8. Energy

Overview

As a result of increasingly heavy United States reliance on foreign oil and mounting concerns about climate change, many US public entities have made efforts to better understand and manage energy consumption and the use of non-renewable energy. Because of New Hampshire's concerns about climate change and its dependence on imported energy it has also taken a number of very important steps:

- March 2007 - Sandwich Town Meeting: Authorized the formation of a Sandwich Energy Committee whose mission is:

  To promote energy conservation and the use of renewable resources for municipal, business and home use for the townspeople of Sandwich.

- December 2007 - Governor Lynch signed an executive order creating a Climate Change Task Force and directing it to develop a *Climate Action Plan*.

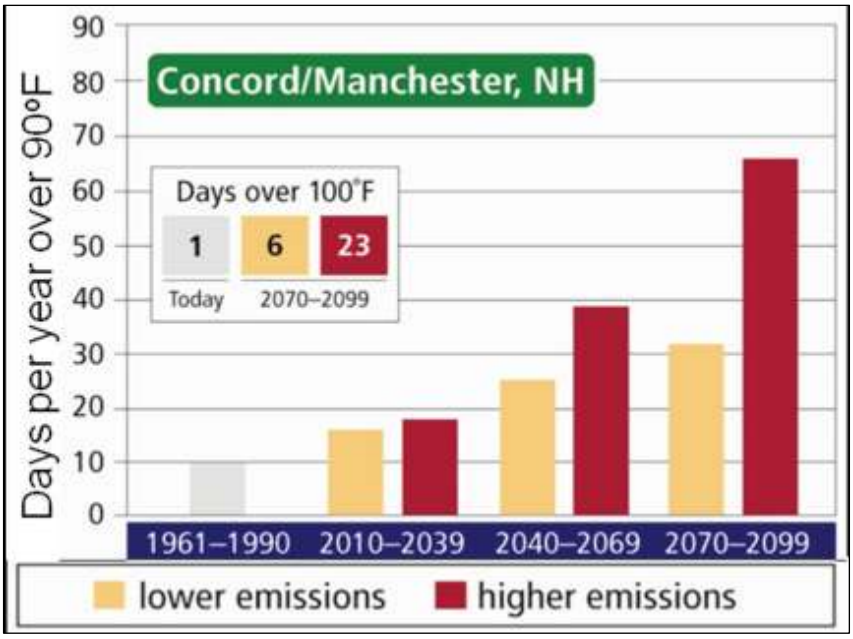
- 2008 - The New Hampshire Legislature adopted an amendment to the state Planning Enabling Legislation indicating that a town's Master Plan may include:

  > *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 674:2 III (n).*

- March 2009 – *The New Hampshire Climate Action Plan, a Plan for New Hampshire's Energy, Environmental and Economic Development Future* is completed and released. The NH Climate Action Plan (NHCAP) found that the temperature effects of a warming climate would increase the number of days over 100°F in the state from 1 per year to 23 by the latter half of this century if aggressive steps are not taken to combat the causes of global warming. Figure 8-1 shows the projected effects of higher and lower emission scenarios on these temperatures. To address these dramatic changes, the Plan set two primary goals:

  - A mid-term goal of reducing green house gases to 20% below 1990 by the year 2025
  - A long term goal of reducing green house gases to 80% below 1990 levels by the year 2050.

Figure 8-1. Temperature Effects of a Warming Climate



Source: NH Climate Action Plan, p.12

This chapter will seek to document the energy uses and needs in Sandwich and recommend steps to reduce energy consumption through a variety of conservation measures and suggest options for increasing the use of renewable energy.

State Energy Supply and Demand

***E**very NH resident consumes the energy equivalent of 1,895 gallons of gasoline per year. 90% of the state's energy comes from petroleum, nuclear, natural gas and coal. The remaining 10% comes from renewable sources which are dominated by wood and hydroelectric.*

Figure 8-2

2008 Per Capita Energy Consumption by State (MBTU)	
United States	326.5
Wyoming (highest in US)	1016.1
Maine	355.6
Pennsylvania	310.3
New Jersey	304.4
Vermont	248.7
New Hampshire	235.5
Connecticut	231.2
California	229.1
Massachusetts	225.4
Hawaii	220.4
Rhode Island	208.9
New York (lowest in US)	204.9
	Source: US EIA

According to the US Energy Information Administration (USEIA), New Hampshire had the seventh lowest total annual energy consumption per person in the country at 235 million British Thermal Units (MBTU) in 2008. That is the equivalent of 1,895 gallons of gas consumed by each person in the state - every year. By comparison, New York had the lowest per capital consumption at 204 MBTU/person and Wyoming had the highest at 1,106 MBTU. The per capita consumption average for the entire country was 326 MBTU.[1] Figure 8.2 shows the corresponding figures for the northeastern states, as well

[1] A full listing of energy source and consumption data can be found at the US Energy Information Administration at www.eia.doe.gov.

as the six states that use less energy per capita than New Hampshire. How do these numbers relate to Sandwich? Based on the state per capita consumption and an estimated Sandwich 2007 population of 1,366 people, Sandwich residents use the energy equivalent of 2.6 million gallons of gasoline per year. Assuming that a typical vehicle has a fuel efficiency of about 20 miles per gallon of gasoline, Sandwich residents use enough energy to drive at least 52 million miles every year.

Figures 8-3 and 8-4 provide a summary of the state's major energy sources and end-uses. Figure 3 highlights the fact that almost 40% of the state's energy comes from petroleum. Nuclear energy accounts for 23% with natural gas providing nearly 18% of New Hampshire's needs. Currently only 10% of the states power supply comes from renewable sources that include hydro, biomass (primarily wood), solar, wind and geothermal.

The state's major end-users are led by transportation, which accounts for 34% of all the energy used in the state. Residential uses consume 29%; commercial activity takes up another 23% with industrial holding the smallest share at 14%.

Figure 8-3

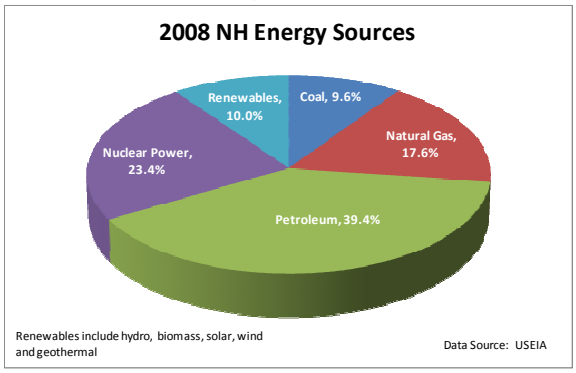
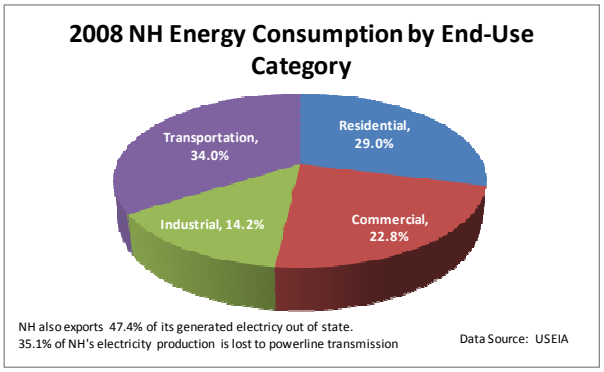


Figure 8-4



A comprehensive chart of the state's energy sources and uses can be found in the Appendix, which further illustrates that:

- Electricity generation consumes 54% of all the energy used in the state, but nearly half of that is exported.
- Out of the total electricity that stays in the state, 67% of it is lost in power production and transmission between the power source and the end user, which is consistent with the losses seen throughout the United States.

New Hampshire produces very little of its own energy from local resources. While it does generate a significant amount of electricity at the Seabrook nuclear power plant, the nuclear fuel rods are brought in from elsewhere. Virtually all petroleum products are imported into the state (nationally 84% of the petroleum is imported from abroad). New Hampshire's only native energy sources are small amounts of wind, solar, hydro, geothermal and biomass

(predominantly wood). As stated above, these native energy sources make up less than 10% of the state's total supply.

Because Sandwich is a small community located in a small state, at the end of most fuel supply chains, much of the energy used in town is susceptible to forces beyond local or even state control. In light of this vulnerability, the Sandwich Energy Committee's mission of encouraging conservation and use of renewable energy seems very pragmatic.

Sandwich Energy Use

Petroleum provides the largest amount of energy in town, but renewable sources appear to be making some gains.

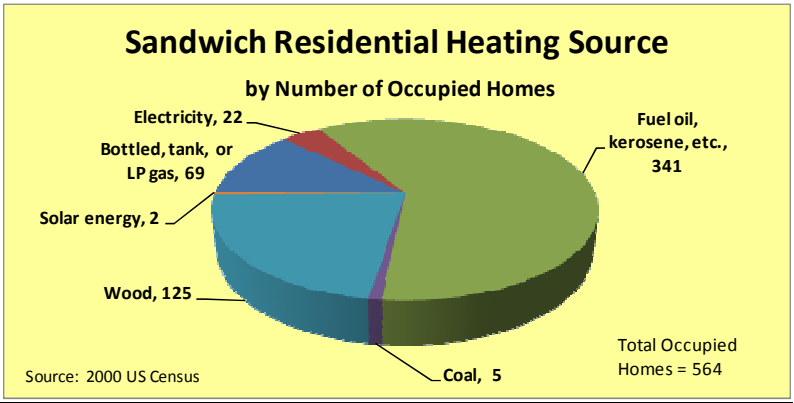
As noted in the Economic Conditions chapter, more than 98% of the town's developed land is used for single family homes. The total non-residential land use comprises only 1.5%. Given the rural character of Sandwich, the very small amount of commercial property, and the relatively rural development densities, both the residential and transportation segments of energy use will claim a much higher percentage of energy use in town as compared to the state-wide averages. Taking the residential and transportation consumption ratios from Figure 4, it is likely that Sandwich consumes about 45% of its energy in the residential sector, with nearly all of the remainder going to transportation. One positive aspect of the dominant residential land use in town is that it enables the community and the Energy Committee to concentrate their efforts on ways to encourage residential energy conservation measures and promote ways to reduce transportation energy use.

Residential Energy Use in Sandwich

From the residential end-use data displayed in the NH Energy Flows chart in the Appendix, we know that a total of 67% of the electrical energy used to supply homes is lost in electrical generation and transmission. The remaining energy is "useable" in homes. 26.1% of the useable residential energy is from electricity; 58.4% is petroleum based; 12.5% is natural gas with the remaining 3% coming from renewable sources. Sandwich does not have access to natural gas, but likely uses more wood for heating than the state average.

Figure 8-5 shows the distribution of heating sources for Sandwich homes in 2000. Not surprisingly, fuel oil (petroleum) provided 60% of the heating needs for the town, with wood coming in second with 22% of the heating source supply. In 2000, only two homes were reported to have

Figure 8-5



used solar power for home heating.
The Sandwich Energy Committee recently undertook an inventory of residential renewable energy users in town. Their preliminary results show the following:

Use	Energy Source	Number of Installations
Domestic Hot Water	Solar hot water	23
Electricity	Photovoltaic	36
	Wind	3
Heating	Geothermal	1
Total		**63**

As of September 2010 a total of 50 residences had installed some form of renewable energy devices. The 63 homes that have renewable energy sources represent only 8% of the town's estimated 640 year round housing stock. Compared to the 2000 housing census information in Figure 5, there has been a significant increase in the amount of solar hot water and photovoltaics in use in Sandwich. The table does not include the approximately 25% of homes that used wood as their primary source of heat in 2000. It is likely that wood heating has seen gains in the last ten years as well.

Residential Opportunities to Reduce Energy Consumption

In order to reduce energy consumption in Sandwich, new buildings could be constructed to much higher energy efficiency standards than current codes specify. Existing buildings can also be retrofitted with a variety of energy conservation measures, including better insulation, weatherstripping, and more efficient lighting and electrical devices. Both new and existing buildings can use renewable energy sources to a much greater degree than at present. In addition to reducing the reliance on imported energy sources, increasing the use of locally generated renewable energy (wind, solar, biomass (wood), and geothermal) can also reduce the total amount of energy that needs to be produced by significantly lowering the electric transmission line losses that result from reliance on centralized power generation. In total, the NHCAP projects that residential energy use should be reduced by as much as 60% (NHCAP, p. 39) to achieve the state's long term energy goals for the year 2050.

Wood
Except for the 25% of homes heated with wood and other renewable energy sources used, the vast majority of Sandwich's energy is imported from out of town, out of state and much of it from outside the country. The Natural Resources chapter documented that 86% of the town land area is forested. Discounting the 28% that is in the White Mountain National Forest, there are approximately 35,000 acres of non-federal forested land in town, only about 10,000 of which is actively managed and harvested.

With sustainable yield management practices, the remaining 25,000 acres of forest in Sandwich offer considerable potential for sustainable energy production. Sustainable yield practices are needed to ensure that there is no net increase in CO_2 emissions from burning wood. Sustainable

yield practices are based on the logic that harvesting wood can be done at a rate no greater than the rate at which trees would mature, die and emit CO_2 as they decompose on the forest floor. The forestry industry estimates that ½ cord of wood can be harvested per acre per year. If all 640 homes in Sandwich heated with wood, at up to 8 cords/house/year, it would take as much as 10,240 acres of managed woodlots to support wood heating for the entire town.

Building Energy Conservation

The main issues that need to be addressed to achieve significant energy reduction in residential buildings are: (1) how to provide the up-front capital to identify and pay for the conservation improvements and (2) educating the public about the costs and benefits of undertaking significant improvements to their buildings.

On August 27, 2010 New Hampshire became the twenty-second state to enable communities to pursue "property assessed clean energy" (PACE) legislation. This is a result of the adoption of New Hampshire House Bill 1554, which towns may now vote to adopt locally. The legislation is now codified as RSA 53-F "Energy Efficiency and Clean Energy Districts." The new statute makes it possible to establish voluntary districts, or the entire town, to finance energy conservation and clean energy improvements to their property and pay off the cost of those improvements over as much as 20 years. If adopted by town meeting, property owners can volunteer to participate in the program, which would require the following steps:

1. An energy audit would be done to their building, energy improvements identified and priced out and an implementation plan agreed to.
2. The property owner would then execute a lien on the property to finance the energy improvements.
3. Repayment of the lien would show as a line item on the property owner's tax bill and be paid off at a rate that would not exceed the annual energy savings on the property.
4. The town, or its agent, would issue a bond to cover the improvement costs within the district and be repaid by each participating property owner for the loan amount, the interest on the bond, and any administrative expenses associated with the program.

The benefit of the program is that the lien runs with the property, and the town is able to recoup all of its associated costs so there is no net cost to the town or other taxpayers who chose not to participate in the program. Adoption of this statute unlocks the door to enable virtually every property owner in the state to undertake energy conservation improvements and sustainable energy investments to their property. With the provisions of RSA 53-F in place, the challenge for Sandwich is now to decide if it wishes to adopt it at the town level and if so, how to set up the program and market it to the community so that it can be widely used.

Renewable Energy Development

The costs of solar hot water, photovoltaic cells, wind and geothermal are becoming more competitive as the cost of the equipment comes down, other energy prices rise, and more financial incentives become available. If the town decides to adopt the provisions of RSA 53-F, as discussed above, then significant interest will likely be generated in pursuing a variety of renewable energy improvements by private property owners. Furthermore, there are currently a number of financial incentives from the NH Public Utilities Commission and the federal government to install renewable energy improvements on residential properties. These government incentives can be applied to the up-front cost of renewable energy installations, lowering the net out-of-pocket cost of the improvement. These incentives can be applied to projects that would qualify under RSA 53-F.

Transportation Energy Use in Sandwich Can Be Reduced

There are three major approaches that can be taken to lower the amount of energy used in transportation: (1) improve the efficiency of vehicles; (2) reduce the number of miles that everyone travels on a daily, weekly or monthly basis; (3) use other forms of transportation that are less energy intensive, such as public transportation, walking and bicycling.

Improved Vehicle Efficiency

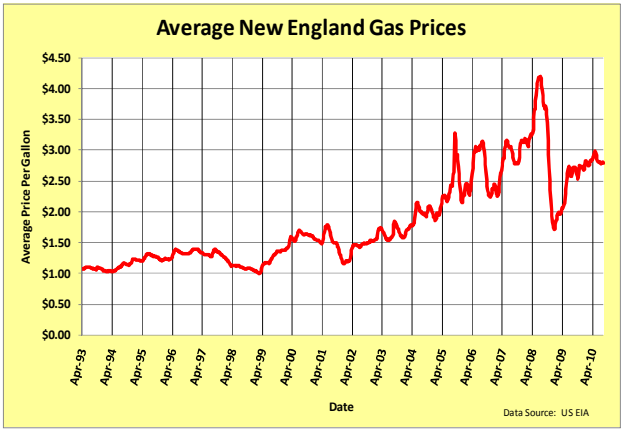
Even the NHCAP recognized that a state as small as New Hampshire does not have enough market clout to force greater fuel efficiency from manufacturers. Regional and federal initiatives to mandate or encourage higher fleet fuel efficiency averages are the only practical approach. In April, 2010, recognizing that there is growing interest in increasing the "corporate average fuel efficiency" (CAFÉ) standards, DOT and EPA announced that a new combined standard (auto and light truck) would begin with the auto model year 2012. The new standard requires combined fuel efficiencies of 34.1 miles per gallon by 2016. As a result of the new standard, EPA predicts that CO_2 emissions in the United States will be reduced by the equivalent of taking 50 million vehicles off the road by 2030.

Reducing Vehicle Miles Traveled

Reducing the number of miles everyone drives is something that every community and individual can directly affect. The simplest way to cut down on travel mileage is to combine multiple trips into one.

- Some communities have instituted programs in elementary schools asking students to encourage their parents to "drive ten fewer miles per week."
- When fuel prices were at $4 per gallon

Figure 8-6



in the summer of 2008 (Figure 8-6), people became motivated to find creative ways to lower their fuel use.

- Car-pooling, particularly for regularly scheduled trips to work, school, etc., is also an easily implemented approach. The NH DOT has an active ride-sharing program that can be found on their web site. They also have reported very heavy use at most of their park-and-ride lots around the state.

A longer term approach to reducing vehicle travel is to promote more compact, mixed-use forms of land development that enable people to live, work and shop within walking distance of their home or business. A recent publication of the Urban Land Institute highlighted the fact that the total number of miles driven in this country has grown three times faster than the growth in the U.S. population. After extensive research on how development influences travel patterns that same publication concluded that: *With more compact development, people drive 20 to 40 percent less, at minimal or reduced cost, while reaping other fiscal and health benefits.*[2]

Encourage Use of Alternative Forms of Transportation

The rural nature of the majority of the community makes any significant provision of public transportation economically challenging. In order for public transportation to be economically viable, concentrations of population are necessary, either in nodes such as village centers or on travel corridors that have higher population densities. The Carroll County Transit Project began a fixed-route transit service in the fall of 2010. This new service travels through Sandwich and connects to Laconia and Ossipee. A connecting route will link the Ossipees with Wolfeboro and North Conway. The Town should explore ways to provide local connecting services to this new bus service. A significant increase in fuel prices, similar to what happened in 2008 (figure 6), could also incentivize public transportation in Sandwich.

Municipal Energy Use in Sandwich

In 2009, Sandwich applied for and received a NH Municipal Energy Assistance Program (MEAP) grant from Clean Air-Cool Planet that was funded by the Public Utilities Commission Greenhouse Gas Emission Reductions Fund. Sandwich was one of only 32 communities selected for the program, which is aimed at providing a step-by-step process to help a select number of New Hampshire communities prepare for municipal building energy improvements that may then be eligible for funding through state and federal implementation programs. Their report: *Municipal Greenhouse Gas and Energy Use Baseline Report for Sandwich, New Hampshire* documents the greenhouse gas emissions and energy use for the town's seven buildings, ten vehicles and forty street lights. Figure 8-7 shows the energy use intensity in thousands of British Thermal Units (kBtu) per square foot of building area and compares the town's buildings to both NH and US EPA averages. The comparison points to the Fire Department and the Town Garage as consumers of about 50% of the energy consumed by municipal buildings.

[2] Reid Ewing, Keith Bartholomew, Steve Winkelman, Jerry Walters & Don Chen, *Growing Cooler: The Evidence on Urban Development and Climate Change* (Washington, D.C., ULI, 2008). p.4

Figure 8-7. MEAP Building Performance:
Energy Use and Intensity of Municipal Buildings

Name of Building	Fuel Type(s)	Area Sq.Ft.	Energy Use: Electricity Million Btu's	Energy Use: Heating Fuel (million Btu)	Total Building Energy Use (million Btu)	Percent of Energy Use	Site Energy Intensity (kBtu/Sq. Ft.)	EPA Average Site kBtu/sq ft for building type	NH Average Site kBtu/sq ft for building type
Town Hall	Electricity and Heating Oil	6000	57.7	208.2	265.9	18%	62.6	32.8	69.3
Town Garage	Electricity and Heating Oil	5800	54.25	309.11	363.36	25%	113.6	77	70.3
Police Station	Electricity and Heating Oil	1496	9.03	112.94	121.97	8%	73.6	81.5	100
Whiteface Fire Department	Electricity and Heating Oil	1450	10.03	99.62	109.65	7%	75.6	78	62.1
Sandwich Fire Department	Electricity and Heating Oil	6884	51.77	325.49	377.26	26%	54.8	77	62.1
Recycling Center	Electricity	64	13.03	0	13.03	1%	0	44	55.5
Wentworth Library	Electricity and Heating Oil	9397	48.26	180.02	228.28	15%	23.8	104	81
Totals		**31091**	**244.07**	**1235.38**	**1479.45**				

Energy use data generated by STOCC software; energy intensity data generated by Portfolio Manager software.

The MEAP report offered seven specific recommendations.

1. Because of its substandard energy performance, a detailed individual building audit should be done on the Town Garage to determine the range of energy improvements that should be considered and evaluate the most cost effective implementation solutions.
2. Sandwich could be used as an energy efficiency educational hub for other area municipalities to learn how to investigate and implement town energy improvements.
3. Because the town vehicles account for at least half of municipal energy use, a comprehensive fleet audit should be done to assess the cost effectiveness of retaining, repairing or replacing existing vehicles based on their energy consumption. This audit should include an assessment of whether each vehicle could be replaced with a smaller, more fuel efficient replacement.
4. Implement a fuel use tracking structure that documents all town vehicle use, gallons consumed and miles driven.
5. Serious consideration should be given to replacing the forty street lights in town with more efficient LED fixtures.
6. The town offices would also be an excellent site to undertake a full building audit and assessment of options. Because of its high use and visibility, energy improvements could be used to showcase how well researched and implemented energy improvements can affect a building's performance.

7. Because Town Hall is scheduled for some significant renovations in the near future, energy improvements should be seriously considered as part of that work, looking at the long term energy savings over the life of the improvements and not just the initial installation costs.

The MEAP report also offered six broader recommendations for energy savings throughout the town (MEAP Report, p.10):

1. Undertake an audit of the town's existing Master Plan, Zoning Ordinances, and other town policies for inconsistencies with the goal to reduce energy usage.
2. Implement a behavioral change program in municipal buildings with municipal employees. Work with the LEC Working Group for guidance to implement this initiative.
3. Implement a buying strategy of Energy Star equipment and products and environmentally sensitive office products, and implement an awareness campaign to encourage "thoughtful" consumption of equipment and products.
4. Evaluate ways to reduce fuel usage within the vehicle fleet. This can be done by analyzing routes, usage, and a strict anti-idling policy.
5. Find alternative energy sources to reduce escalating fossil fuel prices and emissions. Investigate payback for possibly installing: a small combined heat and power (CHP) unit, biomass heating system or geothermal heat pump.
6. Encourage recycling and composting to the extent possible, in order to divert the amount of municipal solid waste (organic matter) going into landfills.

Action Plan

Vision Goals Relating to Energy

Encourage a sustainable community, one that meets our present needs without compromising the ability of future generations to meet their needs

Two other Vision Goals also have important connections to the "sustainable community" goal.

- Vision Goal #10 seeks to provide municipal services in a cost effective manner, including exploration of energy efficiency efforts to improve services and/or reduce overall costs.
- Vision Goal #8 refers to provision of a balanced transportation system, including facilities for pedestrians and bicyclists.

Objective E.1: Undertake Energy Efficiency Improvements in all areas of town government, including buildings, vehicles and operations.

Actions

E.1.1: Continue to follow-up on the Municipal Energy Assistance Program (MEAP) baseline report by undertaking detailed energy audits on existing town buildings, evaluating life cycle costing of energy related improvements and implementing those that provide a reasonable return on the investment, including consideration for increasing energy costs, availability and greenhouse gas emissions.

E.1.2: Establish a town vehicle procurement policy that carefully considers the intended use of the vehicle, its durability, vehicle size, energy efficiency and life cycle capital and operating costs.

E.1.3: Implement a fuel use tracking structure for every town vehicle so that fuel consumption, mileage and use can be monitored to inform decisions about eventual replacement.

E.1.4: Consider replacing existing town street lights with LED light fixtures and study the feasibility of a phased reduction in the number of streetlights.

E.1.5: Evaluate life cycle costs, including possible energy improvements, at the time other municipal building improvements and equipment are being pursued.

Appendix

The following chart displays the sources of energy used in New Hampshire and how much each of them provides to the total needs of the state. The energy sources are shown on the left side of the chart and are linked to the energy use categories, on the right side of the chart, by colored bands whose thickness relates to the amount of energy supplied. The key observations from this comprehensive energy flow chart are summarized on pages 5 & 6.