Town of New Boston
Master Plan Energy Chapter

New Boston, New Hampshire
Town Hall

1. Introduction

1.1. Purpose

Energy efficiency has become a key issue to communities, as energy costs continue to increase and concern grows over the environmental and health costs of major forms of energy production. The purpose of this chapter is to provide guidance and tools and to identify strategies, policies and actions, as well as a vision for achieving energy efficiency and conservation in the Town of New Boston. Promoting and incorporating energy efficient measures in town buildings, activities and ordinances has many benefits to the town, including reducing operating costs and cutting carbon emissions.

1.2. Energy Conservation Related to Sustainability

Energy conservation is the efficient use of energy or the reduction of energy use by implementing energy efficient practices, policies, technologies, construction, development or any other action aimed at reducing energy use.

The 1970 National Environmental Policy Act (NEPA) formally established as a national goal the creation and maintenance of conditions under which humans and nature "can exist in productive harmony, and fulfill the social, economic and other requirements of *present and future generations of Americans*", and this has become an accepted definition of sustainability.

Energy efficiency serves many purposes which include:

- Reducing costs
- Reducing health impacts from pollutants and negative environmental impacts
- Reducing environmental pollutants
- Reducing negative environmental impacts
- Reducing carbon emissions
- Increasing quality of life by reducing environmental, health and economic impacts of conventional means of energy production

1.3. New Boston Energy Goals

The New Boston Planning Board has developed the following goals for energy use and reduction for the town.

1. Reduce municipal energy costs by reducing energy consumption.
2. Increase community awareness, advise and educate residents on reducing energy costs and consumption.
3. Consider ways to decrease energy expenditures, fossil fuel consumption and associated pollution.

2. State Statutes/Plans Related to Energy

State Statutes outline the purpose of land use regulations which are implemented by Planning Boards. Pertinent sections which relate to environment and energy include the following sections:

RSA 672:1

III. Proper regulations enhance the public health, safety and general welfare and encourage the appropriate and wise use of land.

III-a. Proper regulations encourage energy efficient patterns of development, the use of solar energy, including adequate access to direct sunlight for solar energy uses, and the use of other renewable forms of energy and energy conservation. Therefore, zoning ordinances should not unreasonably limit installation of solar, wind, or other renewable energy systems or the building of structures that facilitate the collection of renewable energy, except necessary to protect the public health, safety, and welfare.

RSA 674:2
The master plan shall include, at a minimum, the following required sections:

(n) an energy section, which includes an analysis of energy and fuel resources, needs, scarcities, costs, and problems affecting the municipality and a statement of policy on the conservation of energy.

RSA 38 - D Ch. 275 (effective September 27, 2009)
Enables the appointment of an energy commission by either the local legislative or the local governing body of 3 - 10 members with staggered three year terms. The purpose of an energy commission is "…for the study, planning, and utilization of energy resources for municipal buildings and built resources of such city or town", to research municipal energy use, and recommend to local boards pertaining to municipal energy plans and sustainable practices, such as energy conservation, energy efficiency, energy generation, and zoning practices.

RSA 155 - A:2(VI) permits communities to adopt stricter measures than the New Hampshire State Building Code.

RSA 72:61 - 72 permits municipalities to offer a property tax exemption on solar, wind and wood heating energy systems. These systems include solar hot water, solar photovoltaic, wind turbine or central wood heating systems (not stovetop or woodstoves).

2.1. New Hampshire Climate Action Plan

The 2009 NH Climate Action Plan was developed by the state-authorized, bipartisan Climate Change Policy Task Force composed of representatives from all sectors of New Hampshire. It aims at achieving the greatest feasible reductions in greenhouse gas emissions while also providing the greatest possible long-term economic benefits to the citizens of New Hampshire.

The Task Force concluded the most significant reductions in both emissions and costs will come from substantially increasing energy efficiency in all sections of the economy; continuing to increase sources of renewable energy; and designing our communities to reduce reliance on automobiles for transportation. The Climate Action Plan recommends that New Hampshire strive to achieve long-term reductions in greenhouse gas emissions of 80 percent below 1990 levels by 2050. The Climate Change Policy Task Force also recommends 67 specific actions to achieve the following goals:

- Reduce greenhouse gas emissions from buildings, electric generation, and transportation;
- Protect natural resources to maintain the amount of carbon sequestered;
- Support regional and national initiatives to reduce greenhouse gases;
- Develop an integrated education, outreach and workforce training program; and
- Adapt to existing and potential climate change impacts.

It is envisioned that with participation from all communities, the NH Climate Action Plan will benefit the economy, increase state and regional energy security, and improve environmental quality. In order to meet the recommended goal of reductions in greenhouse gas emissions statewide, it states that NH communities must engage in local energy planning that includes strategies for decreasing their overall emissions.

3. Existing Conditions

3.1. State Energy Supply and Consumption

New Hampshire citizens, businesses, and industries spent almost $5 billion on energy in 2009[1].

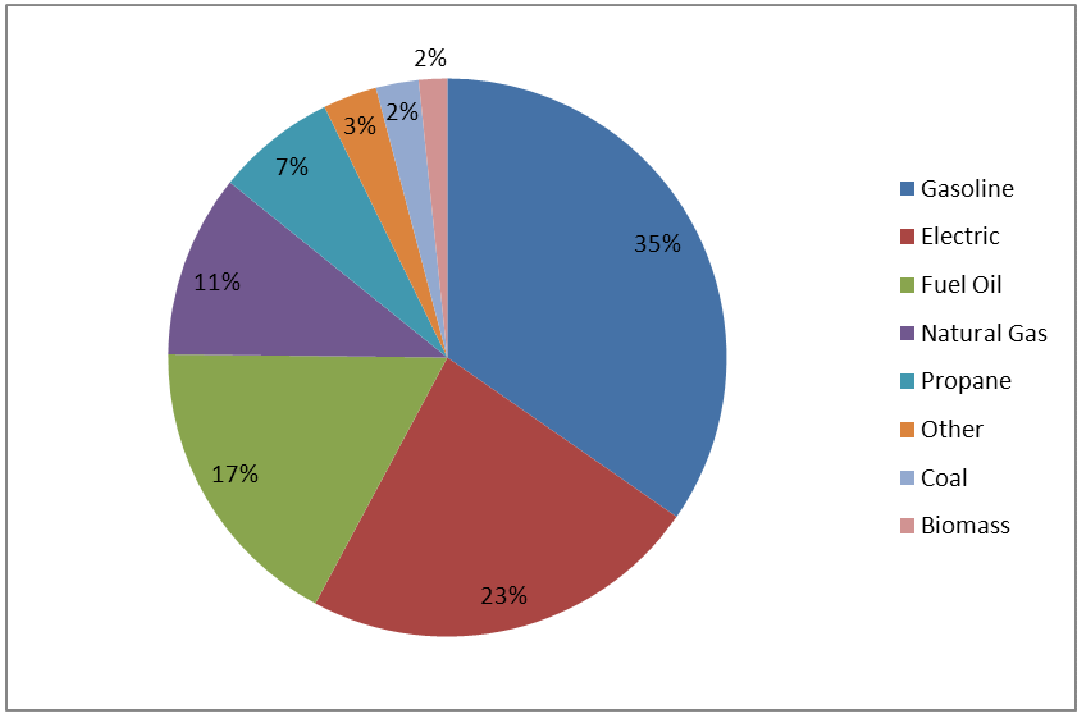
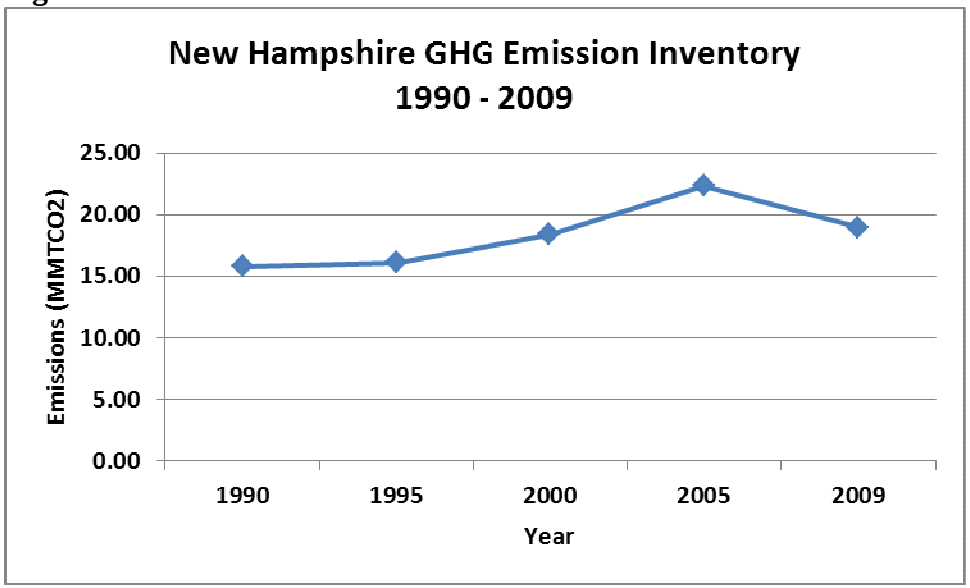


Figure 1.1

Of this money, more than 2/3 of it left the state immediately, much of it to pay for fossil fuels and nuclear fuels imported from overseas.[2] This outflow of dollars represents nearly 7% of New Hampshire's GDP and has been identified as a major drain on the economy. Investments in more efficient energy use could cost up to $2 billion. However, savings would offset the investments in less than 4 years. According to a 2009 study, if all state households achieved the highest level of energy efficiency, residents would save $309 million per year.[3] Commercial and industrial buildings would save $220 million per year.[4]

[1] Energy Information Administration, State Energy Data System 2009, "Table S1b Energy Expenditure Estimates by Source, 2009," http://www.eia.gov/emeu/states/hf.jsp?incfile=sep_sum/plain_html/sum_ex_tot.html.
[2] New Hampshire Office of Energy and Planning, "2007 New Hampshire Energy Facts," http://www.nh.gov/oep/programs/energy/nhenergyfacts/2007/introduction.htm.
[3] This represents energy savings of around 20%, as defined as cost-effective in the study *Additional Opportunities for Energy Efficiency in New Hampshire*, Final Report to the New Hampshire Public Utilities Commission, GDS Associates, Inc., 2009
[4] Independent Study of Energy Policy Issues. Vermont Energy Investment Corporation, Jeffrey Taylor and Associates, Optimal Energy Inc. June 30, 2011

Figure 1.2

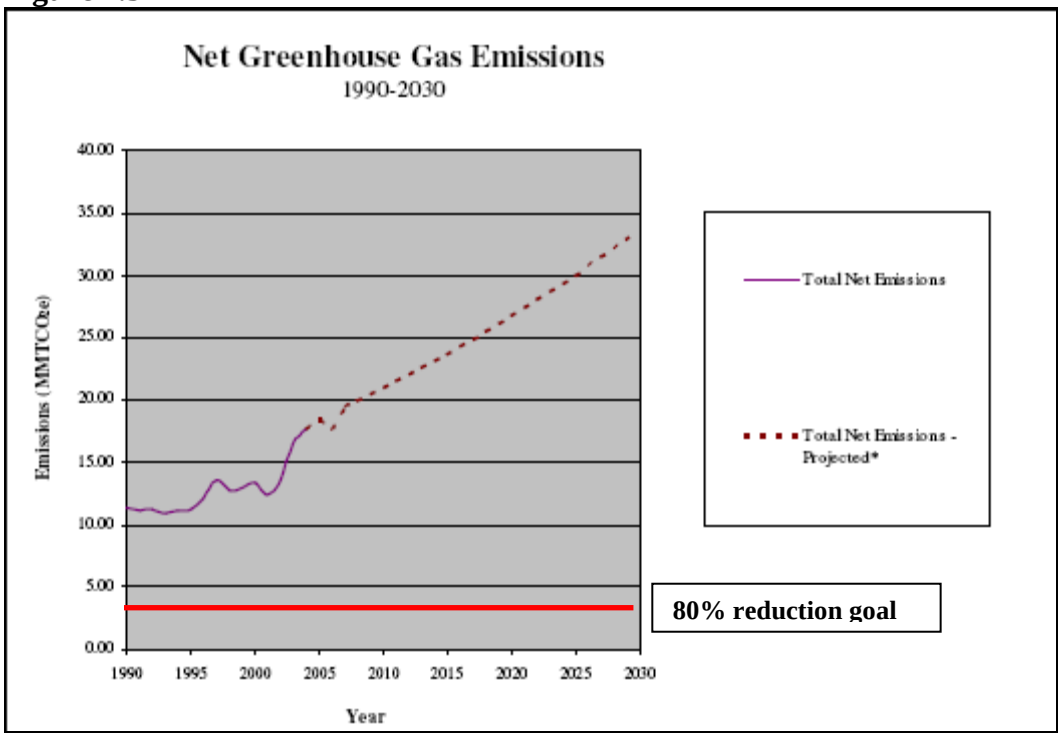


Source: NHDES, An analysis of EIA Energy Consumption Estimates By Sector for New Hampshire from 1960-2009 using EIA emission factors for all fossil fuels with NON-ENERGY emission calculations developed through the EPA's State Inventory Tool.

Figure 1.2 shows the net greenhouse gas emissions from 1990-2009 in New Hampshire. The New Hampshire Climate Action Plan recommends that New Hampshire strive to achieve long-term reductions in greenhouse gas emissions of 80 percent below 1990 levels by 2050. As the graph shows, emissions went up approximately 20% from 1990-2009. The New Hampshire Greenhouse Gas Emissions Reduction Fund (GHGERF) started in 2009. In the first year emissions were reduced by 4,600 metric tons from the projects that were implemented. Details on reductions made in the first year (July 2009 – June 2010) can be found in the Year 1 Evaluation published by Carbons Solutions New England, University of New Hampshire.[5]

[5] Carbon Solutions New England, University of New Hampshire. *The New Hampshire Greenhouse Gas Emissions Reduction Fund Year 1 (July 2009–June 2010) Evaluation*. 2011.

Figure 1.3*



Source: NHDES, EIA. *New Hampshire Greenhouse Gas Emissions Inventory and Projections*, 2008.
*Greenhouse gas emissions from 1990-2005 differ from Figure 1.2 as the uptake of CO2 by forests (carbon sequestration) was subtracted from emissions in Figure 1.3

Figure 1.3 shows net greenhouse gas emissions in New Hampshire from 1990-2004 (with carbon sequestration subtracted) and projections through 2030 for a "business as usual" scenario with no major changes from current trends. Projections are considered to be mid-range estimates and do not account for impact of economic recession, expansion of renewable or clean energy sources, potential shift to fuels with higher life-cycle emissions, loss of forests, or impacts of climate change on heating and cooling loads. Emissions for New Hampshire in 1990 were 14.7 million metric tons of carbon dioxide. To achieve the 80 percent reduction, levels will have to fall to 2.94 million metric tons by 2050. This shows how all municipalities in New Hampshire play an integral part in working towards energy conservation and reducing greenhouse gas emissions while New Hampshire works towards the goals in the New Hampshire Climate Action Plan.

3.2. New Boston Energy Inventories/Audits

New Boston participated in the Energy Technical Assistance and Planning (ETAP) Program during 2010-2011 administered by the New Hampshire Office of Energy and Planning. The town received an initial high level energy assessment of six municipal buildings as part of this program to address the town's interests and needs with respect to energy efficiency improvements and capital upgrades. Those buildings include the Town Hall, Police Station, Central Fire Station, the Wason Building, the Highway Garage and the Transfer Station. Table 1[6] shows the annual utility use and energy density of these six buildings based on data collected from 2009-2011. The highest energy use per square foot of the six municipal buildings assessed is the Wason Building, followed by the Town Hall. These two buildings have the most opportunity for energy reduction and savings in town.

Table 1 – 2009-2011 Annual Utility Use and Energy Density

Building	Square feet	Electricity (kWh)	Oil or Propane Use (gallons)	Total Annual Utility Cost	Electric kBtu/SF(1)	Oil kBtu/SF	Total kBtu/SF
Town Hall	6,720	41,052	2,878 oil	$12,892	21	60	81
Wason	2,958	4,687	2,122 oil	$4,859	5	100	105
Central Fire	5,728	18,104	2,069 oil	$4,859	11	50	61
Police Station	5,148	31,296	783 oil	$6,632	21	21	42
Highway	3,300	22,490	1,075 oil	$5,905	23	45	69
Transfer Station	2,713	31,209	129 prop.	$5,596	NA	NA	NA

[1] Thousand Btu per square foot of gross floor area, reported separately for oil, electricity, and total. ENERGYSTAR reports that total values can range from 30 kBtu/Sf to 340 kBtu/SF.

[6] Appendix B: Peregrine Energy Group. *Energy Efficiency Improvements for New Boston Town Buildings Memorandum*. August 11, 2011.

The Town Hall has a number of opportunities for energy reduction and savings outlined below in Table 2. Further details on these recommendations and the others mentioned below can be found in the attached Energy Efficiency Improvements for New Boston Buildings Technical Memorandum, dated April 29, 2011[7].

Table 2 – Summary of Energy Reduction Opportunities for the Town Hall

Town Hall

	Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance	Simple Payback Yr
					Electric kWh/yr	Oil Gallons/yr		
1	Install boiler controls	$3,840				230	$ 500	7-8
2	Insulate hot water pipes	$3,600				132	$ 300	10-14
3	IR scan walls, insulate voids	$2,600		A		121	$ 300	8-10
4	Air seal & insulate attic	$6,432		A		414	$ 900	6-8
5	Air seal basement & insulate perimeter	$3,660		A		238	$ 500	6-8
6	Update lighting to super T8	$2,400	$400	D	2,538		$ 400	4-6
	Estimated Program	***$22,532***	***$400***		***2,538***	***1,135***	***$2,900***	***7.6***

Notes

(1) Subject to Utility Incentive Policy and Screening Analysis

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$12,892*** ***/yr***

Percent Reduction: ***22 percent***

[7] Appendix A

Wason Building – Historical Society (Old Library)

The Wason Building savings opportunities include:

1. Air seal and install insulation correctly
2. Install a programmable thermostat
3. Improve duct wrap and seal ducts

New Boston Central Fire Station

The Fire Station savings opportunities include:

1. Install boiler controls
2. Insulate hot water pipes
3. Install programmable thermostats and zone the second floor
4. Improve attic insulation and air seal

Table 3 – Summary of Energy Reduction Opportunities for the Police Station[8]

Police Station

	Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance	Simple Payback Yr
					Electric kWh/yr	Oil Gallons/yr		
1	Install programmable thermostats	$1,250		A, C	179	56	$ 190	5-7
2	Replace tankless coil DHW	$1,250				38	$ 110	10-12
3	Insulate hot water pipes	$1,200		A		39	$ 110	10-12
4	Install boiler controls	$1,500		A		61	$ 170	8-10
	Estimated Program	***$5,200***	***$0***		***179***	***194***	***$580***	***9.0***

Notes

(1) Subject to Utility Incentive Policy and Screening Analysis

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$7,032*** ***/yr***

Percent Reduction: ***8 percent***

[8] Appendix B

Table 4 – Summary of Energy Reduction Opportunities for the Highway Garage[9]

Highway Garage

	Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance	Simple Payback Yr
					Electric kWh/yr	Oil Gallons/yr		
1	Insulate attic	$3,960		A		202	$ 560	6-8
2	Seal and insulate ducts	$1,500		A		73	$ 200	6-8
3	Replace overhead door gaskets	$300		A		38	$ 110	2-3
4	Install point-of-use DHW heaters	$700			1,197		$ 190	3-4
	Estimated Program	***$6,460***	***$0***		***1,197***	***313***	***$1,060***	***6.1***

Notes

(1) Subject to Utility Incentive Policy and Screening Analysis

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$6,454*** ***/yr***

Percent Reduction: ***16 percent***

Table 5 – Summary of Energy Reduction Opportunities for the Transfer Station

Transfer Station

	Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance	Simple Payback Yr
					Electric kWh/yr	Propane Gallons/yr		
1	Install point-of-use DHW heater	$700			994		$ 150	4-6
2	Install occupancy sensor for 24/7 lights	$215			710		$ 110	1-3
	Estimated Program	***$915***	***$0***		***1,704***	***-***	***$260***	***3.5***

Notes

(1) Subject to Utility Incentive Policy and Screening Analysis

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

Current Utility Budget: ***$5,596*** ***/yr***

Percent Reduction: ***5 percent***

[9] Appendix B

A number of the buildings assessed have similar recommendations for energy savings and the town might consider aggregating these projects over several buildings to get better pricing on the work. The following recommendations are similar for multiple buildings.

1. Building envelope - air seal and top off insulation.

Recommended for:

- Town Hall
- Wason Building
- New Boston Central Fire Station
- Highway Garage

2. Heating system efficiency - install boiler reset controls, programmable thermostats, insulate hot water pipes

Recommended for:

- Town Hall
- Wason Building
- New Boston Central Fire Station
- Police Station

3. Convert to more efficient domestic hot water production.

Recommended for:

- Police Station
- Highway Garage
- Transfer Station

3.3. Renewable Energy

Renewable energy flows involve natural phenomena such as sunlight, wind, tides, plant growth, and geothermal heat, as the International Energy Agency explains:[10]

"Renewable energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly from the sun, or from heat generated deep within the earth. Included in the definition are electricity and heat generated from solar, wind, ocean, hydropower, biomass, geothermal resources, biofuels and hydrogen derived from renewable resources."

Renewable energy is an important consideration in energy planning. While energy demand cannot be eliminated completely, renewable energy can be a valuable complement to energy efficiency and conservation. The New Hampshire Office of Energy and Planning estimates that, on average, at least 85 percent of our heating energy in New Hampshire comes from imported sources. One of the best opportunities to increase the use of renewable and local energy sources is through residential renewable energy projects. These renewable energy options could also be implemented for larger uses and structures over time.

State law, RSA 72: 61-72 grants municipalities the option to exempt certain renewable energy installations from property taxation. Incentives such as this encourage people to explore different options for home heating and energy, leading to an improvement in the region's economic vitality and energy sustainability. The Town of New Boston has shown its support for renewable energy through the adoption of property tax exemptions for solar and wind power energy installations in 2008.

3.4. Transportation

Transportation is an activity that consumes a great deal of fossil fuel. As communities grow and physically spread out, vehicle miles traveled per household and the associated energy demand have increased to support a more auto-dependent lifestyle. This practice is energy and resource inefficient and promotes unsustainable future transportation, land and energy use trends. Strategies for reducing vehicle miles traveled and reliance on automobiles can help to create a more sustainable, energy efficient transportation network. These strategies can also create transportation systems that better serve more people while fostering economic vitality for both businesses and communities. Strategies include providing multiple routes and multiple types of transportation, providing access to public transportation, implementing complete streets design standards and planning more mixed-use and compact development where appropriate.

[10] IEA Renewable Energy Working Party (2002). *Renewable Energy... into the mainstream*, p. 9.

Complete streets (sometimes livable streets) are roadways designed and operated to enable safe, attractive, and comfortable access and travel for all users, including pedestrians, bicyclists, motorists and public transport users of all ages and abilities.[11]

Major streets with moderate to high volumes of traffic should be transformed into "complete streets." Bike lanes, bike trails, sidewalks, streetscaping, curb extensions, mid-block crossings and other tools are applied.

The June 2011 Technical Memo, *Toward a More Walkable and Livable Manchester,* by the Walkable and Livable Communities Institute suggests:

"Traffic calming and traffic management techniques should be used. On-street parking can be striped, and curb extensions, tree wells and medians can be added. Such improvements not only bring down speeds, they improve town centers and connect streets by reducing noise and perceived danger.

Most principal streets should have lanes narrower than today, especially when combined with bike lanes. Bike lanes add a buffer to parking and sidewalks.

Sidewalk construction and maintenance should be a priority, especially within a quarter-mile or half-mile of town centers and schools.

Ramps should comply with the Americans with Disabilities Act and "universal design" standards."[12]

Complete streets options for New Boston might be most appropriate for the town center area and could include traffic calming and traffic management techniques, narrowing streets with striping techniques, crossing islands or raised intersections and making linkages and connections between walking trails and destinations in town.

3.5. Land Use

The way communities are designed, planned, and built has significant influence over the amount of energy used, how energy is distributed, and the types of energy sources that will be needed in the future. Energy efficiency can be incorporated into land use planning by adopting mixed-used zoning, which would allow greater accessibility to desired services without requiring greater mobility. This can be achieved by promoting Traditional Neighborhood Developments, Village Plan Alternatives (VPA) and conservation subdivisions that promote a mix of uses in larger new

[11] Ritter, John (2007-07-29). *Complete streets' program gives more room for pedestrians, cyclists*. *USA Today*. http://www.usatoday.com/news/nation/2007-07-29-complete-streets_N.htm. Retrieved 2011-09-07.
[12] Walkable and Livable Communities Institute. "Toward a More Walkable and Livable Manchester Technical Memorandum." June 2011.

developments. Other ways to promote energy efficiency and conservation in land use planning include:

- Initiating impact fees that require developers to pay for the increased demands on infrastructure they generate.
- Encouraging alternative forms of transportation in the planning and design of the community.
- Encouraging energy efficient development through subdivision and site plan review regulations, zoning ordinance and building codes. Site design techniques that take advantage of sun exposure, differences in microclimate, and landscaping reduce a development's demand for fossil fuel derived energy sources and reduce overall energy consumption.[13]

3.6. Building Codes

Building codes can be used to promote sustainable, energy-efficient construction in the built environment. Programs like the U.S. Department of Energy's Building Energy Codes Program (BECP) and certifications such as Leadership in Energy & Environmental Design (LEED) offer guidelines and metrics that can be used to increase a building's energy performance and result in greater energy efficiency and ultimately cost savings.

Current building codes represent the minimum legal energy efficiency for structures. These standards focus on the building envelope and mechanical systems and disregard natural and renewable means of reducing a building's environmental impacts. By applying passive solar design in conjunction with building codes, energy utility bills can be decreased by 30 percent. Add to that "well insulated and tightly constructed building shells" and the savings can reach 75 percent.[14]

RSA 155-A: 2 VI allows municipalities to adopt more stringent building codes than the state codes. For examples of more stringent standards that a community may adopt to achieve desired energy savings please see the Innovative Land Use Planning Techniques Handbook.[15]

4. Planning Roles

More often than not, energy initiatives cut across jurisdictional and political boundaries, requiring the cooperation and coordination of many different actors. Thus, for towns such as New Boston, it is essential to understand the various interests involved, as well as the many opportunities available, at the both the state and local levels.

[13] Model ordinance language can be found in *Innovative Land Use Planning Techniques*. October 2008.
[14] Urban Land Institute, 2000
[15] NHDES. *Innovative Land Use Planning Techniques, A Handbook for Sustainable Development*. October 2008.

4.1. State-Level Energy Agencies

- **NH Office of Energy and Planning:** NHOEP is a cabinet-level division of the New Hampshire Executive Branch and reports directly to the Governor. It is charged with overseeing and carrying out a wide array of energy-related activities, including but not limited to the following:
    - Coordination of programs funded by the 2009 American Recovery and Reinvestment Act (ARRA), popularly known as the "Stimulus"
    - Statewide administration of the Fuel Assistance Program (see below)
    - Management of the State's "25 by '25 Program," which seeks to ensure that at least 25 percent of NH energy comes from renewable sources by 2025
    - Administration of the State's Weatherization Program (see below)

- **NH Public Utilities Commission (PUC):** A watchdog agency also affiliated with the Executive Branch, whose job is to make sure that customers of regulated utilities receive safe, adequate and reliable service at just and reasonable rates. Some of the responsibilities of the PUC include:
    - Monitoring and inspecting gas utilities for safety and proper construction
    - Acting as a mediator in disputes between customers and regulated utility companies
    - Initiating public hearings, audits of public utilities, and other forms of inquiry and investigation

- **Office of Consumer Advocate (OCA):** An independent state agency administratively attached to the PUC. However, while the PUC is charged with balancing the interests of ratepayers and utility shareholders, the role of OCA is to advocate exclusively for residential ratepayers

- **Energy Efficiency and Sustainable Energy Board (EESE):** The EESE is a relatively new agency, created in 2008 to help promote and coordinate programs relating to energy efficiency, demand response, and sustainable energy in NH
    - Investigates potential sources of funding for energy efficiency and sustainable energy development
    - Works with local communities, non-profits, and civic engagement groups to increase statewide knowledge about energy efficiency
    - Provides recommendations to the PUC about how to spend energy efficiency and renewable energy funds

4.2. State-Administered Energy Programs and Funding Mechanisms:

- **ARRA (Stimulus) Grants:** Between 2009 and 2012, stimulus grants provided $72 million towards NH energy efficiency projects.

- **State Energy Efficient Appliance Rebate Program (SEEARP):** Offers residential consumers rebates for the replacement of existing hot water heaters, boilers and furnaces to more energy efficient models
- **Enterprise Energy Fund (EEF):** A low-interest loan and grant program to help finance energy improvements in buildings owned or leased by businesses and nonprofits of all sizes
- **State Weatherization Program:** Provides insulation and heating efficiency improvements, carried out by public utility companies and NHOEP
- **RGGI:** The Regional Greenhouse Gas Initiative is a cap and trade program aimed at reducing carbon dioxide emissions across ten participating states in the northeast. It uses sales of emissions permits to fund a wide variety of state-wide energy programs.
- **Low Income Home Energy Assistance Program (LIHEAP):** Offers home-heating assistance to qualifying low-income NH residents
- **Pay For Performance Program:** Helps business owners improve energy efficiency in large commercial and industrial buildings
- **Retail Merchant's Association of NH (RMANH) Energy Program:** Offers detailed energy efficiency audits along with free energy-awareness seminars and printed materials to RMANH members
- **NH Community Loan Fund:** Has provided deep energy efficiency retrofits in approximately 425 manufactured homes located in a score of resident-owned communities throughout the state
- **New England Carbon Challenge:** A joint initiative of the University of New Hampshire and Clean Air - Cool Planet which works to educate, inspire and support sustained reductions in residential energy consumption.
- **Systems Benefits Charge (SBC):** The SBC is a tax on all public utilities, a portion of which is used to fund energy efficiency projects.
- **CORE Energy Star Program:** Helps homes and businesses reach the Energy Star standards adopted by the federal government. So far, approximately 4 percent of NH households have participated in this program with the help of their public utilities provider
- **Electric Assistance Program (EAP):** Provides low-income residents with assistance on their electric bill
- **Property Assessed Clean Energy (PACE)**: On May 12, 2010 the NH Senate passed HB 1554, AKA the "PACE Bill." PACE is an acronym for Property Assessed Clean Energy—its final passage will enable municipalities to establish revolving loan funds to finance energy efficiency and renewable energy projects for both residential and commercial properties. HB 1554 will provide an important tool for financing energy efficiency improvements in existing homes and businesses in a manner that is consistent with the local control ethic of New Hampshire government. It will enable the State's municipalities to provide access to bond-based or other capital for the residents' and businesses' clean energy projects. Eligible projects include weatherization and a variety of innovative renewable energy projects. Financing for these improvements will be achieved through mechanisms that provide for a positive cash flow for the property owner,

based on demonstrable energy efficiency savings. (The arrangement authorized by the bill is similar to special assessment or betterment district mechanisms used to finance street upgrades, utility line burial or other improvements benefitting certain properties, except that participation by property owners in energy efficiency and clean energy districts would be purely voluntary)

4.3. Energy and Sustainability agencies in New Boston

- **Town Board of Selectmen:** The Executive body of New Boston charged with carrying out town policies.
- **Town Planning Board:** Develops and helps to implement the Town's Master Plan, including its Energy Chapter, which reflects the vision of New Boston residents for growth, development and planning.
- **New Boston Energy Commission:** A non-partisan, inclusive, voluntary citizen's commission seeking solutions to reduce carbon emissions and reduce energy costs in New Boston.
- **New Boston Conservation Commission:** A voluntary citizen's commission who works to preserve, protect, and enhance the Town's scenic, recreational, open space and natural resources, as well as its environmentally sensitive areas, and where appropriate, to encourage the enjoyment thereof.
- **New Boston Forestry Committee:** A group of volunteers from the town appointed by the Selectmen, which manages the town forests.
- **New Boston Open Space Committee:** A voluntary citizen's committee working to preserve New Boston's natural resources and rural character

4.4. Current New Boston Initiatives

- **New Boston Energy Commission**

The New Boston Energy Commission (NBEC) started as a committee in 2007 after the citizens of New Boston supported a warrant article for the creation of an energy committee. The committee became a commission in 2010. The mission and goals of the NBEC are as follows:

- To promote energy conservation, efficiency and renewables to reduce energy consumption, save money, strengthen the local economy and improve the environment.
- To study, advise and educate the citizens and town officials on policy and actions to reduce carbon emission.
- To support, encourage and celebrate actions that will lead to carbon emission reductions, while protecting the economy and natural resources.

Goals

- To align with the State renewable energy initiative of 25 X 25 (25 percent renewable energy by 2025)
- To advise and implement actions in accordance with the mission
- To increase community awareness and participation in energy and environmental issues
- To increase renewables
- To decrease energy expenditures, fossil fuel consumption and associated pollution
- To have New Boston move forward looking through the lens of sustainable practices

- **Tax incentives for solar and wind power**
  - In 2008 the citizens of New Boston adopted property tax exemptions for solar and wind power energy installations per RSA 72:61 and RSA 72:65

- **Recycling**
  - In 1993 the Town of New Boston became a 100 percent recycling town
  - The New Boston school recycling program has gained state recognition

- **Community events and outreach**
  - The NBEC periodically coordinates energy savings workshops and events, movie viewings and community discussion
  - The NBEC periodically publishes articles in the paper about what citizens can do for energy efficiency and savings
  - The NBEC helped establish the New Boston Central School recycling program in 2009

- **Energy Technical Assistance and Planning for New Hampshire Communities (ETAP)** is a two year program providing energy efficiency technical assistance at no charge to municipalities and counties in NH. ETAP's goal is to advance energy efficiency in all New Hampshire municipalities and provide the tools communities need to monitor energy performance. ETAP is funded by the American Recovery and Reinvestment Act (ARRA) of 2009 and administered through New Hampshire's Office of Energy and Planning. The program is open to all NH towns, cities, and counties. ETAP aims to achieve the following objectives:

  - Assist participating NH communities to track and understand energy consumption in municipal and county buildings and other major energy uses
  - Provide a web-based tool to communities to benchmark energy performance
  - Work with communities to identify and prioritize energy cost reduction opportunities

- Help develop strategies for energy cost reduction and secure technical and financial resources needed to realize energy savings

5. Issues and Concerns

Over the past several years, the Town of New Boston has made important progress in the areas of energy efficiency and sustainability. However, as the town enters the second decade of the 21st Century, there are still many challenges to overcome.

5.1. Extant Challenges

Many of the problems faced by New Boston are **extant challenges**: challenges which arise from conditions in the outside world. Whether related to climate change, energy consumption, or population growth, extant challenges are tangible and can generally be expressed in quantitative terms. Some examples of extant challenges in New Hampshire and the Town of New Boston include:

1.) **Volatile Fuel Prices:** The price of oil has increased by more than 400 percent since 1998, and in New Hampshire, the cost of home heating oil rose 30 percent between 2010 and 2011[16]
2.) **Commuter-driven Patterns of Development:** In recent decades, development in the United States has been characterized by sprawl: the tendency of communities to fracture into residential and commercial zones, accessible to each other only by automobile
3.) **Lack of adequate Public Transit:** Like many other rural towns, New Boston lacks access to major public transit lines such as rail or bus
4.) **Lack of funding for Energy Efficiency programs:** Between 2009 and 2012, much of NH's energy and sustainability funding came from the ARRA. With stimulus funding scheduled to end by 2012, NH communities will be forced to deal with deep spending cuts in a tough economic climate

5.2. Systemic Challenges

Unlike extant challenges, **systemic challenges** arise from problems within the planning process itself, and thus are not as easy to quantify. Systemic challenges require, not just policy fixes, but also changes in mindset and the way that energy planning is carried out.

1.) **Transactional complexity:** Many energy efficiency and sustainability programs in New Hampshire are complex and difficult for the general public to understand. For instance, one recent survey showed that more than 40 percent of NH residents

[16] New Hampshire Heating Oil Dealers and Price Guide. < http://www.heatingoilnh.com/lowest-prices.htm > Retrieved 2011-10-06

had little to no idea about where to go for sustainable energy loans, rebates, or grants[17]

2.) **Lack of Start-up Capital:** Although cost-effective in the long run, many energy efficiency projects require significant up-front costs that businesses and individuals cannot afford
3.) **Split incentives:** In the case of rented buildings, owners pay the costs of initiating energy efficiency programs, but tenants receive the savings from implementing them (or the costs from not implementing them)
4.) **Lack of residential interest and education:** Depending on the project, energy efficiency projects can seem daunting and complex. Lack of residential interest and education can present a challenge when trying to make positive changes in a community towards energy efficiency and sustainability.

6. New Opportunities for Energy Efficiency

It is widely acknowledged that current patterns of growth, development, and consumption cannot be maintained indefinitely. Fortunately, as the costs of energy grow more prohibitive, many actors are turning to new, more sustainable methods of energy use. These new methods can be direct, such as implementing plans for renewable energy, or indirect, such as increasing citizen awareness about the importance of sustainability.

6.1. Opportunities in Renewable Energy

Solar
New Hampshire has an average solar energy density of 4.0-4.5 kWh/m2/day[18], enough to drive significant amounts of energy on the state's rooftops and fields, as well as through larger distributed systems. Costs have indeed been steadily declining over the past few years, with installed costs for a residential-scale PV system currently averaging below $6.50/W[19]

- **Self-Contained Solar Units** are immune to power outages and offer battery backup for cloudy days. They also are typically easier to maintain than traditionally powered units and reduce ownership costs by eliminating monthly electric bills. Self-contained solar is a good option in places where it may be difficult to run wires or that are especially remote.
- **Solar heating** harnesses the power of the sun to provide heat for hot water, space heating and swimming pools. Solar heating can be either passive, such as simply using large windows to let in more light and warmth, or active, where specially designed mechanical systems increase the heat gained from the sunlight.

[17] *Independent Study of Policy Issues*: Prepared by the Vermont Investment Corporation, June 2011. Appendix A: Page 3.
[18] *Independent Study of Policy Issues*: Prepared by the Vermont Investment Corporation, June 2011. Section 10: Page 28
[19] See above

Wind
Although only 0.3 percent of the state's power supply is currently provided by wind, a recent resource assessment by the National Renewable Energy Lab determined that wind could provide up to 60 percent of the state's current electricity needs.[20]

- Small wind energy systems are turbines which require 1 acre of open land and can lower electricity bills to homes and businesses by 50 to 90 percent[21]
- Smaller, single-unit wind turbines are also less likely than larger units to raise complaints over scenery issues

Hydro-electric
Currently, hydro-electric dams located in New Hampshire produce about six percent of the state's electricity needs. The Northern Pass transmission project, currently in the planning and permitting stages, is designed to deliver up to 1,200 additional megawatts of low-carbon, renewable energy to the state. As one of the most cost-effective and widely available forms of re-usable energy, hydro-electric power is expected to play a big part in NH's future sustainability goals.

LEDs
For most uses, Light Emitting Diodes typically last 20 years, compared to less than a year for incandescent bulbs. In addition to requiring less maintenance, LED bulbs provide up to a 90 percent reduction in power consumption and have a similarly wide-range of application, from commercial and home use, to street and traffic lighting.

Biomass
Unlike coal and oil, biomass has the ability to quickly replenish itself, and is thus considered a renewable energy source. In 2008, biomass represented over 6.5 percent of total New Hampshire electric production and just over 4 percent of residential and commercial & industrial energy consumption.[22]

- Biomass typically takes the form of unused wood chips, stumps, roots, and discarded crop matter, and thus would not negatively affect the lumber or farming industries.

[20] *Independent Study of Policy Issues*: Prepared by the Vermont Investment Corporation, June 2011. Section 10: Page 31.
[21] See above
[22] *Independent Study of Policy Issues*: Prepared by the Vermont Investment Corporation, June 2011. Section 10: Page 36.

- It is estimated that biomass will have a particularly large impact in rural communities with easy access to wood and crop materials. Already, more than 10 percent of rural NH residents use wood as their primary heating source.[23]
- In a recent study, the Northeast Biomass Thermal Energy Working Group developed a vision for heating the Northeast, which estimated that 19 million green tons of forest and crop biomass will be available by 2025 to fuel the region.[24]

6.2. Other Energy-Efficiency and Sustainability Opportunities

Direct

- New Building Codes
- More mixed-use/Village districts
- Walk-able and Bike-able Streets

Indirect

- Provision of free sustainability workshops and seminars
- Encouragement of carpooling and alternative transportation methods
- Festivals or parades with a sustainability focus
- Increased cooperation and collaboration between public and private sectors

[23] *Independent Study of Policy Issues*: Prepared by the Vermont Investment Corporation, June 2011. Section 10: Page 36.
[24] *Independent Study of Policy Issues*: Prepared by the Vermont Investment Corporation, June 2011. Section 10: Page 38

7. Recommendations

Promoting and incorporating energy efficient measures in town buildings, activities and ordinances has many benefits to the town, including reducing operating costs and cutting carbon emissions. The following actions are recommended for the Town of New Boston in order to work towards achieving its energy goals.

7.1 Reduce municipal energy costs by reducing energy consumption.

1a. Prioritize energy efficiency recommendations from the April 29, 2011, and August 11, 2011, ETAP Technical memorandums[25] developed for the building assessments done on the Town Hall, Wason Building, Central Fire Station, Police Station, Highway Garage and Transfer Station.
1b. Track energy use in municipal buildings using the inventory tool or a similar tracking tool
1c. Require quarterly reporting on energy use in municipal buildings to the BOS, Town Administrator and/or Finance Committee
1d. Appoint a responsible party for energy management in town facilities and who will be responsible for exploring and applying for grants or funding that will help the town to implement the prioritized energy efficiency projects and recommendations
1e. Consider establishing a green building ordinance for municipal buildings and vehicles which requires new construction or major renovations for town buildings to meet US Green Building Council LEED standards when possible without increasing the budget for a given project
1f. Encourage department heads to consider energy efficiency projects and possibilities for cost savings as well as coordination on projects between departments which will increase energy efficiency for town facilities
1g. Explore single energy performance contract with neighboring communities

7.2 Increase community awareness, advise and educate residents on reducing energy costs and consumption.

2a. Publicize energy savings measures the town is taking for municipal buildings and progress on reducing municipal energy and costs
2b. Create a page for the New Boston Energy Commission on the Town website and post energy efficiency tips (provided by the NBEC) on the homepage periodically
2c. Continue to publish energy efficiency tips in the local newspaper through the NBEC
2d. Continue to work with the NBEC to hold free sustainability workshops/seminars and to hold events with a sustainability focus

[25] Appendix A and B

7.3 Consider ways to decrease energy expenditures, fossil fuel consumption and associated pollution.

3a. Appoint a BOS representative to the NBEC to work with and coordinate on energy efficiency projects in the Town of New Boston

3b. Consider innovative land use planning techniques such as

i. Energy efficient development planning principles upheld and implemented in subdivision regulations and site plan review, zoning ordinances and building codes

ii. Village plan alternative

3c. Consider adopting more stringent building codes than State codes to increase energy efficiency and decrease energy costs for development in town

3d. Consider ways to encourage alternative transportation methods such as ridesharing, public transportation options and expanding trails and bicycle lanes in town

8. Action Plan

New Boston Master Plan Energy Chapter Action Plan

	Recommendation	Who (Leadership)	When (Suggested Deadline)	How (Resources)
1a	Prioritize energy efficiency recommendations from the April 29, 2011, and August 11, 2011, ETAP Technical memorandums developed for the building assessments done on the Town Hall, Wason Building, Central Fire Station, Police Station, Highway Garage and Transfer Station.	*Board of Selectmen, CIP Committee, Finance Committee*	*2012-2013*	*N/A*
1b	Track energy use in municipal buildings using the inventory tool or a similar tracking tool	*Tax Collector, Selectmen's Assistant*	*Ongoing*	*Staff*
1c	Require quarterly reporting on energy use in municipal buildings to the BOS, Town Administrator and/or Finance Committee	*Tax Collector, Energy Manager*	*Ongoing*	*Staff*
1d	Explore appointing a responsible party for energy management in town facilities and who will also be responsible for exploring and applying for grants or funding that will help the town to implement the prioritized energy efficiency projects and recommendations	*Board of Selectmen*	*April 2012*	*N/A*
1e	Consider establishing a green building ordinance for municipal buildings which requires new construction or major renovations for town buildings to meet US Green Building Council LEED standards when possible without increasing the budget for a given project	*Board of Selectmen, Department Managers*	*April 2012*	*N/A*

New Boston Master Plan Energy Chapter Action Plan

	Recommendation	Who (Leadership)	When (Suggested Deadline)	How (Resources)
1f	Encourage department heads to consider energy efficiency projects and possibilities for cost savings as well as coordination on projects between departments which will increase energy efficiency for town facilities	*Department Heads, Board of Selectmen, Local Energy Commission*	*Ongoing*	*Staff*
1g	Explore single energy performance contract with neighboring communities	*Town Administrator*	*Ongoing*	*Staff*
2a	Publicize energy savings measures the town is taking for municipal buildings and progress on reducing municipal energy and costs	*Energy Manager, Local Energy Commission*	*Ongoing*	*Staff*
2b	Create a page for the New Boston Energy Commission on the Town website and post energy efficiency tips (provided by the NBEC) on the homepage periodically	Local Energy Commission, Website Manager, Town Administrator	*December 2011*	*Staff*
2c	Continue to publish energy efficiency tips in the local newspaper through the NBEC	*Local Energy Commission*	*Ongoing*	*N/A*
2d	Continue to work with the NBEC to hold free sustainability workshops/seminars and to hold events with a sustainability focus	*Energy Manager, Local Energy Commission*	*Ongoing*	*Staff*
3a	Appoint a BOS representative to the NBEC to work with and coordinate on energy efficiency projects in the Town of New Boston	Board of Selectmen, Local Energy Commission	*May 2012*	*N/A*
3b	Consider innovative land use planning techniques such as i. Energy efficient development planning principles upheld and implemented in subdivision regulations and site plan review, zoning ordinances and building codes ii. Village plan alternative	*Planning Board*	*2012*	*N/A*

New Boston Master Plan Energy Chapter Action Plan

	Recommendation	Who (Leadership)	When (Suggested Deadline)	How (Resources)
3c	Consider adopting more stringent building codes than State codes to increase energy efficiency and decrease energy costs for development in town	*Planning Board*	*2012*	*N/A*
3d	Consider ways to encourage alternative transportation methods such as ridesharing, public transportation options and expanding trails and bicycle lanes in town	*Planning Board*	*2012*	*N/A*

Appendices

Appendix A

Definitions

Energy Conservation – the efficient use of energy or the reduction of energy use by implementing energy efficient practices, policies, technologies, construction, development or any other action aimed at reducing energy use.

Greenhouse Gas Emissions – Greenhouse gases are trace gases in the lower atmosphere that trap heat through a natural process called the "greenhouse effect." This process keeps the planet habitable. International research has linked human activities to a rapid increase in GHG concentrations in the atmosphere, contributing to major shifts in the global climate.[26]

Energy Efficiency – **Efficient energy use**, sometimes simply called energy efficiency, is the goal of efforts to reduce the amount of energy required to provide products and services. For example, insulating a home allows a building to use less heating and cooling energy to achieve and maintain a comfortable temperature. Installing fluorescent lights or natural skylights reduces the amount of energy required to attain the same level of illumination compared to using traditional incandescent light bulbs. Compact fluorescent lights use two-thirds less energy and may last 6 to 10 times longer than incandescent lights. Improvements in energy efficiency are most often achieved by adopting a more efficient technology or production process.[27]

Renewable Energy – Renewable energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly from the sun, or from heat generated deep within the earth. Included in the definition are electricity and heat generated from solar, wind, ocean, hydropower, biomass, geothermal resources, biofuels and hydrogen derived from renewable resources.[28]

Carbon sequestration - Carbon that is removed from the atmosphere and retained in a carbon sink (such as a growing tree or in soil).[29]

GDP – Gross Domestic Product.

Life-cycle emissions – The term 'lifecycle greenhouse gas emissions' means the aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes related to the full fuel lifecycle, including all stages of fuel and feedstock production and

[26] US Dept. of Energy. Federal Energy Management Program.
[27] Diesendorf, Mark (2007). Greenhouse Solutions with Sustainable Energy, UNSW Press, p. 86.
[28] International Energy Agency
[29] Energy Terms Glossary. Nebraska Energy Office. http://www.neo.ne.gov/statshtml/glossarys.htm. Retrieved 2011-11-15.

distribution, from feedstock generation or extraction through the distribution and delivery and use of the finished fuel to the ultimate consumer, where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential.[30]

Climate Change – Burning fossil fuels, increased agriculture, and deforestation all emit natural greenhouse gases and are concerning due to their contribution to increased concentrations of these greenhouse gases. Human activities also increase GHG emissions that are not naturally occurring in the atmosphere. These activities include semiconductor manufacturing, refrigerant leaks, and other industrial sources. The high level of greenhouse gases trap heat close to the surface of the earth, contributing to major shifts in the global climate.[31]

IR – Infrared

Super T8 – High-performance "Super T8" lamp and ballast systems provide energy savings and longer lamp life.

DHW – Domestic Hot Water

kWh/yr – Kilowatt hours per year

Simple payback – Payback period in capital budgeting refers to the period of time required for the return on an investment to "repay" the sum of the original investment.

Point of Use DHW heaters – Point of Use Domestic Hot Water heaters. They are typically dedicated use heaters meaning the unit serves one sink / faucet or one shower, etc.

Vehicle miles traveled – Vehicle Miles Traveled (VMT) is the total number of miles driven by all vehicles within a given time period and geographic area.

Complete Streets – Complete streets (sometimes livable streets) are roadways designed and operated to enable safe, attractive, and comfortable access and travel for all users, including pedestrians, bicyclists, motorists and public transport users of all ages and abilities.[32]

Traditional Neighborhood Developments – Traditional Neighborhood Development (TND) is a compact land development pattern that includes a variety of housing types and land uses in a defined area. Public spaces, civic buildings and commercial establishments

[30] US EPA. Clean Air Act Section 211(o)(1)
[31] US Dept. of Energy. Federal Energy Management Program
[32] Ritter, John (2007-07-29). *Complete streets' program gives more room for pedestrians, cyclists*. *USA Today*. http://www.usatoday.com/news/nation/2007-07-29-complete-streets_N.htm. Retrieved 2011-09-07.

are located within walking distance of homes. Community identity, civic spaces and walkability are emphasized.[33]

Village Plan Alternative – The Village Plan Alternative (VPA) is a planning tool that promotes compact development with a mix of land uses, including residential, small-scale commercial, recreation and conservation in close proximity to one another within a neighborhood. It is designed to implement the specific provisions of RSA 674:21.VI(a) to allow for the creation of new villages with mixed-used development that is scaled to the smaller populations and lower density of New Hampshire towns.[34]

ARRA – American Reinvestment and Recovery Act

Small wind energy systems – A wind energy conversion system consisting of a wind generator, a tower, and associated control or conversion electronics, which has a rated capacity of 100 kilowatts or less and will be used primarily for onsite consumption.

Wind turbines – A wind turbine is a device that converts kinetic energy from the wind into mechanical energy.

Light Emitting Diodes (LED) - A light-emitting diode (LED) is a semiconductor light source.[35] LEDs are used as indicator lamps in many devices and are increasingly used for other lighting. Introduced as a practical electronic component in 1962,[36] early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness.

[33]Natural Lands Trust. Conservation Tools. http://conservationtools.org/guides/show/46 Retrieved 2011-11-15
[34] NHDES. Innovative Land Use Planning Techniques Handbook. October 2008.
[35] "LED". The American heritage science dictionary. Houghton Mifflin Company. 2005. Via http://dictionary.reference.com/browse/led and http://www.thefreedictionary.com/LED, Retrieved 2011-11-15
[36] "Nick Holonyak, Jr. 2004 Lemelson-MIT Prize Winner". Lemenson-MIT Program. http://web.mit.edu/invent/a-winners/a-holonyak.html. Retrieved 2007-08-13.

Appendix B

Energy Technical Assistance & Planning
For New Hampshire Communities
Funded by the ARRA Energy Efficiency Conservation Block Grant

TO: **Burton Reynolds, New Boston, New Hampshire**

FROM: **Steven Weisman, Peregrine Energy Group, Inc., and Henry Harvey, P.E.**

DATE: **April 29, 2011**

RE: **Energy Efficiency Improvements for New Boston Town Buildings**

Peregrine Energy Group toured the New Boston municipal facilities on March 30, 2011. We met with Burton Reynolds, Town Administrator for New Boston. Also present was Jillian Harris, planner with New Hampshire's Southern Regional Planning Commission.

The purpose of the visit was to provide an initial high level energy assessment of town buildings. This work has been funded by the New Hampshire Office of Energy and Planning's Energy Technical Assistance and Planning program ("ETAP") to address the town's interests and needs with respect to energy efficiency improvement and capital upgrades. This memorandum summarizes our initial observations and recommendations.

We find that the energy consumption index of the Town's buildings in Btu per square foot of floor area is typical of other municipal facilities in the state. That being said, these buildings generally have ample opportunity to save energy cost-effectively.

In general, we suggest that energy upgrades be incorporated into master planning and major renovations of all the town facilities. The budgets for these energy improvements are often more easily secured in the context of approvals for larger expenditures, particularly when they can be bonded.

Energy Use

Electricity is supplied by the Public Service Company of New Hampshire at a recent average cost of 15¢ per kiloWatt-hour. Number 2 heating oil is delivered by local suppliers. The oil cost has been $2.29 per gallon recently. See Table 1 below.

Table 1 – 2009-2011 Annual Utility Use and Energy Density

Building	Square feet	Electricity (kWh)	Oil Use (gallons)	Total Annual Utility Cost	Electric kBtu/SF(1)	Oil kBtu/SF	Total kBtu/SF
Town Hall	6,720	41,052	2,878	$12,892	21	60	81
Wason	2,958	4,687	2,122	$4,859	5	100	105
Central Fire	5,728	no data	2,069	$4,859		50	50

[1] Thousand Btu per square foot of gross floor area. ENERGYSTAR reports that values can range from 30 kBtu/Sf to 340 kBtu/SF.

The energy use indices for the Town Hall are based on the area of the main office floor, and the second floor, which is largely unoccupied. It does not include the dirt-floored basement. The Town Hall is in the mid range for the municipal office buildings we have looked at in New Hampshire, but this still indicates a building with substantial opportunity to be more efficient. The Wason building has a remarkably high oil use, probably due to the compromised thermal envelope discussed below. The oil usage is the average of the 2008-09 and 2009-10 heating seasons. If the building was used as a library during that period, then usage may drop now that it has been converted to the historical society. The Fire Station has high but not unusual oil use.

Town Hall

The New Boston Town Hall is a former meeting house built in 1889, with a finished area of 6,720 square feet, and a gross area of about 10,000 square feet including the basement, but not the attic. The basement has a dirt floor and a low ceiling. It is a two story wood framed structure with the town offices on the first floor, a meeting space and an office on the second floor, and a basement containing the mechanical equipment. The meeting hall is only used a couple of times per month. Architect David Ely guided us on a tour of this building. He also prepared an energy efficiency report that was used as the basis of an application for an EECBG grant.

The post and beam framing provide a wall cavity of approximately six inches. The walls are at least partially insulated with blown-in cellulose, however there are also large void areas evident from the attic. The large floored attic is unused, and has 6-7 inches of cellulose insulation. There is a clock tower with associated shaft and openings for cables. The slate roof has been recently repaired. The foundation is rubble with granite blocks. There is a dirt floor in the basement, except for a small room of poured concrete for the boilers. All of the first floor and four of the second floor windows are double hung, double glazed vinyl replacement windows. The glazing has a low-emissivity coating, for a U value of .41, according to Mr. Ely's report. Due to the large size of the second floor windows, a fixed light was installed over the double hung window in

each opening. The remaining second floor windows are original single glazed wood windows with pulley weights, and exterior storm panels.

The heating plant consists of two hot water boilers fueled on oil, installed in 2005. Each boiler is rated for 208,000 Btu per hour capacity. There are two circulator pumps delivering hot water to baseboard radiation on the first and second floors. Thermostatic radiator valves control the temperature in each room. Supply and return pipes in the basement are uninsulated.

There is at present no ventilation system in the building, other than the operable windows. Old vents in the wall of the meeting room are unused. The building has efficient T8 fluorescent lights with electronic ballasts.

We recommend the following energy efficiency measures. Many of these are discussed in greater detail in the Energy Efficiency Report for the Town of New Boston prepared by Mr. Ely.

Note that for the Town Hall and other buildings, we recommend various air sealing measures. Air sealing will save energy cost effectively, and many of the buildings have large air leaks providing an excess of air movement. Nevertheless, each building should be checked for adequate ventilation before and after air sealing. If a building does not meet ASHRAE Standard 62-2010 for ventilation, it should have mechanical ventilation installed that brings it up to that standard.

Savings Opportunities

The simplest ways to save energy and increase comfort in the Town Hall are better boiler controls, insulating the heat distribution piping, and upgrading the thermal envelope.

Table 2 -- Summary of Energy Reduction Opportunities for the Town Hall

	Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance	Simple Payback Yr
					Electric kWh/yr	Oil Gallons/yr		
1	Install boiler controls	$3,840				230	$ 500	7-8
2	Insulate hot water pipes	$3,600				132	$ 300	10-14
3	IR scan walls, insulate voids	$2,600		A		121	$ 300	8-10
4	Air seal & insulate attic	$6,432		A		414	$ 900	6-8
5	Air seal basement & insulate perimeter	$3,660		A		238	$ 500	6-8
6	Update lighting to super T8	$2,400	$400	D	2,538		$ 400	4-6
	Estimated Program	***$22,532***	***$400***		***2,538***	***1,135***	***$2,900***	***7.6***

Notes ***Current Utility Budget:*** ***$12,892 /yr***

(1) Subject to Utility Incentive Policy and Screening Analysis ***Percent Reduction:*** ***22%***

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

1. Install boiler controls.

The boilers were observed delivering hot water at 210°F on a mild day. Also the thermostatic radiator valves that control temperature in the rooms have no provision for a night setback. Both issues can be addressed with a boiler controller such as Tekmar or Heat Timer. These controls can regulate hot water supply temperature on a schedule so it is near 180°F in very cold weather, and closer to 140°F on milder days, reducing the heat loss in the pipes, and enhancing control in the rooms. In addition, the controller can have programmable unoccupied periods. The boiler availability will be limited, depending on

outdoor conditions, to reduce the building temperature when it is vacant at night and on weekends, and bring it back up to 70°F for morning occupancy.

<u>Next steps</u>: Obtain quotes from mechanical and/or controls contractors to install a controller with the indicated capabilities.

2. ***Insulate hot water pipes.***

   Long runs of copper hot water pipe in the basement are uninsulated, compromising the delivery of heat to the occupied spaces. While some heating of the basement is desirable to prevent freeze-ups, this is more than necessary. This can be implemented in conjunction with measure 5 below to make sure the basement stays warm.

   <u>Next steps</u>: Hire a commercial piping insulation contractor.

3. ***Thermographic scan of walls and insulation of voids.***

   The walls have some cellulose insulation blown into the framing cavities. This is visible from the attic. Empty areas are also visible. It is impossible to know exactly how much wall area is actually insulated without thermal vision, i.e. an infrared (IR) camera. We recommend an IR scan of the walls to identify voids. The thermographic pictures should be accompanied by visual photographs which can be given to an insulation contractor, so he can fill the voids efficiently. All empty areas should be filled with dense-pack cellulose. We recommend a blower door test at the same time as the IR scan to identify and document major air leakage sites. If there are areas with fiberglass batt insulation, it will be difficult to install dense-pack cellulose over the fiberglass, and the fiberglass itself does not provide an effective air barrier. One remedy for this situation, discussed by Mr. Ely, is to remove the clapboard siding, upgrade insulation, install an air barrier, and replace the siding. This adds to the cost but provides a premium job. While that is the best practice, it is also true than many thousands of homes have been insulated with cellulose in the walls, without full-scale removal of siding, and have benefited greatly.

   <u>Next steps</u>: Have an IR scan and blower door test on the Town Hall (this contractor does not have to prepare another energy audit and report – the deliverables should be IR and visual photographs, blower door results, and a very brief written statement summarizing the major findings). Use the results to obtain insulation quotes.

4. ***Air seal and insulate attic.***

   The attic has some insulation, but the amount is suboptimal for the climate. The attic floor of an older building generally has large sites for air leakage. We recommend sealing open shafts, removing existing insulation and sealing all penetrations for piping, wiring, ducts, flues, structural framing, and at the attic hatch. This should include partition top plates, and an air seal at the eaves, continuous with the top of the walls, both for savings and ice dam mitigation. This work will require that many of the attic floor boards be removed. Leakage sites associated with the clock tower are challenging to seal but should also be addressed. After air sealing, replace the existing insulation, and top off to R50 level with cellulose. In

order to preserve a usable attic space, it may be necessary to remove the attic floor boards, deepen the joist cavity by installing a set of joists on top of and at right angles to the existing joists, and replacing the flooring. This carpentry work will add to the cost of the job.

Next steps: Finalize the plan for the attic floor joists, how to insulate around the clock tower, and other details. Some instructions for the contractors should be developed, at a minimum a description of the scope of work, if not a full specification. Obtain quotes for this work.

5. ***Air seal basement and insulate basement perimeter.***

The granite block and fieldstone foundation has almost no insulating value, and the rim joist area of the basement is a large source of air leakage. We recommend installation of two inches of high density polyurethane foam at the perimeter, including the rim joist area, and extending over and below the granite blocks. At the same time, major leakage sites between the basement and the occupied space above should also be sealed (pipe and wiring penetrations, etc.). The doors at the rear end of the basement should be upgraded and weatherstripped if necessary, and that section of basement wall should be insulated and made airtight.

Next steps: Develop a written scope of work for potential bidders, including the type, thickness, and extent of the insulation, and areas to be addressed for air sealing, weatherstripping, etc. Obtain quotes.

6. ***Upgrade lighting.***

The Town Hall has T8 fluorescent lamps with electronic ballasts, already quite efficient. However lighting technology progresses rapidly, and it is possible to change out T8 lights to "super T8" lights with more efficient ballasts and reflectors, and lower wattage lamps. In many cases over-lit areas can have the total power significantly reduced while still providing fully adequate illumination. We recommend an audit and proposal by qualified lighting contractor(s).

Next steps: Invite lighting contractors to visit the site and submit proposals.

Additional Measures for Town Hall

Replace boilers with condensing propane-fired. Condensing boilers can achieve much higher efficiency than the non-condensing models currently in place, and this should be considered for the future. However the control and envelope measures listed above will be more cost-effective, and this would require installation of propane tanks, and commitment to purchasing propane which can be more expensive on a Btu basis than oil.

Install pellet-fired boiler(s). This would permit the use of a local resource, and should provide moderate cost savings vs. oil. It would be worthwhile to get quotes for the installation of pellet boiler with storage hopper and feed system, and take note of the available bulk delivery pellet prices, to determine if this makes economic sense. Note that consumption will be appreciably

reduced if the above measures are implemented, making the case for a new boiler less compelling.

Wason Building -- Historical Society (Old Library)

The 1927 Wason building, formerly the library, now houses the historical society collections. The conditioned area -- one floor plus a partial basement -- is approximately 3,000 square feet. The building also has open and enclosed porches overlooking the adjacent river. The building size was more than doubled by a cathedral-roofed addition on the back side. The building is not usually occupied. The thermostat was set at 60°F when observed.

The walls are concrete block with a brick façade and plastered interior (no insulation). There is a pitched roof, and an attic with fiberglass insulation, but the insulation has been jumbled and misplaced over time so it is not as effective as it could be. The older section windows are standard: single glazed double hung windows with weights and chains, and storm panels. The newer construction has large areas of double pane fixed glazing, including three patio doors.

Two furnaces in the basement of the old section provide heat. Some ducts serve floor diffusers in the front room, and a large duct runs up to the attic for the rear section. In the attic the sheet metal ducts have branches of insulated flex duct to the diffusers. The ducts are insulated with fiberglass wrap and duct tape. The furnaces burn oil, and each delivers a nominal 87,000 Btu per hour. They are ducted in parallel. There is a small electric domestic hot water heater.

Lights are generally either T8 fluorescent tubes, or compact fluorescent in can fixtures.

Savings Opportunities

This building, at 100 kBtu per square foot for oil, is a very heavy user, especially considering that it is rarely occupied and the thermostat is set at 60°F most of the time, except during the Historical Society meetings.

1. ***Air seal attic and install insulation correctly.***

   The attic of this building has a number of features which make it difficult to insulate and air seal. For one thing, the large chases for ductwork to pass from the basement to the vented attic provide a channel for warm air to exit the building. As well, the concrete block and brick wall between the old and new construction has newer open wood framing providing more channels for air movement. The level changes around the cathedral ceiling section of the new building have large openings in the framing. There are many flex ducts to ceiling diffusers, and a lot of electrical wiring going down to the outlets. The brick walls at the perimeter have a gap between interior plaster and the bricks. All these locations make for a leaky building envelope, and combined with the jumbled fiberglass batts, this goes a long way toward explaining the high heating oil usage.

   We recommend that New Boston hire a competent air sealing contractor to move systematically through the attic, remove the fiberglass insulation, air seal all the above

mentioned leaks and others encountered, then replace the fiberglass in an orderly way. Although fiberglass is not the most effective insulation, it should work if pressed into position and held in place, after a thorough air sealing.

Next steps: Write a scope of work. Diagrams and specific instructions may be necessary. Obtain quotes.

2. ***Install a programmable thermostat.***

   The building was 63°F on the day observed, although unoccupied. A deeper setback may be possible, e.g. 55°F. With a scheduling thermostat, the temperature could be programmed for 70° when meetings or open houses take place, and the deeper setback maintained during unused periods.

   Next steps: Replace existing thermostat with an appropriate programmable one.

3. ***Improve duct wrap and seal ducts.***

   The insulation on the ducts, although mostly in place, has partly fallen away. The duct insulation is held in place with duct tape, which, ironically, does not work for that purpose (it dries out and falls off!). The ducts should have the insulating wrap removed and should be sealed with a mastic formulated for that purpose. The insulation should then be replaced and fastened with a proper tape or crimp stapler.

   Next steps: Hire a commercial duct insulation contractor.

Fire Station

The New Boston Fire Department's Bunting Station in the center of town has three overhead doors in front, and three on the side. It was built in 1973 and has 5,700 square feet of space, including the garages, a small first floor office, and a larger second floor meeting room and kitchen. The hose drying tower is still in use. It is lightly occupied, with generally one person manning the station about 40 hours per week.

The fire station has slab on grade construction, except for a small basement level boiler room. It has framed walls with vinyl siding and gypsum board interiors (wood paneling on the second floor). There is an attic over the large front garage that appears to be insulated with fiberglass batts, but the insulation has been disrupted by workers. The attic area is crowded with stored items, including rolls of fiberglass, and it is hard to tell if the insulation is effectively installed. The second floor ceiling has fiberglass batts laid over dropped ceiling tiles.

There are two 2005 oil-fired hot water boilers piped in parallel. The Ultimate Engineering units provide 208,000 Btu per hour hot water each to unit heaters in the garages and to perimeter baseboard on the second floor. There are two circulating pumps. Copper pipes are uninsulated; the boilers short-fire, and supply water temperature is circa 210°F. There is one thermostat in the main garage, but we were unable to locate a thermostat on for the second floor. The second floor was 76°F when we visited.

The station has T8 fluorescent lights.

Savings Opportunities

1. ***Install boiler controls.***

   The boilers were observed delivering hot water at 210°F on a mild day. This can be addressed with a boiler controller such as Tekmar or Heat Timer. These controls can regulate hot water supply temperature on a schedule so it is near 180°F in very cold weather and closer to 140°F on milder days, reducing the heat loss in the pipes and enhancing control in the rooms.

   Next steps: Obtain quotes from mechanical and/or controls contractors to install a controller with the indicated capabilities.

2. ***Insulate hot water pipes.***

   The copper and steel hot water pipes in the boiler room are uninsulated, causing that room to be overheated and diminishing the delivery of heat to the occupied spaces. The supply and return pipes should be insulated from the boiler room to the occupied spaces (pipes running to the unit heaters in the garage do not need to be included).

   Next steps: Hire a commercial piping insulation contractor.

3. ***Install programmable thermostats and zone the second floor.***

   The second floor meeting room and kitchen were 76°F on the day observed, and no thermostat could be found.

   The second floor should be a separate zone on the heating system, so the first step is to install an electric zone valve for that area, if none exists, with a thermostat. This thermostat, as well as a replacement unit for the two in the garages on the first floor, should be programmable. With programmable thermostats, it will be possible to reduce temperatures at night and bring them back up to the desired level in the morning. When the building is cooler at night, it loses less heat to the outdoors, so that less heat has to be supplied by the boiler. (The heat that it takes to warm the building up in the morning is balanced by the heat that is released when the temperature is set back in the evening, so that's a wash.) Although building staff may do some of this manually, a programmable thermostat makes it much easier and ensures day-on-day control when staff schedules or time demands vary.

   Thermostats available include: seven day programmable (different schedule for each day of the week); 5-1-1 programmable (one schedule for weekdays, one for Saturday, and one for Sunday), and 5-2 programmable (one schedule for weekdays, and one for weekends).

   Next steps: Obtain quotes to zone and install programmable thermostat for the second floor. Change out the garage thermostat and appoint someone to manage both thermostats.

4. ***Improve attic insulation and air seal.***

Major air leaks over the garage should be sealed. One major leak was noted at a shaft with electric wires near the attic door. There may be other leaks at wiring and piping penetrations and at the wall between the garage attic and the finished second floor space. The insulation in the main part of the attic over the garage should be set properly in place. It would be best to top off the fiberglass batts with cellulose to an R50 level.

At the same time, the insulation over the second floor meeting room and kitchen should be corrected. Fiberglass batts laid on ceiling tiles is an inferior construction detail. There is no good air barrier in this case, so the insulation is not effective, and moisture problems may result. We recommend installing the insulation in the roof rafters (if there is no attic), with an air and vapor barrier as needed and vented in accord with sound building practice.

<u>Next steps</u>: Determine the construction details over the second floor space. Develop an insulation detail, with a drawing and instructions. Solicit quotes from contractors.

Appendix C

Energy Technical Assistance & Planning
For New Hampshire Communities
Funded by the ARRA Energy Efficiency Conservation Block Grant

TO: Burton Reynolds, New Boston, New Hampshire

FROM: Steven Weisman, Peregrine Energy Group, Inc.; Henry Harvey, P.E.

DATE: August 11, 2011

RE: Energy Efficiency Improvements for New Boston Town Buildings

Peregrine Energy Group toured New Boston municipal facilities including the Police Station, the Highway Department, and the Transfer Station, on June 20, 2011. This report covers those three facilities, and is a follow-up to our March 30, 2011 visit when we audited the Town Hall, the Wason Building (Historical Society), and the Central Fire Station, and subsequently issued an April 29, 2011 report.

As noted previously, the purpose of the visit was to provide an initial high level energy assessment of town buildings. This work has been funded by the New Hampshire Office of Energy and Planning's Energy Technical Assistance and Planning program ("ETAP") to address the town's interests and needs with respect to energy efficiency improvement and capital upgrades. This memorandum summarizes the initial observations and recommendations.

We find that the energy consumption index of the Town's buildings in Btu per square foot of floor area is generally on the low side relative to other municipal facilities in the state. There are few dramatic opportunities for energy conservation in these buildings.

In general, we suggest that energy upgrades be incorporated into master planning and major renovations of all the town facilities. The budgets for these energy improvements are often more easily secured in the context of approvals for larger expenditures, particularly when they can be bonded.

Energy Use

Electricity is supplied by the Public Service Company of New Hampshire at a recent average cost of 15¢ per kiloWatt-hour. Number 2 heating oil is delivered by local suppliers. The oil cost has been $2.29 per gallon recently. Based on recent prices, we are assuming a cost of $2.80 per gallon going forward, for the purpose of calculating the value of energy savings. Table 1 below summarizes the energy consumption of the three facilities under consideration in this report, as well as those covered previously.

Table 1 – 2009-2011 Annual Utility Use and Energy Density

Building	Square feet	Electricity (kWh)	Oil or Propane Use (gallons)	Total Annual Utility Cost	Electric kBtu/SF(1)	Oil kBtu/SF	Total kBtu/SF
Town Hall	6,720	41,052	2,878 oil	$12,892	21	60	81
Wason Building	2,958	4,687	2,122 oil	$4,859	5	100	105
Central Fire	5,728	18,104	2,069 oil	$4,859	11	50	61
Police Station	5,148	31,296	783 oil	$6,632	21	21	42
Highway	3,300	22,490	1,075 oil	$5,905	23	45	69
Transfer Station	2,713	31,209	129 prop.	$5,596	NA	NA	NA

[1] Thousand Btu per square foot of gross floor area, reported separately for oil, electricity, and total. ENERGYSTAR reports that total values can range from 30 kBtu/Sf to 340 kBtu/SF.

The Transfer Station uses waste oil that they do not pay for to heat the recycling building. This is not shown in the table above. The electric use at the Transfer Station is partly a function of the run hours of the compactor and balers. Also the floor area of the compactor hopper house is hard to define. Hence the Btu per square foot index is not useful for this facility and not shown in the table.

The Police Station has typical electric use and very modest oil use, indicating a fairly tight, well insulated building. From the monthly electric use, it appears that only 6% or $300 of electricity is used for air conditioning.

Electric and oil consumption at the Highway Garage have some potential for improvement. Electric use at the Highway Garage is quite moderate in warm weather, but spikes during winter, presumably due to the use of engine block heaters, as well as any extra run hours for the lights. The garage can only accommodate two vehicles, so the rest are parked outside and require electric block heaters in cold weather. From the monthly bills, 57% of the electric use at the Highway Garage is for engine heaters (and any extra lighting in the winter months). This is 13,000 kWh worth about $2,000 annually.

Police Station

The Police Station is a wood framed residential style building dating from 1993. The offices are on the upper level. The lower level is a finished basement with a two door garage; it contains the boiler room, server room, and storage spaces. The gross area of

the building is about 5,000 square feet, but the occupied offices are only 2,700 square feet. We were assisted in our audit by Cathy Widener, administrative assistant.

Generally the building is occupied from 6:00 am to 11:00 pm Monday through Friday, and until 2:00 am on Friday, Saturday, and Sunday. There is no dispatcher at this station, hence no 24/7 occupancy. Generally there are two to four officers on duty, as well as the administrative assistant. They are in and out of the building through the day. Building temperature setpoints for heating and cooling remain constant.

The walls are of 2x6 framing with fiberglass insulation, vinyl siding, and interior gypsum board. The attic has fiberglass batt insulation, which was replaced in 2010 after damage from a roof leak. The aluminum double-glazed windows are of reasonably good quality.

A Smith oil-fired hot water boiler provides heat. It has a capacity of 150,000 Btu per hour, and contains a tankless coil that provides domestic hot water (DHW). The five hydronic zones are apparently the Chief's office, other upper level offices, basement rooms, garage, and sally port. Each zone has a simple thermostat. There are five window air conditioning units installed and removed seasonally.

Lighting is T8 fluorescent. The balance of energy using equipment includes computers (all flat screen), printers, radio, and battery chargers.

Savings Opportunities:

The Police Station is already fairly efficient so there are no dramatic conservation opportunities. However there are some simple and effective measures that New Boston could take.

Table 2 -- Summary of Energy Reduction Opportunities for the Police Station

	Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings Electric kWh/yr	Potential Utility Savings Oil Gallons/yr	Annual Cost Avoidance	Simple Payback Yr
1	Install programmable thermostats	$1,250		A, C	179	56	$ 190	5-7
2	Replace tankless coil DHW	$1,250				38	$ 110	10-12
3	Insulate hot water pipes	$1,200		A		39	$ 110	10-12
4	Install boiler controls	$1,500		A		61	$ 170	8-10
	Estimated Program	***$5,200***	***$0***		***179***	***194***	***$580***	***9.0***

Notes ***Current Utility Budget:*** ***$7,032 /yr***

(1) Subject to Utility Incentive Policy and Screening Analysis ***Percent Reduction:*** ***8%***

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

1. ***Install programmable thermostats.*** Programmable thermostats allow temperatures to be reduced at night and on unoccupied days, and brought back up to the desired level on the next workday morning. When the building is cooler at night, it loses less heat to the outdoors, so that less heat has to be supplied by the boiler. Although building staff may do some of this manually, a programmable thermostat makes it easier.

Thermostats available include: seven day programmable (different schedule for each day of the week); 5-1-1 programmable (one schedule for weekdays, one for Saturday, and one for Sunday), and 5-2 programmable (one schedule for weekdays, and one for weekends).

<u>Next steps</u>: Obtain quotes to install programmable thermostats for all five zones. Appoint someone to manage thermostats.

2. ***Replace tankless coil DHW***. Since the boiler has a tankless domestic hot water (DHW) heater, it has to run in the summer. The large mass of the boiler has to be heated continually, with consequent losses. A storage type oil-fired hot water heater can operate more efficiently in summer and winter. An electric tank type DHW heater is also an option, though less preferable due to the high cost of electricity. Because hot water is used in the Police Station for washing cars, taking showers, washing dishes, and in the bathrooms, a demand type water heater is not a good option.

   <u>Next steps:</u> Obtain quotes for installing a storage type oil-fired DHW heater, (including a plan for venting the new heater and for decommissioning the existing tankless water heater).

3. ***Insulate hot water pipes.*** The length of ¾" and 1" uninsulated copper hot water piping in the boiler room alone must run near 200 linear feet. In addition, the piping network through the building is presumably also uninsulated. The large amount of radiated heat from these pipes is a drag on the system. This also causes the room above the boiler room to overheat. The supply and return pipes should all be insulated between the boiler to the radiators.

<u>Next steps</u>: Hire a commercial piping insulation contractor.

4. ***Install boiler controls.*** It appears that this boiler delivers 180°F supply water at all times. Efficiency can be improved with a boiler controller such as Tekmar or Heat Timer. These controls can regulate hot water supply temperature on a schedule so it is near 180°F in very cold weather, but closer to 140°F on milder days, reducing heat loss in the pipes and improving temperature control and comfort in the rooms.

   Next steps: Obtain quotes from mechanical and/or controls contractors to install a controller with the indicated capabilities.

Highway Garage

The Highway Garage is a wood-framed rectangular building dating from 1975 and including 3,300 square feet of occupy-able space. It has two large overhead doors, garage space, an office, break room, furnace room, and storage area. The hours of use are typical: four ten-hour days per week in the summer, five eight-hour days per week the rest of the year, and as needed during snowstorms. We met with road agent Dick Perusse for this building assessment.

The walls have T-111 exterior siding, plywood and sheetrock interior finish, and are reported to be insulated. The attic has six inch fiberglass batt insulation laid in the joists of the roof trusses. There are few windows, and these are double-glazed.

A new furnace was installed in April 2011. It is an oil-fired Thermo Pride with a heating capacity of 145,000 Btu per hour, and a nominal thermal efficiency of 78% (near the low end for available models). The duct runs are not very long; however, none of the ductwork is sealed or insulated. There is a programmable thermostat kept at 60°F. Domestic hot water is provided by a 40 gallon electric tank.

There is some T8 fluorescent tube lighting for the office and other areas. The garage space is lit by three large overhead fixtures with 175 Watt metal halide lamps, as well as some fluorescent tubes. As well there is a variety of exterior lights for the garage, shed, lean-to, and gas pump, most of which appear to be incandescent.

Savings Opportunities:

Like the Police Station, the Highway Garage does not have many "low hanging fruit" energy saving measures, apart from the attic insulation.

Table 3 -- Summary of Energy Reduction Opportunities for the Highway Garage

	Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings: Electric kWh/yr	Potential Utility Savings: Oil Gallons/yr	Annual Cost Avoidance	Simple Payback Yr
1	Insulate attic	$3,960		A		202	$ 560	6-8
2	Seal and insulate ducts	$1,500		A		73	$ 200	6-8
3	Replace overhead door gaskets	$300		A		38	$ 110	2-3
4	Install point-of-use DHW heaters	$700			1,197		$ 190	3-4
	Estimated Program	***$6,460***	***$0***		***1,197***	***313***	***$1,060***	***6.1***

Notes ***Current Utility Budget:*** ***$6,454 /yr***

(1) Subject to Utility Incentive Policy and Screening Analysis ***Percent Reduction:*** ***16%***

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

1. ***Insulate the attic.*** This is a straightforward rectangular attic with very few ceiling penetrations. Blow cellulose insulation over the existing fiberglass, adding R40 cellulose to achieve R50 total. This will be the most effective conservation measure for this building.

   Next steps: Write a description of the scope of work. Obtain quotes.

2. ***Seal and insulate ducts.*** Although the length of duct runs is not extensive, the system will deliver better air flow and run more efficiently with sealed ducts. All the ducts should be sealed with mastic or tape designed for the purpose, and the ducts should be insulated in the furnace room at least.

   Next steps: Solicit quotes from commercial sheet metal or insulation contractors.

3. ***Replace overhead door gaskets.*** As noted by the road agent, existing gaskets are worn. Replacing them will reduce air leakage heat loss when the doors are closed.

   Next steps: This can be done in-house.

4. ***Install point of use DHW heaters.*** The vehicles are washed with cold water, so domestic hot water (DHW) is only for bathrooms. Standby losses from the existing 40 gallon electric tank may be greater than the actual usage.

   An alternative is to install a much smaller electric water heater at the point of use, i.e. in the bathroom. This could be a "mini-tank" model made by Ariston (as an example, there are many manufacturers), or a model with no storage at all (100% instantaneous heating) such as those made by EEMAX or Powerstream Pro. The Ariston models have an energy factor of about .94, and the EEMAX models have an energy factor of .99. Either way the stand-by and distribution losses will be reduced and there will be energy and cost savings.

   Next step: Solicit quotes for the installation of point of use DHW heaters in the bathroom and removal of the existing electric tank heater.

Additional Measures for Consideration:

Replace incandescent lights with compact fluorescent. Install exterior duty compact fluorescent lights with sufficient lumens to replace flood lights.

Replace metal halide with fluorescent lights. T8 or T5 overhead fluorescent lights would not have the delayed strike time of the metal halide. They could provide light more quickly when personnel enter the garage at night, and they could be turned on and off more easily during the day, to generate energy savings.

Improve efficiency of engine block heaters. The high electric use in winter shows that the block heaters are drawing significant power. It could be worthwhile to check the thermostatic elements on the heaters, and shop for more efficient models.

Transfer Station

This facility consists of a small stand-alone office with an attached shed (about 120 ft2), a metal recycling building (2,532 ft2), and a compactor (this has a small office and a roof over the compactor so the building square footage is hard to define). It is open to the public three days per week, and the staff are present four days per week. We spoke with manager Gerry Cornett.

The small office has a propane heater which uses about $400 of propane per year. The recycling building is metal framed, sided, and roofed, with vinyl-faced fiberglass insulation. It is heated by a waste oil furnace, with an electric heater for the bathroom. The bathroom has a 40 gallon electric domestic hot water tank. The office in the compactor building is also heated by an electric heater.

Lighting is mostly T8 fluorescent. The major equipment on site includes the compactor itself, three balers, and forklifts.

The manager of the transfer station has implemented a number of energy conservation measures at this facilty already.

- The recycling building was difficult to heat, so the staff did some air sealing. They foamed the leaks at beam penetrations, panel joints, and where the shed meets the main building. In addition, they insulate and seal the roof vent manually each winter.
- They put freezer vinyl strips on the recycling windows to reduce air flow when they are open in winter. They also ordered insulated panel doors that slide up and down for the recycling windows -- like miniature overhead garage doors.
- The trash compactor has a 3 phase 30 hp motor, but the building only has single phase power. It had a "phase inducer" that ran constantly during operating hours. They retrofitted a VFD on the motor and eliminated the phase inducer. The VFD ramps up at start and then appears to operate at full speed, so the savings are apparently in eliminating the phase inducer. Also the operators were trained to use the ram less frequently -- only when the bin is 1/2-3/4 full.
- One other measure was to build a cover for the compactor feed-hopper and trash delivery truck. This keeps rainwater out of the trash, reducing weight and cost for New Boston. This doesn’t save energy at the transfer station, but it does save energy at the incinerator, where a significant amount of the energy in the trash is spent evaporating water.

Gerry Cornett reports large savings from these measures, and has others planned. The trash compactor is hydraulic and has a reservoir of oil. Submerged oil heaters keep the

oil reservoir at 50F at all times. His plan is to replace this with an oil that works at low temperatures and then to turn off the heater. Another possible measure is to retrofit the paper and cardboard balers with variable frequency drives. Cornett believes this is not cost-effective at present.

Gerry Cornett is to be commended for savings he has achieved to date. The Transfer Station has reduced energy use through a variety of innovative measures. We believe New Boston should write an article or deliver in person presentations to assist other communities in reducing energy use at transfer stations. Measured savings would make this very influential. Sharing these successes with local energy committees across the state would be another way to get the word out.

Savings Opportunities:

The following measures would complement the ongoing program.

Table 4 -- Summary of Energy Reduction Opportunities for the Transfer Station

	Description	Approximate Implementation Cost	Utility Incentive Available[1]	Other Benefits[2]	Potential Utility Savings		Annual Cost Avoidance	Simple Payback Yr
					Electric kWh/yr	Propane Gallons/yr		
1	Install point-of-use DHW heater	$700			994		$ 150	4-6
2	Install occupancy sensor for 24/7 lights	$215			710		$ 110	1-3
	Estimated Program	***$915***	***$0***		***1,704***	***-***	***$260***	***3.5***

Notes ***Current Utility Budget:*** ***$5,596 /yr***

(1) Subject to Utility Incentive Policy and Screening Analysis ***Percent Reduction:*** ***5%***

(2) A - Better Comfort; B - Improved Reliability; C - Reduced Maintenance; D - Enhanced Appearance

1. ***Install point of use DHW heater.*** Since the domestic hot water (DHW) use is minimal, standby losses from the existing 40 gallon tank may be greater than the actual usage. An alternative is to install a much smaller electric water heater at the point of use, i.e. in the bathroom. This could be a "mini-tank" model made by Ariston (as an example, there are many manufacturers), or a model with no storage at all (100% instantaneous heating) such as those made by EEMAX or Powerstream Pro. The Ariston models have an energy factor of about .94, and the EEMAX models have an energy factor of .99. Either way the stand-by and distribution losses will be reduced and there will be energy and cost savings. This works well for bathroom use. If there is a need for large quantities of hot water for washing equipment, a point-of-use heater will not do the job.

   Next step: Solicit quotes for the installation of point of use DHW heaters in the bathroom and removal of the existing electric tank heater.

2. ***Install occupancy sensor for 24/7 lights.*** Lights are kept on near the compactor to protect personnel entering this space. A motion sensor would energize the lights whenever someone walked in.

   Next Step: A qualified lighting contractor can identify the best location and type of sensor, and provide a quote.

Other Measures for Consideration:

Install programmable thermostats. Programmable thermostats allow temperatures to be reduced at night and on unoccupied days, and brought back up to the desired level on the next workday morning. Although building staff may do some of this manually, a programmable thermostat makes it easier. In this case the recycling shed already has a programmable thermostat, but the offices could benefit. There would also be minor savings in electricity and propane.

A seven day programmable thermostat would be recommended here (different schedule for each day of the week).

Replace electric heaters with propane-fired. Electricity is 50-60% more expensive per Btu than propane, so it makes sense to install through-the-wall propane fired heaters instead of electric, in the bathroom and compactor office. One such heater is already present in the main office. However the relatively small amount of energy involved means that the savings would be small ($200 per year or less).

More air sealing. The air sealing work that has already been started in the recycling shed could be continued by sealing additional leaks at construction joints, around doors, windows, beams, and other penetrations. The two small offices could also benefit from systematic air sealing. Use of a blower door can assist in finding air leaks, and in verifying the effectiveness. Savings are primarily in waste oil, but comfort would be improved, and it would also save a small amount of electricity and propane.

Insulate recycling shed bathroom. The bathroom is heated by electricity, so savings are available by upgrading the thermal performance of this area at least. Rigid or blanket insulation can be installed on the inside of the steel framing. This could also be done for the main area of the recycling shed; however this is presently heated by waste oil, so the motivation would be to improve comfort.