Fleet Emissions Share - By Agency



SOLID WASTE

Table 13: Solid Waste Facilities

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (%)	CO2 (MMBtu)	Cost ($)
Solid Waste Facilities	465	12	35	800	0.8	3,492	59,942

Table 14: Government Generated Solid Waste Estimate

Estimated Emissions (tons CO_2 Equivalent)	333

EMPLOYEE COMMUTE

Table 15: Employee Commute Summary

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (% total)	CO2 (MMBtu)	Cost ($)
Employee Commute	3,008	190	135	3,039	3.2	38,502	918,666

RECOMMENDATIONS FOR FUTURE GHG EMISSIONS INVENTORIES

With this report, the City of Madison has taken the first step towards developing a comprehensive plan for addressing GHG emissions. Equally important however, is that the city works toward achieving the other GHG emission reduction milestones as outlined above in the LGOP.

In the process of completing a baseline report for the City of Madison Government Operations, team members gained knowledge of the City's accounting system and experience with the CAPC software and LGOP protocol. The following is a summary of recommendations for completing the ICLEI GHG emission reduction timeline.

ESTABLISH COMMUNITY BASELINE OF THE CITY OF MADISON

With the establishment of a baseline for the city of Madison's Government Operations, community emissions (emissions from the rest of city) from 2007 should be inventoried and a corresponding baseline established. Completing the community baseline for the city will give a more complete picture of emissions coming from Madison. Once the community baseline is established, GHG remediation plans can be created and put into action to address the city as a whole.

IDENTIFY THE NEXT REPORTING YEAR

Now that a baseline of emissions has been established for the city's government operations, the next year in which an inventory will be taken should be identified. Periodically reassessing the emissions of the city's government operations is important in order to tack trends in emissions and to determine the effectiveness of any remediation plans put into action. ICLEI recommends completing periodic GHG inventories at leastevery two to three years. Based on the team's experience in completing this baseline analysis, we believe that it is possible to inventory emissions on an annual basis if data collection is systematized.

IDENTIFY THE PROCESS BY WHICH THE INVENTORY WILL BE PERFORMED IN THE FUTURE

Establishing a GHG emission baseline for the City of Madison is a project that has been several years in the making, mostly due to a lack of dedicated manpower. In order to ensure that the next inventory is completed efficiently the process should be organized ahead of time with an emphasis placed on systematizing the collection and reporting of data. Identifying the individual City Staff members who will be responsible for collecting the data needed for each sector in the CACP modeling software, and the methods that will be used to aggregate and clean the necessary data are key responsibilities to identify. It is the opinion of the baseline inventory team that were data collection and aggregation systematized and made a regular part of city operations, equal in weight and priority to other city accounting practices, the amount of time necessary to complete future inventories could be dramatically decreased.

WORK WITH THE REPORTING SYSTEMS TO GENERATE REPORTS THAT CAN EASILY BE TRANSFERRED INTO THE CACP SOFTWARE

In order to save time and prevent data entry errors custom reports should be created with the city's reporting systems that easily allow for the transfer of information into the CACP software. The majority of the time spent preparing this baseline report was devoted to cleaning data, and eliminating double counting issues. Much of this work can likely be automated. As such, future inventories will benefit from the development of reports tailored for use with the CACP modeling software. (Appendix C presents a more detailed account of recommended changes in data collection and reporting.)

TRACK MISSING INFORMATION

Throughout this report, information that is currently not being tracked has been identified. Missing information should be tracked in the future in order to improve the accuracy and completeness of the GHG inventory. Information identified as missing include: refrigerants, vehicle records for the DCNET (Dane County Narcotics), water utility and metro staff vehicles.

RECOMMENDATIONS FOR GHG POLICY DEVELOPMENT AND EVALUATION

In 2008 the City Operations of Madison started to participate in Madison Gas and Electric's (MG&E) Green Power Tomorrow (GPT) Program. GPT allows electricity users to purchase electricity from renewable sources at a premium price (1.25 cents extra per kilowatt-hour as of May 2010). This agreement requires MG&E to supply their service area with renewable energy in accordance with the purchased amount, and allows the City to offset its emissions. Madison currently offsets 22% of the electricity it purchases from MG&E, which supplies an approximate 97% of the electricity that City purchases (3% comes from Alliant Energy).

If the City would have offset 22% of their electricity in 2007, it would have significantly reduced its GHG emissions. In 2007, the City purchased 56,565,761 kWh, 22% of which is 12,444,467 kWh. The CO2e coefficient that was used for this study was 1.869 lbs/kWh. Given these assumptions, the City would have avoided 23,258,709 lbs or 10,550 metric tons of CO2e. However, this would have come to a cost of $155,556 (assuming the 2010 premium of 1.25 cents/kWh).

The City of Madison should evaluate renewable (such as GPT purchases) and energy efficiency measures together in order to prioritize those which are most cost-effective. For example, it currently costs the City an incremental 1.25 cents/kWh to purchase GPT in order to offset its GHG emissions, but energy efficiency measures avoid both emissions and utility energy and demand costs at same time (electricity costs the city an approximate 10 cents/kWh and additional demand charges apply during peak events). The City should work with internal staff and/or contracted consultants familiar with energy systems and economic costs and benefits of GHG reduction measures. This way the city can analyze its current GPT purchases, and either increase the percent it offsets through GPT, or decrease the percent and divert the money they would have spent on more cost-effective energy efficiency options. Deciding optimal levels of GPT purchases and total resource allocation within a larger GHG reduction plan is crucial when attempting to simultaneously meet environmental and economic goals.

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Local Government Operations Protocol September 2008. Retrieved May 10, 2010 from The Climate Registry: http://www.theclimateregistry.org/resources/protocols/local-government-operations-protocol/

APPENDIX A: DETAILED METHODOLOGY

The following section details the data collection, preparation methodology used in preparing the GHG baseline inventory. GHG and CAP emission coefficients were entered for the inventory year according the CACP users guide using emissions factors from the LGOP appendix G.

In all cases, data was entered into the CACP software using the copy and paste "assistant" functions present in the software so as to eliminate manual entry and reduce introduced error. In cases where agency information was recorded (Buildings & Facilities and Vehicle Fleet) the different city agencies were entered into CACP using the list manager function under the categories tab. Once all relevant agencies were added, the assistant was used to copy the sector to the clipboard. This was then pasted into a blank Microsoft Excel spreadsheet in order to serve as a template. Data collected from city agencies were then added to the appropriate columns in the spreadsheet and the columns for Coefficient Sets and Energy Units were copied down through all data points. Agency references were added where relevant, formatted identically to the agency listing as added to CACP. Once energy use and final cost data aggregation was complete, the entire spreadsheet was copied and then pasted back into CACP using the assistant. It is important to note that in cases where large quantities of data are pasted into CACP, the software may take half an hour or more to process and save all of the data.

STATIONARY SOURCES

Data used to calculate GHG emissions from the Buildings and Facilities, Water Delivery Facilities, Streetlights & Traffic Signs, Wastewater Facilities, Solid Waste Facilities came from Kay Schindel, Engineer with the city Engineering division. Individual data sets for each city agency were produced using the division's Utility Manager software. These individual spreadsheets were checked to remove all instances of totals and subtotals so as to prevent double counting. Additionally, entries listed as "unknown" that corresponded in value to the sum of other entries within the same agency were removed. Data was then organized according to the five stationary sources sectors listed above. Pumping stations were designated to the water delivery sector , and lift stations to wastewater. Entries corresponding to the Buildings and Facitlies sector were then arranged by agency.

The energy used data from Utility Manager was combined with total cost data by energy source for each data point. Electricity cost was calculated as the product of the reported energy use and a weighted average of the electricity rates reported by Alliant Energy and Madison Gas and Electric. Weights were determined using the percentage share of city purchased electricity supplied by each utility. Electricity rates were determined to be $0.0992 per kWh. Gas rates were determined using the transport cost supplied by Madison Gas and Electric combined with a per-therm fuel cost as estimated by City Engineering. Natural gas cost was determined to be $0.84 per therm.

Using the data import method described above, the data for all stationary sources was added to the baseline inventory model.

VEHICLE FLEET

Information for the vehicle fleet sector came from City Staff member Bruce Nelson, the Fleet Services program supervisor. Two spreadsheets listing gas and diesel information were provided. The spreadsheets listed the

city department number, vehicle number (unique), year, make, model, quantity of fuel (gallons) and fuel cost for each vehicle. Some departments also had a line item entitled "gas cans." The fuel and cost from these line items were allocated to the vehicles in the department based on the percentage of total fuel each car used in the department. All vehicles were then labeled with the heading recognized by and provided in the CACP software. For example, a 2002 Ford Taurus was given the CACP label "2002 passenger car". At the time the inventory was taken (Spring 2010) the CACP software only included vehicle information up to the year 2005. Therefore all vehicles with model years after 2005 were entered into the year 2005 at the recommendation of an ICLEI representative.

Once all vehicles were labeled the working spreadsheet was sorted by vehicle type and model year. The information from the spreadsheet was then copied and pasted into the CACP input spreadsheet which was copied out of the CACP software into excel. Once the CACP input spreadsheet was populated it was then pasted back into the CACP software.

TRANSIT FLEET

The information for the transit fleet sector came from City Staff member Andy Probst in the Finance department. A spreadsheet was provided which listed total gas and diesel usage in total by the following vehicle types used by the Metro department. Transit types included buses, paratransit vehicles, metro staff cars and heavy duty trucks. All vehicles were then labeled with the correct heading recognized and provided by the CACP software. For example, the paratransit vehicles were given the label "Heavy Duty vehicles All MY". Note, "All MY" stands for all model years and that this is how vehicle information is entered into the CACP software for heavy duty diesel vehicles. Once all vehicles were labeled, information from the spreadsheet was then copied and pasted into the CACP input spreadsheet which was copied out of the CACP software into excel. Once the CACP input spreadsheet was populated it was then pasted back into the CACP software.

EMPLOYEE COMMUTE

The information for the employee commute sector came from the 2007 commuter survey for city employees called Commuting Incentive Report, which was provided by Jeanne Hoffman, the city Facilities and Sustainability manager. The commuter survey contained two separate questions in regards to how far employees commuted to work and what means they used to commute to work. Only a summary of the results was available as no details from the actual surveys could be found. The result of not having the detail resulted in the inability to determine what means an employee used to commute the miles they listed as their commute distance. To estimate the total fuel used from the employee commute the survey results were extrapolated over the number of city employees (2,700 in 2007 per Jeanne Hoffman). Specifically, total miles commuted was calculated using the response to the question "How many miles is it one way from your home to your place of work?" with the following equation:

$$n \times p \times \frac{h + l}{2} \times 2 = Total\ miles\ commuted\ by\ city\ employees$$

where *n* equals the number of employees in 2007, *p* equals the percentage of employees who responded as yes to the commute category range and *h* and *l* equal the high and low commute miles from the commute

category range. The formula is multiplied by two as the survey listed commute distances as miles commuted each way. Once the number of miles commuted was calculated for each category, they were multiplied by 241, which is the number of commuting days in 2007. The commuting days was arrived at by taking the number of business days in 2007 of 251 and then subtracting an assumed two weeks vacation for each employee. Once the total miles commuted was calculated the miles were then allocated to commuting means, such as "drove alone" using the "During an average week which of the following ways have you used to travel to/from work" survey question, based on the percentage of responses to each category. The average fuel price in Wisconsin[6] and the average age and fuel efficiency of a passenger car[7] in 2007 were used to further calculate the total amount of fuel used and its related cost. Since fuel used by city buses has already been counted in the transit fleet sector, all miles commuted by employees using the bus had zero diesel usage associated with them.

EMPLOYEE SOLID WASTE

GHG emissions from city employee generated solid waste was calculated using a per-employee waste coefficient as estimated by the state of California for solid waste generated by public administration employees.[8] This waste coefficient was applied to the estimated 2700 employees in 2007 in order to come up with a total tonnage of waste. This total amount was then converted to GHG emissions using the solid waste module of the community analysis function of the CACP software. The estimated emissions from employee waste was then copied back into the government analysis section of the software as an additional observation under the Solid Waste Facilities sector. Emissions were entered as CO_2. The entry created in the community analysis data was then deleted.

[6] http://www.atg.wa.gov/uploadedFiles/Another/Safeguarding_Consumers/Antitrust/Unfair_Trade_Practices/Gas_Prices/2007%20Gas%20Price%20Study%20-%20phase%20I.pdf

[7] http://www.fueleconomy.gov/feg/mobile.shtml

[8] http://www.calrecycle.ca.gov/wastechar/DispRate.htm

APPENDIX B: FULL RESULTS

Table 16: Summary of GHG Emissions by Sector

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv (tons)	CO2 Equiv (%)	CO2 (MMBtu)	Cost ($)
Buildings and Facilities	33,313	965	1,744	33,481	35.3	186,597	3,605,408
Water Delivery Facilities	21,373	700	683	21,489	22.7	82,904	2,329,753
Transit Fleet	14,809	94	97	14,825	15.7	183,698	3,199,043
Vehicle Fleet	11,371	518	982	11,462	12.1	142,466	2,665,828
Streetlights & Traffic Signs	9,130	239	618	9,173	9.7	62,986	1,145,835
Employee Commute	3,008	190	135	3,039	3.2	38,502	918,666
Solid Waste Facilities	798	12	35	800	0.8	3,492	59,942
Wastewater Facilities	451	15	14	454	0.5	1,680	48,821
Total	**94,255**	**2,732**	**4,308**	**94,723**	**100**	**702,325**	**13,973,296**

Table 17: Criteria Air Pollutant Emissions by Sector

	NO_x (lbs)	SO_x (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)
Buildings and Facilities	112,042	258,755	22,102	2,835	16,609
Streetlights & Traffic Signals	30,200	63,027	6,138	852	4,128
Water Delivery Facilities	73,457	190,521	13,930	1,585	11,971
Wastewater Facilities	1,555	4,072	294	33	255
Solid Waste Facilities	1,527	3,025	315	45	200
Vehicle Fleet	49,496	2,424	245,647	26,892	2,329
Employee Commute	19,074	968	192,499	20,195	412
Transit Fleet	273,454	8,897	180,644	23,022	13,556
Total	560,803	531,689	661,568	75,460	49,462

Table 18: GHG Emissions by Agency

	Emission Type	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv. (tons)	CO2 Equiv (%)	Energy (MMBtu)	Cost ($)
Comm&Econ Development	Buildings & Facilities	236	7	9	237	0.3	1,074	26,579
Engineering	Buildings & Facilities	472	10	44	474	0.5	4,240	64,604
Fire	Buildings & Facilities	1,594	37	134	1,601	1.7	13,226	212,231
Golf	Buildings & Facilities	615	19	25	618	0.7	2,843	69,526
Library	Buildings & Facilities	2,923	89	128	2,939	3.1	14,245	334,539
Monona Terrace	Buildings & Facilities	5,938	197	179	5,971	6.3	22,093	642,157
Overture	Buildings & Facilities	4,245	137	145	4,268	4.5	17,248	467,019
Parks	Buildings & Facilities	2,629	70	172	2,642	2.8	17,600	327,031
Police	Buildings & Facilities	1,141	31	74	1,146	1.2	7,555	141,463
Public Works	Buildings & Facilities	360	10	19	361	0.4	2,001	42,506
Streets	Buildings & Facilities	1,969	45	171	1,977	2.1	16,729	264,285
Traffic Engineering	Buildings & Facilities	24	1	1	25	0	91	2,639
Transit	Buildings & Facilities	3,029	98	104	3,045	3.2	12,325	333,292
MMB & CCB	Buildings & Facilities	8,138	214	541	8,177	8.6	55,325	677,539
Building Inspection Division	Vehicle Fleet	53	4	3	54	0.1	679	12,946
CDA Housing Operations	Vehicle Fleet	121	14	11	124	0.1	1,550	29,613
County Animal Control	Vehicle Fleet	19	2	1	19	0	237	4,524
Engineering	Vehicle Fleet	689	19	33	692	0.7	8,597	158,389
Fire	Vehicle Fleet	886	38	66	892	0.9	11,015	207,275
Fleet Service	Vehicle Fleet	128	12	10	129	0.1	1,628	30,893
Health	Vehicle Fleet	45	2	2	46	0	581	11,001
Information Technology	Vehicle Fleet	2	0	0	2	0	25	473
Library	Vehicle Fleet	7	1	1	8	0	95	1,782
Madison City Channel	Vehicle Fleet	6	0	0	6	0	73	1,367
MPD	Vehicle Fleet	2,133	90	128	2,148	2.3	27,296	534,620
Overture	Vehicle Fleet	7	0	0	7	0	84	1,603
Parking Utility	Vehicle Fleet	103	5	5	104	0.1	1,309	24,572
Parks	Vehicle Fleet	1,541	78	161	1,555	1.6	19,303	371,837
Police	Vehicle Fleet	99	3	6	99	0.1	1,263	24,176
Schools	Vehicle Fleet	233	8	21	235	0.2	2,898	52,843
Streets	Vehicle Fleet	5,024	223	512	5,064	5.3	62,358	1,132,878
Traffic Engineering	Vehicle Fleet	262	16	19	265	0.3	3,302	61,529
Water Utility	Vehicle Fleet	13	1	1	14	0	172	3,506
Subtotal Buildings and Facilities	Buildings and Facilities	33,313	965	1,744	33,481	35.3	186,597	3,605,408
Subtotal Vehicle Fleet	Vehicle Fleet	11,371	518	982	11,462	12.1	142,466	2,665,828
Total		**44,684**	**1,483**	**2,726**	**44,943**	**47**	**329,063**	**6,271,236**

Table 19: GHG Emissions by Source - By Sector

	CO2 (tons)	N2O (lbs)	CH4 (lbs)	CO2 Equiv. (tons)	CO2 Equiv (%)	Energy (MMBtu)	Cost ($)
Buildings and Facilities Sector							
Electricity	28,629	947	861	28,785	30.4	106,513	3,095,876
Natural Gas	4,684	18	883	4,696	5	80,084	509,531
Subtotal	33,313	965	1,744	33,481	35.3	186,597	3,605,408
Streetlights & Traffic Signals Sector							
Electricity	6,960	230	209	6,998	7.4	25,896	752,675
Natural Gas	2,169	8	409	2,175	2.3	37,091	393,159
Subtotal	9,130	239	618	9,173	9.7	62,986	1,145,835
Water Delivery Facilites Sector							
Electricity	21,572	714	649	21,689	22.9	80,257	2,332,704
Natural Gas	253	1	48	254	0.3	4,327	45,870
Subtotal	21,825	715	696	21,943	23.2	84,584	2,378,575
Solid Waste Facilities Sector							
Carbon Dioxide	333	0	0	333	0.4	0	0
Electricity	334	11	10	336	0.4	1,242	36,089
Natural Gas	132	0	25	132	0.1	2,250	23,853
Subtotal	798	12	35	800	0.8	3,492	59,942
Vehicle Fleet Sector							
Diesel	2,033	12	11	2,035	2.1	25,212	461,860
Gasoline	3,688	217	230	3,724	3.9	47,205	922,599
Off Road Diesel	5,595	287	735	5,647	6	69,342	1,266,337
Off Road Gasoline	55	3	6	56	0.1	707	15,031
Subtotal	11,371	518	982	11,462	12.1	142,466	2,665,828
Employee Commute Sector							
Gasoline	2,991	189	133	3,022	3.2	38,280	913,362
Off Road Gasoline	17	1	2	18	0	222	5,304
Subtotal	3,008	190	135	3,039	3.2	38,502	918,666
Transit Fleet Sector							
Diesel	14,706	87	93	14,720	15.5	182,376	3,170,204
Gasoline	103	6	5	104	0.1	1,322	28,839
Subtotal	14,809	94	97	14,825	15.7	183,698	3,199,043
Total	***94,255***	***2,732***	***4,308***	***94,723***	***100***	***702,325***	***13,973,296***

APPENDIX C: RECOMMENDATIONS FOR ACCOUNTING GOING FORWARD

In the process of completing a baseline report for the City of Madison Government Operations, team members gained knowledge of the City's accounting system and experience with the CAPC software. The following is a guide to the data used for this report as well as a summary of suggestions for how the City of Madison's Government Operations staff could modify accounting practices to make data collection for carbon accounting more accurate and easier in the future. The CACP software allows users to enter data collection notes within sectors, but we have chosen to include this information in the final report for the city.

GENERAL ACCOUNTING AND REPORTING

The vast majority of the time spent in preparing this GHG baseline report was spent preparing data collected from City of Madison sources. Based on conversations with agency staff, it is our determination that a great deal of time could be saved if output reports are developed in such a way as to facilitate the efficient entry of that data into the CACP software. In particular output data should have all totals and subtotals removed so as to prevent double counting and potential errors in data preparation. Additionally, the CACP software has the ability to produce detailed reports, showing the emissions produced by every building, facility, or vehicle. The way in which identifying information is recorded, particularly for buildings and facilities should be evaluated so as to be useful to those who would use the output reports. For example a building listed as "11196870" does not shed much light on the location or nature of use of this facility.

SOLID WASTE

The city of Madison does not currently record the amount and composition of solid waste produced by city employees as employee waste is currently collected on routes that also collect non-city waste rendering landfill weight measurements useless for calculating the amount generated by city employees. As a result an estimate was produced for this report using a generalized waste coefficient. In order to increase the accuracy of future inventories, the following steps are recommended for increasing the quality of data accounting:

- The city should consult with the Madison Streets Division in order to determine if it is feasible to shift routes in order to collect city waste on a separate route, thereby allowing for precise measurement of total waste produced.
- As such as change in solid waste disposal operations may increase cost and reduce productivity, it may be possible to perform such a modified pickup only periodically in lengths of one week so as to sample city employee waste generation rates. This rate can then be multiplied out over the entire year to determine the total amount of city generated solid waste.
- If the above measures prove too costly otherwise infeasible, a modified per-employee waste coefficient could be generated by sampling trash receptacles in buildings where city employees work. This, combined with an accurate count of the number of trash receptacles and the number of employees could be used to produce a modified per-employee waste generation factor which could be used in the same way as outlined in this report.

VEHICLE FLEET

The CACP 2009 software requires fleet information to be entered by vehicle type (i.e. passenger car, light truck, heavy duty truck) and vehicle year. Significant time savings could be achieved in the future if the city's fleet fuel usage report could be formatted to output data in this manner, see example below.

Department	Vehicle Year	Vehicle Type	Gasoline Used (gal)	Gasoline Cost	# of Vehicles
Parks	2000	Passenger car	1000	$3,000	20

There are several minor changes that could be made to accounting practices to greatly increase the accuracy of accounting for vehicle fleet GHG emissions. Current detailed vehicle records are not kept for either the DCNET (Dane County Narcotics) or the water utility. Going forward, it would be beneficial to know what kind of vehicles the departments are using as well as the fuel consumption by vehicle type and year. A comprehensive summary of all vehicles would ensure that the city's carbon baseline reflects accurately the emissions from City Operations In addition, tracking the total miles traveled by each vehicle would enhance and add to the accuracy of the GHG emissions analysis. In addition, Refrigerants added to vehicles should be tracked in the future in order to calculate the amount of these refrigerants being emitted to the atmosphere.

TRANSIT FLEET

There are several minor changes that could be made to accounting practices to greatly increase the accuracy of accounting for transit fleet GHG emissions. Current detailed vehicle records are not kept for the metro staff vehicles. Going forward, it would be beneficial to know what kind of vehicles the departments are using as well as the fuel consumption by vehicle type and year. Refrigerants added to vehicles should be tracked in the future in order to calculate the amount of these refrigerants being emitted to the atmosphere. A comprehensive summary of all vehicles would ensure that the city's carbon baseline reflects accurately the emissions from City Operations. In addition, tracking the total miles traveled by each vehicle would enhance and add to the accuracy of the GHG emissions analysis.

EMPLOYEE COMMUTE

In future employee surveys the survey data should be retained to more accurately associate commuting miles with the means employees are using to commute the miles. Alternatively, the raw data from the previous employee commuter survey could be found.