Cities for Climate Protection Campaign
Portsmouth, NH
Summary Report

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Under the Supervision of: Peter Britz, Environmental Planner

September 20, 2007

Introduction

This report summarizes the progress of the City of Portsmouth's pledge to the Cities for Climate Protection campaign (CCP) during the summer of 2007. The CCP campaign is one of the components of the city's commitment to becoming a sustainable community. The CCP campaign guides the city toward reducing energy consumption and corresponding greenhouse gas emissions through the establishment of a Local Action Plan. The City of Portsmouth signed a commitment to the CCP campaign on November 13, 2006. This report summarizes the completion of the first two "milestones" in the city's commitment. This first milestone includes establishing a base year, gathering base year energy consumption and waste generation data, and calculating greenhouse gas emissions for the base year. The second milestone establishes a greenhouse gas emissions reduction target. This report was researched and assembled under the supervision of Peter Britz, the city's Environmental Planner by James Ryan, an intern hired by the city during the summer of 2007. Funding for this effort was provided by the New Hampshire Charitable Foundation, Otto Fund.

The Cities for Climate Protection Campaign

The Cities for Climate Protection campaign is an international campaign organized by the International Council for Local Environmental Initiatives (ICLEI). ICLEI is an international association of local governments that have made a commitment to sustainable development. There are currently more that 250 towns, cities, counties and other organizations in the United States that are members of ICLEI. ICLEI works with its members by providing guidance and technical support for the several programs they supervise. One of the programs that ICLEI organizes is the CCP campaign

The CCP was established in 1993 at a United Nations meeting in New York where municipal leaders approved a declaration calling for local governments to reduce greenhouse gas emissions, improve air quality and enhance urban sustainability. Since its inception, over 650 local governments have pledged to take greenhouse gas emissions reduction measures as part of the CCP campaign. While local governments work to implement their new policies and practices, ICLEI provides them with guidance and technical support.

The Cities for Climate Protection campaign is a very intuitive means of reducing greenhouse gas emissions due to the dual role of cities as part of the climate change solution and part of the problem. During the industrial revolution, with the advent of concentrated energy generation and distribution, population and industry growth in cities boomed. As cities grew and energy demand increased, pollution from coal and oil turned cities into dirty and polluted places. With cheap gasoline and cars, people relocated to cleaner, more pleasant suburbs, which increased inefficiency and energy demand by introducing a large number of single family homes and extending commutes. The density of urban development provides the potential for sustainable practices in large communities. Public transportation, pedestrian travel, and common-wall housing, are reasons cities hold great potential as either part of the problem or part of the solution. The Cities for Climate Protection campaign is an effort to transform cities into part of the solution.

Cities for Climate Protection Campaign Methodology

ICLEI recommends a five "milestone" plan that serves as a standardized outline for local governments to follow as they complete their commitment to the CCP campaign. The milestones defined by ICLEI are:

> **"Milestone 1.** Conduct a baseline emissions inventory and forecast. Based on energy consumption and waste generation, the city calculates greenhouse gas emissions for a base year and for a forecast year. The inventory and forecast provide a benchmark against which the city can measure progress.
>
> **Milestone 2.** Adopt an emissions reduction target for the forecast year. The city establishes an emission reduction target for the city. The target both fosters political will and creates a framework to guide the planning and implementation of measures.
>
> **Milestone 3**. Develop a Local Action Plan. Through a multi-stakeholder process, the city develops a Local Action Plan that describes the policies and measures that the local government will take to reduce greenhouse gas emissions and achieve its emissions reduction target. Most plans include a timeline, a description of financing mechanisms, and an assignment of responsibility to departments and staff. In addition to direct greenhouse gas reduction measures, most plans also incorporate public awareness and education efforts.
>
> **Milestone 4**. Implement policies and measures. The city implements the policies and measures contained in their Local Action Plan. Typical policies and measures implemented by CCP: participants include energy efficiency improvements to municipal buildings and water treatment facilities, streetlight retrofits, public transit improvements, installation of renewable power applications, and methane recovery from waste management.
>
> **Milestone 5**. Monitor and verify results. Monitoring and verifying progress on the implementation of measures to reduce or avoid greenhouse gas emissions is an ongoing process. Monitoring begins once measures are implemented and continues for the life of the measures, providing important feedback that can be used to improve the measures over time." (taken from www.iclei.org)

This report summarizes Portsmouth's completion of milestone 1, 2, the beginnings of 3 and should serve as a guideline for future inventory development. With a detailed explanation of both the data and the methodology of the data gathering, future inventories can be assembled in the same manner to ensure a comparison of similar data sets. Explanation of how data was gathered, assumptions that were made, and missing data are explained in this report along with supplemental notation within the reports generated by the Clean Air and Climate Protection (CACP) software ICLEI provides its members.

The Clean Air and Climate Protection Software

The CACP software estimates the following air pollutants from inputted energy usage and waste generation data:

CO_2: Carbon Dioxide
NO_x: Oxides of nitrogen, primarily NO_2
SO_x: Oxides of Sulfur, primarily SO_2
CO: Carbon Monoxide
VOC: Volatile Organic Compounds
PM: Particulate Matter

To simplify the data output, the program converts all of the gases into one CO_2 equivalent value according to the relative greenhouse effect of each gas. For example, NO_2 is about 275 times more potent than CO_2 as a greenhouse gas, so the program multiplies the mass of NO_2 by 275 to obtain the CO_2 equivalent value. The program requires that the information be input based upon two primary categories: government and community. Government includes all city-owned facilities, properties, equipment, buildings, and operations. Community includes everything within the city limits (including the government). The two primary categories are then broken down further into "analysis" and "measures." Analysis is where the current usage data is entered and measures is where particular energy and waste saving measures can be implemented and their effects measured. The measures section will provide the city with an easy way of quantitatively comparing the impact of future emissions reduction plans with the economic repercussions they include. The reports generated by the Clean Air and Climate Protection software are included in the appendices of this report with notations explaining how the data was gathered.

The Municipal Analysis

The municipal analysis generates greenhouse gas emissions data for all government owned and operated facilities. Examination of the trends in the data will aid in the development of specific measures to reduce. This initial analysis serves as a valuable tool for developing a municipal action plan and a baseline inventory to compare future progress against. The data presented in the body of this report is based upon the data generated from the CCP software the specific reports generated by the software are included in the appendices to this report.

The data is divided into five categories:

- *Buildings*: Emissions resulting from municipal buildings
- *Vehicle Fleet*: Emissions resulting from city owned vehicles
- *Employee Commute:* Emissions resulting from city employees commutes
- *Streetlights:* Emissions resulting from electricity generation for street and traffic lights
- *Water/Sewage*: Emissions resulting from electricity generation for pumps, wells, and booster stations are part of the water and sewer system.

The overall summary of each category's CO_2 equivalent contribution is shown in figure 1.

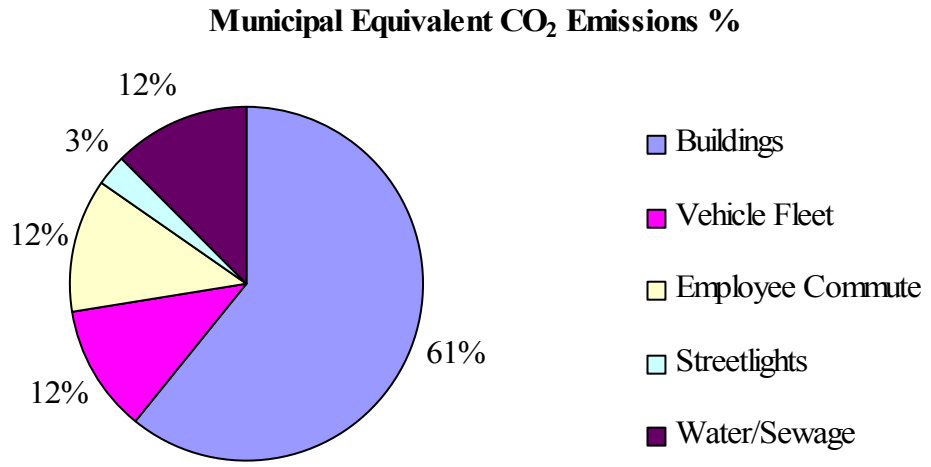

Figure 1 – Summary of Municipal Equivalent CO_2 emissions distributed by sector.

Buildings

The municipal buildings generated 61% of Portsmouth's 2006 greenhouse gas emissions; making it by far the largest contributor. The city buildings generated 3,378 tons and 5,616 tons of equivalent CO_2 emissions from electricity and natural gas respectively. The buildings in the city vary widely in size. The energy usage per 1000 ft^2 is compared in figure 2 to enable a useful comparison of each building's efficiency.

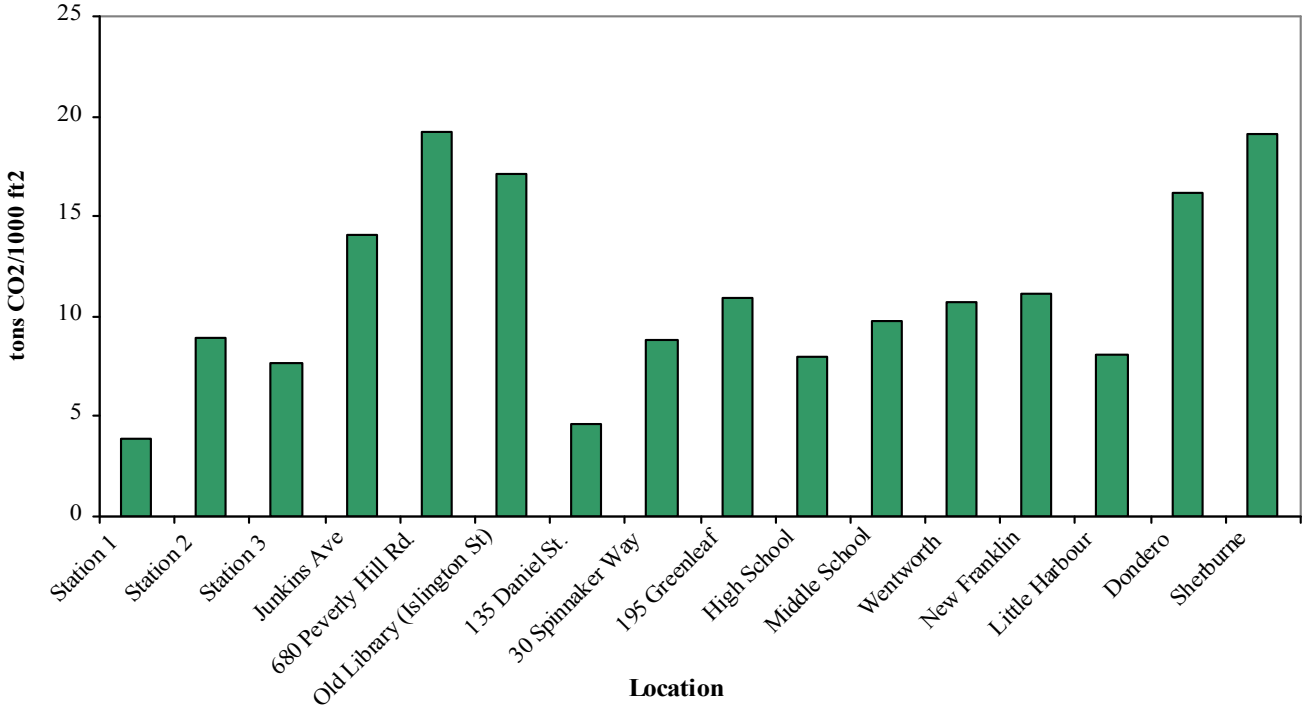

Figure 2- Tons CO_2 equivalent emissions per 1000 ft^2 versus municipal location. The locations displayed in this graph do not include facilities with energy intensive operations such as the drinking water treatment facility, wastewater treatment facility, and indoor pool.

From figure 2 it can be seen that the Public Works facility on Peverly Hill Rd. and the Sherburne school are the two most energy intensive municipal buildings. This analysis may aid in targeting the most problematic buildings for improvement. Improvements upon the most inefficient buildings could range from educating the people using the buildings about how to use energy more resourcefully, to modifying the building to improve its energy efficiency. Monitoring the city building's is relatively easy because energy usage records are updated monthly in the finance department. The city's mobile sources usage is more difficult to track.

Vehicle Fleet

The city's vehicle fleet contributed 12% of the total municipal CO_2 equivalent emissions in 2006. The fleet includes vehicles from the public works, police, fire, school, school bus, and housing authority departments. The breakdown of each department's contribution to the vehicle fleet's 1,785 tons of CO_2 equivalent emissions in 2006 is shown in figure 3. The records for each individual vehicle's fuel consumption are kept by public works and could be better organized for future monitoring. More details regarding this record keeping can be found in the detailed report Appendix A. Improved record keeping should be a priority as targets are set, so that progress can be properly monitored.

The public works department has 78 vehicles and their large contribution can be attributed to the large number of vehicles and the frequently used heavy trucks that are involved in the trash pickup, plowing, and construction that public works is responsible for. The police department has 30 vehicles and their second largest contribution can be attributed to the patrol vehicles' low fuel efficiency, and 24 hour operation. The school buses are not owned by the city, but they are used by city residents so they were included in this analysis. The fire department has 18 vehicles; the engines and ladder trucks have very low fuel efficiencies, but they are not used as regularly as most other vehicles. The housing authority has 4 senior transportation vans and 5 maintenance vehicles. The school department has 6 maintenance pickup trucks, a box truck, and 2 sedans that use a relatively small amount of fuel.

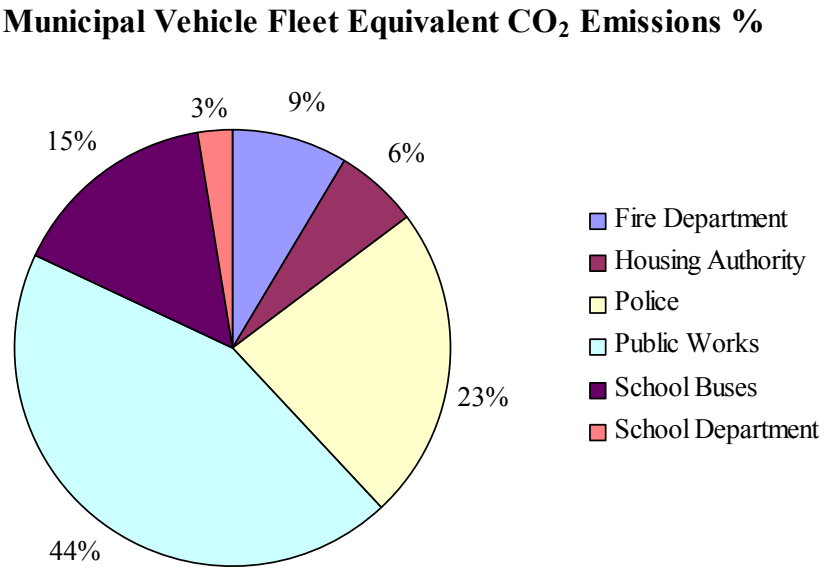

Figure 3- The percentage of the total municipal vehicle fleet's CO_2 equivalent emissions that each department's vehicles generate.

Employee Commute

The employee commute contributed 12% of the total municipal greenhouse gas emissions in 2006. The share of these emissions was divided up according to the varying amounts of annual work days each type of employee has. The emissions amounts from each type of employee are reflective of how many days each type of employee commutes. The distribution of the emissions is shown in figure 4. Average commute distances were calculated to get a better picture of how far each type of employee commutes. These distances are shown in table 1.

Employee Type	Number of employees	Average miles per commute
Full Time City	327	16.2
Part Time City	182	6.6
Full Time School	466	17
Part Time School	432	15

Table 1- Average commute distances for each employee type

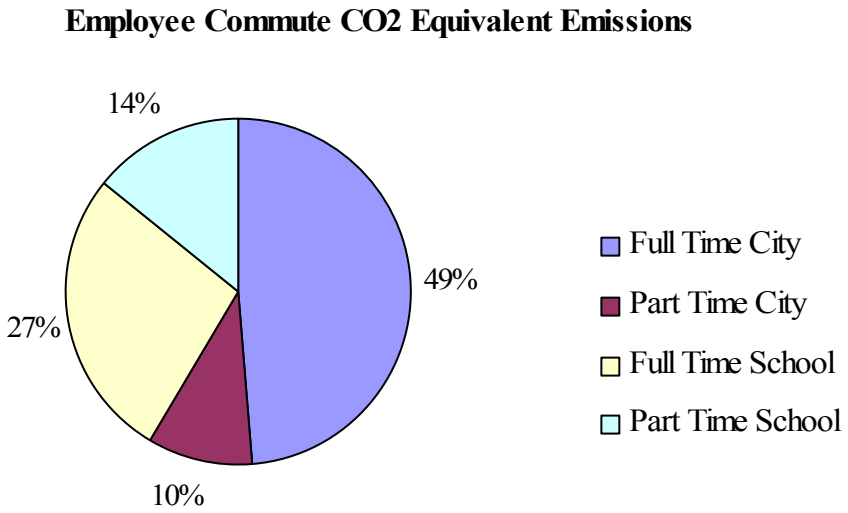

Figure 4- Distribution of CO_2 equivalent emissions from municipal employee commutes.

Streetlights

The streetlights sector includes all the streetlights and traffic lights in the city. The electricity to power these lights produces 3% of the city's total emissions. The streetlights in the city are almost entirely high pressure sodium fixtures and the traffic lights are almost entirely LED. The streetlights are owned by PSNH, and the high pressure sodium bulbs are the most efficient they install. The city's traffic lights utilize LED bulbs, which are widely accepted as one of the most common efficiency measures currently being implemented.

Water/Sewer

The water and sewer department's pumping stations, wells, and booster stations generated 12% of the city's greenhouse gas emissions. There are a total of 32 water and

sewer locations in the city that are using energy, but three pumping stations in the city accounted for the majority of the energy usage. Freshet Road, Deer Street, and Rye Street each generated about 22% of the total water and sewer sector's emissions. It is important to note that this sector does not include the waste water and drinking water treatment facilities.

Municipal Emissions Reduction Measures

As the City of Portsmouth continues in its ongoing effort to become more sustainable, it will be taking certain measures to reduce its air emissions. The following are some of the municipal measures implemented after the baseline inventory year of 2006 and some potential suggested measures. Along with a description of the measure is the annual equivalent CO_2 reduction in tons, the percentage of the municipal emissions that it would reduce, and the financial savings. Using the CACP software, proposals for reducing emissions can be quantified and presented as they are in this report. Having a concrete estimate of the reductions from a measure aids in the decision making process about where the largest improvements can be made.

Municipal Measures Already in Place

Opening of LEED certified Public Library:

In January of 2007 a new 39,000 square foot, Leadership in Energy and Environmental Design (LEED) certified public library was opened at 175 Parrot Ave. This new library is an example of the potential for energy efficiency in the municipal buildings in the city of Portsmouth. Since the new library has opened, it has demonstrated that to heat one square foot of building space it requires only one fourth of the natural gas the old library required. Even with the addition of 40 new computers, the electricity usage per square foot in the building is 39% less. The public library should serve as an example for both future municipal and private building projects. Public awareness of the building's benefits can help spur momentum for private builders to do the same. The potential energy savings and corresponding CO_2 emissions reductions associated with LEED building design can already be seen from this analysis.

Annual Equivalent CO_2 Reduction: 88 tons (0.57%)

Savings: According to the preliminary energy analysis for LEED Credit EA 1 prepared by Andelmann and Lelek Engineering, Inc: $23,600/year

Use of B-20 Diesel Fuel in Public Works Vehicle Fleet:

In August 2007 the city's public works department will started phasing in the use of B-20 blended diesel fuel in its diesel-powered vehicles. B-20 is a blended fuel comprised of 20% biodiesel and 80% ULSD diesel fuel. Biodiesel is a cleaner-burning renewable fuel derived from vegetable oils. The many benefits of biodiesel include;

- Lower unburned hydrocarbon, particulate, and SO_x emissions
- No modifications to the existing diesel engine are necessary
- Can be blended with petroleum based fuels

- It can be domestically produced, reducing dependence upon unstable foreign suppliers
- It is renewable

As confidence in the fuel increases, integration into the entire diesel vehicle fleet will hopefully take place. Making it visible to the public that the municipal vehicle fleet is using biodiesel can spark interest and confidence in the fuel's integrity as a viable alternative to petroleum based fuels. A public works plow truck with the words "Powered by biodiesel" written on the side could be an effective means for community awareness.

Annual Equivalent CO_2 Reduction: 97 tons (0.6%)

Savings: Implementing the use of biodiesel will not have any direct economic savings. A capital cost of $5000 is estimated. As of July 24, 2007 the pre-tax price the city will pay for B-20 biodiesel blend and diesel are $2.3705/gal and $2.2749/gal respectively. If there was no reduction in the amount of fuel used, the additional cost would be $9300/year. The cost of this program could potentially be offset through the use of the Clean School Bus USA funding that is available through the EPA's Regional Diesel Collaborative program.

Potential Suggested Municipal Measures:

Cleaning up the School Bus Fleet:

Using biodiesel in Portsmouth's school bus fleet has potential for significant GHG emissions reductions. Portsmouth's school buses are owned and operated by a private contractor, but the services they provide to city residents consume approximately 26,000 gallons of diesel fuel per year. Lowering emissions from school buses has the dual benefit of lowering the overall carbon footprint of the city, and reducing the amount of concentrated diesel exhaust soot. The emissions could be lowered even further by retrofitting the buses with improved particulate removal technology. The EPA has funding available for cleaning up school bus fleets through its "Clean School Bus USA" program. The potential for the measure to be put in action rests largely with the ability to negotiate with the contractor.

Annual Equivalent CO_2 Reduction: From using B-20 biodiesel: 55 tons (0.4%)

Savings: This measure would not yield any direct financial savings. The benefits would be purely emissions and health related. The cost of this program could potentially be offset through the use of the Clean School Bus USA funding that is available through the EPA's Regional Diesel Collaborative program.

Community Analysis

The community analysis is not as in depth as the government analysis due to the larger size, and complexity of gathering data for an entire city. The community analysis breaks the data into five categories: residential, commercial, industrial, transportation and waste. The transportation sector is all of the traffic in the city. The waste sector emissions are from the decomposition of the city's solid waste. The residential, commercial, and industrial sectors correspond with each sector as defined by the utility and fuel suppliers that provided data. Due to the reluctance of some utility providers to release sector-specific data there was some estimation involved to generate the data in this analysis. These estimations coupled with the vast number of variables involved in the city's energy consumption patterns make it difficult to quantify current usage and determine what progress is being made on the community level. The various assumptions and methods that were used to generate the community wide data are explained in Appendix B. The total 2006 equivalent CO_2 emissions for the city were approximately 678,000 tons. The breakdown of these emissions by sector can be seen in figure 5.

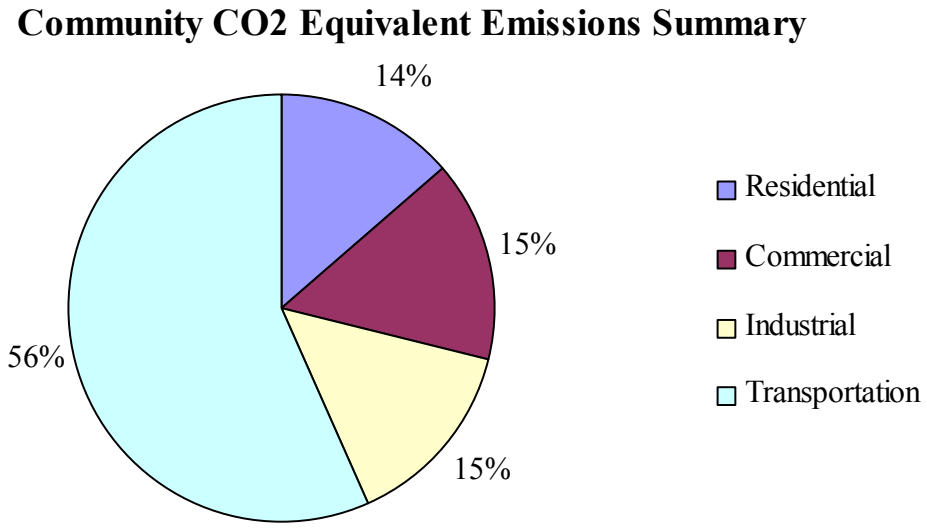

Figure 5 – Percentage of the total community CO_2 equivalent emissions that each sector contributes. The waste emissions contribution is not shown because it is less than 1%. For more detailed information about the waste sector see Appendix B.

Community Measures

The ability to reduce the community's greenhouse gas emissions is limited by the willingness of community members. Education about the critical nature of global warming and the importance of citizens role taking action should be the first steps towards making change in the community. It seems safe to say at this point that most residents are aware of global warming, but not aware of how easy it is to alter their lifestyles in simple ways to reduce their impact. In addition to educating people about how to reduce environmental impacts, education about the positive economic aspects of greener living should also be considered. Broader knowledge of these ideas can be accelerated by community programs

such as Portsmouth Listens, where individuals can hear about how other individuals are making changes. As awareness about the importance of reducing greenhouse gas emissions becomes more widespread, there will likely be more community support for measures such as green building requirements and vehicle mileage standards.

Appendix A

CACP Software Report: Detailed Government Analysis

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Buildings				
Portsmouth, NH				
135 Daniel St. (Connie Bean Center)				
Electricity	20	0.1	183	6,682
Natural Gas	81	0.5	1,308	19,387
Subtotal 135 Daniel St. (Connie Bean Center)	101	0.7	1,491	26,069

The following notes apply to the entire buildings sector:

The data for the buildings sector was gathered from the finance department. The data that was supplied included monthly usage reports and annual departmental spending amounts. The monthly usage reports were broken up by building. A percentage of the total utility usage was calculated for each building within each department. The percentage was then multiplied by the total utility spending for that department to find the amount spent on each building.

Some of the building groups include more than one account number. All of the account numbers for each location were combined into one group.

195 Greenleaf Ave				
Electricity	12	0.1	105	3,832
Light Fuel Oil	64	0.4	779	8,245
Subtotal 195 Greenleaf Ave	76	0.5	884	12,077
30 Spinnaker Way				
Electricity	161	1.1	1,449	52,879
Natural Gas	121	0.8	1,953	28,946
Subtotal 30 Spinnaker Way	281	1.8	3,402	81,825
680 Peverly Hill Rd.				
Electricity	109	0.7	981	37,804
Natural Gas	203	1.3	3,294	52,764
Subtotal 680 Peverly Hill Rd.	312	2.0	4,274	90,568
Andrew Jarvis Dr. (Indoor Pool)				
Electricity	141	0.9	1,274	46,491
Natural Gas	256	1.7	4,140	61,353
Subtotal Andrew Jarvis Dr. (Indoor Pool)	397	2.6	5,414	107,844

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Dondero				
Electricity	103	0.7	928	37,001
Natural Gas	706	4.6	11,435	79,677
Subtotal Dondero	809	5.3	12,364	116,678

The school department's natural gas records from the finance department do not give each school's usage individually. The per school usage data was obtained from Darlene Main. She can provide usage of natural gas by each school in therms. This data was used to figured out what percentage of the total school department's usage each school uses. To find the cost, this percentage was then multiplied by the total amount spent by the department on natural gas.

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Hanover St. Parking Garage				
Electricity	190	1.2	1,711	65,154
Natural Gas	0	0.0	4	247
Subtotal Hanover St. Parking Garage	190	1.2	1,715	65,401
High School				
Electricity	1,027	6.7	9,269	369,459
Natural Gas	1,746	11.4	28,257	196,886
Subtotal High School	2,773	18.2	37,527	566,345

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Junkins Ave				
Electricity	444	2.9	4,002	154,232

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Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Natural Gas	494	3.2	8,000	128,169
Subtotal Junkins Ave	938	6.1	12,002	282,401

This group includes all city facilities on Junkins Ave.

Ladd St.				
Electricity	1	0.0	10	339
Subtotal Ladd St.	1	0.0	10	339
Library (Islington St.)				
Electricity	121	0.8	1,094	43,877
Natural Gas	119	0.8	1,924	29,277
Subtotal Library (Islington St.)	240	1.6	3,018	73,154
Little Harbour				
Electricity	201	1.3	1,816	72,376
Natural Gas	330	2.2	5,335	37,171
Subtotal Little Harbour	531	3.5	7,151	109,547

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Marcy St.				
Electricity	0	0.0	1	30
Subtotal Marcy St.	0	0.0	1	30
Market Square				
Electricity	1	0.0	5	207
Subtotal Market Square	1	0.0	5	207

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Middle School				
Electricity	160	1.1	1,448	57,722
Natural Gas	650	4.3	10,519	73,292
Subtotal Middle School	810	5.3	11,967	131,014

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New Franklin				
Electricity	107	0.7	962	38,331
Natural Gas	235	1.5	3,798	26,460
Subtotal New Franklin	341	2.2	4,759	64,791

The school department's natural gas records from the finance department do not give each school's usage individually. The per school usage data was obtained from Darlene Main. She can provide usage of natural gas by each school in therms. This data was used to figured out what percentage of the total school department's usage each school uses. To find the cost, this percentage was then multiplied by the total amount spent by the department on natural gas.

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Parrot Ave				
Electricity	0	0.0	0	7
Subtotal Parrot Ave	0	0.0	0	7
Pease Wastewater Treatment				
Electricity	8	0.1	72	2,976
Natural Gas	3	0.0	46	3,365

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Propane	91	0.6	1,250	18,114
Subtotal Pease Wastewater Treatment	101	0.7	1,368	24,455

The buildings at the wastewater treatment plant are heated with propane. The propane billing records can be found in the city finance department in accounts payable, under "Energy USA Propane."

Pierce Island

Electricity	48	0.3	431	15,718
Subtotal Pierce Island	48	0.3	431	15,718

This is the drinking water treatment plant.

Pierce Island Wastewater Treatment

Electricity	247	1.6	2,227	92,540
Light Fuel Oil	32	0.2	382	7,180
Propane	45	0.3	621	9,031
Subtotal Pierce Island Wastewater Treatment	323	2.1	3,229	108,751

The Pierce Island waste water treatment facility has two buildings heated with fuel oil. The sewer department also uses fuel oil to operate 7 emergency generators. The fuel oil usage data for the department does not distinguish where the oil was used, so it is all lumped into this group since most of it gets used to heat the two buildings at the plant.

The rest of the buildings at the plant get heated with propane. The propane records can be found in the finance department in accounts payable under "Energy USA Propane."

Redundent Back up system

Electricity	0	0.0	3	140
Subtotal Redundent Back up system	0	0.0	3	140

Rock St.

Electricity	0	0.0	1	38
Subtotal Rock St.	0	0.0	1	38

Rockland St.

Electricity	17	0.1	153	5,601
Subtotal Rockland St.	17	0.1	153	5,601

Sherburne

Electricity	30	0.2	275	10,995
Natural Gas	305	2.0	4,936	34,392
Subtotal Sherburne	335	2.2	5,211	45,387

The school department's natural gas records from the finance department do not give each school's usage individually. The per school usage data was obtained from Darlene Main. She can provide usage of natural gas by each school in therms. This data was used to figured out what percentage of the total school department's usage each school uses. To find the cost, this percentage was then multiplied by the total amount spent

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
by the department on natural gas.				

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Spaulding Trnpke Water Treatment				
Electricity	151	1.0	1,366	54,074
Propane	68	0.4	946	14,013
Subtotal Spaulding Trnpke Water Treatment	220	1.4	2,312	68,087

The heat for this facility was converted from oil to propane, not sure of the exact date.

The Propane figure for this group includes the facility's usage along with the propane that gets distributed to back-up generators for the wells. The billing records only keep track of where the propane gets delivered, not where it actually gets used. These records can be found in the finance department. Under the "Energy USA Propane" file in accounts payable.

Station 1				
Electricity	33	0.2	301	12,389
Natural Gas	39	0.3	634	9,994
Subtotal Station 1	72	0.5	935	22,383
Station 2				
Electricity	8	0.1	72	2,974
Natural Gas	21	0.1	346	5,449
Subtotal Station 2	29	0.2	418	8,423
Station 3				
Electricity	17	0.1	155	6,372
Natural Gas	26	0.2	419	6,601
Subtotal Station 3	43	0.3	573	12,973
Wentworth				
Electricity	21	0.1	187	7,444
Natural Gas	281	1.8	4,553	31,722
Subtotal Wentworth	302	2.0	4,739	39,166

The school department's natural gas records from the finance department do not give each school's usage individually. The per school usage data was obtained from Darlene Main. She can provide usage of natural gas by each school in therms. This data was used to figured out what percentage of the total school department's usage each school uses. To find the cost, this percentage was then multiplied by the total amount spent

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)

by the department on natural gas.

Darlene Main
Accountant Assistant
Portsmouth School Dept.
50 Clough Dr.
Portsmouth, NH 03801
603-431-5080 Ext. 224
Fax 603-431-6753

Woodbury Ave				
Electricity	0	0.0	1	25
Subtotal Woodbury Ave	0	0.0	1	25
Subtotal Buildings	9,294	60.9	125,359	2,079,444
Vehicle Fleet				
Portsmouth, NH				
Fire Department				
Gasoline	38	0.2	447	6,767
Diesel (ULSD)	115	0.8	1,323	21,579
Subtotal Fire Department	153	1.0	1,770	28,346

The following notes apply to all groups within the vehicle fleet analysis:

1) Figures were available from the finance department for the annual amounts of gasoline and diesel used. The overall annual cost data was grouped into one group entitled "gasoline." This presented a problem when trying to figure out the individual cost of gasoline and diesel. The costs were found by using an annual average price for the two fuels. This wouldn't be the most accurate method due to the high fluctuation of the fuel prices, but with the data available this was the only way.

2) The distribution of the gasoline between vehicle types was found as follows:
The overall fuel consumption for each department was obtained from finance.
All of the departments get most of thier fuel from a centralized "Gasboy" system at the public works department. Tom Richter in the public works department can assist with navigating the gasboy system. There is a record within the fuel system that keeps track of "key numbers" and fuel pumped to each key. The records of what key corresponds to which vehicle are not very well kept, so as many keys as possible were identified with thier corresponding cars. The updated records from the 2007 inventory are with the rest of the files from the summer of 2007 intern. Then each vehicle was assigned a type and a percentage of each type of vehicle was found and multiplied by the overall records from finance. The resulting figures were entered into CACP.

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Housing Authority				
Gasoline	60	0.4	708	11,327
Diesel (ULSD)	51	0.3	586	9,871
Subtotal Housing Authority	111	0.7	1,294	21,198
Police				
Gasoline	414	2.7	4,856	76,418
Diesel (ULSD)	1	0.0	16	220
Subtotal Police	415	2.7	4,872	76,638
Public Works				
Gasoline	295	1.9	3,459	57,138
Diesel (ULSD)	490	3.2	5,648	98,312
Subtotal Public Works	785	5.1	9,107	155,450
School Buses				
Diesel (ULSD)	276	1.8	3,178	54,845
Subtotal School Buses	276	1.8	3,178	54,845

The school buses in Portsmouth are owned and operated by Laidlaw education services. They are very helpful with providing data. Branch Manager, Robert Lachance is a good person to talk to.

Contact:
Roger W. Lachance
Branch Manager
Laidlaw Education Services
121 Whitehouse Road
Rochester, NH 03867
Phone: 603.692.4406
Fax: 603.692.4327

School Department				
Gasoline	45	0.3	527	9,625
Subtotal School Department	45	0.3	527	9,625
Subtotal Vehicle Fleet	1,785	11.7	20,748	346,102

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Employee Commute				
Portsmouth, NH				
Full Time City Employees				
Gasoline	899	5.9	10,530	
Subtotal Full Time City Employees	899	5.9	10,530	

The employee commute data was calculated as follows.

The zip codes of all the city employees were obtained from finance. Jason Wise at the department of public works used GIS to find a straight line distance between the center of the zip code and city hall. That distance was then assigned to the employee as the commute distance. The following locations were then visited:

1. Little Harbour School
2. Portsmouth High
3. Portsmouth Middle School
4. Public Works
5. City Hall
6. Police Department
7. Fire station 1

An inventory of the types of vehicles parked in the employee parking lots of these locations was taken. A percentage of vehicle type was then found and applied to the total miles driven by the employee commuters. The total miles driven accounted for the varying vacation days of the school employees.

There are obvious inaccuracies with this method, they include,

1. This assumes everyone commutes alone and in a car.
2. Not everyone one is commuting from the center of their respective zip code to city hall.
3. Many city employees work within city limits, a commute distance of 2.7 miles was assumed for these employees.

Administering a survey was considered as an option for evaluating commuting patterns, but it seemed too time consuming.

A future survey could be beneficial in the following ways:

1. With the current growth of hybrid and fuel-efficient vehicles it would be interesting to take a survey that questions what type of vehicle individuals are considering purchasing next.
2. Rideshares could be suggested to individuals who live near one another.
3. One could gain a more accurate idea of how many people already use alternative methods of getting to work.

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Full Time School Employees				
Gasoline	501	3.3	5,862	
Subtotal Full Time School Employees	501	3.3	5,862	
Part Time City Employees				
Gasoline	186	1.2	2,183	
Subtotal Part Time City Employees	186	1.2	2,183	
Part Time School Employees				
Gasoline	263	1.7	3,084	
Subtotal Part Time School Employees	263	1.7	3,084	
Subtotal Employee Commute	1,849	12.1	21,659	
Streetlights				
Portsmouth, NH				
Entire City				
Electricity	445	2.9	4,018	260,529
Subtotal Entire City	445	2.9	4,018	260,529

The electricty records for the city are kept in the monthly energy worksheets that can be obtained from Gail Cunningham in the Finance department. This file outlines the energy usage of each streetlight location, but it was deemed to time consuming to enter every location individually.

Subtotal Streetlights	445	2.9	4,018	260,529
Water/Sewage				
Portsmouth, NH				
120 Gosling Rd.				
Electricity	15	0.1	132	5,501
Natural Gas	2	0.0	33	2,375
Subtotal 120 Gosling Rd.	17	0.1	165	7,876

The following notes apply to the entire Water/Sewage sector:

The data for the Water/Sewage sector was gathered from the finance department. The data that was supplied included monthly usage reports and annual departmental spending amounts. The monthly usage reports were broken up by location. A percentage of the total usage was calculated for each location within each department. The percentage was then multiplied by the total utility spending for that department to find the amount spent on each location.

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)

Some of the water/sewage locations had more than one account number. All of the account numbers for each location were combined into one group.

60 Freshet Rd.				
Electricity	414	2.7	3,733	147,808
Subtotal 60 Freshet Rd.	414	2.7	3,733	147,808
Bracket Rd.				
Electricity	1	0.0	10	403
Subtotal Bracket Rd.	1	0.0	10	403
Constitution Ave				
Electricity	9	0.1	83	3,455
Subtotal Constitution Ave	9	0.1	83	3,455
Constitution Ave (water)				
Electricity	2	0.0	18	698
Subtotal Constitution Ave (water)	2	0.0	18	698
Dearborn St.				
Electricity	2	0.0	14	580
Subtotal Dearborn St.	2	0.0	14	580
Deer St.				
Electricity	165	1.1	1,486	61,746
Subtotal Deer St.	165	1.1	1,486	61,746
Essex Ave				
Electricity	2	0.0	17	686
Subtotal Essex Ave	2	0.0	17	686
F W Hartford Dr.				
Electricity	16	0.1	143	5,950
Subtotal F W Hartford Dr.	16	0.1	143	5,950

There are two listings in the electricity billings record for this location. They are both included in this group
63-02-06919-0-1
63-02-06977-0-0

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Gosport Rd.				
Electricity	4	0.0	34	1,407
Propane	1	0.0	11	160
Subtotal Gosport Rd.	5	0.0	44	1,567
Grafton Dr.				
Electricity	18	0.1	164	6,486
Subtotal Grafton Dr.	18	0.1	164	6,486

There are two listings in the billings record for this location. This group includes listings with electricity account numbes:

63-04-00007-0-3
63-04-00676-0-3

Greenland Rd.				
Electricity	49	0.3	445	17,598
Subtotal Greenland Rd.	49	0.3	445	17,598
Griffin Road				
Electricity	10	0.1	87	3,629
Natural Gas	1	0.0	14	1,049
Subtotal Griffin Road	11	0.1	102	4,678

There are two listings in the billings record for this location. This group includes the listings with electricity account numbers:
63-02-09569-0-8
63-02-09570-0-5
and the natural gas account number:
837-352-002-2

Harvard St.				
Electricity	29	0.2	258	10,222
Subtotal Harvard St.	29	0.2	258	10,222
Heritage Ave				
Electricity	5	0.0	46	1,921
Subtotal Heritage Ave	5	0.0	46	1,921

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
International Dr.				
Electricity	3	0.0	24	946
Subtotal International Dr.	3	0.0	24	946
Lafayette Road				
Electricity	99	0.6	893	37,119
Natural Gas	10	0.1	165	12,013
Subtotal Lafayette Road	109	0.7	1,058	49,132

There are two listings in the billings record for this location. This group includes the listings with electricity account numbers:
63-02-08061-0-3
63-02-08447-0-8

and natural gas account numbers:
048-452-005-2
983-452-004-0

Marcy St.				
Electricity	9	0.1	78	3,237
Natural Gas	3	0.0	46	3,314
Subtotal Marcy St.	11	0.1	123	6,551
Market St.				
Electricity	22	0.1	199	8,257
Natural Gas	1	0.0	16	1,180
Subtotal Market St.	23	0.2	215	9,437
Mechanic St.				
Electricity	383	2.5	3,453	143,492
Natural Gas	12	0.1	190	13,825
Subtotal Mechanic St.	394	2.6	3,642	157,317
Mill Hill Rd.				
Electricity	9	0.1	81	3,209
Subtotal Mill Hill Rd.	9	0.1	81	3,209
Mill Pond way				
Electricity	2	0.0	16	670
Subtotal Mill Pond way	2	0.0	16	670

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Northwest St.				
Electricity	1	0.0	13	538
Subtotal Northwest St.	1	0.0	13	538
Northwood Rd.				
Electricity	3	0.0	26	1,027
Subtotal Northwood Rd.	3	0.0	26	1,027
Post Rd. (Greenland)				
Electricity	95	0.6	855	33,844
Subtotal Post Rd. (Greenland)	95	0.6	855	33,844
Preble Way				
Electricity	10	0.1	89	3,707
Subtotal Preble Way	10	0.1	89	3,707
Rye St.				
Electricity	398	2.6	3,589	149,165
Subtotal Rye St.	398	2.6	3,589	149,165
Sherburne Rd.				
Electricity	69	0.5	621	24,572
Subtotal Sherburne Rd.	69	0.5	621	24,572

There are two listings in the billings record for this location. This group includes the listings with electricity account numbers:
63-04-00050-0-9
63-04-00095-0-6

Spinney Rd.				
Electricity	15	0.1	139	5,492
Subtotal Spinney Rd.	15	0.1	139	5,492
Staysail Way				
Electricity	2	0.0	21	842
Subtotal Staysail Way	2	0.0	21	842
West Rd.				
Electricity	8	0.1	73	3,046
Subtotal West Rd.	8	0.1	73	3,046

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Subtotal Water/Sewage	1,896	12.4	17,314	721,169
Total	15,269	100.0	189,097	3,407,244

Appendix B

CACP Software Report: Detailed Community Analysis

Community Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Residential			
Portsmouth, NH			
Entire City			
Electricity	56,178	8.3	506,907
Light Fuel Oil	16,306	2.4	197,255
Natural Gas	20,034	3.0	324,269
Propane	465	0.1	6,420
Subtotal Entire City	92,983	13.7	1,034,851

Natural Gas: The natural gas data was collected directly from Northern Utilities. Northern Utilities owns the pipeline for Portsmouth. Other gas suppliers can use the pipeline, but have to pay a per volume rate to use it. Therefore, Northern Utilities has records of the gas that is sold to customers in Portsmouth. Don DiNunno was able to provide a breakdown of the customers into residential, commercial and industrial.

Contact:
Don DiNunno
Communications & Community Relations
Bay State Gas Company/Northern Utilities
(508) 580-0100 ext. 1311
Cell: (508) 864-7099
ddinunno@nisource.com

Fuel Oil: Data request letters were sent to all the local oil companies that have customers in the city. Some return letters were received very promptly, but other companies refused to provide the information. After this approach failed another alternative was chosen.

The assessor's office has data for residences that includes type of home heating, and square footage. A per square footage oil usage amount of 0.3 gal/ft^2 was then estimated from the Energy Information Agency's New Hampshire data. The total square footage for residences with oil heat was found from the assessor's data and then multiplied by 0.3 to yield an annual usage.

Propane: The propane data was found using data request letters. Due to the smaller number of providers, this method worked.

Electricity: The electricity data was gathered from Kathleen Lewis, the community relations manager at PSNH. The data that was provided by PSNH was not separated by sector. Kathleen Lewis said the information was "proprietary" and due to customer confidentiality could not be released. Due to this lack of detail the figures from the PSNH annual report for the entire state were used to calculate a percentage that was then applied to the Portsmouth total. The percentages were found to be:

Residential: 38.5%
Commercial: 41.7%
Industrial: 19.7%

Contact:

Kathleen Lewis
Public Service of New Hampshire
Community Relations Manager
1700 Lafayette Road
Portsmouth, New Hampshire 03801
603 436-7708 Ext. 5628
FAX: 603 431-8931

Community Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
lewiskx@psnh.com			
Subtotal Residential	92,983	13.7	1,034,851
Commercial			
Portsmouth, NH			
Entire City			
Electricity	60,847	9.0	549,039
Natural Gas	40,797	6.0	660,337
Propane	1,059	0.2	14,628
Subtotal Entire City	102,703	15.1	1,224,005

Natural Gas: The natural gas data was collected directly from Northern Utilities. Northern Utilities owns the pipeline for Portsmouth. Other gas suppliers can use the pipeline, but have to pay a per volume rate to use it. Therefore, Northern Utilities has records of the gas that is sold to customers in Portsmouth. Don DiNunno was able to provide a breakdown of the customers into residential, commercial and industrial.

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(508) 580-0100 ext. 1311
Cell: (508) 864-7099
ddinunno@nisource.com

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1700 Lafayette Road
Portsmouth, New Hampshire 03801
603 436-7708 Ext. 5628
FAX: 603 431-8931
lewiskx@psnh.com

Community Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)

Propane: The propane data was found using data request letters. Due to the smaller number of providers, this method worked.

Subtotal Commercial	102,703	15.1	1,224,005
Industrial			
Portsmouth, NH			
Entire City			
Electricity	28,746	4.2	259,378
Light Fuel Oil	573	0.1	6,952
Natural Gas	69,715	10.3	1,128,405
Subtotal Entire City	99,034	14.6	1,394,735

Natural Gas: The natural gas data was collected directly from Northern Utilities. Northern Utilities owns the pipeline for Portsmouth. Other gas suppliers can use the pipeline, but have to pay a per volume rate to use it. Therefore, Northern Utilities has records of the gas that is sold to customers in Portsmouth. Don DiNunno was able to provide a breakdown of the customers into residential, commercial and industrial.

Contact:
Don DiNunno
Communications & Community Relations
Bay State Gas Company/Northern Utilities
(508) 580-0100 ext. 1311
Cell: (508) 864-7099
ddinunno@nisource.com

Fuel Oil: The fuel oil data was obtained from the DES. The air permitting divison has the permit holders report fuel usage. This is most likely not a complete index of the usage.

Newton Strickland
Inventory Section Supervisor
NH Dept of Environmental Services
Air Resources Division
PO Box 95
Concord, NH 03302-0095
603/271-6283

Electricity: The electricity data was gathered from Kathleen Lewis, the community relations manager at PSNH. The data that was provided by PSNH was not separated by sector. Kathleen Lewis said the information was "proprietary" and due to customer confidentiality could not be released. Due to this lack of detail the figures from the PSNH annual report for the entire state were used to calculate a percentage that was then applied to the Portsmouth total. The percentages were found to be:

Residential: 38.5%

Community Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)

Commercial: 41.7%
Industrial: 19.7%

Contact:

Kathleen Lewis
Public Service of New Hampshire
Community Relations Manager
1700 Lafayette Road
Portsmouth, New Hampshire 03801
603 436-7708 Ext. 5628
FAX: 603 431-8931
lewiskx@psnh.com

Subtotal Industrial	99,034	14.6	1,394,735

Transportation

Portsmouth, NH

Entire city

Gasoline	318,062	46.9	3,719,017
Diesel	67,024	9.9	772,210
Subtotal Entire city	385,086	56.7	4,491,226

The transportation data was estimated as follows:

1) AADT data was obtained from the DOT website. The data provides AADT figures for different points throughout the city. The data points vary from year to year, probably due to construction and development interests. Each road on which the data points were taken belong to a "functional class." The functional classes are as follows:

11 - Principal Arterial (interstate)
12 - Principal Arterial (other freeways and expressways)
14 - Other principal arterials
16 - Minor arterials
17 - Collector
19 - Urban
Further explanation of functional classes can be found at http://www.dot.state.oh.us/planning/Functional%20Class/BackgroundInfo.htm

Average AADT were calculated for each functional class. A GIS layer showing the streets in Portsmouth according to functional class was found by Peter Britz in the Planning Department. He was able to find the length of road in each functional class within the city. The functional classes were then paired in descending order of size and the AADT and street lengths were entered into the transport assistant.

The Rochester Planning committee was also investigated as a possible data source. They have a traffic model that could be used. The DOT though that most traffic estimations were done the way that I was approaching it. They said it would be very difficult to get a more accurate estimation.

Community Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)

Contacts:

NH DOT:Traffic Department- William Lambert (603) 271-2291
Rochester Planning Committee: Tom Faulk tfalk@rpc-nh.org

Subtotal Transportation	385,086	56.7	4,491,226

Waste

Portsmouth, NH

Aggregate Recycling Corp — *Disposal Method - Controlled Incineration*

Wood/Textiles	64	0.0
Subtotal Aggregate Recycling Corp	64	0.0

Portsmouth's wood waste is sent to Aggregate Recycling Co. in Elliot ME where the pressure treated wood is separated, it is chipped and used for power generation in Livermoore Falls ME.

Contacts:
Silke Psula: Portsmouth's Solid waste coordinator, xt. 1454

Earth Tenders — *Disposal Method - Compost*

Plant Debris	483	0.1
Subtotal Earth Tenders	483	0.1

Portsmouth's Yard waste is shipped to a composting facility called Earth Tenders in Farmington NH.

Contacts:
Silke Psula: Portsmouth's Solid waste coordinator, xt. 1454

Turnkey Landfill — *Disposal Method - Managed Landfill*

Paper Products	-568	-0.1
Food Waste	55	0.0
Subtotal Turnkey Landfill	-513	-0.1

Turnkey Landfill is located in Rochester NH. Turnkey recovers most of its landfill gas. Eventually the gas is going to be purified and sent to the UNH cogen facility for power generation. The composition of the waste deposited at the landfill had to be estimated.
The composition was estimated as follows,
1) If the waste composition is unknown, the CACP software recommends the following composition,
Paper: 38%
Food Waste: 13%
Plant Debris: 10%
Wood and Textiles: 4%
Other: 35% (other is basically non-biodegradable material)

Community Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)

2) The waste that is sent to Turnkey is broken down into Bulky waste and municipal solid waste, so these recommended percentages were used, but adjusted to reflect the following factors.

3) Wood waste and Yard waste do not go to Turnkey so they can be eliminated. Portsmouth has a mandatory recycling program, so paper should theoretically be zero. Instead an 80% recycling rate will be assumed for paper products. With these factors considered I adjusted the recommended percentages to better suit Portsmouth.

Contacts:

Silke Psula: City's solid waste coordinator xt. 1454 - Provided data concerning the composition and tonnage of the waste produced by the city.

Tom Willis: Rochester Public Works - Tom provided information regarding the methane recovery at the Turnkey Landfill. 332-4096

Subtotal Waste	34	0.0	
Total	679,840	100.1	8,144,817