Municipal Greenhouse Gas and Energy Use Baseline Report for Chesterfield

This report is a summary of greenhouse gas emissions and energy use for the town of Chesterfield, NH for the year 2005. The focus of this report is the municipal operations of the town, with special emphasis on town-owned buildings. It does not encompass residential, commercial, or industrial energy use. It has been prepared by the Cool Monadnock Project,[1] a collaborative project of Clean Air-Cool Planet, Antioch New England Institute, and the Southwest Regional Planning Commission. Data was gathered through the volunteer efforts of the Cool Monadnock Town Representative and analyzed by the Cool Monadnock team, using EPA Portfolio Manager software and Clean Air and Climate Protection software provided by ICLEI.[2]

Cool Monadnock Town Representative: John Kondos.
This report was prepared by Brendan Banerdt.

Municipal overview

Town population: 3,925[3].
Area of municipality: 47.6 sq. mi.
Population density: 82.5 people/sq. mi.
Cool Monadnock region total population: 102,926 (2006 estimate).
Municipal population as a percent of Cool Monadnock region population: 3.81%.
Number of municipal buildings: 14.
Total area of municipal building space: 39,955 sq. ft.
Average energy intensity of all municipal buildings: 53 kBtu/sq. ft.
Number of street lights: 114.
Number of vehicles in fleet: 20.
Total cost of municipal energy use in 2005: $104,701.
Total municipal energy use in 2005: 5,771 MMBtu.
Total municipal CO2 emissions in 2005: 511 tons.

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[1] www.coolmonadnock.org.
[2] For more information on EPA Portfolio Manager Software, see www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager. Information on CACP software is at www.cacpsoftware.org.
[3] Population numbers are taken from the 2006 estimates from the Census Bureau at http://factfinder.census.gov/servlet/SAFFPopulation?_submenuId=population_0&_sse=on.

Municipal Sector Analysis

For each participating municipality, data was gathered on the operations of several sectors under the jurisdiction of the municipal government: the buildings, vehicle fleet, employee travel (how much municipal employees travel for municipal business), street lights, water and sewage, and waste. Different types of energy use were considered depending on the sectors, such as electricity use, heating fuel use, fuel for vehicles, and tons of waste. Where records were available, the costs of purchasing these energy sources were factored in to the analysis. The CACP software was used for the analysis of the aggregate data on all municipal sectors

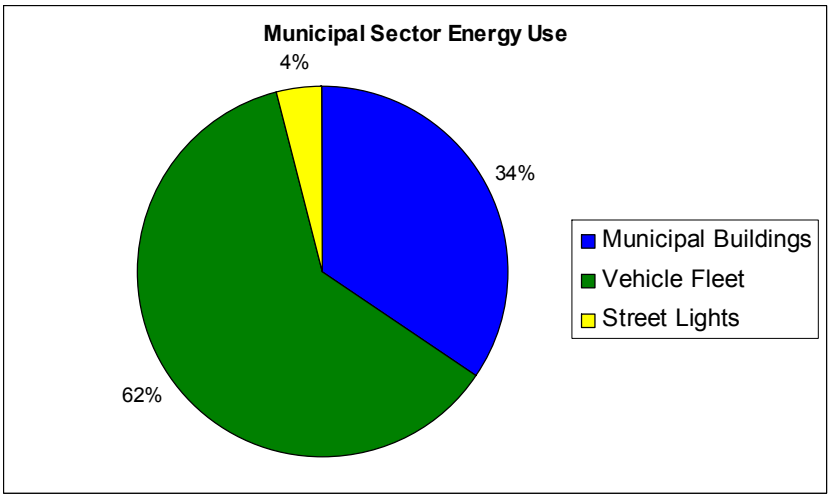
Table 1. Energy use, equivalent carbon emissions[4], and costs, by municipal sector

Municipal Sector	Energy Use (MMBtu)[5]	Energy Use (%)	Equivalent CO_2 (tons)	Equivalent CO_2 (%)	Energy Cost (US$)	Energy Cost (%)
Municipal Buildings	1981	34	178	35	39697	38
Vehicle Fleet	3568	62	308	60	51425	49
Street Lights	222	4	25	5	13619	13
Total	**5771**		**511**		**104741**	

Source: 2005 Cool Monadnock inventory (compiled 2009)
Generated by CACP Software

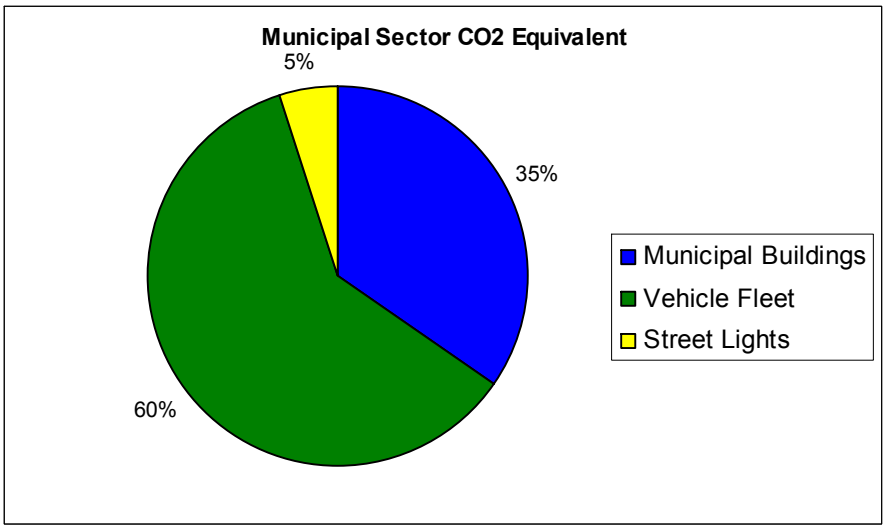
Snapshot of 2005 Municipal Energy Use, Emissions, and Costs by Sector

Graph 1a. Municipal Energy Use (MMBtu)

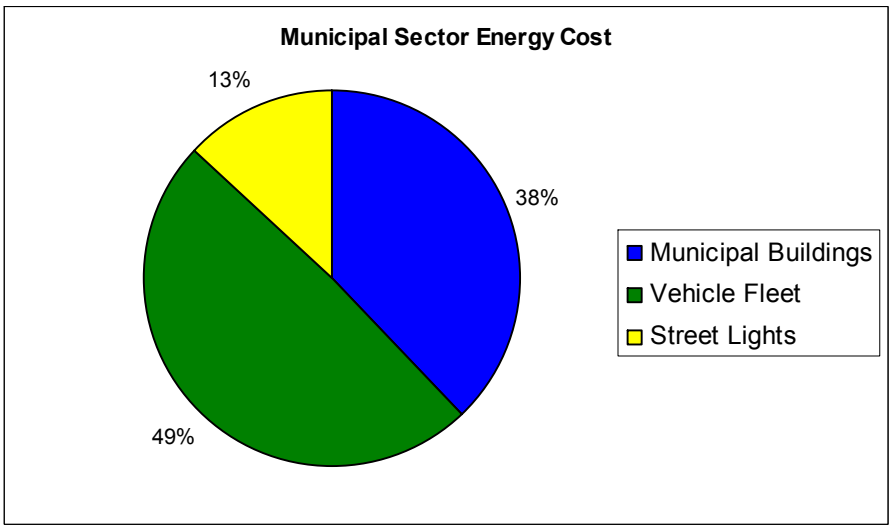


[4] According to the Clean Air and Climate Protection software, "Equivalent CO2 (eCO2) is a common unit that allows emissions of greenhouse gases of different strengths to be added together. For carbon dioxide itself, emissions in tons of CO2 and tons of eCO2 are the same thing, whereas for nitrous oxide, an example of a stronger greenhouse gas, one ton of emissions is equal to 310 tons eCO2."
[5] The Clean Air and Climate Protection software presents energy use in MMBtus, which is one million British Thermal Units, a common measure of energy consumption (see www.energyvortex.com/energydictionary/british_thermal_unit_(btu)_mbtu_mmbtu.html).

Graph 1b. Municipal Carbon Equivalent Emissions (tons)



Graph 1c. Energy Costs by Municipal Sector ($)



We examine three sectors in this report: municipal buildings, the vehicle fleet, and street lights. This includes 14 buildings, 20 vehicles, and 114 street lights. The vehicle fleet is the most significant sector in all respects, accounting for 62% of energy use, 60% of carbon emissions, and 49% of energy costs. The other major sector, municipal buildings, account for 34% of energy use, 35% of carbon emissions, and 38% of energy costs. The next section contains a more detailed analysis of the municipal building sector. Recommendations for further investigation of the vehicle fleet can be found at the end of this report.

Building Performance: Energy Use, Emissions, Costs

Data was gathered for each individual building managed by the municipality. The following table combines data from EPA Portfolio Manager software (energy intensity, CO2 emissions) and CACP software (energy use). Data on costs were entered into the Portfolio Manager software. Graphs below illustrate the relative intensity of energy use and their costs among the buildings under the municipal jurisdiction.

Table 2. Energy Use, Carbon Emissions, and Energy Cost for Municipal Buildings

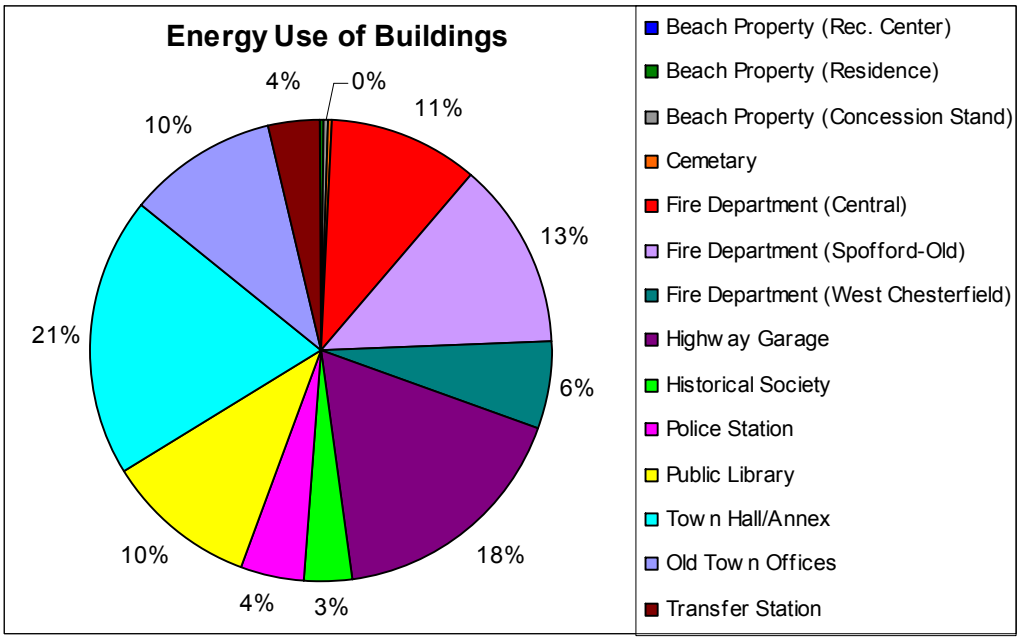
Name of Building	Energy Use (MMBtu)	Energy %	CO2 emissions (tons)[6]	CO2 %	Energy Cost (US$)	Energy Cost %
Beach Property (Rec. Center)	1	0	0	0	1361	3
Beach Property (Residence)	3	0	0	0	194	0
Beach Property (Concession Stand)	6	0	1	1	351	1
Cemetary	5	0	1	1	278	1
Fire Department (Central)	213	11	4	3	3295	8
Fire Department (Spofford-Old)	254	13	22	15	4374	11
Fire Department (West Chesterfield)	121	6	9	6	1831	5
Highway Garage	343	18	34	22	7676	20
Historical Society	69	3	5	3	1261	3
Police Station	87	4	3	2	2926	7
Public Library	207	10	19	13	4856	12
Town Hall/Annex	393	21	30	19	5409	14
Old Town Offices	207	10	15	10	3260	8
Transfer Station	72	4	8	5	2625	7
Totals	**1981**		**151**		**39697**	

Source: 2005 Cool Monadnock inventory (compiled 2009)
Carbon data generated by EPA Portfolio Manager Program; energy use generated by CACP software

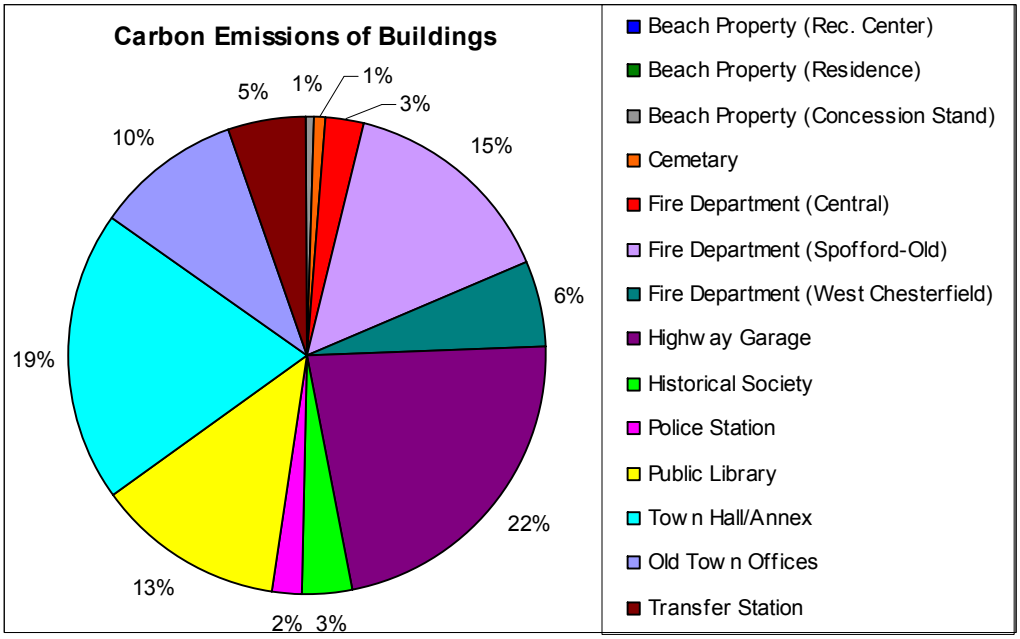
[6] Carbon emissions on the EPA Portfolio Manager software are measured as carbon dioxide emissions only and do not include equivalents for other types of greenhouse gas emissions.

Snapshot of 2005 Energy Use, Emissions, and Costs, by Building

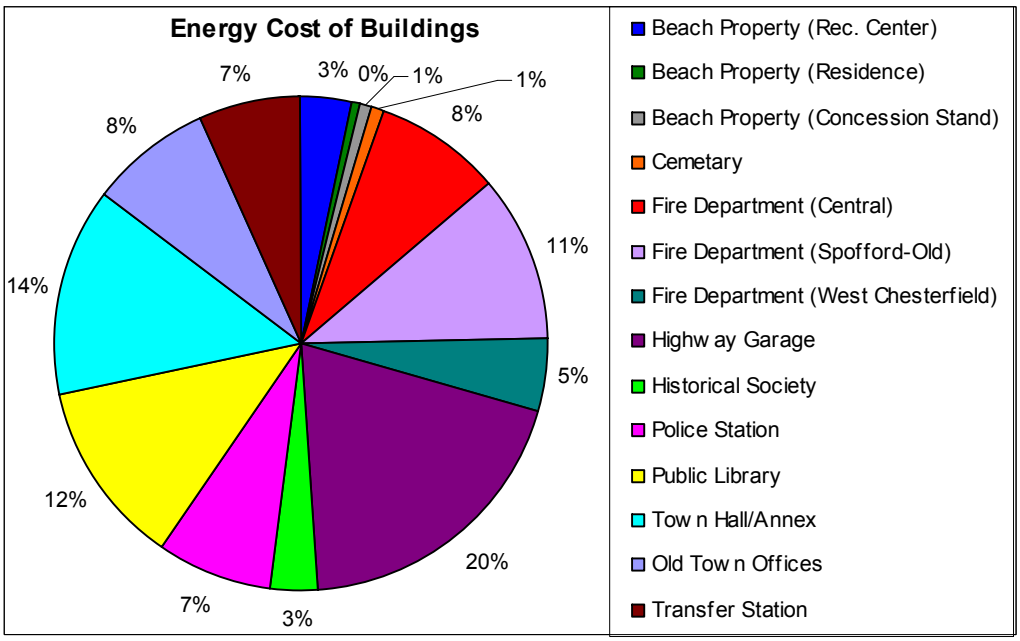
Graph 2a. Energy Use by Building (MMBtu)



Graph 2b. Carbon Dioxide Emissions by Building (tons)



Graph 2c. Energy Costs by Building ($)



The two buildings that use the most energy are the Town Hall/Annex and the Highway Garage. (Note: The Highway Garage is heated by fuel from same tank vehicles refuel from. The energy usage of the garage is based on estimated values provided by the Highway Department.)

Other buildings that use high amounts of energy include the Public Library, Old Spofford Fire Department, Central Fire Department, and the Old Town Offices. Note that the Central Fire Department has much smaller carbon emissions than the other buildings in this group, probably due to less electricity use (a trait shared by the other fire departments, compared to library and offices) combined with less fuel for heating. It may be worthwhile to study this building for ideas to reduce emissions in other buildings.

Smaller but still significant consumers of energy include the Transfer Station, Police Station, Historical Society, and the West Chesterfield Fire Department.

Schools were not assessed because they are not included in the municipal budget. Local Energy Committees may approach school boards and encourage them to engage in an assessment process for school operations. The Jordan Institute can be approached as a resource to assist in this process.

Building Performance: Energy Intensity

Table 3. Energy Intensity, by municipal building

Name of Building	Type(s) heating fuel used	Area (Sq. Ft.)	Site energy intensity (kBtu/sq ft)[7]	Average Site kBtu/sq ft for building type	Source energy intensity (kBtu/sq ft)[8]	Average source kBtu/sq. ft for building type
Beach Property (Rec. Center)		1141*	1	65	3	136
Beach Property (Residence)		1141*	2	87	8	194
Beach Property (Concession Stand)		1141*	5	104	17	213
Cemetary		1000**	5	104	16	213
Fire Department (Central)	Oil	5120	6	78	20	157
Fire Department (Spofford-Old)	Oil	3977	64	78	81	157
Fire Department (West Chesterfield)	Kerosene	1300	90	78	108	157
Highway Garage	Diesel***	7600	53	104	83	213
Historical Society	Oil	4558	15	104	19	213
Police Station	Oil	1329	62	77	186	182
Public Library	Oil	5400	38	104	67	246
Town Hall/Annex	Oil	3000	129	77	144	182
Old Town Offices	Oil	2960	70	77	103	182
Transfer Station	Propane	288	253	77	718	182

Source: 2005 Cool Monadnock inventory (compiled 2009)
Energy intensity data generated by EPA Portfolio Manager Program

* Square footage of Beach Properties estimated by dividing combined area between individual buildings.

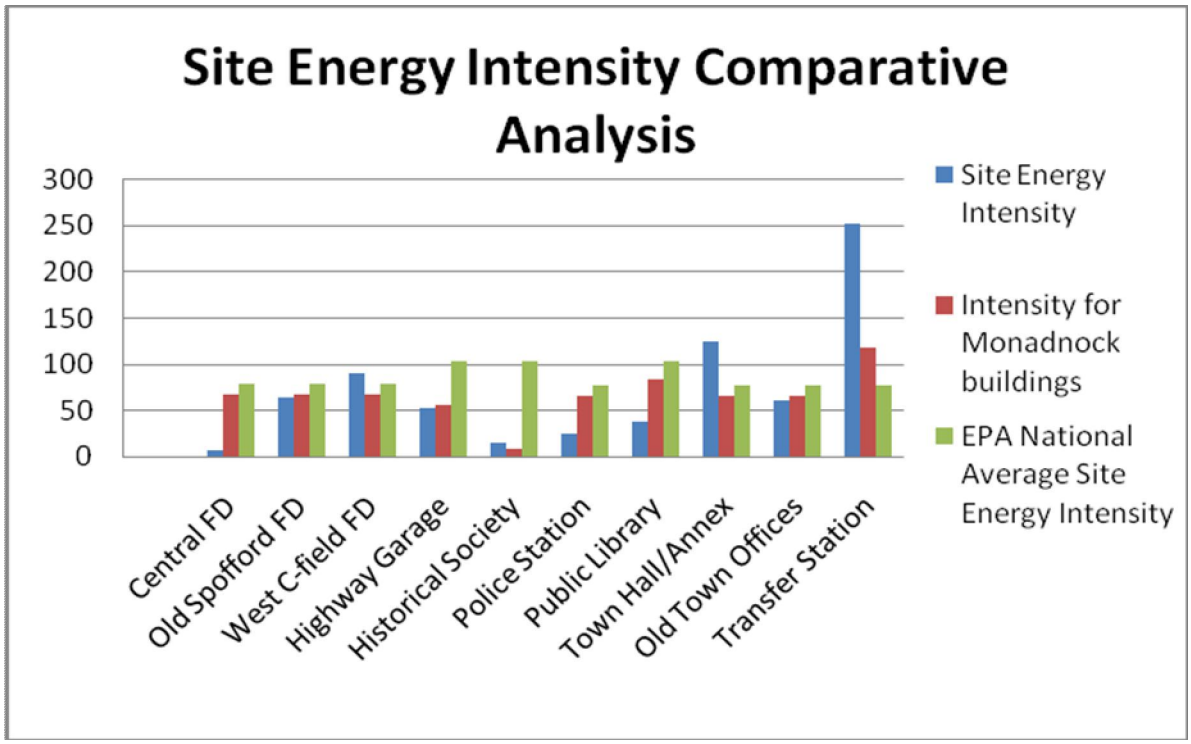
** Square footage of Cemetary building is based on rough estimate provided by Chesterfield LEC member.

*** Highway Garage heated by fuel from same tank vehicles refuel from. Energy usage based on estimated values provided by the Highway Department.

[7] Site energy intensity = amount of energy expended per square foot *on site* to heat, cool, and electrify the area. This measure relates to how much is being used on site and fluctuates directly with how much lighting is being used, how thermostats are kept, etc.
[8] Source energy intensity = amount of energy expended per square foot based on the source of energy (hydropower, nuclear, coal, fuel oil, etc) and the efficiency of that fuel type.

Snapshot of 2005 Energy Intensity by Building

Graph 3. Site Energy Intensity (kBtu/sq. ft.) of significant Chesterfield buildings relative to buildings of similar usage in the Monadnock area and across the nation.



Energy intensity is the most powerful tool that the Cool Monadnock Project has available for measuring the relative energy efficiency of particular buildings. Site energy intensity can be addressed through behavioral and energy conservation measures whereas source energy intensity would require alterations in the type of energy being used to power, heat, or cool a space. The best opportunities for saving energy on site would involve behavioral changes (such as keeping lights and computers turned off; turning down thermostats) and energy conserving technologies (such as motion sensor lighting). Measures to save source energy would include switching the type of fuel being used to heat or cool a space and asking your electricity provider to use green sources of energy. The graph presents site energy intensity data only, as this is the area that can most easily be addressed through energy reduction efforts (source data is available in Table 3).

The EPA Portfolio Manager software allows for the comparison of buildings to a hypothetical "average building" of similar usage in the same geographic region. Most buildings in Chesterfield compare favorably to the average comparison building, with the exception of the Transfer Station, Town Hall/Annex, and the West Chesterfield Fire Department. Since the Transfer Station is a special case (explained below), the Town Hall/Annex is the building with the highest energy intensity, and probably offers the most opportunities for energy savings, followed by the West Chesterfield Fire Department.

(The Transfer Station does have an extremely high energy intensity, but it creates a misleading impression in this case. Energy intensity is based on the square footage of a building, and is more appropriate for measuring the energy efficiency of a heated space than a facility that runs heavy machinery.)

The Old Spofford Fire Department and Old Town Offices (both currently closed, new uses yet to be determined), and the Highway Garage have a slightly better than average energy intensity, while the Public Library and Historical Society are much better than average. These buildings are significantly better than the Town Hall/Annex, but will likely still have some room for improvement.

Including Chesterfield, we have completed 2005 municipal energy assessments in eight Monadnock area towns. Chesterfield buildings are compared to these averages in graph 3. Our sample included 13 fire departments, three of which are located in Chesterfield. The Central Fire Department had a significantly lower energy intensity than any other fire house in the region. The old Spofford Fire Department was close to the average in the area; and the West Chesterfield Fire Department was slightly higher than average. In the same way, the Highway Garage had a very average energy intensity compared to the 9 garages in our sample. The historical society is a very light energy intensity building, and so is the one other historical society in our sample. The Police Station, Town Hall, and Town Offices were included with the 13 office-type buildings in our sample. The police station and town offices were found to have lower energy intensities than the regional average, but the Town Hall/Annex had a relatively high energy intensity. The Public Library is a less energy intensive building compared to the nine local libraries. While the Transfer Stations is a very intensive energy user relative to the average, it is operating in a much smaller space in terms of square footage, which increases its relative intensity significantly.

Analysis: General Recommendations for Municipal Energy Savings

1. Evaluate ways to reduce fuel usage with vehicle fleet. This can be done by analyzing routes, usage, and a strict anti-idling policy.
2. Review existing Master Plan, Zoning Ordinances, and other town policies for inconsistencies with the goal to reduce energy usage.
3. Implement a behavioral change program based on the CA-CP guide. The guide is in revision process and will be provided as soon as possible.
4. Implement buying strategy of Energy Star equipment and Products and environmentally sensitive office products, and implement awareness campaigns to encourage “thoughtful” consumption of equipment and products.
5. Monitor performance of the new Spofford Fire Department’s geothermal heating system for applicability elsewhere.
6. Encourage recycling and composting to the extent possible, in order to divert the amount of municipal solid waste (organic matter) going to landfill.

Recommended Priorities for Chesterfield

1. Data collection in Chesterfield was particularly challenging as bills are paid by several separate departments and files are not collected in one office. Continued monitoring of energy use and energy costs is a very important practice that will be useful for applying for funds for energy retrofits. It will be extremely useful to have copies of data (fuel bills, electricity bills, etc) stored in one office.
2. It would be very desirable to reduce the emissions from the vehicle fleet sector. The first step to saving on vehicle fleet energy use would be to set up a system to track fuel use and costs more specifically (or otherwise study how vehicles are used in the town). The fuel currently goes to a common tank used to refuel vehicles and heat the Highway Garage. It would also be worthwhile to check in to options for buying lower-emission fuels.
3. Tour the town hall/annex, highway garage and fire houses and identify easy energy-saving opportunities such as changing lamps to CFLs, using task lighting where appropriate, changing temperature control regimes, turning off office machines when not in use, and implementing simple weatherizing and insulation measures.
4. The town hall/annex is the most significant energy user of town buildings, and has a higher than average energy intensity. This building, as it is an older facility, may also benefit from an insulation project. It is recommended that a building audit be done to determine specific areas of focus.
5. Complete collection of full year of data for new buildings. Continue to collect data for all buildings and compare changes in energy use caused by the replacement of certain buildings, as well as changes within buildings. A comparative energy assessment report can be prepared by Cool Monadnock as soon as new buildings have been in operation for a full year (preferably a January-December cycle to match the 2005 assessment).

Next Steps

As members of the Southwest Regional Planning Commission and the Cool Monadnock project, your municipality has access to support and guidance as you plan for the most effective and targeted energy saving measures. It is recommended that each town have a Local Energy Committee that will meet with the Cool Monadnock staff to review the findings of this report. The Carbon CO2alition's New Hampshire Handbook on Energy Efficiency and Climate Change can be a resource on energy committee formation and energy efficiency options.[9] Also see the Cool Monadnock Resource Guide at www.coolmonadnock.org for a compilation of background information and resources to put your municipal report in context and learn about options for saving energy. Through collaboration and consultation between the Local Energy Committee, the Board of Selectpersons or City Council, and Cool Monadnock, the town may identify the most

[9] http://www.antiochne.edu/anei/download/238_energy_handbook_carbon_version_final_draft.pdf.

effective and feasible projects that are likely to save energy and costs in the shorter and longer terms. With further collaborative research, the committee, with the assistance of the Cool Monadnock staff, can then identify any sources of financial support that will facilitate energy saving projects.

Methods

Greenhouse gas inventory approach

Data collection for this inventory involved collaborative efforts between the Cool Monadnock staff, which organized the data collection process over all, and the local town representative volunteers. With personal connections to their home towns, volunteers were better able to ascertain where to access certain data and to spend time at local offices sorting through bills and records. To collect the data in each town, data sheets were developed based on the software/program that was used for data processing. We used 2005 as a baseline year to collect the fuel and energy consumption information. Data sheets were sent to the town representative, who then collected and/or accessed the data. Follow-ups were done on a regular basis to make sure that the inventory progressed, the data collection process was effective, and the data needed was more or less accurately collected.

Data processing and data analysis

To process the data collected, we used two types of fuel and energy assessment software. The first was the Clean Air and Climate Protection (CACP) software used to quantify and estimate the amount of energy used and the greenhouse gases (GHG) generated from the energy usage. The CACP software allowed us to make community and government analysis of the GHG inventory. The second was the EPA Portfolio Manager Benchmarking Program, used to assess the energy consumption and GHG generated in specific buildings, based on square footage.

List of Acronyms

CACP	Clean Air and Climate Protection (software)
CA-CP	Clean Air-Cool Planet
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
kBtu	Kilo British Thermal Units
MMBtu	Million British Thermal Units
SWRPC	Southwest Region Planning Commission