MISSOULA GREENHOUSE GAS EMISSIONS INVENTORY AND ANALYSIS, 2003-2008:

Toward A Blueprint For Municipal Sustainability

SEPTEMBER 2010

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PREFACE

This document represents the City of Missoula's effort to understand its carbon footprint. Like most emissions inventories, this report can't account for every variable or reflect policy choices made in the spirit of serving the community. We leave a sizeable footprint, we know, but in exchange, we meet the daily needs of thousands of citizens whose own footprints would grow while their pocketbooks would shrink were it not for municipal government. This report is designed to inform our decisions as we move the community forward. We made many changes in the way we do business before we embarked on creating this inventory. And, already, the City's investing millions in reducing our footprint as we move forward, in part because of this report, in part because we know it's the right thing to do and in part because conservation of natural resources makes good financial sense. Our hope and our goal is to work to make this report obsolete sooner rather than later.

John Engen, City of Missoula Mayor

ACKNOWLEDGEMENTS

We heartily thank Missoula Mayor John Engen for his leadership in addressing climate change locally. Without his embracing of the U.S. Conference of Mayors Climate Protection Agreement, Missoula would not be taking this important step of conducting a greenhouse gas emissions inventory of municipal operations.

We are grateful for the opportunity to assist the City by conducting real-world applied research. We appreciate the chance to learn about City operations and offer recommendations for reducing Missoula's energy use, saving on energy costs, and shrinking the City's carbon footprint.

We also appreciate working in close partnership with the City and interacting with and getting to know the City's dedicated, professional staff. We very much appreciate the time and effort that many City personnel devoted to the project in providing information, spending time helping us understand and interpret data and commenting on draft chapters. We also thank members of Mayor Engen's Administrative Leadership Team, along with numerous City personnel, for their valuable guidance and assistance.

Although the involvement of these individuals is described in applicable chapters, several individuals require special recognition for their outstanding contributions to our collective effort. First and foremost is Ginny Merriam, the City's Public Information/Communications Officer, who coordinated the project, routed our various information requests and helped tremendously with the survey we conducted of employee commuting, to name just a few of her contributions. We are grateful for her dedication to the project, good nature, patience and helpfulness. City Chief Administrative Officer Bruce Bender also helped us coordinate with various personnel and directly responded to many of our requests.

We would be remiss without extending special appreciation to Mary Kay Wedgwood in the Finance Department for her helpfulness in providing access to utility billing records on numerous occasions. Vicki Judd, Manager of Community Relations for NorthWestern Energy in Missoula, also graciously responded to multiple data requests and generously gave her time to the project, for which we are grateful.

We are also most appreciative of Jack Stucky, the City's Vehicle Maintenance Supeintendent, particularly for providing fuel use data on the municipal fleet, for helping us identify and understand utility billing for municipal buildings, and for providing information about the City's existing energy conservation and efficiency efforts. We are also grateful to Jack Stucky for his helpful comments and critiques of drafts of various chapters, which allowed us to make significant improvements to this report.

We appreciate the 125 anonymous City employees who completed our employee commuting survey. We also thank the Missoula Greenhouse Gas & Energy Conservation Team for their valuable input in the early stages of the project, long-standing work on municipal sustainability, and interest in this report.

Finally, we thank The University of Montana Sustainable Campus Committee and the Provost and Vice President for Academic Affairs Royce Engstrom, Chuck Harris of the UM Social Science Research Lab, and the Environmental Studies Program (EVST) for their support for this project. Last but not least, EVST students Matt Hodges and Laura Goldberg also contributed to this report.

EXECUTIVE SUMMARY

GOALS AND OBJECTIVES

As frequent stories in the news attest, climate change is harming the natural assets that Montanans value. Scientists predict that threats to our forests, streams, wildlife, working farms, and our state's economy will grow in the future as things continue to heat up and dry out. Indeed, climate change threatens the local economy in Missoula, the fiscal well-being of City government, and our local quality of life.

As major contributors of greenhouse gas emissions that are causing climate change, cities around the world, including several cities in Montana, are facing up to their responsibility to be part of climate change solutions. In an era of ever-increasing energy costs, cities are finding many good reasons to lead by example.

Because addressing climate change involves using less energy and using it more wisely, it can allow services that the public demands to be maintained in tough economic times and prevent undesirable and forced choices to be made.

Missoula is not alone in recognizing that taking action as a community can improve fiscal well-being as well as benefitting the local economy and enhancing quality of life. However, to be effective, efforts require careful analysis and planning. This report seeks to assist in that regard by methodically carrying out the first of five steps for local governments to achieve emission reductions under the *U.S. Conference of Mayors Climate Protection Agreement:* conducting a greenhouse gas (GHG) emissions inventory of municipal operations.

Specific goals of this report are:

1. To present a baseline greenhouse gas emissions inventory for the City of Missoula that quantifies total energy use and associated emissions for municipal operations.
2. To identify major sources of municipal GHG emissions and relative contributions within and among the various sectors examined.

3. To analyze changes and trends in energy use, costs and emissions from Fiscal Years (FY) 2003 to 2008.
4. To identify opportunities and offer recommendations to achieve future municipal GHG emission reductions and energy cost savings.

Our study examines the following emissions sectors: (1) wastewater treatment; (2) buildings; (3) vehicle fleet; (4) employee commuting; (5) lighting; and (6) water. Emissions related to solid waste disposal were not included.

To conduct this emissions inventory and analysis, University of Montana Professor Robin Saha and students in his graduate course called Local Solutions to Climate Change examined energy use and costs for each municipal sector. Energy use data were converted to common energy units and used to calculate GHG emissions in terms of metric tons of carbon dioxide equivalents, which we refer to as *tons of CO_2e*.

Inventoried energy use primarily included: (1) purchased energy (electricity and natural gas) for over 250 NorthWestern Energy accounts billed to the City; and (2) unleaded gasoline and diesel fuel consumption by the municipal fleet and employee commuting. Captured and released biogas from the wastewater treatment plant was another significant energy use and emission source.

NorthWestern Energy and dozens of City personnel were integral at each step of conducting this municipal emissions inventory and analysis by providing essential information, reviewing draft chapters, and contributing in many other ways. Indeed, this report is the product of a more than year-long partnership between The University of Montana Environmental Studies Program and the City of Missoula that was initiated by the request of Mayor John Engen.

KEY FINDINGS

In Fiscal Year (FY) 2008, total greenhouse gas emissions from Missoula's municipal operations totaled 11,540 tons of CO_2e, or 25.45 million pounds. This represents the equivalent weight of over 143,000 adults, or nearly three times the weight of the City of Missoula's adult population. Put another way, this is equivalent to the weight of nearly 7,500 Subaru Outback Wagons, which, lined up bumper-to-bumper, would stretch from downtown Missoula to Lolo, Montana, and back.

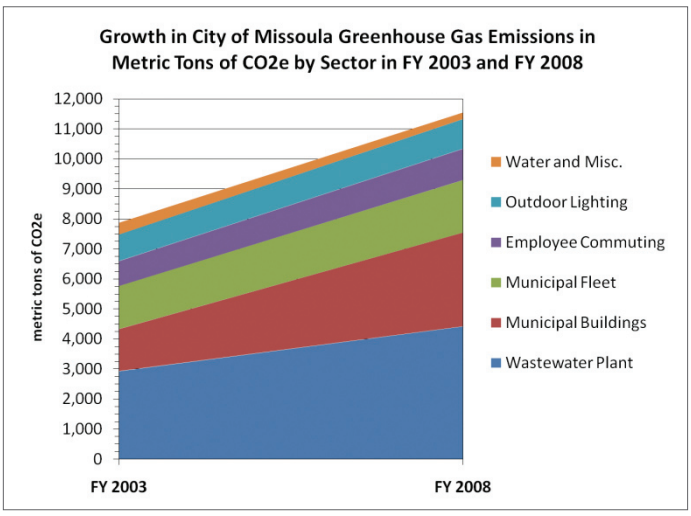

Figure A

Municipal greenhouse gas emissions increased 46% from FY 2003 to FY 2008. This represents an average annual increase of 9.3%, or 731 tons of CO_2e, and is akin to each year adding the equivalent of emissions associated with the energy use of City Hall (435 Ryman St.) and City Council Chambers (140 W. Pine St.).

All major sectors examined contributed to the recent increase in emissions, including wastewater treatment, buildings, municipal fleet, employee commuting, and lighting (Figure A). Emissions from wastewater treatment and municipal buildings increased 51% and 124%, respectively, from FY03 to FY08, and together accounted for about 55% of total emissions in both years.

The growth in emissions from wastewater treatment is the result of upgrades to the system, expansion in capacity, and increase in volume of wastewater treated. The increase in emissions from buildings is primarily the result of the addition of new buildings, expansion of existing buildings, and an increase in the number of City employees. The latter is also responsible for the growth in emissions from employee commuting, which accounted for 9% of municipal GHG emissions in FY08.

The municipal fleet is also a significant contributor to the City's GHG emissions and accounted for 15% of total emissions in FY08. Fleet emissions increased 21% from FY03 to FY08 primarily due to increases in fuel use by the Police and Fire departments. Emissions from lighting increased 11% from FY03 to FY08 and accounted for 8.5% of total emissions in FY08.

Missoula's rate of increase in GHG emissions is greater than those of other Montana cities that have conducted GHG emissions inventories and also are greater than those of The University of Montana (Table A). For example, Bozeman's municipal emissions increased 29% from 2000 to 2006, and UM's emissions increased 16% from 2000 to 2007. Helena reduced its emissions 18% from 2001 to 2007 by making energy efficiency improvements to its wastewater treatment plant.

Table A shows the emission reduction targets of the other cities in Montana and UM, which are included in their respective climate action plans under the *Mayors Climate Protection Agreement* and the *American College and University Presidents Climate Commitment.*

Table A: Recent Changes in GHG Emissions and Reduction Targets for Montana Cities and The University of Montana

	Recent % Change	Ave. Annual % Change	Emissions Reduction Target for 2020
Bozeman	29.3%	4.9%	15% below 2000 level
Helena	-18.1%	-3.0%	15% below 2007 level
Missoula	46.4%	9.3%	Not yet applicable
Univ. of MT	16.4%	3.3%	100% below 2007 level

Missoula's recent rates of increase in total emissions were used to generate a crude forecast of future emissions under a "business as usual" scenario. First, we used an average annual rate of increase of 6% from FY03 to FY08 that excludes the addition of recent buildings (Forecast 1 in Figure B). This rate assumes there will be no new municipal buildings added in the next decade. Second, we used the average annual rate of increase of 9.3% for all municipal emissions (Forecast 2 in Figure B). These forecasts predict that, without proactive steps, emissions will increase 41-65% from FY08 levels by 2015 and 71-111% by 2020.

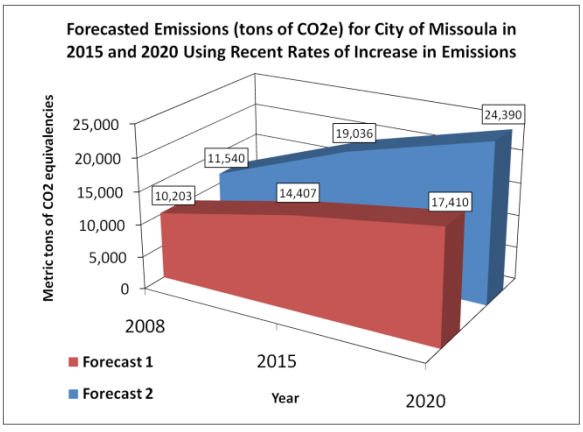

Figure B

Inaction will carry high costs. From FY03 to FY08, Missoula's energy costs were found to increase at a much faster rate than energy use and emissions have increased. Although energy use increased 41% from FY03 to FY08, energy costs increased at a nearly six-times greater rate (233%) during this period.

Adjusting for inflation by using 2009 constant dollars, *purchased energy costs* increased nearly three-fold during this five-year period, from $341,010 to $1.28 million (Figure C). This represents more than a 50% average annual rate of increase.

Fuel costs for the municipal fleet also increased rapidly: 176% during the study period, from $217,060 in FY03 to $599,490 in FY08. This represents a 35% average annual rate of increase.

Thus, the total inflation-adjusted municipal energy and fuel costs increased $1.32 million from FY03 to FY08, from $558,070 to $1,877,637. This represents a $263,913 average annual increase in energy costs.

Escalating energy costs are not solely the result of utility rate and fuel cost increases. They are also affected by the increases in energy use.

CONCLUSIONS

This municipal greenhouse gas inventory shows that recent increases in the City's energy use and associated greenhouse gas emissions have been accompanied by even steeper and unsustainable increases in energy costs. From a fiscal standpoint alone, it appears that energy cost increases are not sustainable, particularly if energy use continues to increase. Even if energy use were not to increase, energy costs are still likely to increase faster than inflation and faster than growth in revenue.

Although Missoula has already begun to take steps to reduce energy use and costs, Missoula is behind other cities in Montana that are part of the *U.S. Conference of Mayors Climate Protection Agreement.* Nevertheless, elected officials, citizens, and business leaders are committed to municipal sustainability, maintaining quality of life, supporting the local economy, and protecting the environment.

Moreover, Missoula has a concerned and talented pool of City employees, civic leaders, nonprofit organizations, and a state university to draw on for leadership and expertise in taking its next steps. Indeed, Missoula has the capacity and interest in making further progress on energy and climate change. Missoula is well-positioned to become a leader among cities in Montana in addressing climate change at the local level and continuing down the path of municipal sustainability.

Using less energy and using what we use more wisely takes concerted and coordinated effort. It takes planning, and it takes involvement and cooperation of the public and private sectors. We hope that by revealing recent trends in energy use, costs, and associated GHG emissions, and by showing what is at stake and what can be done, this report gives impetus to City leaders and the broader community to confront the challenges head on.

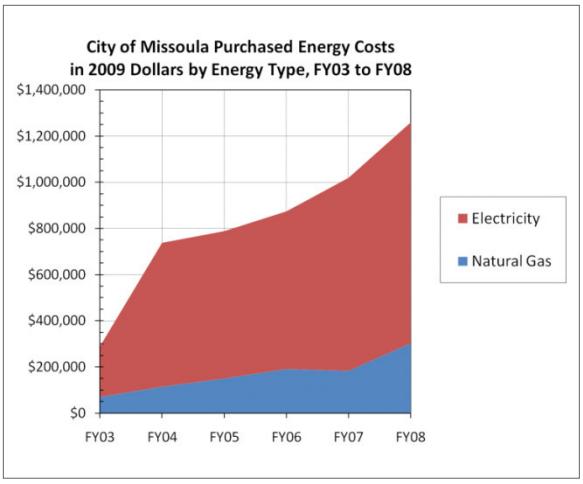

Figure C

We believe Missoula is ready to follow suit with other cities in Montana and across the country in coming together to take the next step in the *Mayors Climate Protection Agreement*: setting an emission reduction target and developing a climate action plan for the City.

The benefits of local solutions to climate change go far beyond more efficient local government. In taking the next steps, the City of Missoula can lead by example for all Missoulians. Moving forward in ways that we have outlined in our recommendations will

help protect the things the Missoula community values most: our parks and open spaces, working farms, forests and streams, wildlife habitat, public health, quality of life, and livability of our neighborhoods.

Reducing the City of Missoula's carbon footprint will also improve our buildings, waste management, and transportation systems. It will leave more in our pocketbooks and improve the local economy. It will enhance the designs of our neighborhoods, our air quality, our health and well-being as individuals, families and as a community.

EMISSION REDUCTION STRATEGIES AND "NEXT STEPS" FOR MISSOULA

We recommend four basic strategies to reduce municipal emissions and save on energy costs: (1) reducing energy use through energy conservation and efficiency; (2) generating renewable energy; (3) purchasing renewable energy; and (4) offsetting emissions.

We recommend that City officials and concerned citizens consider each of these strategies within the Cities for Climate Protection framework. Under that framework, Missoula's next steps should be:

1. To set a greenhouse gas emissions reduction target, e.g., zero net emissions by 2020; without a clear goal, progress will be hard to achieve or measure.
2. To carry out a climate action planning process – to identify, prioritize, and adopt policies to support emission reduction goals.
3. To develop an efficient energy use monitoring and reporting system – to assure accountability and gauge progress toward emission reduction goals.
4. To delegate responsibility for implementing, managing and reporting on energy-saving measures; climate action takes dedicated personnel.

OVERARCHING RECOMMENDATIONS

Developing a climate action plan with a sound emissions reduction strategy that is appropriate for Missoula will require expertise, leadership, and citizen participation. Climate-related policies, programs, and projects that are right for Missoula will need to be cost-effective. Fortunately, a number of proven "no-net cost" policies exist. The following recommendations were crafted with these considerations and the experiences of other cities in mind (see full report for additional information).

- Form a Climate Action Plan Task Force to Develop a Climate Action Plan for Missoula: Missoula is fortunate to have active citizen involvement in municipal climate change and energy initiatives. We recommend that the mayor of Missoula form a task force that brings together individuals and elements from city government, nonprofit organizations, The University of Montana, and the business community with expertise and interest in developing a comprehensive climate action plan. Helena and Bozeman found staffing, leadership and effective workgroups to be the key to success in setting feasible emission reduction goals and devising ways to achieve them.
- Utilize Climate Action Planning Tools to Analyze Net Costs and Saving of Specific Emission Reduction Measures: The Climate Action Planning Program Assistant (CAPPA) tool can assist in developing customized plans for reducing GHG emissions in a cost-effective manner. We encourage its use by City divisions and departments for forecasting energy cost savings from specific emissions reduction measures. The University of Montana used similar software to conduct its climate action planning.
- Consider a Four-Day Work Week and Work-at-Home: Such measures can reduce energy use and costs for heating, cooling, lighting of municipal buildings, and the operation of office equipment; it can also reduce employee commuting. Although this recommendation may not be

feasible for some departments while also maintaining City services, it could considerably benefit departments in offices and buildings that consume large amounts of energy.

- Create a Revolving Energy Loan Fund for City Energy Conservation and Efficiency Projects: Such a fund could support energy conservation and efficiency projects in municipal buildings, wastewater treatment, lighting and other City operations. The fund could pay up-front costs for various projects and would be paid back by energy savings, ensuring the sustainability of the fund to support additional projects and long-term energy costs savings.
- Expand Renewable Energy Generation and Explore Renewable Energy Generation Partnerships: Solar, wind, biomass, and biogas projects can reduce reliance on fossil fuels, provide energy security, create jobs, and support the local economy. Although some projects require significant capital investment and thus partnership with other public entities and the private sector, other smaller-scale renewable energy technologies can be more readily deployed. Additional solar panels on City buildings, further capture and use of biogas from the City's wastewater treatment plant, and solar water heating at aquatic recreation facilities should be an immediate priority. New buildings could utilize green building designs and groundwater heat-exchange systems for heating and cooling.
- Advocate for Creation of a Municipal Energy Bond or Energy Improvement Districts: Inability to finance up-front costs is widely recognized as an impediment to implementing climate action strategies such as green buildings and green fleet policies and renewable energy projects. Although authority to issue energy bonds or create energy improvement districts does not currently exist, there is great interest in Montana to enable cities to raise funds for energy improvements, much the way cities can for parks and open space. We recommend that Missoula, in conjunction with other cities in Montana, make a case and advocate accordingly.
- Hire a Municipal Sustainability Coordinator: Although the City already has many employees advancing municipal sustainability in myriad ways, concerned citizens have been advocating that Missoula follow other cities in Montana and The University of Montana and hire a coordinator to lead and expand such efforts. Experience has shown that real progress on climate change – being green, not just talking green – requires a dedicated person to lead efforts for municipal operations and facilitate a broader vision of municipal sustainability.
- Make Sustainability a Part of Employee Hiring, Orientation, and Evaluation: We recommend that skill, experience, and desire in the area of municipal sustainability be among the criteria used in advertising open positions and making hiring decisions. We also recommend that new employee orientations and trainings cover energy and water conservation. This could be accomplished by further institutionalizing the City's Green Team. In addition, we recommend incentives, rewards, and other ways of encouragement for existing City employees for leading projects that achieve emission reductions and energy savings.
- Integrate Consideration of Greenhouse Gas Emissions into Planning and Decision Making: We recommend that future planning processes, as well as land use, transportation, building and construction projects take into consideration impacts on the City's GHG emissions and adopt measures to minimize and mitigate impacts.
- Establish a Renewable Energy Certificate (REC) Program: RECS, also called green tags, are tradable energy commodities that represent proof that one megawatt-hour (MWh) of electricity was or will be generated from a renewable energy source. RECs are a market-based approach to encouraging development of renewable energy. RECs also provide a means for utilities to meet their obligations under Montana's Renewable Portfolio Standard. RECs can help cities, businesses, and institutions become carbon neutral, i.e., move toward having zero net GHG emissions. RECs also provide a means for cities to raise revenue, improved the lives of residents, add jobs, support the local economy, and help lower residential energy bills.

- Establish a Carbon Offsets Program: A *carbon offset* is another free market tradable commodity. It typically represents a metric ton of carbon dioxide equivalent (ton of CO_2e) prevented from entering or removed from the atmosphere. Offsets may be purchased by the City and other energy consumers to "offset" emissions, such as those associated with electricity consumption or vehicle use. Purchased offsets are used by a third party to finance projects that would not have otherwise occurred and that can achieve new GHG reductions or prevent emissions. Offsets can support renewable electricity generation, energy efficiency measures, methane capture at wastewater treatment plants, and reforestation projects. Like RECS, offsets can help in meeting emission reduction targets and can be part of a broad-based strategy that goes beyond "picking the low-hanging fruit."

SECTOR-SPECIFIC RECOMMENDATIONS

The wide range of sources of municipal emissions necessitates a broad-based approach that seeks emission reductions from each sector. Although further analysis is needed to determine which sectors offer the most cost-efficient and cost-saving opportunities, we offer a wide range of resources and approaches from which to choose. We recognize that it may be difficult for any single measure to stave off the growth in emissions or reduce overall emissions. Some highlights of our sectors-specific recommendations include:

- *For the wastewater sector*: (1) increase the quantity of biogas reclaimed for heat production to offset the amount of purchased energy for facility operations; (2) support community-wide water conservation measures to reduce the amount of sewage the plant receives that requires treatment; (3) consider energy efficiency and GHG emissions when designing future upgrades to ensure that energy-efficient equipment is chosen; and (4) consider on-site renewable energy production, for example solar or wind power production, to reduce the quantity of purchased energy needed for wastewater treatment operations.
- *For the buildings sector*: (1) adopt a comprehensive green buildings policy that requires LEED certification for new buildings, a LEED program for existing buildings and a no-net-increases in GHG emissions from buildings; (2) conduct energy audits of all municipal buildings that have not been audited and carefully consider energy performance contracting for all municipal buildings; (3) develop a new program to set building energy performance goals and monitor and assess performance; (4) consider using Energy Performance Certificates, "energy identity cards," that rate the energy efficiency of buildings, display building energy use, and provide a comparison with similar structures; (5) hire a new position to manage energy use for buildings, or train and reassign existing staff to serve in that capacity; and (6) build on the success of the City's Green Team by continuing to encourage voluntary energy conservation measures by City employees.
- *For the municipal fleet sector*: (1) consider adopting a comprehensive green fleet policy; (2) encourage efficient vehicle choice and use by City employees (needs-based vehicle selection); (3) adopt proposed anti-idling changes to Administrative Rule #11; (4) further prioritize energy efficiency considerations in vehicle replacement and maintenance; (5) consider and expand use of alternative fuel sources; and (6) continue to encourage the use of alternative transportation (such as Mountain Line buses) for City business-related trips, minimization of vehicle use, and other voluntary measures by City employees.
- *For the employee commuting sector*: (1) promote the City employee "cash for commuters" program to encourage greater use of Mountain Line transit; (2) encourage more employees to participate in commuter vanpools, carpools and ride sharing after work; (3) provide free parking for employees who carpool; (4) consider incentives for living in Missoula or closer to work; (5) partner with Missoula In Motion on an employee car-share program; and (6) research additional ways to incentivize low-carbon and carbon-free employee commuting.

- *For the outdoor lighting sector*: (1) give attention to high annual ownership, operation and maintenance charges for Lighting Districts and other outdoor lighting; (2) for streetlights, consider partnering with NorthWestern Energy to replace High Pressure Sodium Vapor (HPSV) lamps with Light-Emitting Diode (LED) luminaries which use less than half as much energy; (3) initiate outdoor lighting replacement projects for City-owned lights; (4) conduct other lighting efficiency upgrades; and (5) install small solar power cells on outdoor lighting fixtures.
- *For the water sector*: (1) invest in improvements to water distribution infrastructure; (2) support water conservation practices; (3) conduct facility-by-facility water audits; and (4) speed up schedule for metering all municipal water use.

5. To address climate change is to achieve a broader vision of a prosperous and sustainable future that is only limited by our imagination and courage. It is our hope that this report lays a foundation for such a vision and moves our community closer to creating a blueprint for municipal sustainability — and taking the next steps, one by one, together.

1. INTRODUCTION

BACKGROUND AND OVERVIEW

Missoula's nickname, the Garden City, embodies the ideals of living sustainably, self-sufficiently, and harmoniously with the tremendous natural assets we all enjoy. Missoula has taken many steps over the years to protect our quality of life and assure individual and collective responsibility. One such step occurred on June 17, 1996, when the Missoula City Council passed and Mayor Dan Kemmis signed Resolution #5890, which committed Missoula to join with cities from all over the world in the *Cities for Climate Protection Campaign*.

Missoula thereby resolved to take a leadership role in developing a plan to reduce greenhouse gas (GHG) emissions and increase energy efficiency of municipal operations and throughout the community. With the involvement of local officials, citizens and the business community, the City released the *Missoula Greenhouse Gas-Energy Efficiency Plan* on May 10, 2004 (City of Missoula 2004). The Plan has served as a guiding document for the public and private sectors by providing a blueprint and resources for reducing greenhouse gas emissions in Missoula. At that time, the City also formed a Greenhouse Gas & Energy Conservation Team to advise City Council.

City officials renewed the commitment to reduce greenhouse gas emissions and improve energy efficiency on May 3, 2007, when Mayor John Engen signed a resolution of support for the *U.S. Conference of Mayors Climate Protection Agreement.*[1] Missoula became one of what is now over 1,000 cities in the United States, including a handful in Montana, to have signed the *Mayors Climate Protection Agreement.*

The Cities for Climate Protection Campaign, which is supported by the International Council for Local Environmental Initiatives (ICLEI), and the U.S. Mayors Climate Protection Center provide a framework for

1 See http://www.usmayors.org/climateprotection/agreement.htm.

local governments to achieve emission reductions.[2] The framework is highly adaptable to unique local conditions and consists of the following five milestones:

1. Conduct a Greenhouse Gas Emissions Analysis (Baseline Inventory and Forecast)
2. Establish a Reduction Target
3. Develop a Climate Action Plan
4. Implement the Climate Action Plan
5. Monitor Progress and Report Results (ICLEI 2009d)

Other cities in Montana, including Helena and Bozeman, have conducted detailed data-intensive GHG emissions analyses of municipal operations, have developed comprehensive action plans, and are in the process of implementing them (Kline 2008; Bozeman Climate Protection Task Force 2008). Although the City of Missoula is behind our peer cities in various ways in rigorously reaching these milestones, Mayor Engen and the Missoula City Council have undertaken various climate change, energy conservation and sustainability initiatives that are beginning to make a difference. For example, Mayor Engen created a Mayor's Advisory Group on Climate Change and Sustainability, and with City Council adopted policies for energy conservation in municipal buildings and fuel reductions for the municipal vehicle fleet.

Wanting to continue to build on these efforts, Missoula Mayor John Engen requested the assistance of University of Montana (UM) Environmental Studies professor Robin Saha and UM students in conducting a detailed municipal greenhouse gas emissions inventory for Missoula. In addition to identifying and quantifying various direct and indirect emissions from municipal operations, this inventory examines changes in emissions from fiscal years 2003 to 2008 in order to determine sectors and sources within sectors for which emissions are increasing, decreasing and remaining stable over time.

We chose 2003 as our "base year" for this inventory and analysis because it was the earliest year for which hard copy records of purchased energy existed for most sectors. Likewise, 2008 was chosen as the "target year" because it was the most recent year for which an entire year's data could be obtained when we began this inventory.

Our emissions inventory specifically examines the following emissions sectors[3]:

1. Wastewater Treatment
2. Buildings
3. Vehicle Fleet
4. Employee Commuting
5. Lighting
6. Water

This inventory is not intended to be a full life-cycle analysis of embodied energy of municipal goods, services and purchases, though we did conduct an analysis of purchased energy used by Mountain Water Company to deliver water to the City for municipal operations. This inventory primarily examines emissions directly resulting from purchased energy and fuel for municipal operations and for public services paid for by the City or inherently municipal in nature, such as street lighting. Thus, purchased energy for the Missoula Parking Commission and Missoula Redevelopment Agency were included in our analyses.

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2 International Council for Local Environmental Initiatives (ICLEI), and now ICLEI-Local Governments for Sustainability, was founded in 1990 when more than 200 local governments from 43 countries convened at its inaugural conference at the United Nations in New York (ICLEI 2009a, 2009b). ICLEI is a membership association of local governments and national and regional local government associations that have made a unique commitment to sustainable development. Currently, ICLEI is made up of 1,075 local governments, including Missoula, and represents over 400 million people worldwide (ICLEI 2009c).

3 Other Montana cities that have conducted emissions inventories, as well as The University of Montana, examined emissions related to the solid waste stream (Davies 2008). These inventories found solid wastes to contribute only a very small amount of overall emissions (less than 2%). The Bozeman inventory has curiously argued that its landfill serves as a carbon sink, i.e., it stores carbon that would otherwise be released as carbon dioxide (Bozeman Climate Protection Task Force 2008). Because of the relatively small amount of emission, the limited number of people working this project and the tight timeframe, we did not examine waste-related emissions, which nevertheless should be included in future inventories.

The primary objectives for this report are to: (1) present a baseline emissions inventory for the City of Missoula that quantifies total municipal energy use and associated GHG emissions for each municipal sector; (2) identify major sources of municipal emissions, relative contributions within and among the sectors; (3) examine changes and trends in energy use, costs and emissions from 2003 to 2008; and (4) identify opportunities and offer recommendations to achieve future municipal GHG emission reductions. These recommendations include suggestions for consistently monitoring energy use, costs and emissions over time.

It is our hope that this inventory and analysis provides valuable information for City officials to consider when setting emissions reduction targets, devising appropriate emissions reduction strategies, and conducting future emissions inventories.

Forecasting future emissions and analyses of costs of emissions reduction measures is also needed to make good decisions regarding an appropriate and achievable emissions reduction target. We provide crude projections of future emissions that are likely to occur without proactive emission reductions. Our projections provide a rough estimate based on recent rates of change in emissions. However, more refined forecasting scenarios and cost analyses of emission reduction measures were beyond the scope of this project.

The remainder of this introductory section describes climate change impacts in Montana and the compelling need of local action on climate change. We also outline the role of local government in addressing climate change and highlight some of the City of Missoula's existing climate change and energy conservation/efficiency efforts. That is followed by a description of the data gathering and analysis methods employed and the process for drafting this report. All of these stages involved close collaboration and coordination with City personnel.

CLIMATE CHANGE IMPACTS IN MONTANA – THE NEED FOR LOCAL SOLUTIONS

Global climate change is widely acknowledged as one of the most pressing issues of our time. Climate change poses serious risks to Montana's human communities, our economy, and the natural ecosystems. Relatively recent changes in the Earth's climate have been linked to human activities that have increased the concentration of certain greenhouse gases (GHGs) that trap heat in the atmosphere (IPCC 2007a). Carbon dioxide (CO_2) is the primary greenhouse gas of concern.[4] The burning of fossil fuels – coal, petroleum products, and natural gas in particular – and deforestation are major sources of atmospheric carbon dioxide emissions.

In Montana, we have 60% higher per capita GHG emissions (40 metric tons/year) than the rest of the country (25 metric tons/year). Emissions in Montana are estimated to have increased 14% between 1990 and 2005 (Montana Climate Change Advisory Committee 2007, hereafter Montana CCAC 2007). Net annual GHG emissions in Montana now average approximately 12 million metric tons[5] of carbon dioxide equivalents (Montana CCAC 2007).

According to the National Climatic Data Center, the global accumulation of GHGs in the atmosphere has contributed to increases in global surface temperatures of 0.11 degrees Fahrenheit (°F) per decade over the last century. However, this rate has increased to about 0.32 °F in the last few decades (Nowakowski 2008). Atmospheric and ocean temperatures are also rising (Intergovernmental Panel on Climate Change 2007a, hereafter IPCC 2007a).

4 Other significant GHG gases include methane (CH4), nitrous oxide (N2O), halocarbons and ozone (IPCC 2007a).

5 A metric ton is 1,000 kilograms or approximately 2,205 pounds.

In referring to a recently published study, The University of Montana's renowned climate scientist Professor Steven Running recently stated that average temperatures in the northern Rocky Mountains are projected to increase 3.6 to 7.2 °F in the next century. Thus, we can expect to experience longer summer droughts and shorter winters. In fact, from 2003 to 2007, the state of Montana already experienced a rise in temperature of 2.1°F above average temperatures of the 20th century (Kinsella 2008).

Although it is a complex endeavor to predict future impacts of global climate change at the regional, state and municipal levels, various studies reveal adverse impacts of climate change that we are already experiencing in Montana. These impacts include the spread of pest insects, diseases and invasive species; damage to crops and trees; and increased risk of wildfires (Montana Climate Change Advisory Committee 2009; Moy 2010). Due to diminished winter snowpack, alterations in the timing and magnitude of summer run-off, and warmer air and water temperatures, climate change is expected to threaten water supplies, forest productivity, crop production, and fish and wildlife habitat (Kinsella 2008; MDEQ 2008).

For example, an average annual air temperature increase of 1.8 °F could reduce suitable habitat area of various prized trout species in the Rocky Mountains up to 16%, and 9°F increase could reduce trout habitat up to 70% (Keleher and Rahel 1996).

Indeed, climate change poses significant threats to outdoor recreation and economies close to home, particularly to Montana's tourism industry, which is the fifth largest employer in our state. According to The University of Montana's Institute for Tourism and Recreation Research, tourism expenditures in 2007 supported an estimated 45,000 jobs in Montana, an increase of 36% since 1997. Tourism travel in Montana reached nearly $10.7 million in 2007, an increase of over 20% from 1997, and non-resident travel expenditures reached $3.9 million in 2007, a 3% increase from 2006 (Grau 2008). Climate change impacts to tourism could cost jobs and reduce income for local business and tax revenue for local government.

In fact, Montana's Department of Fish, Wildlife and Parks has already been forced to close streams to fishing due to low summer flows. Such closures can hurt revenues for the $31 million guided fishing industry. Climate change poses similar threats to the river recreation industry, which outfitted nearly 120,000 rafting and boating enthusiasts in 2005, and to the $40 million hunting outfitter industry, which faces change to the hunting season and availability and accessibility of game species as animals adapt to climate change. Montana's ski industry, which employs more than 1,100 people, is also highly vulnerable to changes in snowfall patterns, as are forest and recreation areas, which also have been closed in recent seasons due to threats from wildfires (MDEQ 2008; Hall and Higham 2005). All of these industries provide economic benefits to Missoula.

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LOCAL GOVERNMENT CLIMATE CHANGE INITIATIVES

Because of the types of threats posed by climate change, state and local governments throughout the United States are taking steps to reduce their greenhouse gas emissions. In fact, local governments, in particular, have the potential to affect 30-50% of the nation's GHG emissions through policies, programs and incentives designed to reduce the "carbon footprint" of municipal operations, residents and businesses (Lindseth 2009).

Local governments are uniquely positioned to provide the leadership needed to develop long-term and effective solutions to climate change by integrating climate change mitigation into municipal planning and decision-making processes and by building public-private partnerships (ICLEI 2009d, 2009e, 2009f).

An obvious first step toward reducing GHG emissions is for local governments to inventory their emissions and develop and implement climate action plans regarding various aspects of municipal operations, including service delivery and the design and administration of schools, public lands and parks and recreation facilities. City and county governments can take a wide variety of measures to help citizens reduce greenhouse gas emissions by adopting energy efficient building codes, land use and zoning measures, transportation and infrastructure improvements, energy improvement bonds, and the like. Local government officials and employees can be energy conservation leaders and influence consumer choices in transportation, housing, food and agriculture, and other areas (ICLEI 2009a).

City and county governments can take a wide variety of measures to help citizens reduce greenhouse gas emissions…

However, any move a community makes toward sustainability relies on planning, policy and practice, a model that has proven successful in such diverse places as St. Paul, Minnesota (Zahran et al. 2008); Boulder, Colorado; Portland, Oregon (Portney 2003a); and Newcastle, UK (Bulkeley and Betsill 2003). However, local initiatives have been less successful in moving communities toward their sustainability goals in places where disconnected and piecemeal actions are implemented outside of a broader context of sustainability or where environmental priorities are seen as being in conflict with other municipal agendas (Portney 2003b).

Fortunately, the actions taken thus far by City officials and the support they have from Missoula residents indicate a vested interest and a concerted effort to reduce the City of Missoula's carbon footprint and work toward effective local solutions to climate change. Municipalities, including the City of Missoula, stand to benefit from expanding their climate protection measures. In doing so, cities become more sustainable, build the local economy, save taxpayer dollars, improve air quality and human health, connect with other leaders and resources, inspire community engagement, and build a tradition of climate leadership (ICLEI 2009a). Indeed, Missoula and its City leaders are already well on the way to creating such a legacy.

CLIMATE CHANGE AND ENERGY EFFICIENCY INITIATIVES IN MISSOULA

The City of Missoula is currently engaged in a wide range of local climate solutions and has already taken several important steps…

The City of Missoula is currently engaged in a wide range of local climate solutions and has already taken important steps too numerous to detail here. Many of these are described in relevant sections of this report. Resolution #7241 is among the most noteworthy recent policies. In passing Resolution #7241 on July 2, 2007, the City adopted "an energy efficiency and GHG reduction policy for municipal building projects, including new buildings, building additions and major remodels." The City has also embarked on an energy audit program for existing buildings along with performance contracting in order to benefit from external expertise and financing for energy efficiency retrofits and upgrades. City employees have formed a Green Team that developed a set of energy conservation behaviors that Mayor Engen has endorsed and directed City personnel to follow.

On November 3, 2008, City Council passed Resolution #7375, which set a 10% reduction goal for fuel consumption and energy use by the City of Missoula below 2007 levels by January 1, 2011. As a result, Mayor Engen directed City departments and divisions to develop plans to achieve the policy goals. Indeed, a wide-reaching vehicle fleet fuel reduction plan is already being implemented and is on track to succeed.

In addition, on February 9, 2009, the City adopted Resolution #7398, which created a renewable energy certificates program (called the Green Power Missoula program). The program allows Missoula residents and others to voluntarily offset their GHG emissions by purchasing renewable energy credits, which can help Missoula achieve GHG reductions goals in the future. Revenue from sales of these credits can be used by the City to carry out new energy conservation or GHG emission reduction projects. Some recent projects funded through other means provide good examples of possible uses of funds generated from the Green Power Missoula program. These projects include the installation of solar panels at City Hall and two fire stations and installation of energy-efficient Light Emitting Diodes (LEDs) in 11 traffic signals. The Green Power Missoula program allows citizens to invest in a sustainable future for Missoula and help the City raise much needed funds.

The City promotes non-motorized and healthy transportation options for Missoulians through its Bicycle / Pedestrian Program and its Safe Routes to School Program. It also encourages employees to join the *Way to Go* commuter club through Missoula In Motion, provides free Mountain Line Bus passes to employees, and supports alternative and public transportation in many other ways.

In collaboration with NorthWestern Energy, City leaders recently started the Green Blocks pilot program, which resulted in energy audits and energy efficiency improvements to 93 homes in seven two-block areas (Engen 2010). In conjunction with Missoula County, the City is also participating in the federal Energy Efficiency and Conservation Block Grant (EECBG) Program, which has enabled the City to hire a municipal energy efficiency grants administrator, fund energy-efficiency projects, and develop new initiatives, some of which are recommended in this report. Using EECBG funds, the City renewed its partnership with NorthWestern Energy to launch a second Green Blocks pilot project, this time providing energy-saving retrofits to 300 homes, beginning in late summer 2010 (Engen 2010). A commercial-building pilot project is in the works. In short, Missoula is on a roll!

Although these policies and initiatives significantly help move Missoula toward a more sustainable future, Missoula has yet to establish an emissions reduction goal and adopt a coordinated set of policies to reach such a goal. The laudable steps already taken are somewhat disconnected efforts and are not part of a comprehensive sustainability approach seen in some other communities where energy conservation, land use planning, housing, air and water quality, public health and safety, transportation, municipal waste and recycling, and economic and industrial development fall under an umbrella of municipal sustainability. As the City continues to grow and develop, new opportunities will arise for City leaders and citizen alike to continue to define in policy and practice the ideals of the Garden City.

This report can serve as an important step toward establishing an emissions reduction target and adopting a comprehensive climate action plan, and doing so in the broader context for sustainability and environmental stewardship. Indeed, Missoula is well-poised and ready to make further progress as a sustainable city.

EMISSIONS INVENTORY PLANNING AND COORDINATION

This project represents a unique partnership between the City of Missoula and The University of Montana. Mayor Engen's leadership and vision was instrumental in developing this partnership, which has provided an opportunity for students and the faculty project director to lend our expertise, learn from City personnel about municipal operations, develop new working relationships with City personnel, and provide a service to the City. Several planning and coordination meetings helped make for a productive collaboration.

On February 10, 2009, an initial meeting was held at City Hall with the UM working group, which included Professor Robin Saha and most of The University of Montana student co-authors of this report, Mayor Engen, his Administrative Leadership Team, and other City personnel. At this meeting, we discussed sources of municipal GHG emissions to include, took important steps to define the scope and objectives of the inventory, identified data sources and limitations, established informal protocols for working together, and obtained an initial list of City contacts for each sector.

At this meeting, various division and department heads provided valuable information and advice for what came to be a complex Herculean endeavor. Ginny Merriam, the City's Public Information/ Communications Officer, agreed to serve as the project coordinator for the City and the point person for our various data and information requests. The project could not have been completed without her generous assistance, dedication, and patience. No other City personnel were assigned to work on the project in a dedicated manner.

On February 19, 2009, our working group met in Helena with Tim Magee, Helena's Administrative Service Director, and Liz Hirst and Carrie Hahn, both in Helena's Utility Billing Department. They shared lessons learned in compiling Helena's GHG emissions inventory. They advised us to not analyze emissions related to solid wastes, because of the amount of effort needed to inventory a very small amount of emissions that likely would be associated with solid waste disposal. We also were not able to include energy generated and use by solar panels at City Hall and Fire Station #4 because of a lack of available data, and therefore, this inventory underestimates energy use by an unknown amount. We also did not include in our analysis emissions associated with the composting of sewage sludge from the City's wastewater treatment plant by EKO Compost.

In March, our working group met with the Missoula Greenhouse Gas & Energy Conservation Team and presented the planned scope of the inventory, obtained further guidance and suggestions, and made plans to present our findings to the Team in April 2009.

DATA GATHERING AND ANALYSIS

Detailed descriptions of the methods used for data collection and analysis for each sector can be found in the respective sections of this report. We obtained many of the NorthWestern Energy electricity and natural gas account numbers and associated energy usage and cost data for this inventory from the City's hard-copy energy billing records for Fiscal Year (FY) 2003 and FY 2008, particularly for wastewater treatment, municipal buildings, and lighting sectors. We accessed these records with permission from, and under the supervision of Ginny Merriam, Mary Kay Wedgwood in the Finance Department, and Marty Rehbein, the City Clerk.

Because some of the needed records were not available in hard-copy form with the City, Ginny Merriam requested that NorthWestern Energy provide electronic records of City utility records for FY 2003 and FY 2008. Vicki Judd, Manager of Community Relations for NorthWestern Energy in Missoula, furnished us with electronic files of electricity and natural gas usage and billing data for NorthWestern Energy accounts that we identified from the hard-copy records. We used the electronic records to verify data compiled from hard copy records.

Because it became apparent that we had not identified all of the City's NorthWestern Energy accounts, we made additional requests in October and December 2009 for complete electronic records for all accounts billed to the City of Missoula, Missoula Parking Commission, and Missoula Redevelopment Agency. As a result, we identified almost 60 additional accounts that we had not previously identified. Energy use and costs for several of these accounts have been added to the analysis of appropriate sectors. The other recently-identified accounts are included in an "Other Miscellaneous" energy use section of this report.

A statistic software package (SPSS) and Microsoft Excel were used to compile and analyze the electronic data obtained from NorthWestern Energy. Table 1-1 shows the total number of NorthWestern Energy electricity and natural gas accounts by sector in FY 2003 and FY 2008.[6] In FY03 there were 243 accounts, 227 and 16 of which were for electricity and natural gas, respectively. In FY08, the City had 272 accounts with NorthWestern Energy, 248 for electricity and 24 for natural gas. It should be noted that the City also purchases energy from other providers for the wastewater treatment system and has several accounts with the Missoula Electrical Cooperative and Jefferson Energy.

Table 1-1: Number of NorthWestern Energy Accounts by Energy Type and Sector for the City of Missoula, FY03 and FY08

Sector and Energy Type	FY03	FY08
Municipal Buildings	**31**	**48**
Electricity	18	26
Natural Gas	13	22
Wastewater Treatment	**28**	**35**
Electricity	28	34
Natural Gas	0	1
Lighting	**113**	**124**
Electricity	113	124
Natural Gas	0	0
Other Miscellaneous	**71**	**65**
Electricity	68	64
Natural Gas	3	1
Total (All Sectors)	**243**	**272**
Electricity	227	248
Natural Gas	16	24

The most recent data we obtained from NorthWestern Energy also included energy use and costs for accounts billed to the City of Missoula, Missoula Parking Commission, and Missoula Redevelopment Agency for FY02 through FY09. These data allowed us to examine year-to-year changes and assess overall trends for the buildings and other sectors that rely on purchased energy, the costs of which have increased dramatically in the last several years.

6 Each fiscal year begins on July 1 and ends on June 30 of the year identified. Thus, FY 2003 began on July 1, 2002, and ended on June 30, 2003. Fiscal years are relevant to budgeting processes used by division and department heads and proved to be an efficient means of gathering and organizing energy use and cost data for this report.

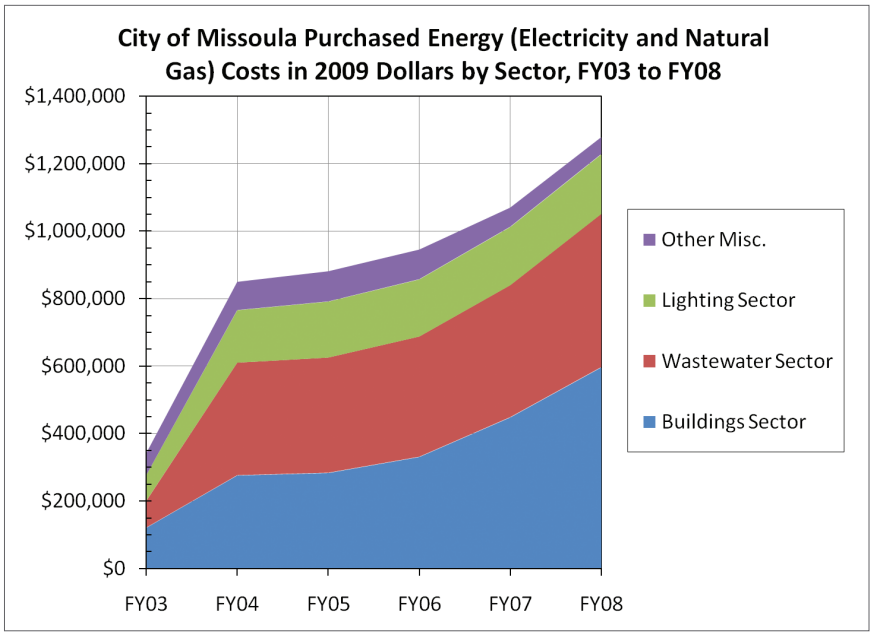

Figure 1-1

For example, Figure 1-1 shows total costs of energy purchased from NorthWestern Energy in 2009 dollars and illustrates the compelling need to reduce municipal energy consumption aside from energy conservation, climate change and sustainability goals. After controlling for inflation[7], total costs of purchased energy increased at a seemingly unsustainable rate of 274% from FY03 to FY08, from $341,010 to $1,278,428. This $937,000 increase is mostly due to rate increases, since total electricity usage increased only 40% and natural gas usage increased 99% from FY03 to FY08. The rate increases appear to have been greater for electricity than natural gas. In FY03 and FY08, electricity costs accounted for 76% of the total costs of energy purchased from NorthWestern Energy (see Figure 1-2 and Appendix I-1).

This energy cost increase represents an average annual rate of increase of 55%. The average annual rate of increase was greatest for the wastewater sector (96%), followed by the buildings sector (79%), and the lighting sector (26%). Other miscellaneous purchased energy costs decreased an average of 4.8% per year. See Appendices I-1 and I-2 for detailed tabulations of these data. More detailed sector-specific energy costs data are also presented later in this report. However, in subsequent chapters, energy cost data are generally not reported in constant dollars as they are here.

To obtain data on fuel use by the municipal vehicle fleet and various gasoline, diesel, and propane powered equipment, we relied on information from Jack Stucky, the City's Vehicle Maintenance Superintendent. Jack Stucky maintains a comprehensive database of municipal fleet fuel purchases and also provided helpful assistance for the buildings sector section of this report.

To estimate fuel use and associated GHG emission resulting from employee commuting, we conducted an employee commuting survey, for which we received 125 responses.

7 Values shown in Figure 1-1 and Appendices I-1 and I-2 represent constant dollars in 2009. Thus, changes shown do not include increases due to inflation. By using constant dollars here, we took into account the annual Consumer Price Index (CPI) by using a U.S. Department of Labor Statistics CPI inflation calculator. See: http://data.bls.gov/cgi-bin/cpicalc.pl .

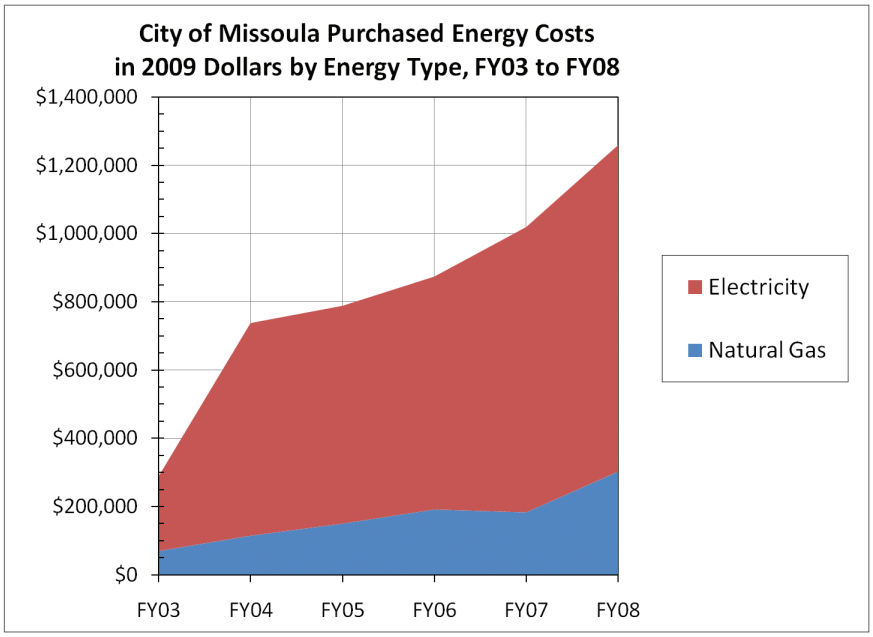

Figure 1-2

To determine embodied energy associated with delivery of water for municipal uses, we used information on metered and unmetered water use from John Kappes, Assistant General Manager for Mountain Water. John Kappes provided us with estimates of NorthWestern Energy electricity used by Mountain Water to deliver water used in City buildings and parks and recreational facilities. We found this electricity usage to be a very small percentage of the City's energy portfolio.

Additional Assistance from City Personnel and Others

Throughout the project, Ginny Merriam directed us to sources of needed information for this project. For example, Jason Diehl, Missoula's Assistant Fire Chief, and his staff compiled records of fuel consumption by Fire Department vehicles for wildland firefighting, which are not otherwise accounted by the fuel purchasing record system. We also obtained assistance from Mountain Water personnel for our analysis of embodied energy in water used by the City. Additional City employees and others who contributed to this report are identified in each section of the report.

Greenhouse Emissions Calculations

To calculate greenhouse gas emissions for City of Missoula municipal operations, we utilized ICLEI's Clean Air and Climate Protection (CACP) Software (ICLEI 2009g). The CACP software uses regional grid intensity factors and other accepted conversion factors to calculate carbon dioxide equivalencies associated with purchased electricity and natural gas use. The grid intensity factors are based on the mix of electricity-producing technologies and the design and emission characteristics of each type of facility used in various regions of the country.

The CACP software was a collaborative product of the National Association of Clean Air Agencies (NACAA) and the U.S. Environmental Protection Agency (EPA). The agencies sought to develop a software product to help local governments conduct greenhouse gas emissions inventories, quantify the benefits of reduction measures, and formulate local climate action plans.

We used the 2003 version of this software to compile the Missoula municipal emissions inventory detailed in this report. We chose this software because it is endorsed by ICLEI and readily accounts for emissions from facilities, operations, programs, and vehicles owned and/or operated directly by the local government (Torrie Smith Associates et al. 2003). Moreover, the software has been used by other Montana cities, including the City of Helena, for their inventories.

We used the Government Analysis module of the CACP software, which calculates GHG and Clean Air Act criteria air pollutant emissions from local government operations based on information entered on fuel consumption, use of purchased electricity and natural gas, and solid waste production. For electricity-related emissions, we used one of the 15 built-in regional grid intensity factors for 2003 and 2008. Specifically, we used Region 11, the Western Systems Coordinating Council/NWP grid intensity factor.

Emissions generated by the software set to these specifications are based on estimated emission from electricity generation in the Pacific Northwest region, where emissions per unit of electrical power tend to be lower than the rest of the country, because of Bonneville Power's large hydroelectric generation capacity. Although electricity purchased and delivered by NorthWestern Energy is not entirely generated in Montana, the company is likely to rely on more carbon-intensive energy supplies than the regional average due to the relatively small amount of hydroelectric power in the state compared to the region. Although grid intensity factors for NorthWestern Energy are available, we were not able to evaluate their reliability and instead used the regional grid intensity factor. As a result it is possible that our emissions inventory significantly underestimates actual emissions. Thus, our calculations represent conservative estimates.

STUDENT INVOLVEMENT

Six University of Montana students conducted initial research and analysis for this report during the spring of 2009 and took the lead on various emission sectors: Michelle Lanzoni for water; Michael Lattanzio for the municipal fleet; Kathryn (Katie) Makarowski for wastewater; Bethany Taylor for employee commuting; Russ Van Paepeghem for buildings; and Owen Weber for lighting. Katie Makarowski continued to work on revisions to and editing of all chapters of this report until its publication. This report would not have been possible without the hard work and commitment of all of the student authors.

STAFF REVIEW OF DRAFT SECTIONS

Each section of this report went through several iterations over the last year. Student authors wrote and revised initial drafts in spring 2009. All of these draft sections were subsequently checked and rechecked for accuracy and were revised by Katie Makarowski and Robin Saha during the summer and fall of 2009. Draft sections were then submitted to various City divisions and department heads for comments and suggestions and for circulation to appropriate personnel. In some instances, verification of information or additional information was requested at that time. Ginny Merriam and Bruce Bender helped involve the City personnel as needed in the review process. We responded to all feedback and suggestions received. For the buildings section, we also obtained valuable comments and suggestions from Cherie Peacock, the Sustainability Coordinator for The University of Montana. In addition, staff from Missoula In Motion provided valuable suggestions for the employee commuting section. This review process served as a quality control function and greatly improved the quality of the report.

PRESENTATION OF PRELIMINARY FINDINGS

Student authors and Professor Saha made three presentations of preliminary findings in spring of 2009, first to the Greenhouse Gas & Energy Conservation Team on April 9. Additional presentations were made to the Mayor's Advisory Group on Climate Change and Sustainability on May 12, and Mayor Engen's Administrative Leadership Team (ALT) on June 16. We used feedback and suggestions obtained from these presentations to make additional revisions.

REPORT ORGANIZATION

Our inventory and analysis of greenhouse gas emissions is presented as separate chapters corresponding to the various emission sectors that we examined. These include: wastewater; buildings; municipal fleet; employee commuting; lighting; and water. An additional chapter examines energy use, costs and emissions for miscellaneous NorthWestern Energy accounts not included in the other sectors.

Each of these chapters includes sector-specific recommendations. The chapters on the various sectors are followed by a summary of findings chapter that compares energy use, costs and emissions among the various sectors and examines Missoula overall emission trends in relation to other cities in Montana.

The final chapter of this report offers our overall recommendations to City officials to address climate change and energy use and costs. The final chapter also summarizes the sector-specific recommendations and offers concluding comments regarding next steps for Missoula in relation to the *U.S. Conference of Mayors Climate Protection Agreement*.

For the complete report, please visit the City of Missoula web site at www.ci.missoula.mt.us.

Please contact us to share your ideas

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Special thanks to photographer Jackie Corday,
who directs the City of Missoula's Open Space Program.