APPENDIX M

City of Bath
Energy Inventory and Climate Action Plan

2007 Greenhouse Gas Emissions and Energy Use Inventory and Recommended Municipal and Community Actions

Presented to Bath City Council
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I. Executive Summary

Climate change and energy use have become extremely important issues worldwide. There is a solid scientific consensus that carbon dioxide and other greenhouse gases released into the atmosphere are having a profound effect on the earth's climate, including rising sea levels, a decline in Arctic ice thickness, increasing levels of air pollution and general climate disruption. Scientists have also determined that energy consumption, specifically the burning of fossil fuels, like coal, oil, and gas, accounts for more than 80% of U.S. greenhouse gas emissions.

Individuals, businesses and government agencies are becoming aware of the consequences of our decisions, not only due to the consequences of pollutants and gas emissions, but also because of rising prices associated with energy use. State and local governments throughout the nation and the world are reducing global warming pollutants through programs that provide economic and quality of life benefits such as reduced energy bills, green space preservation, air quality improvements, reduced traffic congestion, improved transportation choices, and economic development and job creation through energy conservation and new energy technologies. Many measures to reduce energy consumption also save money for the City government, its businesses, and its citizens.

This study was created for the City of Bath through collaboration with the Bath Cool Communities committee and Bowdoin College's summer fellowship program. The study used a software program designed for greenhouse gas emissions inventory and gives Bath a 2007 baseline of emissions and energy use for the government and the community at large. With it, the researcher is able to determine what areas consume the most energy and emit the most greenhouse gases. The software can also help us determine the effectiveness of actions which reduce energy and emissions.

The Bath Government, Bath School System, businesses and individuals in the community have all taken steps to address energy use. The City of Bath has implemented a number of conservation measures over the years, and Bath Iron Works and the Bath Schools have both been recognized by the State of Maine for their commitment to reduce energy emissions and be more environmentally aware. As energy costs rise and concerns about global warming increase, many individuals are making personal changes to address energy issues. Explanations of many of these measures are listed in the Achievements section of this document.

This report gives the Bath Government and Bath Citizens information needed to take action and commit to reduce energy consumption and emissions. A commitment to reduce government energy use has the direct benefit of immediately reducing greenhouse gas emissions, and an indirect benefit of generating greater public awareness.

We would like to see the community commit to reducing overall emissions reduced by at least 2% each year, achieving a goal of at least 20% reduction from 2007 levels by the year 2018. We believe this is an achievable goal and that action is necessary in light of recent increases in energy costs across the board.

Many communities have signed the U.S. Mayor's Agreement for Climate Protection. That agreement is based on reducing energy use to below 1990 levels by 2012 and has other specifications Bath might not be able to meet within the suggested timeframe. As an alternative to the U.S. Mayor's Agreement, we have written a Resolution specific to Bath that highlights the steps we think Bath can take within this more accurate time frame. The text for this resolution is included in the appendix. We hope that the Bath City Council will sign this agreement and make energy reduction a priority.

Considering the inventory for the City of Bath, the following recommendations are made to help reduce future energy and emissions:

Recommended Actions for the Bath City Government:

- Reduce heating fuel use by undergoing energy audits for municipal buildings, insulating buildings and sealing air leaks, consider new high-efficiency boilers and HVAC systems.
- Reduce electricity use by replacing lights with high-efficiency bulbs and fixtures, installing automatic light switches in select areas, purchasing Energy Star-rated appliances and equipment, and educating employees on energy saving habits.
- Reduce vehicle fuel use by replacing the police fleet with hybrid or extremely fuel efficient vehicles, considering biodiesel possibilities, and enforcing "no idling" policies.
- Consider a cost-benefit analysis of alternative energy sources such as wind power, solar power, and harnessing landfill gas.
- Consider changing streetlight bulbs to LED bulbs to reduce energy use.
- Continue to mitigate emissions by continuing to create parks and trails, plant trees, enhance recycling options, and keeping the City a walkable community.
- Promote public education about energy and environmental issues.

Recommended Actions for the Bath Community and Residents:

- Reduce home energy use by insulating homes, investing in high-efficiency boilers and water heaters, setting more moderate air and water temperatures, replacing lights with high-efficiency bulbs and fixtures, purchasing Energy Star-rated appliances, and adjusting personal habits to turn off lights and appliances when not in use. Consider investing in alternative energy sources.
- Reduce electricity use by businesses and industry using many of the same methods listed above.
- Utilize alternative means of transportation such as City buses, biking, walking and carpooling to reduce gas and diesel use.
- Continue reducing household waste and increasing recycling.

- Educate others about energy consumption and greenhouse gas emissions, support programs that inform the public about energy options, and support services that assist citizens with acting on those decisions.

The City of Bath has the opportunity to be a leader in energy reduction and climate action. With the methods outlined in this document, we can maximize our energy efficiency and minimize the community's emissions and costs.

I. Introduction

On August 1, 2007, Bath Cool Communities, a local citizens group, made a presentation to the Bath City Council about their growing climate and energy concerns. They asked the Council to sign the U.S. Mayor's Climate Protection Agreement and charge citizens and municipal employees to work together to create a Climate Action Plan specific to Bath. The Council did not sign the agreement at that time, but asked the committee to work with City employees and the City Manager to create a Climate Action Plan for the City of Bath.

Over the course of the year, City of Bath employees worked with Cool Communities members to research and initiate strategies to help the municipal government become more energy efficient. In April, 2008, Cool Communities received a grant from the Sierra Club to help finance a Bowdoin College intern, Brooks Winner, who was charged with completing a greenhouse gas emissions inventory for Bath. He worked part time for 8 weeks through the summer and used a software program from *ICLEI-Local Initiatives for Sustainability*, formerly known as International Council for Local Environmental Initiatives (ICLEI) to input data about municipal, residential, and commercial energy use and analyze the city's greenhouse gas emissions.

This report summarizes the greenhouse gas emissions data for the community for the baseline year 2007. Energy use and emissions were determined by entering data such average costs, payment information, and amount of energy used. Data was obtained through public utilities companies such as Central Maine Power and local fuel companies; City of Bath budgets and average household energy use and payments determined by utility companies; and U.S. Census data from the 2000 census. Some data was supplemented by regional averages provided by ICLEI and the State of Maine. The software computes this data into energy use and emissions and can create reports, charts, and graphs displaying the statistics. With this data, we can determine which areas create the most emissions and use the most energy.

The report also highlights recommended actions for the Bath Municipal Government, the Cool Communities Committee, and other partner organizations. The ICLEI software is able to estimate cost savings and emission reduction for a number of actions or "measures." One can choose the issue; such as "building electricity," a measure; such as "replace lighting with compact fluorescent lights," include the number of lights changed, and the software will compute the average energy cost savings and emissions reduction for that measure. With this information, the City will be able to determine how changes might reduce the City's emission levels and energy costs.

All recommendations made in the Action Plan section of this report are general measures communities can take. We hope that the City of Bath, Bath City Council, and community members will look into other possible changes to determine the best solutions for Bath. The City of Bath has the opportunity to be a leader in energy reduction and climate action. With the methods outlined in this document, we can maximize our energy efficiency and minimize the community's emissions and energy costs.

III. Research Summary

Data for the greenhouse gas emissions inventory were gathered from several different sources at community and municipal government levels for the baseline year of 2007. The data collected were then entered into the Clean Air and Climate Protection (CACP) inventorying software provided by ICLEI. This software uses coefficients to calculate the total energy consumption in MMBtu (Million British thermal units) and greenhouse gas emissions in metric "tonnes" of equivalent carbon dioxide (eCO_2). Energy use information is plugged into the software, which then uses equations that calculate the average amount of eCO_2 produced by each different type of energy use. The software calculates emissions in tonnes of equivalent CO_2 because CO_2 is the most common greenhouse gas and it is standard to account for other greenhouse gases in terms of their effect on climate compared to CO_2.

The analysis portion of the survey is divided into the Community Analysis, which accounts for the total emissions of the entire city of Bath, and the Government Analysis, which accounts for only those emissions created by the Bath Municipal Government and Bath Public Schools. It is important to note that the emissions from the Government Analysis are also included in the total emissions for the community, quantified in the Community Analysis. Analyzing municipal emissions separately allows governments to identify ways in which they may play a leadership role in reducing energy use and greenhouse gas emissions in the community, and does not result in double counting emissions.

The baseline year of 2007 was used because this was the year for which the most complete and reliable energy use information was available. Future inventories and emissions studies will use this year as a reference to track reductions progress and set further goals.

Community Analysis
The CACP software used for this inventory breaks community emissions into six sectors: *Residential, Commercial, Industrial, Transportation, Waste,* and *Other*. Waste data for the community were entered in the *Other* sector of the software because ICLEI recently changed its protocol for calculating waste emissions. For the purposes of this report, however, I have included this data in the *Waste* sector

Data collected for the *Residential* sector included Bath's total electricity use in kilowatt hours (kWh), as provided by Central Maine Power (CMP), and heating fuel use in gallons calculated using statewide average consumption per household for Maine provided by the Energy Information Administration (EIA).

Total Residential Energy Consumption: 605,047 MMBtu
Total Equivalent CO_2 production: 50,071 tonnes

Data collected for the *Commercial* sector included the total electricity use provided by CMP and estimated heating fuel use calculated using the average energy intensity per

square foot provided by the EIA. Also included was the electricity use from unmetered street lights and area lights owned by commercial establishments and provided separately by CMP. Electricity use from city-owned streetlights is included in the Government Analysis.

Total Commercial Energy Consumption: 178,255 MMBtu
Total Equivalent CO_2 production: 17,588 tonnes

Data collected for the *Industrial* sector included total electricity use provided by CMP and heating fuel use calculated using the average energy intensity per square foot provided by the EIA.

Total Industrial Energy Consumption: 275,331 MMBtu
Total Equivalent CO_2 production: 32,005 tonnes

Data collected for the *Transportation* sector included the total vehicle-miles traveled within the city based on traffic survey estimates provided by the Maine Department of Transportation (MDOT). This includes travel by vehicles passing through the city, and does not include travel by Bath residents outside of the city.

Total Transportation Energy Consumption: 325,789 MMBtu
Total Equivalent CO_2 production: 25,272 tonnes

Data collected for the *Waste* Sector included the total amount of waste in tons contained in the Bath Landfill and the rate of methane recovery provided by the Public Works Department.

Total Waste Energy Consumption: N/A
Total Equivalent CO_2 production: 2,835 tonnes

Government Analysis
The CACP software breaks government emissions into seven sectors: *Buildings, Vehicle Fleet, Employee Commute, Streetlights, Water/Sewage, Waste,* and *Other*. These sectors are more specific to the operations of a municipal government and allow for a more detailed analysis that also includes energy costs. Waste data were entered in the *Other* sector of the software, but are included under the *Waste* sector for the purposes of this report.

Data collected for the *Buildings* sector included electricity and fuel costs from the 2008-2009 FY Budget for buildings owned and operated by the City of Bath. Data were provided by the Office of Finance.

Total Buildings Energy Consumption: 41,387 MMBtu
Total Equivalent CO_2 production: 3,417 tonnes
Total cost: $790,895

Data collected for the *Vehicle Fleet* sector included the gallons of gasoline and diesel fuel used by each City-owned vehicle and the cost of fuel in 2007. This information was provided by the Public Works Department, who maintains the municipal fuel storage.

Total Vehicle Fleet Energy Consumption: 9,230 MMBtu
Total Equivalent CO_2 production: 720 tonnes
Total cost: $208,105

Data collected for the *Employee Commute* sector included the total yearly vehicle-miles traveled to and from work by city employees in each department as well as what type of vehicle they drove. School employees were not included in the commuting survey.

Total Employee Commute Energy Consumption: 2,117 MMBtu
Total Equivalent CO_2 production: 164 tonnes
Total Cost: N/A

Data collected for the *Streetlights* sector included the total energy cost for the 650 lights owned by the city. This information was contained in the 2008-2009 FY Budget provided by the Office of Finance.

Total Streetlights Energy Consumption: 3,739 MMBtu
Total Equivalent CO_2 production: 455 tonnes
Total cost: $109,273

Data collected for the *Water/Sewage* sector included the electricity and heating fuel cost at the Wastewater Treatment Plant and pumping stations contained in the 2008-2009 FY Budget provided by the Office of Finance. Energy use from the Bath Water District was not included in the government inventory because their operations are not controlled entirely by the City.

Total Water/Sewage Energy Consumption: 7,100 MMBtu
Total Equivalent CO_2 production: 817 tonnes
Total Cost: $197,426

Because the landfill is owned and operated by the City, methane emissions from decaying waste were calculated in the Government Analysis, as well as the Community Analysis. Data collected for the *Waste* sector included the total amount of waste in tons contained in the Bath Landfill and the rate of methane recovery provided by the Public Works Department.

Total Waste Energy Consumption: N/A
Total Equivalent CO_2 production: 2,835 tonnes
Total Cost: $259,823

IV. Data Results and Analysis

This section outlines the results of the inventory. Complete reports of all of the data compiled in the CACP software can be found in the appendixes section of this report. It is important to note that the data presented in this section are estimates and that the precision of these estimates is limited by the following deficiencies:

- In some instances, necessary data were not attainable for a variety of reasons, including the reluctance of organizations to disclose energy use information and the limited time available to conduct the inventory. Emissions of some greenhouse gases such as perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs) are difficult to calculate because the use of chemicals that release them is not well recorded.
- Some of the data collected for the inventory were only approximations, but estimations were made only when information was unavailable from primary sources. For example, the heating fuel consumption for the Commercial and Industrial sectors was estimated using the average fuel use per square foot of floor space for buildings in the Northeast because area heating fuel vendors were unable to provide that information. This average was attained from a study conducted in 2001 by the EIA. Because Maine's heating needs may be different from those of other New England states, the estimate may be slightly inaccurate.
- The time periods for which the data were collected varied somewhat based on the availability of information. Though most data were compiled for the 2007 calendar year, some data were only available for the 2007-2008 fiscal year and some estimates were based on data from the 2000 census.
- Human error must always be taken into account when conducting an emissions inventory. There have been many instances when either researchers or sources of data have neglected to account for significant portions of energy use and emissions. For example, in Portland's 2001 inventory, a significant portion of electricity use was not accounted for due to a CMP reporting error.

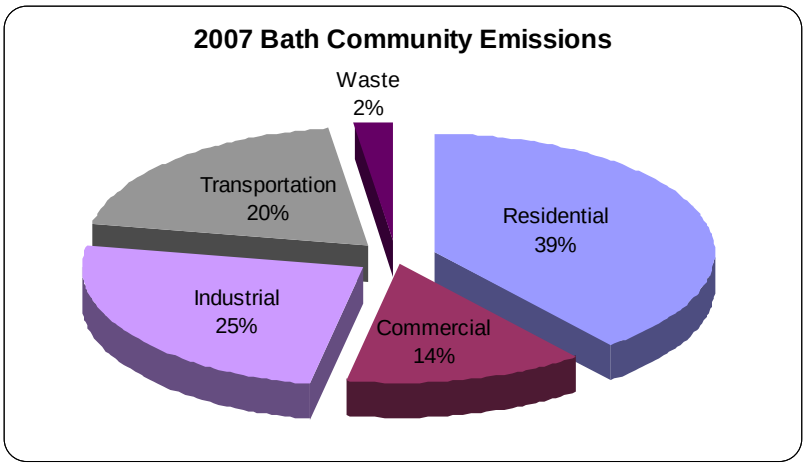
Despite these deficiencies and difficulties, every effort was made to obtain the most accurate data for each sector.

Community Emissions and Energy Use

The Community Analysis accounts for the emissions and energy use for the entire Bath community. This includes electricity and heating fuel use in residential, commercial, and industrial buildings, fuel use from transportation within the community, and direct methane emissions from solid waste.

In 2007, Bath emitted 127,772 metric tonnes of eCO_2 and consumed 1,284,423 MMBtu of energy. Emissions from the Bath municipal government are included in the Commercial sector of the community emissions analysis. A separate government inventory is conducted so that City administrators may have an idea of how much they

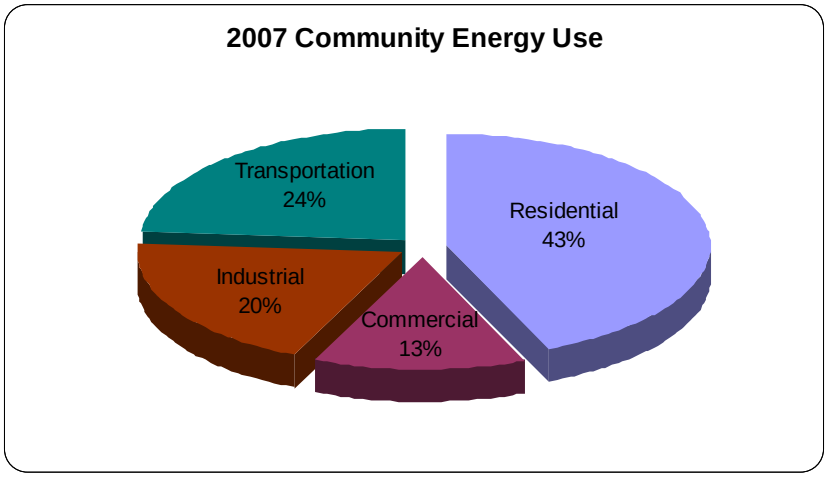
contribute to their community's emissions and how they can provide assistance and leadership in reducing the community's carbon footprint.



Though the Community Analysis provides a good idea of the city's overall emissions, it is important to note that the data for the community is much less precise and is more difficult to acquire than information for the Government Analysis. Because the community inventory relies on estimation more than the government inventory, it may be less accurate. ICLEI inventory protocol is designed to calculate emissions to 95% accuracy and every effort was made by those conducting the inventory to comply with this protocol.

Residential

Bath residents emitted approximately 50,071 tonnes of eCO_2 during the 2007 calendar year. This was 39.2% of the total emissions from the city. The Residential sector also consumed 605,047 MMBtu of energy, 43.7% of overall consumption. Residential energy use was the largest single contributor to Bath's overall community emissions.



The Comprehensive Plan estimates Bath's 2007 population to be 8,702, a 564-person difference from the estimate of 9,266 in the 2000 census. Data from the 2000 census was used to calculate the heating fuel use for homes in Bath, which may have caused some overcalculations in the Residential sector's emissions estimate. However, Bath's housing stock is very old which may make the buildings more energy intensive than the average home, resulting in a possible underestimation of Bath's residential heating fuel oil consumption. Also, slightly less than 400 homes in Bath were heating with propane gas in 2000. This is a significant portion of homes, but it is difficult to calculate emissions from propane heating because there is currently no standard for estimating propane use based on square footage of homes.

Commercial

Commercial businesses in Bath accounted for 17,588 tonnes of the community's eCO_2 emissions, 13.8% of the total. Businesses also consumed 178,255 MMBtu of energy,

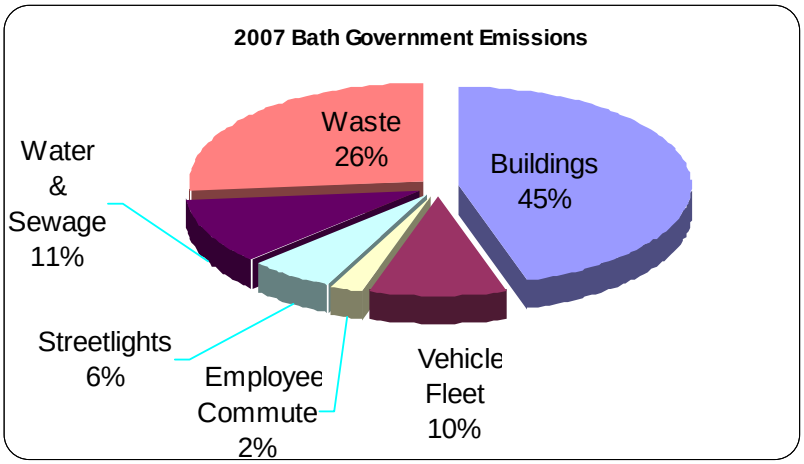
12.9% of total consumption. The municipal government's emissions are contained in the Commercial sector and account for 48% of the total commercial emissions. There are many home businesses in Bath, which may mean that many smaller businesses are actually listed in the Residential sector.

Industrial
The emissions from the Industrial sector amounted to 32,005 tonnes of eCO_2, 25% of all community emissions. Industries also consumed 275,331 MMBtu of energy, 19.9% of total consumption. Bath Iron Works is the largest industrial facility in Bath and accounts for 95% of the square footage of the city's industrial establishments. It can therefore be assumed that BIW produces the vast majority of the emissions from the industrial sector. They have already taken many steps, however, to reduce their environmental impact and their greenhouse gas emissions.

Transportation
Transportation within the city produced 25,272 tonnes of eCO_2 emissions in 2007. This was 19.8% of the total community emissions. Transportation also consumed 325,789 MMBtu of energy, 23.5% of total consumption. These figures account for the transportation within the city boundaries and do not include travel outside of Bath.

Waste
Methane gas released by decaying solid waste in the Bath Landfill produced 2,835 tonnes of eCO_2 emissions, 2.2% of the total community emissions. The Landfill currently flares about 85% of its landfill gas, reducing emissions significantly. If the gas were not captured and flared, the emissions from the landfill would be more than six times what they are currently.

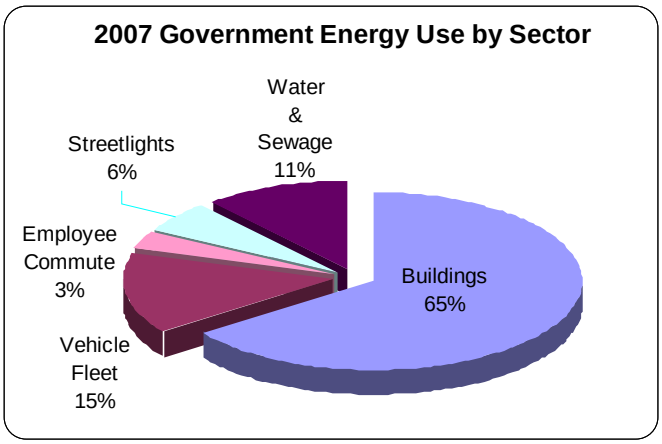
Government Emissions and Energy Use

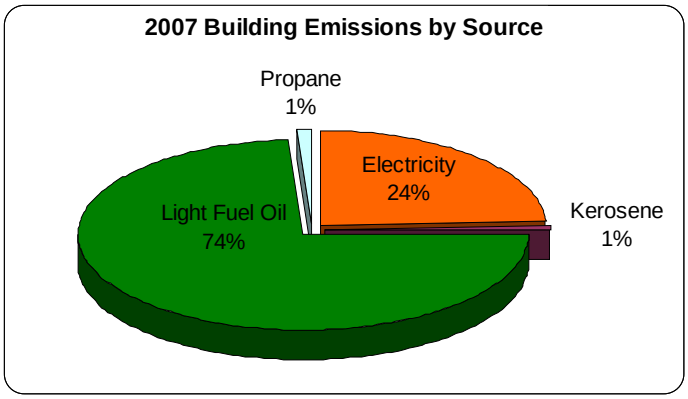


The Governmental Analysis accounts for the emissions and energy use from all operations of the municipal government. This includes electricity and heating fuel use in municipal buildings, gasoline and diesel fuel use by the vehicle fleet, fuel use from employee commuting, electricity for streetlights, electricity for water/sewage management, and direct methane emissions from solid waste. **The city government generated a total of 8,408 metric tonnes of eCO_2 emissions**, 6.6% of the total community emissions. **The city also consumed 63,573 MMBtu of energy** 4.6% of the total community consumption.

Buildings

Emissions from government buildings amounted to 3,417 tonnes of eCO_2 and accounted for approximately 40.6% of the total municipal output. Buildings used 41,387 MMBtu of energy, 65% of the total consumption. They were the largest source or carbon emissions for the municipal government. Within the buildings, heating fuel oil was the most significant source, accounting for 74% of building emissions, and electricity was also a substantial source of emissions, accounting for 24%. Emissions from kerosene and propane combined amounted to about 2%.



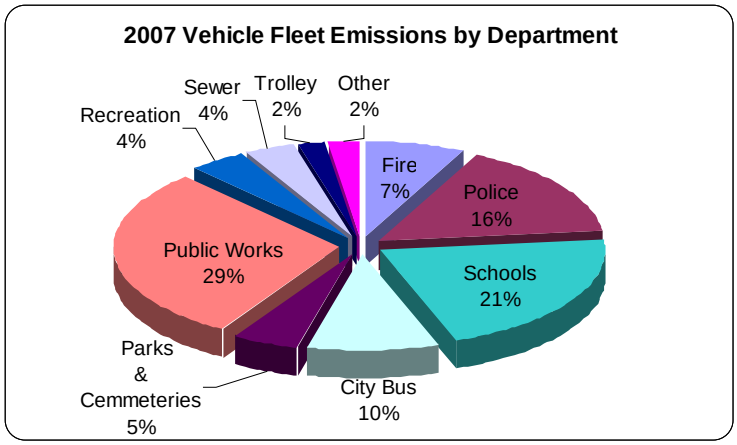


Energy use from the Buildings sector also cost the city approximately $790,895. This was almost four times as high as the cost of fueling the vehicle fleet, the next-most costly sector.

Bath schools were still under City management during the baseline year of 2007, and their emissions have been included in the Government Analysis. Bath school buildings were responsible for over 72% of the total building emissions and 29% of the total government emissions. It is important to note, however, that the transfer of management from the City to Regional School Unit 1 creates some problems for future emissions inventories, because emissions from school buildings will no longer be technically attributable to the municipal government. This will have to be taken into consideration the next time the city surveys its emissions.

Vehicle Fleet

Bath's municipal vehicle fleet produced 720 tonnes of eCO_2 emissions, 8.6% of the total government emissions. The fleet consumed 9,230 MMBtu of energy, 15% of the total consumption. The biggest contributor of emissions was the Public Works Department, emitting 212 tonnes of eCO_2, 29% of all emissions from the vehicle fleet. Other significant contributors were the Bath School District (152 tonnes, 21%) and the Bath Police Department (115 tonnes, 16%).



Fuel from the vehicle fleet cost the City $208,105 in 2007.

The school department owns its own bus fleet, making the city responsible for those emissions, so emissions from the vehicle sector are higher than they would be if the city rented school buses as many other communities do.

Employee Commute
Employee commuting by municipal workers produced 164 tonnes of eCO_2, 1.9% of total emissions. Commuting also consumed 2,117 MMBtu of energy, 3.3% of total consumption. The average yearly commute for City employees was 2,937.5 miles and the average daily commuting distance was 6.8 miles, but about 46% of employees work 3 miles or less from where they work.

Streetlights
Streetlights owned by the City accounted for 455 tonnes of CO_2e, 5.4% of the total emissions. Powering the lights consumed 3,739 MMBtu of energy, 5.9% of total consumption, and cost the City $109,273.

Water/Sewage
Operating the Wastewater Treatment Plant and pumping stations resulted in 817 tonnes of CO_2e emissions, 9.7% of total emissions, and consumed 7,100 MMBtu of energy, 11.1% of total consumption. These numbers may be inflated due to the fact that the energy use calculations are based on cost figures from 2007, not actual energy use. After the emissions had already been calculated, it was pointed out that the City pays to operate the pumping stations assuming that they run at maximum capacity constantly because CMP must always produce the maximum amount of energy. In reality, the system often runs at far less than maximum capacity and reaches maximum capacity relatively infrequently, such as during heavy rain and snow melt. Therefore, the actual energy use and emissions from the station may be lower than calculated.

Waste
Methane gas from decaying solid waste in the Bath Landfill produced 2,835 tonnes of CO_2e emissions, 33.7% of the total emissions. This percentage of emissions is very high because waste attributed to the municipal government includes all of the waste from the entire community of Bath. The City of Bath owns and operates the landfill and is therefore technically responsible for its emissions. Energy use from transporting waste and managing the landfill was not calculated, but haulage and tipping cost the city $259,823.

V. Achievements

The Bath Government, Bath School System, businesses and individuals in the community have all taken steps to address energy use. The City of Bath has implemented a number of conservation measures over the years and some departments have done significant building renovations with energy efficiency in mind. The Bath Schools and Bath Iron Works have both been recognized by the State of Maine for their commitment to reduce energy emissions and be more environmentally aware. As energy costs rise and concerns about global warming increase, many individuals are making personal changes to address energy issues. The following list is not complete, but gives an idea of the actions that have been accomplished.

Government Achievements:

Buildings
Most, but not all new equipment, computer, copier, and printer purchases have been Energy Star (high efficiency) appliances. City Hall has been replacing old light bulbs with new compact fluorescent (CFL) bulbs as the old bulbs burn out, and the City Hall bell tower is lit with LEDs (Light Emitting Diodes). Lights in the basement, bathrooms, and storage rooms were recently replaced with occupancy switches, which automatically turn out the light after a person leaves the room. The Fire Department recently installed a new super-efficient boiler, an energy efficient hot water heater, energy star appliances in the kitchen, and CFL lights in the garage. They also installed new windows, doors, and garage doors with good insulation, which complements the new heating system. The Public Works garage was also recently renovated, and now has additional insulation and new skylights to reduce electricity use. They have installed a propane heater in the landfill scale house to avoid use of electric heat.

Vehicle Fleet
Both the Public Works Department and the Police Department have addressed idling practices among employees and instituted “no idling” policies. The City has begun looking into alternative transportation choices, such as biodiesel for large trucks and hybrid vehicles for police cars.

Waste
City offices have made recycling a priority in the past five years. Many employees use both sides of paper for printing, notes, and scrap paper. All city offices have single stream recycling bins in each office. The Public Works department implemented a gas mitigation system at the landfill in the spring of 2008. They are currently collecting and burning the gases so that they are not released into the atmosphere. The City is also investigating whether it would be cost-effective to harness landfill gases for energy use.

Other
The City has changed all traffic lights to LED lights. In 2008, all Christmas lights in the trees downtown were changed to LED lights.

We are an extremely walkable city with maintained sidewalks and streets conducive to biking and other modes of transportation. We have been a "Tree City USA" since 1998, thanks to our active Forestry committee and City Arborist. This helps Bath maintain a large amount of green space including public parks, pocket parks, and expanses of undeveloped forest; much of which also has walking trails.

Community Achievements:

Residential
Our old housing stock has a major impact on emissions, and as energy costs rise, citizens have begun to turn to alternative heating and energy methods as well as renovating homes with good insulation. Many individuals have changed their habits to save energy.

Local organizations like Bath Cool Communities and a number of others groups, such as churches, have made concerted efforts to educate the public about energy use. Midcoast Maine Community Action Agency (formerly CED) has had a strong winterization program for many years, assisting low income people better insulate their homes.

Waste
The community has made a significant adjustment in their waste and recycling habits with single stream recycling and the Pay-As-You-Throw program. Bath has a fantastic curbside recycling program which takes about 30 different materials. Residents have doubled their recycling and significantly reduced their household trash. With so much trash being recycled, the stream of waste going into the landfill has been drastically reduced.

Water/Sewer
A quasi-municipal agency, Bath Water District has made substantial headway in energy efficiency. They have installed solar panels at water tank sites for their electricity needs and removed both from the grid; isolated "heat sink" areas at the treatment plant; and installed a "Time of Use" electric meter at the plant so they can shut down on high demand days. Bath Water District has also made changes to their office building, including installation of an energy efficient oil furnace and a programmable thermostat to automatically adjust temperatures. The Water District also recently replaced fogged windows with clear windows at their warehouse to reduce lighting needs.

Schools
The Bath Public Schools have completed their own greenhouse gas assessment and enacted a number of measures to reduce emissions and energy. Their Facilities Director has made significant upgrades to lighting and electrical systems, in particular the Bath Middle School gymnasium lights. The schools have made upgrades to boilers and heating systems, and reported a savings of 9,000 gallons of heating fuel after installing a new burner control system at the Bath Middle School. The schools have also instituted "no idling" practices for buses and other vehicles. Bath Schools have been recognized for their renovations by State of Maine agencies and worked closely with Efficiency Maine.

Industrial
BIW, which accounts for 95% of Bath's Industrial Sector energy and emissions, has received the Governor's Award for Environmental Excellence six times between 2000 and 2008 because of their strong commitment to prevent pollution and reduce their environmental footprint. BIW has instituted an Energy Conservation Plan which includes the following: a conservation awareness campaign, replacing lights with CFLs, repairing hoses and steam lines, regulation of steam system, installing a new air tank and air compressor, and replacing many of their constantly operating motors with efficient motors.

They have air quality control measures, including filtering devices on equipment that discharges into the atmosphere, use "low VOC paints" to reduce the amount of volatiles released in to the environment, and use low-sulfur fuel on all boilers and rolling stock. Bath Iron Works also implements water quality control measures, including a "Storm Water Pollution Prevention Plan," which installs control equipment in critical areas to treat storm water runoff before it reaches the river. There are routine inspections and double containment around all oil storage tanks. BIW recycles about 75% of their total solid waste and operates solvent distillation units, which reduce hazardous waste from the painting process.

VI. Action Plan – Next Steps

Through the greenhouse gas emissions inventory, we have been able to determine which areas produce the most emissions and consume the most energy. This section concentrates on issues and possible measures to address them, along with expected emissions reductions and general implementation cost for many of the solutions. We have divided this into government and community action plans. Greenhouse gas emissions from all of these areas can be greatly reduced by exchanging current standards with new technologies or promoting changes in habits.

In each area there may be some upfront costs, but most measures will see a fairly timely return and are likely to save money in the long-term. In the past several years, alternative energy technologies have become more financially available through federal and state assistance such as grants, loans, and incentives programs. As technologies are developed and manufactured for the general public, costs may become even more manageable.

Recommended Measures for Municipal Government

The Government Analysis showed several areas that the municipal government can improve upon. The largest emissions came from the following areas: high fuel use in the buildings, high electricity use in buildings and in the water pumping and sewage treatment process, and high gas and diesel use in the vehicle fleet. Each of these is also a financial issue, as the city has experienced a significant rise in prices for heating fuel, gas, and diesel over the past several years. Please note that the government analysis also includes Bath schools buildings, which were still under City managements for the baseline year of 2007, but are now run by Regional School Unit 1. The school system has already taken great steps to decrease their own energy use.

City of Bath Resolution
Public commitment has the direct benefit of immediate changes, with an indirect benefit of greater public awareness. The City of Bath has the opportunity to be a leader in energy reduction and climate action. With the methods outlined in this document, we can maximize our energy efficiency and minimize the community's emissions and costs.

Many communities have signed the U.S. Mayor's Agreement for Climate Protection. That agreement is based on reducing energy use to below 1990 levels by 2012 and has other specifications Bath might not be able to meet within the suggested timeframe. As an alternative to the U.S. Mayor's Agreement, we have written a Resolution specific to Bath that highlights the steps we think Bath can take within this more accurate time frame. The text for this resolution is included in the appendix. We hope that the Bath City Council will sign this agreement and make energy reduction a priority.

Buildings: Fuel Use
Municipal buildings accounted for 40% of government emissions and 65% of government energy use. In the building analysis, 74% of that was from light fuel oil. Energy use from the buildings sector cost the city approximately $790,895.

There are several ways to address fuel use. The city could consider having a complete professional energy audit for each building. This would show the building's "envelope" and identify areas of inefficiency that need to be renovated. The city would then make the necessary alterations to better insulate the building, including better wall and foundation insulation, replacing windows and doors, and sealing gaps. An audit would also address heating/cooling systems and assess whether changes can be made to increase efficiency. This might include a new highly efficient boiler system, insulating pipes, cleaning HVAC systems, or replacing air conditioners with another cooling method.

If energy efficiency in government buildings was improved by just 10% through the installation of double-paned windows and better insulation, the city could save almost $50,000 per year in heating fuel costs and reduce eCO_2 emissions by 120 tonnes, 1.4% of total government emissions.

Buildings and Water Treatment: Electricity Use

Electricity accounted for 24% of building emissions. Electricity used by the Water and Sewage systems added an additional 9.7% to the total government emissions. As noted in the Data section, actual emissions of the water and sewage process may be far less than calculated; however because of the high cost of running the system, it is still worth looking into alternative energy sources for this system.

One way to reduce building emissions is to replace all lighting with more efficient CFL bulbs, change fluorescent lighting to T-8 fixtures, and install automatic switches to turn off lights in uninhabited areas. The city has begun to do this as needed, but has not made a concerted effort to replace a large quantity of lights. Another way to reduce electricity use is to purchase all Energy Star appliances and equipment, including copiers, computers, printers, refrigerators, and more. It is also possible to eliminate any unnecessarily duplicated appliances and equipment by supporting resource sharing. Regardless of these changes, the City should increase employee awareness about energy use and advise all employees to follow energy saving guidelines such as turning off unneeded devices and lights.

Alternative energy sources are also a possibility. As technology becomes financially available, the City should consider solar, wind, and geothermal energy for municipal buildings and/or for the city at large. The water and sewage pumping stations and Wastewater Treatment Plant might greatly benefit from an alternative energy source for their daily processing and for stormwater needs.

Reducing the electricity use in municipal buildings by 10% through replacing old appliances with Energy Star-rated appliances, and changing lights to CFLs and high-efficiency T-8 fluorescents would save the city nearly $20,000 per year in electricity costs. This would also reduce the government's eCO_2 emissions by 80 tonnes.

Municipal Vehicle Fleets
Bath's municipal vehicle fleet produced 8.6% of the total government emissions and consumed 15% of the total energy. Fuel for the vehicle fleet cost the City $208,105 in 2007. This number includes school buses, not owned or maintained by the city.

As gas prices rise, so does the cost of maintaining a gas and diesel-run fleet. The city could consider hybrid options for police and fire cars and biodiesel for public works trucks, fire engines, and the two city buses. Hybrid cars would incur a cost, but the savings would be clear. Biodiesel requires some vehicle modification, causes slightly different wear-and-tear on parts and is currently more expensive to buy than regular diesel fuel. A switch to biodiesel may be a good option down the road when the technology develops further.

Replacing older vehicles with hybrids and instituting a strict "no-idling" policy for fleet vehicles are two cost-effective ways to save fuel and reduce emissions. The Ford Escape hybrid and the Toyota Prius are two possible options for fleet replacements. A study conducted by ICLEI found the payback on a switch from the Ford Crown Victoria to the Escape hybrid to be only about two years. This figure should be even less now that gasoline prices are have climbed to more than $4 per gallon. Switching 12 city vehicles to hybrids could save almost $25,000 dollars per year and reduce eCO_2 emissions by about 60 tonnes. The City could immediately replace some municipal vehicles with hybrids and replace the rest when the time comes to purchase new vehicles thereby spreading out the upfront costs and decreasing payback times.

Waste
Methane gas from decaying solid waste in the Bath Landfill produced 33.7% of the total emissions. In 2008, the City began burning landfill gases (including methane) so that they would not be released directly into the atmosphere. There is potential to harness landfill gases to create energy, and the city has begun to look into the costs and benefits of that system.

Streetlight Efficiency
Streetlights cost the City $109,273 per year and account for 5.4% of the total emissions and 5.9% of total consumption. Right now, the city has the most efficient bulbs CMP installs. We do have the choice to purchase and install LED streetlights, which are a good deal more efficient that the current CMP lights.

Replacing the current lights with LEDs seems to be one of the most cost-effective measures available. Over its ten-year life span an LED streetlight can save $1,111 compared to a normal streetlight. This means that each bulb has a payback period of about 3.3 years assuming that it costs $365 to install. This measure would also reduce CO_2e emissions by over 200 tonnes, 2.5% of total government emissions.

Employee Commute
The employee commute was only 3% of total energy use, 1.9% of city emissions, and is not a factor in city budgeting. It may be easy to reduce this number, since many city

employees live within 2-3 miles of their work place and could use other modes of transportation. The city could consider some form of incentive program to encourage staff to carpool, walk, or bike to work.

If city employees reduced their vehicle-miles traveled to work 30% by walking, biking, and carpooling they would reduce carbon emissions by 44 tonnes and could save almost $20,000 per year. This initiative would be a great measure for the municipal government to start with because there are virtually no upfront costs and it would save employees quite a bit of money.

Recommended Measures for the Community

Many of these recommendations to reduce community emissions and energy use must be taken by individuals. The City and other organizations should work together to share information with the public and to create education campaigns so that Bath residents are aware of their impact on the environment, the choices they have, and alternative options. Some issues, like transportation, can also be addressed by government-community partnerships. As more energy-related funding becomes available from state and federal sources, the City might serve as a conduit for loans, grants, services and information.

Residential Heating and Electricity

The residential sector accounts for 43.7% of city-wide energy consumption and 39.2% of the total emissions. This was the largest emitter of greenhouse gases. As fuel prices go up, more residents will struggles to afford home heating costs and meet basic needs. Increasing home heating efficiency is necessary from both economic and environmental perspectives. Residents can address their personal energy consumption in a number of ways. Most electrical energy use can be reduced by using CFL bulbs, energy star appliances, and by turning off lights and appliances when not in use. Home heating can be made more efficient with proper insulation, insulating windows and doors, using efficient boilers and keeping the home at a moderate temperature. Other remedies are super-efficient hot water heaters, insulating pipes, or investing in alternative energy sources such as solar panels.

Residents should have accessible information to help them decide who to contact and what to do to make their home more efficient. The City of Bath should support education campaigns with partner organizations so that residents learn how to reduce their energy use. To encourage citizens to reduce their energy consumption, the City could adopt a campaign similar to Keene, New Hampshire's "10% Challenge." This program provides residents with information about how to reduce their energy needs and recognizes those who succeed with awards. This approach could be an effective way to get citizens involved and excited about the city's efforts to reduce carbon emissions and energy consumption. If 30% of Bath residents reduced their heating fuel and electricity by 10%, they would reduce community emissions by over 1,300 tonnes of eCO_2 and could save a total of over $500,000 in energy costs.

Industrial and Commercial Electricity
Together, industrial and commercial energy use amounts to 38.8% of all community emissions and 32.8% of all energy use. BIW has done much to reduce their emissions, although they still produce about a quarter of total community emissions.

Smaller businesses can also have an impact on emissions and energy use by following many of the same guidelines that homeowners to, and becoming as energy efficient as possible. Lighting is a large factor and is one that can be most easily remedied –it will reduce emissions as well as help them reduce their own overhead costs. Commercial entities should have access to resources that can assist them, and an education campaign geared toward businesses may be worthwhile.

If 30% of businesses reduced their energy use by 10%, they would reduce carbon emissions by over 500 tonnes of eCO_2 and could save $160,000 in energy costs. If Bath were to incorporate a "10% Challenge" or other campaign, businesses could also be involved.

Transportation
Transportation amounts to just under 20% of total emissions in Bath. This is another reduction that the City and partner organizations can address through a public education campaign to support alternative transportation.

Public transportation is available and should be encouraged. There are two city-run buses that have regular routes and schedules; yet despite promotions and free rides, the buses are underutilized. It would be beneficial to have a community campaign to persuade more people to ride. The City could also post the schedule in more places, and clearly define bus stops.

We are a relatively small city and most residents are within 2-3 miles of services and businesses. The City and partner organizations should promote our "walkability" and "bikeability." The additional health benefits of walking/biking and reducing individuals' vehicle costs can be stressed. The City could create a bike path or trail system and define those routes; they could also consider installing more bike racks around the city.

If Bath residents managed to reduce their vehicle-miles traveled by just 5% by walking more, biking instead of driving, and carpooling to work, they would reduce Bath's eCO_2 emissions by nearly 900 tonnes and could save over $350,000 yearly.

VII. Final Conclusions

Climate change and energy use are important issues. Individuals, businesses and government agencies are becoming aware of the consequences of our decisions, not only due to the consequences of pollutants and gas emissions, but also because of rising prices associated with energy use.

This report gives the Bath Government and Bath Citizens information needed to take action and commit to reduce energy consumption and emissions. A commitment to reduce government energy use has the direct benefit of immediately reducing greenhouse gas emissions, and an indirect benefit of generating greater public awareness. All recommendations in the action plan section of this report are suggestions. We hope that the City of Bath, Bath City Council, and community members will consider a variety of possible changes to determine the best solutions for Bath.

In each area there may be some upfront costs, but most measures will see a fairly timely return and are likely to save money in the long-term. In the past several years, alternative energy technologies have become more financially available through federal and state assistance such as grants, loans, and incentives programs. As technologies are developed and manufactured for the general public, costs may become even more manageable.

Ultimately, we would like to see Bath's overall emissions reduced by at least 2% each year, with the goal of reducing carbon emissions by at least 20% from 2007 levels by the year 2018. As an alternative to the standard U.S. Mayor's Agreement, we have written a Resolution specific to Bath that highlights the steps we think Bath can take within this time frame. We hope that the Bath City Council will sign this agreement and make energy reduction a priority.

The City of Bath has the opportunity to be a leader in energy reduction and climate action. With the methods outlined in this document, we can maximize our energy efficiency and minimize the community's emissions and costs.

VIII. Appendixes

City of Bath Resolution
on Energy Conservation and Climate Protection

WHEREAS, A scientific consensus has arisen that carbon dioxide and other greenhouse gases released into the atmosphere will have a profound effect on the earth's climate, including rising sea levels, decline in Arctic ice thickness, increasing levels of air pollution and general climate disruption; and,

WHEREAS, Energy consumption, specifically the burning of fossil fuels, e.g. coal, oil, and gas, accounts for more than 80% of the U.S. greenhouse gas emissions; and,

WHEREAS, State and local governments greatly influence their community's energy usage by exercising key powers over land use, transportation, building construction, and waste management; and,

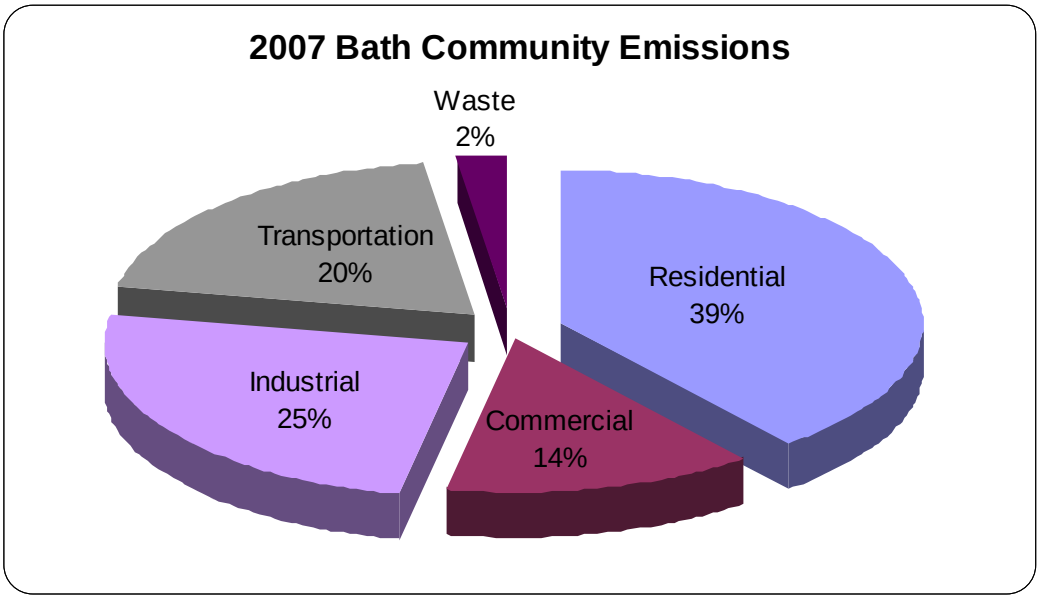
WHEREAS, State and local governments throughout the nation and the world are reducing global warming pollutants through programs that provide economic and quality of life benefits such as reduced energy bills, green space preservation, air quality improvements, reduced traffic congestion, improved transportation choices, and economic development and job creation through energy conservation and new energy technologies and saving money for the City government, its businesses, and its citizens;

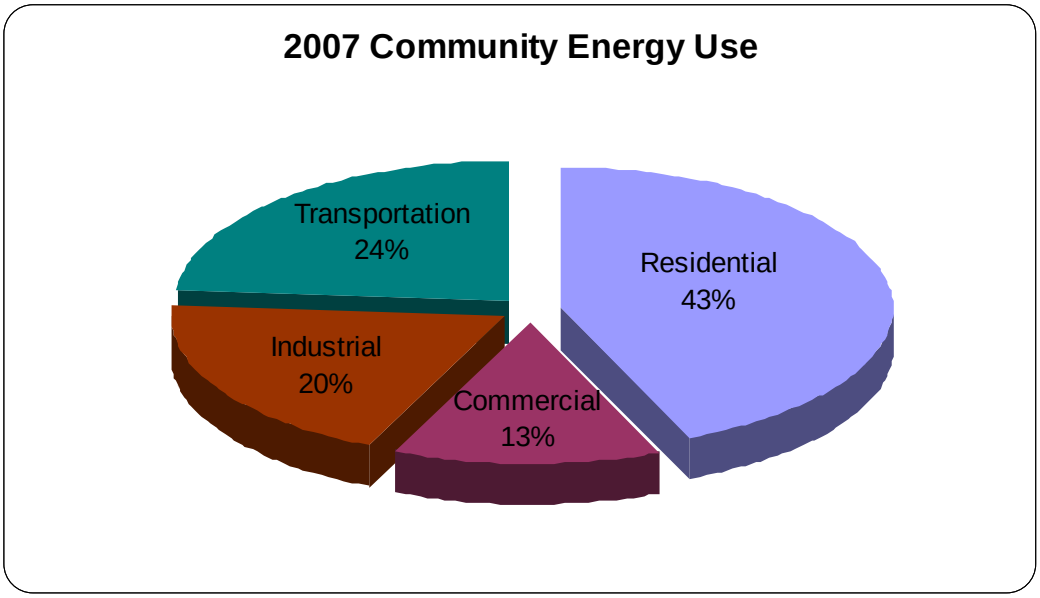
NOW, THEREFORE, BE IT RESOLVED that the City of Bath pledges to take a leadership role to minimize the community's energy costs and maximizing energy efficiency through the following measures:

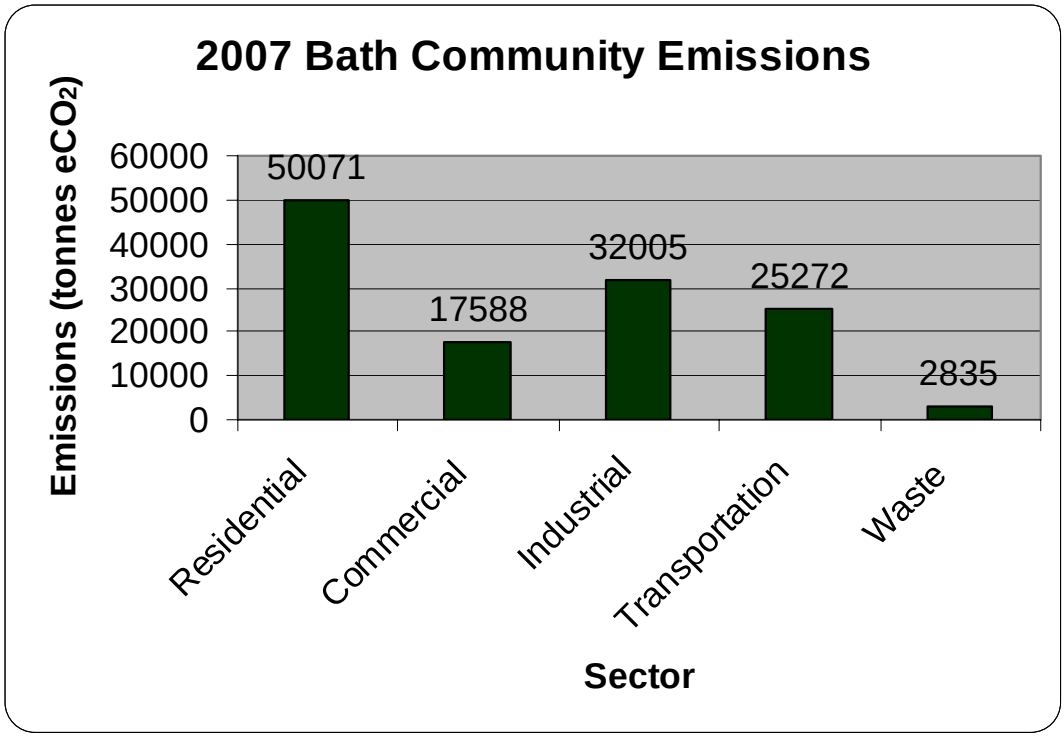
1. Continue to periodically inventory the City's use of all forms of energy through energy audits to identify improvements that will increase energy efficiency through retrofitting city facilities with energy efficient technologies;
2. Promote habit changes among our employees to reduce energy use and increase recycling in City facilities;
3. Consider land-use policies that preserve open space to maintain a compact urban community;
4. Continue to promote alternative transportation options including public transport and walking and bike trails;
5. Continue to explore the use of economically viable alternative energy sources, including the production of biofuels, methane recovery, and waste and bio-mass to energy technology;
6. Purchase only Energy Star and other energy efficient equipment and appliances for City use;
7. Consider requiring all City funded new construction and renovations meet the U.S. Green Building Council's LEED certification program or the Maine State Housing Authority's Green Building Standards;

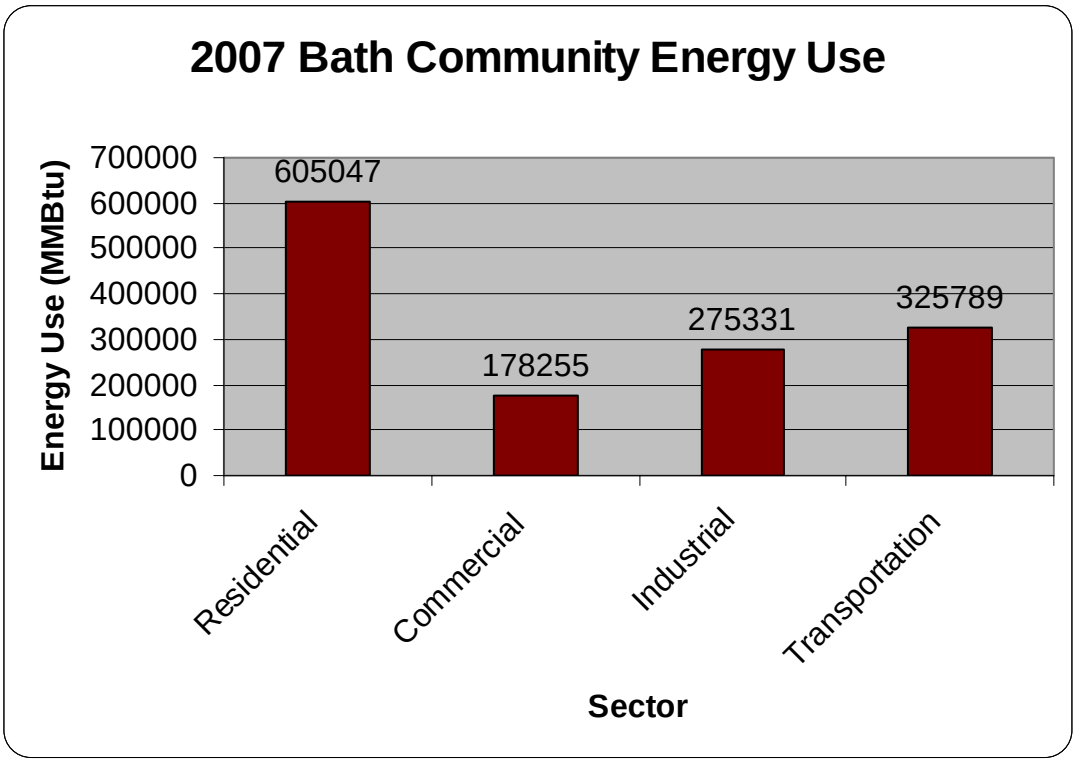
8. Increase fuel efficiency of City vehicles through managing the size and composition of the City's fleet, purchasing alternative energy vehicles when appropriate and available, and educating City drivers on operating the fleet to conserve fuel, including reduction of idling;
9. Continue to increase recycling rates and reduce waste;
10. Maintain and expand a healthy public tree population in the City;
11. Support community education programs to help inform the public about energy-related choices;
12. Set a target emissions reduction of 2% each year, with the goal of reducing carbon emissions by at least 20% by the year 2018.

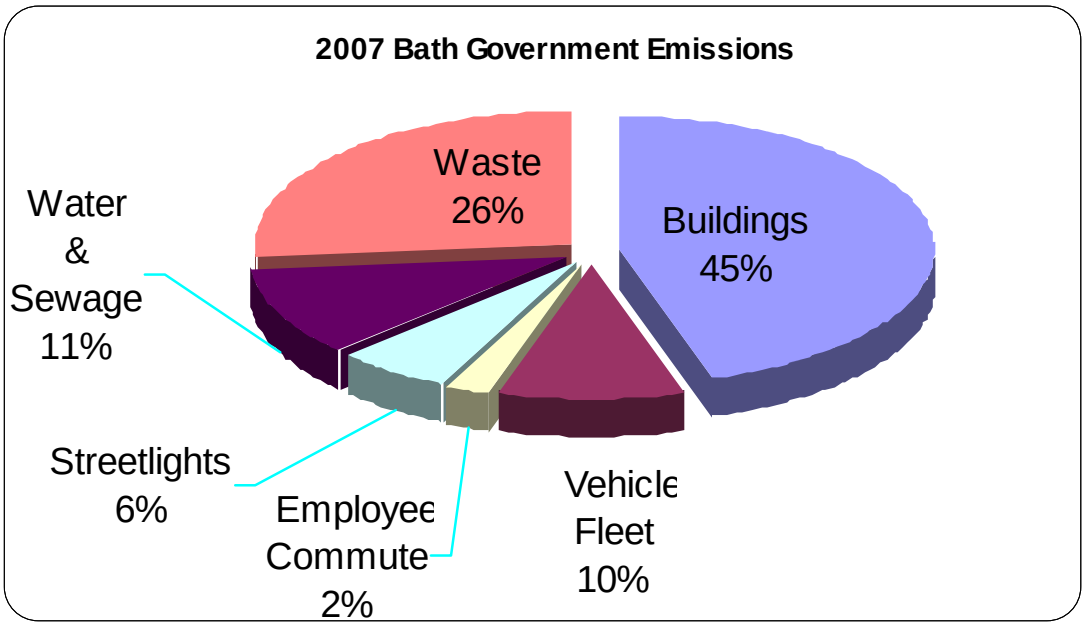
Appendix 2: Charts and Graphs

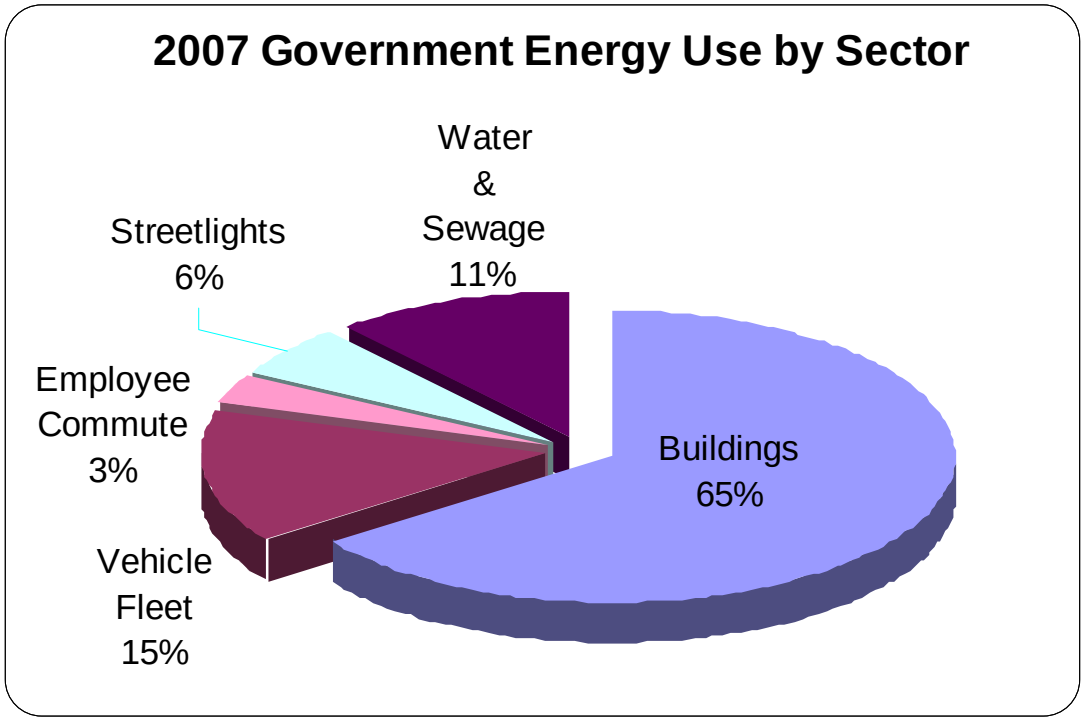


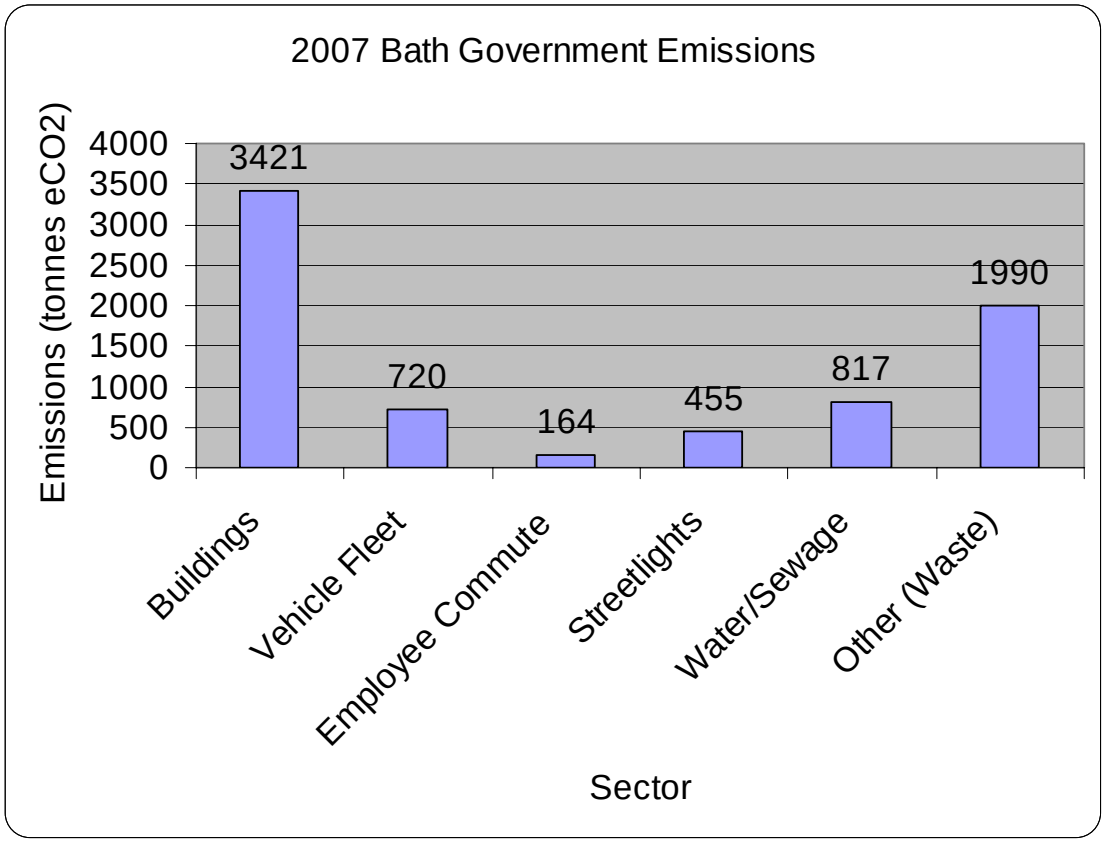


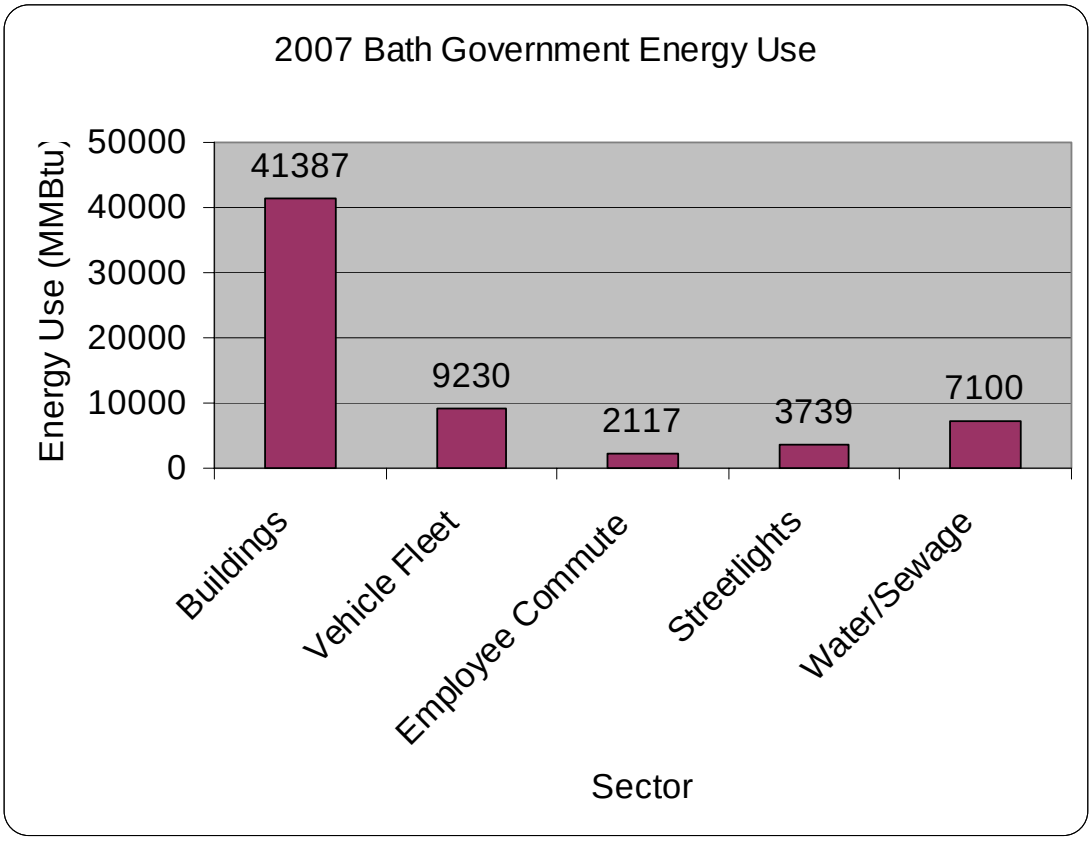

2007 Bath Community Emissions
Emissions (tonnes eCO2)
60000
50000
40000
30000
20000
10000
0
50071
17588
32005
25272
2835
Residential
Commercial
Industrial
Transportation
Waste
Sector

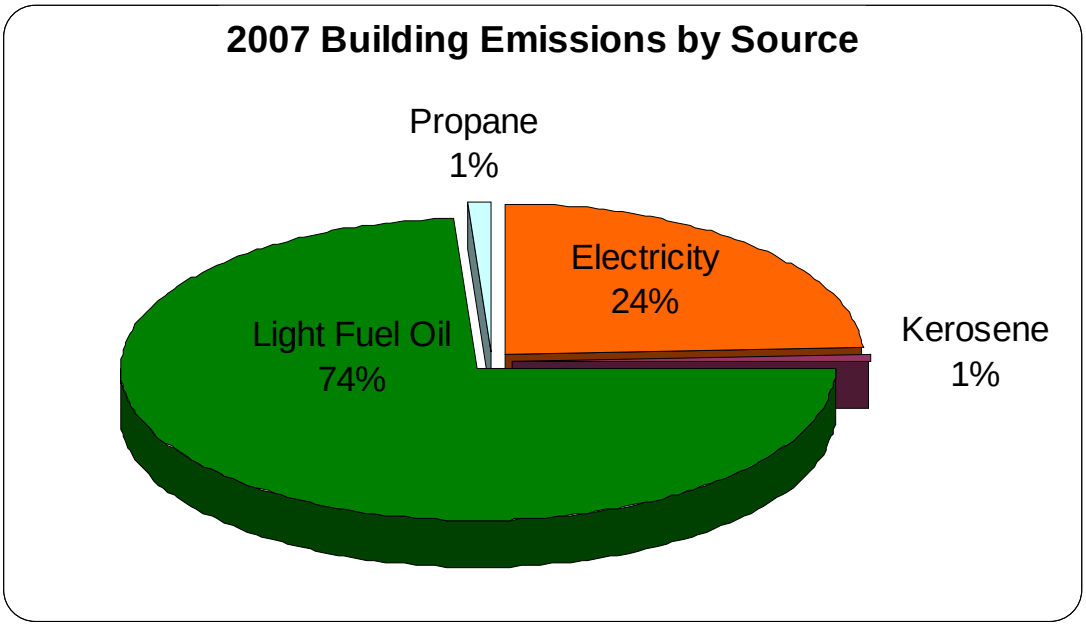

2007 Bath Community Energy Use
Energy Use (MMBtu)
700000
600000
500000
400000
300000
200000
100000
0
605047
178255
275331
325789
Residential
Commercial
Industrial
Transportation
Sector

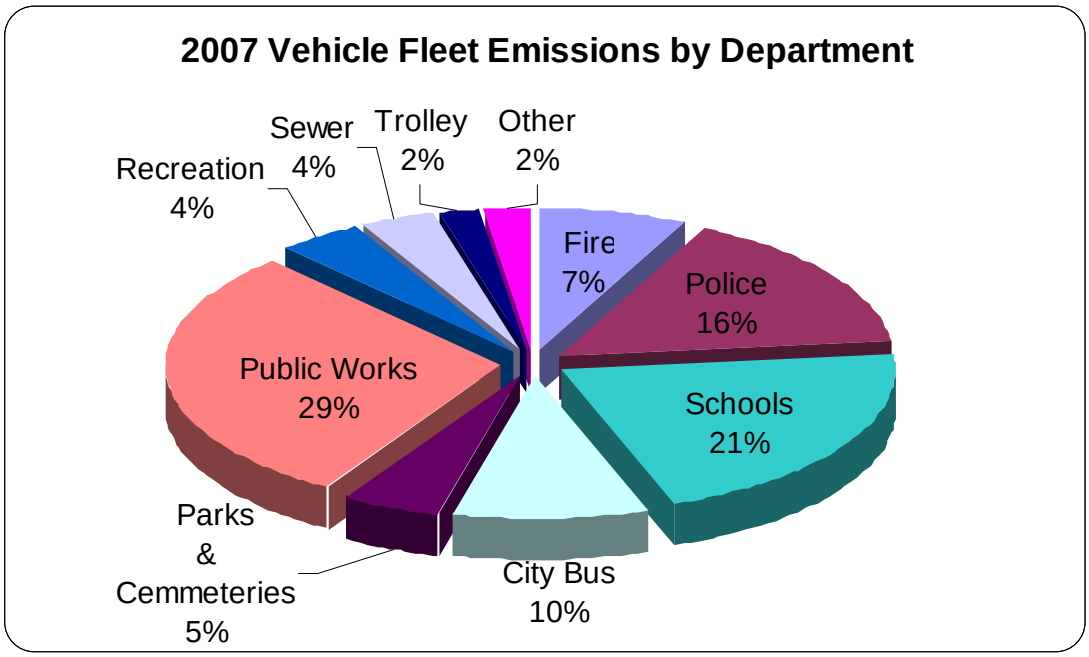

2007 Bath Government Emissions
Waste
26%
Buildings
45%
Water
&
Sewage
11%
Streetlights
6%
Employee
Commute
2%
Vehicle
Fleet
10%


2007 Government Energy Use by Sector
Water
&
Sewage
11%
Streetlights
6%
Employee
Commute
3%
Buildings
65%
Vehicle
Fleet
15%


2007 Bath Government Emissions
Emissions (tonnes eCO2)
4000
3500
3000
2500
2000
1500
1000
500
0
3421
720
164
455
817
1990
Buildings
Vehicle Fleet
Employee Commute
Streetlights
Water/Sewage
Other (Waste)
Sector


2007 Bath Government Energy Use
Energy Use (MMBtu)
50000
40000
30000
20000
10000
0
41387
9230
2117
3739
7100
Buildings
Vehicle Fleet
Employee Commute
Streetlights
Water/Sewage
Sector


2007 Building Emissions by Source
Propane
1%
Electricity
24%
Light Fuel Oil
74%
Kerosene
1%


2007 Vehicle Fleet Emissions by Department
Sewer
4%
Trolley
2%
Other
2%
Recreation
4%
Fire
7%
Police
16%
Public Works
29%
Schools
21%
Parks
&
Cemmeteries
5%
City Bus
10%

Appendix 3: Inventory Reports

Bath

Community Greenhouse Gas Emissions in 2007
Summary Report

	Equiv CO_2 (tonnes)	Equiv CO_2 (%)	Energy (MMBtu)
Residential	50,071	39.2	605,047
Commercial	17,588	13.8	178,255
Industrial	32,005	25.0	275,331
Transportation	25,272	19.8	325,789
Other	2,835	2.2	
Total	127,772	100.0	1,384,423

This report has been generated for Bath, Maine using STAPPA/ALAPCO and ICLEI's Clean Air and Climate Protection Software developed by Torrie Smith
Associates Inc.

Bath

Government Greenhouse Gas Emissions in 2007
Summary Report

	Equiv CO_2 (tonnes)	Equiv CO_2 (%)	Energy (MMBtu)
Buildings	3,417	40.6	41,387
Vehicle Fleet	720	8.6	9,230
Employee Commute	164	1.9	2,117
Streetlights	455	5.4	3,739
Water/Sewage	817	9.7	7,100
Waste	0	0.0	
Other	2,835	33.7	
Total	8,408	100.0	63,573

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Associates Inc.

Community Greenhouse Gas Emissions in 2007
Report by Source

	Equiv CO_2 (tonnes)	Equiv CO_2 (%)	Energy (MMBtu)
Residential Sector			
Electricity	11,942	9.3	98,181
Kerosene	5,809	4.5	75,893
Light Fuel Oil	32,320	25.3	430,974
Subtotal	50,071	39.2	605,047
Commercial Sector			
Electricity	11,006	8.6	90,487
Light Fuel Oil	6,582	5.2	87,769
Subtotal	17,588	13.8	178,255
Industrial Sector			
Electricity	28,827	22.6	236,991
Heavy Fuel Oil	3,050	2.4	36,630
Light Fuel Oil	128	0.1	1,710
Subtotal	32,005	25.0	275,331
Transportation Sector			
Diesel	3,419	2.7	43,457
Gasoline	21,852	17.1	282,332
Subtotal	25,272	19.8	325,789
Other Sector			
Methane	2,835	2.2	
Subtotal	2,835	2.2	
Total			
	127,772	100.0	1,384,423

This report has been generated for Bath, Maine using STAPPA/ALAPCO and ICLEI's Clean Air and Climate Protection Software developed by Torrie Smith
Associates Inc.

Government Greenhouse Gas Emissions in 2007
Report by Source

	Equiv CO_2 (tonnes)	Equiv CO_2 (%)	Energy (MMBtu)
Buildings Sector			
Electricity	829	9.9	6,815
Kerosene	21	0.3	280
Light Fuel Oil	2,528	30.1	33,704
Propane	39	0.5	588
Subtotal	3,417	40.6	41,387
Vehicle Fleet Sector			
Diesel	423	5.0	5,376
Gasoline	297	3.5	3,854
Subtotal	720	8.6	9,230
Employee Commute Sector			
Diesel	5	0.1	62
Gasoline	159	1.9	2,055
Subtotal	164	1.9	2,117
Streetlights Sector			
Electricity	455	5.4	3,739
Subtotal	455	5.4	3,739
Water/Sewage Sector			
Electricity	741	8.8	6,095
Light Fuel Oil	75	0.9	1,005
Subtotal	817	9.7	7,100
Waste Sector			
All Other Waste	0	0.0	
Subtotal	0	0.0	
Other Sector			
Methane	2,835	33.7	
Subtotal	2,835	33.7	
Total			
	8,408	100.0	63,573

This report has been generated for Bath, Maine using STAPPA/ALAPCO and ICLEI's Clean Air and Climate Protection Software developed by Torrie Smith
Associates Inc.

Bath

Community Greenhouse Gas Emissions in 2007
Indicators Report

	Equiv CO_2 (tonnes)	Energy (MMBtu)
Residential		
Bath Aggregate		
Per household	12.4	149.7
Sector Average		
Per capita	5.8	69.5
Per household	12.4	149.7
Commercial		
Bath Aggregate		
Per 1000 sq. ft.	10.8	109.7
Per commercial establishment	33.4	339.1
Sector Average		
Per 1000 sq. ft.	10.8	109.7
Per capita	2.0	20.5
Per commercial establishment	33.4	339.1
Industrial		
Bath Aggregate		
Per industrial establishment	2,667.1	22,944.3
Sector Average		
Per capita	3.7	31.6
Per industrial establishment	2,667.1	22,944.3
Transportation		
Sector Average		
Per capita	2.9	37.4
Other		
Sector Average		
Per capita	0.3	

This report has been generated for Bath, Maine using STAPPA/ALAPCO and ICLEI's Clean Air and Climate Protection Software developed by Torrie Smith
Associates Inc.

Bath

Government Greenhouse Gas Emissions in 2007
Indicators Report

	Equiv CO_2 (tonnes)	Energy (MMBtu)	Cost ($)
Vehicle Fleet			
City Buses			
Per vehicle	34.5	438.0	6,407.4
Per vehicle mile	0.0	0.0	0.3
Animal Control			
Per vehicle	7.1	91.5	1,867.9
Bath Fire Department			
Per vehicle	5.8	74.6	1,815.5
Bath Police Department			
Per vehicle	11.5	148.7	3,017.3
Bath School District			
Per vehicle	8.0	102.4	2,429.8
Parks & Cemeteries			
Per vehicle	4.7	60.3	1,320.3
Trolley			
Per vehicle	13.1	169.4	3,827.4
Forestry			
Per vehicle	8.1	105.8	2,146.3
Public Works			
Per vehicle	7.9	100.3	2,505.5
Recreation			
Per vehicle	3.0	38.0	835.5
Sewer Maintenance			
Per vehicle	13.5	171.9	4,431.3
Sector Average			
Per vehicle	8.1	103.4	2,330.8
Per vehicle mile	0.0	0.0	0.3
Streetlights			
Bath Total			
Per streetlight	0.7	5.8	168.1
Sector Average			
Per streetlight	0.7	5.8	168.1
Waste			
Bath Landfill			
Per employee	0.0		57,738.4
Sector Average			
Per employee	0.0		57,738.4

This report has been generated for Bath, Maine using STAPPA/ALAPCO and ICLEI's Clean Air and Climate Protection Software developed by Torrie Smith Associates Inc.

Appendix 4: Community and Government Measure Analysis Reports

Bath

Community Greenhouse Gas and Air Pollutant Reductions in 2018
Target Year Measures Listing

Residential Sector **Location of Measure: Bath, Maine**

Type of Measure: Energy Efficiency: Buildings

Measure Name

Ten Percent Challenge (30% participation)

Measure Details

Affected Energy Source 1 Electricity		Affected Energy Source 2 (Optional) Light Fuel Oil Residential	
Energy Reduction	2,941	Energy Reduction	12,924
Unit	(MMBtu)	Unit	(MMBtu)
Price per Unit	$29.34	Price per Unit	$33.01
Ramp-In Factor	100%	Energy Reduction (MMBtu)	15,864
Year Implemented	2010	Emission Reduction (tonnes eCO2)	1,314
Implementation Cost	$0	Savings ($/year)	$512,894
		Payback Period (years)	0

The emission reduction from this measure as a percentage of total reductions: 20.5%

NOx Reduction (lbs)	SOx Reduction (lbs)	CO Reduction (lbs)	VOC Reduction (lbs)	PM10 Reduction (lbs)
3,918	2,621	1,912	250	1,204

Full Description of Measure

Challenge citizens to increase home energy efficiency and reduce energy use (electricity and heating fuel) by 10%. Assuming heating fuel oil cost of July 2008 average $4.62/gal and projected average of 10.014 cents/kWh provided by Maine Public Utilities Commision report and assuming 30% participation (3% total reduction). Energy reduction calculations made according to total Residential energy consumption in MMBtu. Light fuel oil accounted for 71.2% of energy consumed by the Residential Sector and electricity accounted for 16.2%, so fuel use and electricity reductions were weighted according to those percentages. Propane use was not accounted for.

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Associates Inc.

Bath

Community Greenhouse Gas and Air Pollutant Reductions in 2018
Target Year Measures Listing

Residential Sector **Location of Measure: Bath, Maine**

Type of Measure: Energy Efficiency: Buildings

Measure Name

Ten Percent Challenge (50% paticipation)

Measure Details

Affected Energy Source 1 Electricity		Affected Energy Source 2 (Optional) Light Fuel Oil Residential	
Energy Reduction	4,901	Energy Reduction	21,540
Unit	(MMBtu)	Unit	(MMBtu)
Price per Unit	$29.34	Price per Unit	$33.01
Ramp-In Factor	100%	Energy Reduction (MMBtu)	26,441
Year Implemented	2012	Emission Reduction (tonnes eCO2)	2,190
Implementation Cost	$0	Savings ($/year)	$854,823
		Payback Period (years)	0

The emission reduction from this measure as a percentage of total reductions: 34.2%

NOx Reduction (lbs)	SOx Reduction (lbs)	CO Reduction (lbs)	VOC Reduction (lbs)	PM10 Reduction (lbs)
6,530	4,368	3,187	417	2,006

Full Description of Measure

Challenge citizens to increase home energy efficiency and reduce energy use (electricity and heating fuel) by 10%. Assuming heating fuel oil cost of July 2008 average $4.62/gal and projected average of 10.014 cents/kWh provided by Maine Public Utilities Commision report and assuming 50% participation (5% total reduction). Energy reduction calculations made according to total Residential energy consumption in MMBtu. Light fuel oil accounted for 71.2% of energy consumed by the Residential Sector and electricity accounted for 16.2%, so fuel use and electricity reductions were weighted according to those percentages. Propane use was not accounted for.

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Bath

Community Greenhouse Gas and Air Pollutant Reductions in 2018
Target Year Measures Listing

Commercial Sector **Location of Measure: Bath, Maine**

Type of Measure: Energy Efficiency: Buildings

Measure Name

Ten Percent Challenge (30% participation)

Measure Details

Affected Energy Source 1 Electricity		Affected Energy Source 2 (Optional) Light Fuel Oil Commercial	
Energy Reduction	2,717	Energy Reduction	2,631
Unit	(MMBtu)	Unit	(MMBtu)
Price per Unit	$29.34	Price per Unit	$33.01
Ramp-In Factor	100%	Energy Reduction (MMBtu)	5,348
Year Implemented	2010	Emission Reduction (tonnes eCO2)	516
Implementation Cost	$0	Savings ($/year)	$166,559
		Payback Period (years)	0

The emission reduction from this measure as a percentage of total reductions: 8.1%

NOx Reduction (lbs)	SOx Reduction (lbs)	CO Reduction (lbs)	VOC Reduction (lbs)	PM10 Reduction (lbs)
1,162	2,835	1,268	147	818

Full Description of Measure

Challenge all businesses to increase energy efficiency and reduce energy use (electricity and heating fuel) by 10%. Assuming heating fuel oil cost of July 2008 average $4.62/gal and projected average of 10.014 cents/kWh provided by Maine Public Utilities Commision report and assuming 30% participation (3% total reduction). Energy reduction calculations made according to total Residential energy consumption in MMBtu. Light fuel oil accounted for 49.2% of energy consumed by the Commercial Sector and electricity accounted for 50.8%, so fuel use and electricity reductions were weighted according to those percentages.

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Bath

Community Greenhouse Gas and Air Pollutant Reductions in 2018
Target Year Measures Listing

Industrial Sector **Location of Measure: Bath, Maine**

Type of Measure: Absolute Emissions Reduction

Measure Name

BIW 5% emissions reduction by 2010

Measure Details

Emission Affected	Carbon Dioxide		
Emissions Reduction	1,502		0
Unit	(tonnes CO2)	Unit	
Price per Unit	$.00	Price per Unit	$.00
Ramp-In Factor	100%	Energy Reduction (MMBtu)	0
Year Implemented	2010	Emission Reduction (tonnes eCO2)	1,502
Implementation Cost	$0	Savings ($/year)	$0
		Payback Period (years)	0

The emission reduction from this measure as a percentage of total reductions: 23.5%

NOx Reduction (lbs)	SOx Reduction (lbs)	CO Reduction (lbs)	VOC Reduction (lbs)	PM10 Reduction (lbs)
0	0	0	0	0

Full Description of Measure

Bath Iron Works has pledged to reduce its greenhouse gas emissions by 5% from 2007 levels by 2010.

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Bath

Community Greenhouse Gas and Air Pollutant Reductions in 2018
Target Year Measures Listing

Transportation Sector **Location of Measure: Bath, Maine**
Type of Measure: Walking/Biking

Measure Name

Bath Bike Path/Bike Campaign

Measure Details

Initial Fuel and Vehicle Type		Replacement Fuel and Vehicle Type	
Gasoline		Gasoline	
Passenger Vehicle		Passenger Vehicle	
Usage Before	1,792,651	Usage After	1,703,018
Unit	(US gal)	Unit	(US gal)
Price per Unit	$4.00	Price per Unit	$4.00
Ramp-In Factor	100%	Energy Reduction (MMBtu)	11,258
Year Implemented		Emission Reduction (tonnes eCO2)	872
Implementation Cost	$0	Savings ($/year)	$358,530
		Payback Period (years)	0

The emission reduction from this measure as a percentage of total reductions: 13.6%

NOx Reduction (lbs)	SOx Reduction (lbs)	CO Reduction (lbs)	VOC Reduction (lbs)	PM10 Reduction (lbs)
3,611	264	56,458	5,319	82

Full Description of Measure

Build new bike paths around the city and encourage people to use them for biking to work, into town, etc. Assuming a 5% total reduction in community VMT and $4 per gallon for gasoline.

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Bath

Government Greenhouse Gas and Air Pollutant Reductions in 2018
Target Year Measures Listing

Buildings Sector **Location of Measure: Bath, Maine**

Type of Measure: Energy Efficiency: Buildings

Measure Name

Window Upgrades and Increased Insulation

Measure Details

Affected Energy Source 1		Affected Energy Source 2 (Optional)	
Light Fuel Oil		Electricity	
Commercial			
Energy Reduction	12,041	Energy Reduction	0
Unit	(US gal)	Unit	(kWh)
Price per Unit	$4.00	Price per Unit	$.00
Ramp-In Factor	100%	Energy Reduction (MMBtu)	1,685
Year Implemented	2010	Emission Reduction (tonnes eCO2)	126
Implementation Cost	$0	Savings ($/year)	$48,163
		Payback Period (years)	0

The emission reduction from this measure as a percentage of total reductions: 23.9%
This emission reduction as a percentage of emission reductions required to meet target: 7.9%

NOx Reduction (lbs)	SOx Reduction (lbs)	CO Reduction (lbs)	VOC Reduction (lbs)	PM10 Reduction (lbs)
447	1,392	90	15	53

Full Description of Measure

Install energy efficient double-paned windows and better insulation for City Hall and other municipal buildings. Assuming 5% reduction in fuel use and 5% reduction in electricity use. Ramp-in schedule starting with 40% in 2010, then 30%, 20%, and 10% in the following years until it is completed in 2013. Assuming (very conseratively) a price of $3.00 per gallon for heating fuel. Electricity price is based on current price from CMP which will likely increase.

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Bath

Government Greenhouse Gas and Air Pollutant Reductions in 2018
Target Year Measures Listing

Buildings Sector **Location of Measure: Bath, Maine**

Type of Measure: Energy Efficiency: Equipment and Lighting

Measure Name

Energy Star Appliance Replacement

Measure Details

Affected Energy Source 1		Affected Energy Source 2 (Optional)	
Electricity			
Energy Reduction	199,690	Energy Reduction	0
Unit (kWh) Unit			
Price per Unit	$.10	Price per Unit	$.00
Ramp-In Factor	100%	Energy Reduction (MMBtu)	682
Year Implemented	2009	Emission Reduction (tonnes eCO2)	80
Implementation Cost	$0	Savings ($/year)	$19,917
		Payback Period (years)	0

The emission reduction from this measure as a percentage of total reductions: 15.1%
This emission reduction as a percentage of emission reductions required to meet target: 5.0%

NOx Reduction (lbs)	SOx Reduction (lbs)	CO Reduction (lbs)	VOC Reduction (lbs)	PM10 Reduction (lbs)
117	166	283	31	184

Full Description of Measure

Replace appliances, computers, other equipment with Energy Star rated units when they are due to be replaced. Assuming minimum total energy savings of 10%.

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Bath

Government Greenhouse Gas and Air Pollutant Reductions in 2018
Target Year Measures Listing

Vehicle Fleet Sector **Location of Measure: Bath, Maine**

Type of Measure: Increase in Fuel Efficiency

Measure Name

Hybrid vehicles for Police and Fire

Measure Details

Initial Fuel and Vehicle Type		Replacement Fuel and Vehicle Type	
Gasoline		Gasoline	
Passenger Vehicle		Auto - Sub-Compact/Compact	
		SULEV	
Use Before	13,488	Use After	7,480
Unit	(US gal)	Unit	(US gal)
Price per Unit	$4.00	Price per Unit	$4.00
Ramp-In Factor	100%	Energy Reduction (MMBtu)	755
Year Implemented	2010	Emission Reduction (tonnes eCO2)	59
Implementation Cost	$36,000	Savings ($/year)	$24,034
		Payback Period (years)	1.5

The emission reduction from this measure as a percentage of total reductions: 11.1%
This emission reduction as a percentage of emission reductions required to meet target: 3.7%

NOx Reduction (lbs)	SOx Reduction (lbs)	CO Reduction (lbs)	VOC Reduction (lbs)	PM10 Reduction (lbs)
519	24	6,333	788	1

Full Description of Measure

Replace 12 government vehicles with Ford Escape hybrids. Assuming $4/gallon of gass and avg. 33 mpg for Escape hybrid.

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Bath

Government Greenhouse Gas and Air Pollutant Reductions in 2018
Target Year Measures Listing

Employee Commute Sector **Location of Measure: Bath, Maine**
Type of Measure: Car/Van Pooling

Measure Name

Bath Municipal Carpooling

Measure Details

Initial Fuel and Vehicle Type		Replacement Fuel and Vehicle Type	
Gasoline		Gasoline	
Passenger Vehicle		Passenger Vehicle	
Use Before	276,977	Use After	193,884
Unit	(vehicle-miles)	Unit	(vehicle-miles)
Price per Unit	$.22	Price per Unit	$.22
Ramp-In Factor	100%	Energy Reduction (MMBtu)	570
Year Implemented	2010	Emission Reduction (tonnes eCO2)	44
Implementation Cost	$0	Savings ($/year)	$18,162
		Payback Period (years)	0

The emission reduction from this measure as a percentage of total reductions: 8.4%
This emission reduction as a percentage of emission reductions required to meet target: 2.8%

NOx Reduction (lbs)	SOx Reduction (lbs)	CO Reduction (lbs)	VOC Reduction (lbs)	PM10 Reduction (lbs)
183	13	2,860	269	4

Full Description of Measure

Carpooling program for Bath City Employees. Assuming that employees carpool with one other person and VMT decreasing by 30% and a conservative gasoline price of $4 per gallon.

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Bath

Government Greenhouse Gas and Air Pollutant Reductions in 2018
Target Year Measures Listing

Streetlights Sector **Location of Measure: Bath, Maine**

Type of Measure: Energy Efficiency: Lamp and Ballast

Measure Name

LED Replacement

Measure Details

Affected Energy Source			
Electricity			
Energy Reduction	547,788		0
Unit	(kWh)	Unit	
Price per Unit	$.10	Price per Unit	$.00
Ramp-In Factor	100%	Energy Reduction (MMBtu)	1,870
Year Implemented	2010	Emission Reduction (tonnes eCO2)	219
Implementation Cost	$237,250	Savings ($/year)	$54,636
		Payback Period (years)	4.3

The emission reduction from this measure as a percentage of total reductions: 41.5%

This emission reduction as a percentage of emission reductions required to meet target: 13.7%

NOx Reduction (lbs)	SOx Reduction (lbs)	CO Reduction (lbs)	VOC Reduction (lbs)	PM10 Reduction (lbs)
320	455	775	85	506

Full Description of Measure

Replace current street lights with LEDs at a rate of 20% per year. Assuming implementation cost of $237,250 ($365/bulb).

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