INTRODUCTION

The last CNHRPC regional plan did not have an energy chapter - one indication of how the energy landscape has changed in the last 10 years. Now more than ever, the environmental and economic implications of energy use are factors that need to be incorporated into planning and land use decisions. Reliable, affordable sources of energy are critically important to everyone's quality of life and impact our economic and environmental sustainability. Whether the intent is to reduce municipal expenditures through energy efficiency improvements to municipal buildings and the transportation fleet, adopting additional building energy code standards or focusing on incorporating renewable energy and energy efficiency into land use planning, all of these approaches work towards the achievement of efficient communities – in energy use, land use, transportation use, etc. Like many of the other resources discussed in this plan, energy efficiency goes beyond municipal borders yet has its roots at the local level. Shared concerns such as reducing energy consumption often need to start at the local level and build outward to include a regional perspective. There also needs to be mechanisms in place to ensure a coordinated response to state and federal policies on energy.

This chapter focuses on the link between energy supply, energy use and land development patterns. It will outline key findings on energy efficiency activities at both the state, regional and local level, including the work of local energy committees and projects that have been implemented through various mechanisms. Balancing the work completed to date with the role available funding plays in the implementation of future work is also examined. The goal is to provide context for the concerns of local government and the role energy efficiency can and does play in the regional landscape. The extensive outreach conducted throughout the Regional Plan development and the metrics available to assess the status and trends of energy efficiency are also woven into this discussion. The outcomes of these efforts are:

- a summary of the current status of energy use, renewables, and efficiency initiatives at each level of government;
- a refinement of the shared concerns identified from local planning efforts and conversations throughout the region;
- an identification of challenges to be addressed; and
- a summary of recommendations/actions on how to meet those challenges.

EXISTING CONDITIONS / NEW HAMPSHIRE'S ENERGY LANDSCAPE

Energy efficiency is continuing to emerge not only as a solution to high energy costs and supply concerns, but as a response to current understanding of climate change impacts. An important concept to keep in mind is that New Hampshire is part of a region and really a world market when it comes to energy. Since 1997, ISO-NE (Independent System Operator of New England) has been managing the

regional electricity demand and supply in New England; what we can do as a state and a region is influence overall use and fuel choice.

Many of the New England states have significantly increased energy efficiency over the last few years as evidenced in the recent American Council for an Energy Efficient Economy (ACEEE) ranking of states' overall energy efficiency initiatives.

New Hampshire ranked 21st in the 2013 State Energy Efficiency Scorecard, dropping three spots compared to 2012. The state scored 20 points out of a possible 50, two points less than it earned in 2012. According to their assessment of New Hampshire's energy efficiency initiatives when compared to other states, the Council states that "though New Hampshire has some policies that promote energy efficiency, the state lags behind other states in the Northeast and has dropped in the rankings since last year. Designing a long-term framework for investments in energy efficiency, such as an energy efficiency resource standard, would move New Hampshire up the rankings and put it on par with other states in the region." The New England states rank as follows:

Table 9.1: New England States Rank

Massachusetts	**1**
Connecticut	**5**
Rhode Island	**6**
Vermont	**7**
Maine	**16**
New Hampshire	**21**

Quick Facts from U.S. Energy Information Administration, March 2014

- New Hampshire was the ninth lowest per capita consumer of energy among the states in 2011.
- The Seabrook nuclear power reactor, the largest in New England, provided 55% of New Hampshire's 2013 net electricity generation.
- New Hampshire's Renewable Portfolio Standard requires 24.8% of electricity sold to come from renewable energy resources by 2025; 16% of New Hampshire's 2013 net electricity generation came from renewable energy.

Energy use in the Central NH Region parallels patterns throughout the state and the northeast. New Hampshire relies on a number of different types of energy supplies – each with its own unique costs. Some important facts to remember:

FACT: New Hampshire relies on external sources of energy for nearly 90% of its total energy consumption.

FACT: Population growth has slowed but is still increasing. Household changes are also leading to changes in how energy is used – computers, phones, TVs. Any gains in efficiency may be partially offset by the increasing electric demand associated with the number of devices and appliances per household.

FACT: Energy costs and supply are dynamic; costs are not fixed.

FACT: Demand patterns for energy may decrease, BUT expenditures are increasing due to rising fuel prices.

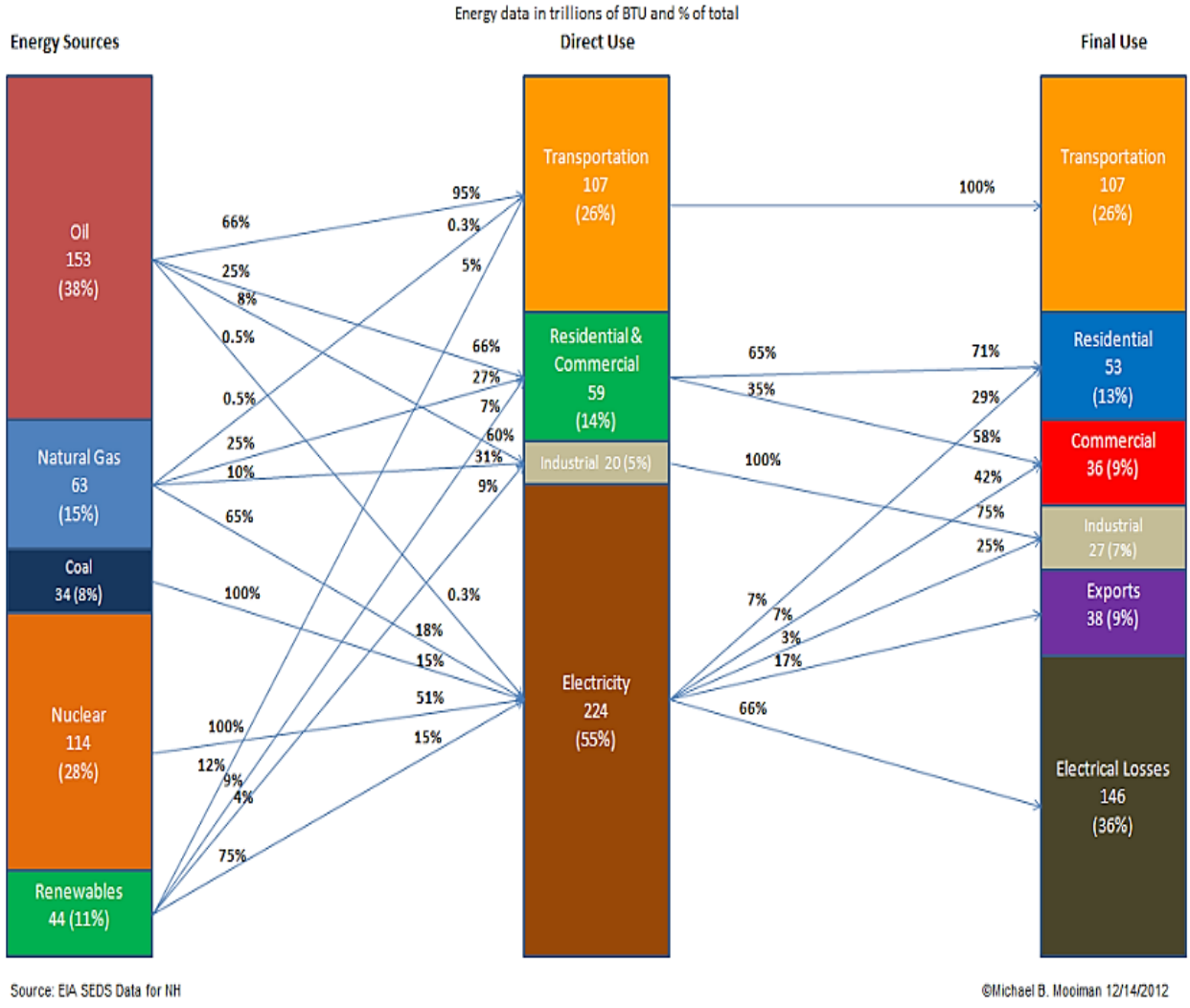
FACT: Decisions concerning energy supply and usage directly impact individual energy bills and the overall economy.

THE ENERGY PROFILE

There is certainly no lack of data on energy use and consumption. The challenge is the number of sources that exist and how to pull it all together into a comprehensive profile. While there has been no attempt here to create an exhaustive list of energy data in this regional plan, there is an attempt to highlight the more pertinent information. The biggest challenge is to correctly describe the flow of energy - from its supply, utilization and final usage - as there can often be a misunderstanding of the relationship between energy, generation, consumption, and the final disposition of energy once part of the supply has been converted to electricity and distributed to consumers.

With permission from the author, Dr. Michael Mooiman, Franklin Pierce University, **Figure 9.1** outlines this flow and summarizes the key concepts of New Hampshire's energy profile.

Figure 9.1: 2010 New Hampshire Energy Sources and Uses Analysis



Based on 2010 data available from the U.S. Energy Information Agency (EIA), this chart analyzes statewide energy flows in New Hampshire and presents a more comprehensive picture of what happens to energy in the state. There are three columns in the diagram, each connected with a number of arrows showing allocation percentages. The first column to the left shows energy supply, the middle column identifies how the energy is used directly and the last column shows the final allocation of energy that was once part of the energy supply and has been converted to electricity. The author of this chart makes the excellent point that it is important to keep in mind that electricity is not an energy source; connecting these three columns allows one to see the flow from the source to the use, including electricity, and finally, how all this energy is utilized.

Looking at the column to the left, energy sources, one can see that the largest slice of the energy supply, 38%, came from crude, oil based fuels. The other fossil fuels, natural gas and coal, made up 15% and 8% respectively. Overall, fossil fuels provided 60% of the state's energy sources. Nuclear energy supplied about 28% of the overall total. Renewables – hydroelectric, wood, waste and ethanol in gasoline, represented 11% of the total. It should be noted that a small amount of electricity was purchased from out of state in 2010, but the amount was less than 0.5% and was not included in these figures.

How the energy was used is the purpose of the center column. Examining this column in closer detail shows that direct energy use falls into four main categories: 55% went to electricity generation; 26% to transportation, and the remainder to heating for residential and commercial buildings (14%) and industrial use (5%). Looking next at the fan of arrows and their percentages, the number at the head of the arrow shows the amount of energy used in an application from a specific source and the number at the end of the arrow shows the amount of a supply used for that application. As an example, the top arrow in the diagram shows that 66% of our oil based energy supply was used for transportation and, following that arrow to the next column, it shows that 95% of energy used in this section was from oil based fuels.

As we follow these arrows for the first two columns, some highlights from the data are:

- 25% of natural gas is used in the residential and commercial sectors.
- 65% of natural gas supply is used to generate electricity and it represents 18% of the primary energy supply used to generate electricity.
- 66% of energy usage for heating households and businesses comes from oil.
- 25% of the oil supply to the state is used to heat these households and businesses.
- 15% of the total energy supply for generating electricity is from renewables; 75% of the renewable energy supply is used to generate electricity.
- 100% of coal and nuclear supply is directed towards electricity generation, making up 15% and 51% respectively of the supply for generating that electricity.

The last column of this chart looks at final use or what happened to all the energy. For electricity, it's important to note that two thirds of the energy that went into production was lost as waste heat. It is sometimes a surprise that electricity generation produces so much waste. One interesting note on this last column is that 17% of the electricity generation is actually exported out of state.

Some notable points from this last column are:

- 71% of energy for our homes came from mostly fossil fuels for direct heating and hot water applications. The remainder of the energy to our homes is from electricity usage.
- 58% of energy use for businesses was from heating and 42% is electricity.

- → 36% of energy supplied was lost as waste heat during the generation and transmission of electricity, 9% was exported out of state and transportation consumed 26% of the energy supply.

Now that there is a clearer view of energy flows in New Hampshire, a brief discussion of some of the sources follows.

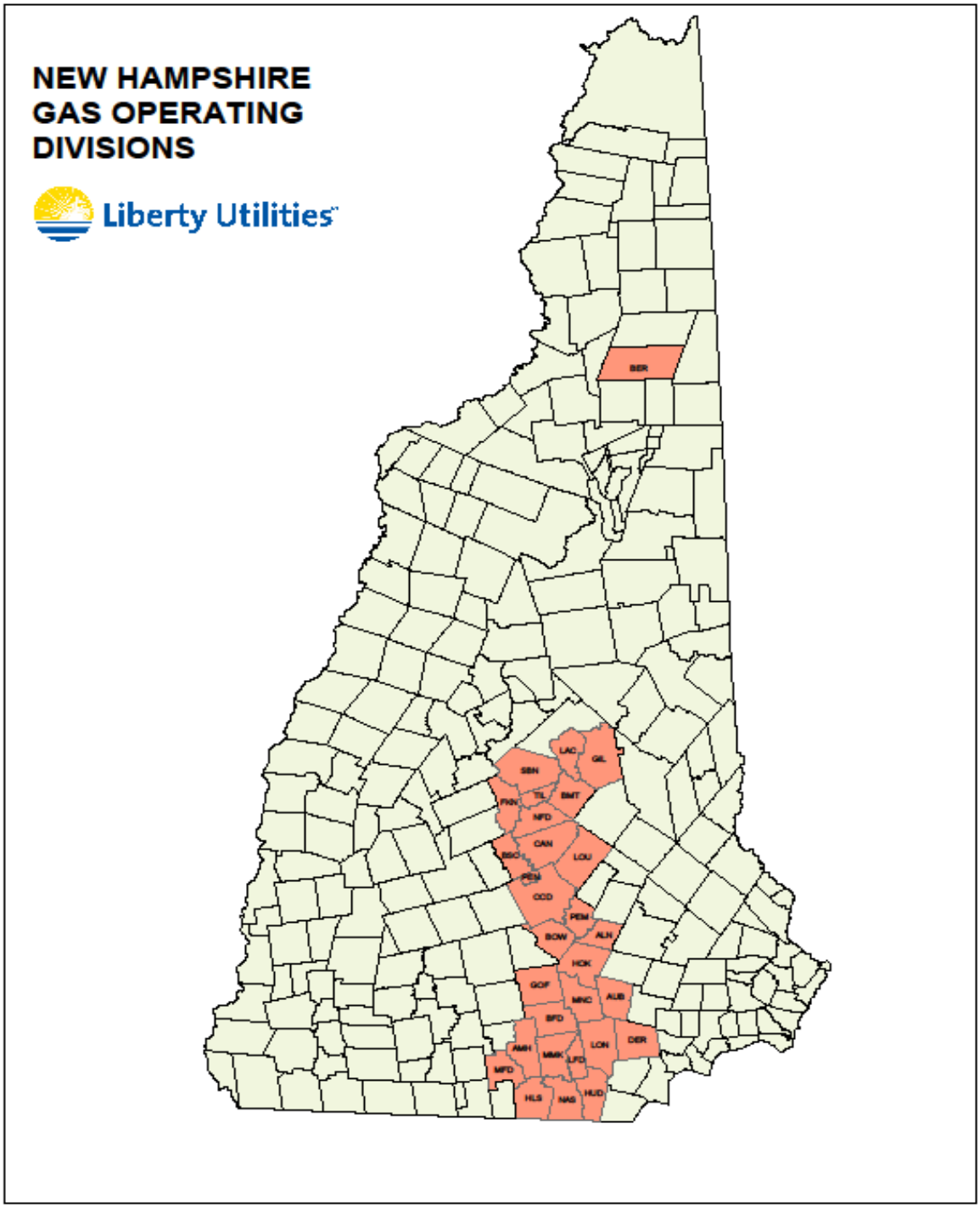
SOURCES

Natural Gas

In New Hampshire, there are four natural gas pipelines. The significant line for state residents is the Tennessee Gas Pipeline (TGP) which is owned by Kinder Morgan and brings gas from Texas, Louisiana, and the Gulf of Mexico into New England. This pipeline crosses New York and Massachusetts and distributes gas across a large section of Massachusetts. There are several tributaries off of the main line, one of which branches off near Lowell and heads north through the communities along the Merrimack River and into the Lakes Region.

According to the EIA, "about one in five New Hampshire households uses natural gas for primary home heating. Because of recent differences between natural gas and home heating oil prices, there has been an increase in the number of homeowners who have been switching to natural gas in New Hampshire and throughout New England. However, New Hampshire is still among the lowest states in per capita natural gas consumption, in part because large areas of the state do not have the natural gas distribution infrastructure." Some of the Central NH Region's communities (see following map) are served by Liberty Utilities and are able to heat with natural gas. In Concord, close to 50% of heating is from natural gas.

Figure 9.2: Liberty Utilities Service Area



Petroleum

Nearly half of all New Hampshire households rely on fuel oil for heat in the frigid winters. (EIA, NH Energy Profile)

Nearly half of all New Hampshire households rely on petroleum as their primary heating fuel, making the state and the Region particularly vulnerable to fuel oil shortages and price spikes during the winter months.

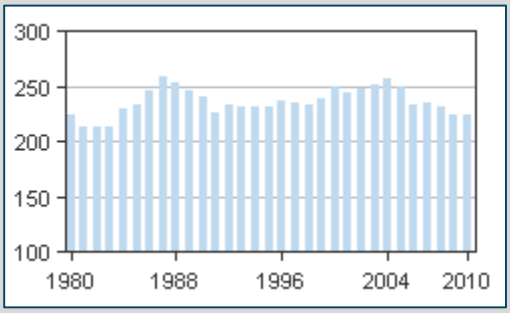
The transportation sector consumes more petroleum products than any other sector. State law requires the use of a biodiesel blend in state vehicles unless the blend costs more than all-petroleum fuel. The state also requires reformulated motor gasoline blended with ethanol in the populated areas of southeastern New Hampshire to limit ozone formation.

Total Per Capita Energy Consumption for New Hampshire

One measure of the energy intensity of the New Hampshire economy deals with the gross measure of total energy consumed divided by the state population. This per capita indicator is a good measure of energy consumption because decisions by individual consumers have an important effect on overall energy consumption.

Source: U.S. Energy Information Administration (EIA) State Energy Data System (SEDS database).

Figure 9.3: Total Energy Consumption per Capita 1980 – 2011(million Btu)



Coal (EIA Data)

New Hampshire has two coal-fired generating stations, Schiller at Portsmouth and one in the Central NH Region, Merrimack Station at Bow. Both are owned and operated by PSNH and the Merrimack Station is the utility's largest plant and generates approximately 439 megawatts (MW), enough to roughly supply 190,000 households. One unit of the plant was built in 1960; the other in 1968. In response to a 2006 state law (RSA 125-O), PSNH installed a scrubber system by 2011 that is targeted to capture 80% of the mercury from the coal and reduce sulfur dioxide emissions by roughly the same percentage. The cost of the scrubber system increased from an estimate cost of $250 million in 2006 to $422 million. The Public Utilities Commission (PUC) is currently examining what portion of that cost could be passed on to ratepayers. The Schiller station can burn either coal or oil, and one unit was converted in 2006 to burn woody biomass. Although coal's share of New Hampshire electricity generation has declined in the face of cheaper natural gas, it still typically provides up to one-seventh of net electricity generation.

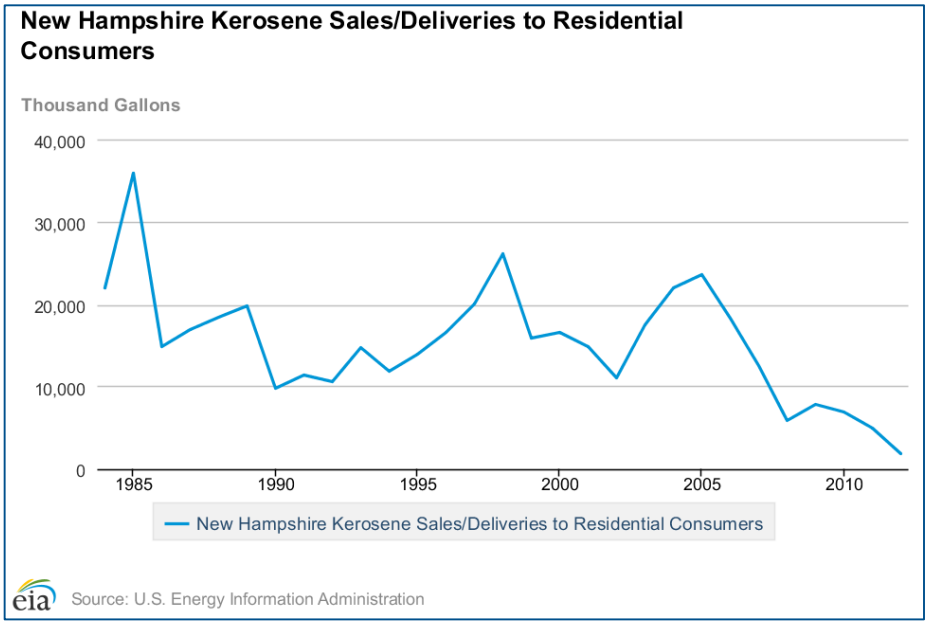
Propane

Propane is a hydrocarbon gas that is a byproduct of natural gas and oil extraction and makes its way to New Hampshire's retailers via rail, propane tanker trucks or ship. Propane is stored as a liquid underpressure until utilized; In New England, there are two large propane storage termininals, one in Providence, Rhode Island and the other in Newington, New Hampshire. Propane use in New Hampshire has increased steadily over the years, averaging out to around a four percent/year increase since 1960. While propane does not represent a high percentage of New Hampshire's energy use, it is important in more rural areas without access to natural gas. Currently, there is an excess of propane produced and the US is actually exporting it. The propane industry is not regulated by PUC and pricing can fluctuate significantly from dealer to dealer.

Kerosene

Kerosene is a stable, cold temperature fuel source that is often a source of home heating oil for mobile or manufactured homes. Since these homes tend to have storage tanks located outside of the home, kerosene has historically been the fuel of choice in a northern state like New Hampshire. Unfortunately, it is one of the most expensive home heating fuels - though not as expensive as heating with electricity. Close to 6% (2012 ACS data) of New Hampshire's housing stock is categorized as mobile homes, 6.4% in the Central NH Region, and these higher fuel prices often impact those with lower incomes who can't necessarily afford these costs. Many of these homes were built before 1980 and are often in need of weatherization improvements as well. The good news is that kerosene use has declined markedly in recent years (see **Figure 9.4** below), indicating that other choices in heating such as conversion to propane systems or mixing of fuels are being made.

Figure 9.4: New Hampshire Kerosene Sales/Deliveries to Residential Consumer



A Further Note on Electricity:

Seabrook, the largest nuclear plant in New England, can provide up to half of New Hampshire's generation.

Most of New Hampshire's net electricity production comes from just five large generating plants. Electricity generation from natural gas has increased markedly since 2003 with the commissioning of two large generating stations. As increasing amounts of natural gas are used for electricity, in New Hampshire and in New England as a whole, assurance of natural gas supply is becoming a critical strategic energy issue for the region.

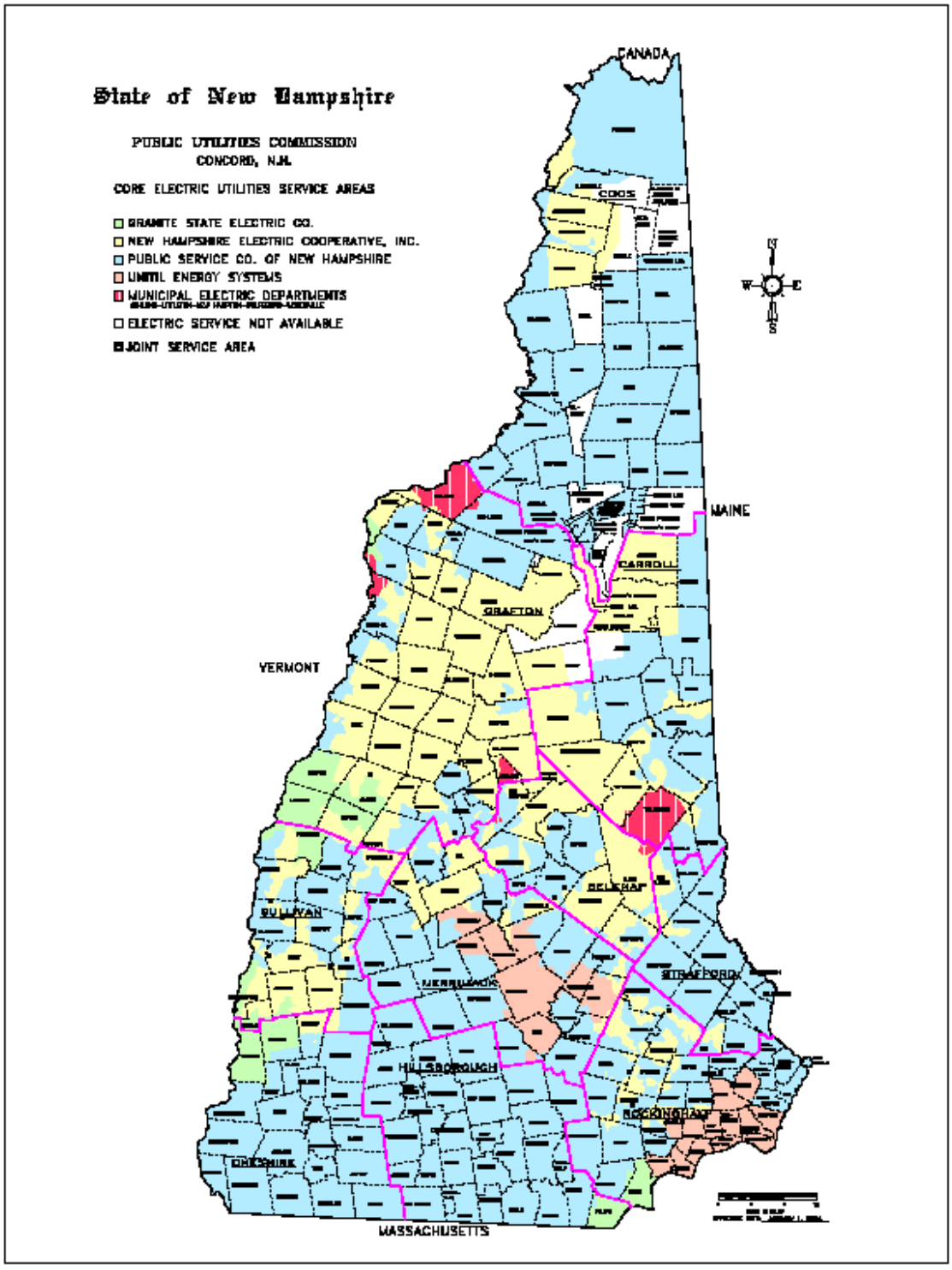
The Central NH Region is served by the following utilities: PSNH, NH Electric Coop and Unitil. (see **Figure 9.5**).

Cogeneration: Concord Steam

Concord Steam Corporation uses biomass to produce steam to heat downtown Concord and also to produce electricity for sale to utilities. This district heating company has been supplying steam to downtown Concord since 1938. There are around 110 customers with close to 200 commercial and institutional buildings with the largest base of customers the State of New Hampshire and the City of Concord. Forestry waste, such as tree tops and branches normally left behind in the forest after timber-harvesting operations, is used. To supplement its wood-burning operation, Concord Steam uses natural gas or #2 oil, the same oil that is used to heat residential homes. Burning this resource generates steam which turns turbines to produce electricity. When the steam leaves the generator at a lower pressure and temperature, it can then be piped to Concord's businesses for heat. This process is called "cogeneration," a way of getting the most out of a fuel source. On average, two megawatts are available for electric generating capacity.

The operation originally planned to relocate to a different site on South Main Street in Concord but that is no longer an option and they are negotiating to remain at the current location on the State Hospital grounds. www.concordsteam.com/index.html

Figure 9.5: Core Utility Service Areas



RENEWABLE ENERGY SOURCES

DEFINITIONS

Coupled with the vast amount of data, there is also an "energy dialect" that needs to be understood, particularly in the area of renewable energy. Below is a list of definitions that may clarify some of the terms used in this section and chapter as well as in the energy efficiency field.

Energy Conservation - reducing or going without a service to save energy. Turning off lights, reducing vehicle trips are a couple of examples.

Energy Efficiency – using less energy to provide the same service. Anywhere energy is used there are opportunities to increase efficiency. In most cases, energy efficiency measures will pay for themselves over time with lower energy bills.

Renewable Energy - source of clean energy that can be replenished. Does not change the amount of energy consumed but uses a renewable energy source.

Renewable Portfolio Standard (RPS) – New Hampshire's RPS was established in May 2007 as RSA 362-F and requires the state's electricity providers -- with the exception of municipal utilities -- to acquire by 2025 renewable energy certificates (RECs) equivalent to 24.8% of retail electricity sold to end-use customers. The RPS includes four distinct standards for different types of energy resources; these are classified as Class I (largest class and includes new and existing renewable facilities), Class II (solar), Class III (existing biomass and landfill gas facilities) and Class IV (existing, small hydro with certain restrictions). See www.puc.gov for a detailed explanation of the classes. What an RPS does is establish a base level of demand but allows the market to determine which renewable energy resources will meet that demand. Initially proposed as a mechanism to support renewable energy development in competitively restructured electricity markets, the RPS model today is now seen to serve other functions such as encouraging fuel diversity and economic development.

Renewable Energy Credits (RECs) – Renewable energy credits or certificates (RECs) are sold separately from the underlying physical electricity and are tracked, traded and sold in the market. As renewable generators produce electricity, one REC is created for every 1 megawatt-hour (MWh) of electricity placed on the grid. RECs represent the "attributes" (environmental, social, and other non-power qualities of renewable electricity generation) of renewable electricity generation from the physical electricity produced, serving as "currency" for renewable energy markets. Since RECs only represent the non-power attributes, they are not subject to delivery constraints.

Alternative Compliance Payments (ACPs) - If utilities do not meet their renewable energy quotas, they are required to make what is known as "alternative compliance payments" to the state for every megawatt hour of energy for which they did not acquire RECs. These alternative compliance payments are essentially an assessed fee to those utilities and competitive electricity providers that have not complied with the RPS. If RECs are not available or prices exceed the alternative compliance price, the electrical supplier will often elect to pay the fee, i.e., the alternative compliance payment.

THE SOURCES

Biomass

According to the U.S. Energy Information Administration, nearly 1 in 12 homes in New Hampshire depend on wood products as a primary heat source. New Hampshire is still 84% percent forested and roughly 81% is considered viable timberland. Biomass products such as wood pellets and chips, logwood and briquettes, are an important part of the state's economy and can keep fuel dollars in the local economy.

According to a recent presentation by the Northern Forest Center to the Energy Efficiency and Sustainable Energy (EESE) Board on January 17, 2014, about 50% of the wood pellets consumed in New Hampshire are from in-state sources.

As noted in **Table 9.2** below, only natural gas is cheaper based on the heat content. Since biomass is part of the renewable energy market, there is the opportunity to sell the renewable energy attributes or RECS. As discussed earlier in this Chapter, these renewable energy attributes or RECs are traded separately from the underlying electricity. New Hampshire was the first state in the nation to create RPS incentive provisions for thermal renewable systems that are equivalent in value to those for renewable electric technologies.

Table 9.2: 2014 Heat Cost Comparison

Current Heating Fuel Values - September 2, 2014			
Fuel Type	Price/Unit	Heat Content Per Unit (BTU)	Price Per Million BTU (See Note 1)
Fuel Oil (#2)	$3.496/Gallon	138,690	$25.20
Propane	$3.097/Gallon	91,333	$33.91
Kerosene	$4.154/Gallon	135,000	$30.77
Natural Gas 1st Tier (<100 Therms)	$0.848/Therm	100,000	$8.48
Natural Gas 2nd Tier (>100 Therms)	$0.800/Therm	100,000	$8.00
Wood (Bulk Delivered Pellets) (See Note 2)	$245.97/Ton	16,500,000	$14.91
Wood (Cord) (See Note 3)	$310/Cord	20,000,000	$15.50
Electricity	$0.1531/kwh	3,412	$44.88

Source: NH Office of Energy and Planning, September 2014 data

Notes:

1. Pricing information is presented in per-BTU (British Thermal Unit) format in order to give consumers an idea of the true cost of the fuel per unit of heat. A gallon of oil, when burned, will produce a different amount of heat than a ton of wood. If you are wondering what the cost savings might be if you were to switch to a different fuel type for heating your home, the US Energy Information Administration has produced a calculator to help with that.
2. Wood pellets priced contain 70% - 85% hardwood; delivery size: 3-10 tons.
3. The price of firewood sold by the cord can vary widely depending on the location, time of year and quality of the wood being sold. The cost shown here is an average of "seasoned" cordwood to allow for a general comparison to other forms of energy. Cordwood can be highly variable in moisture content, quality, species makeup, etc., correspondingly heat values and prices will vary. For information on using cordwood, see Heating with Wood from the UNH Cooperative Extension.

Electricity in New Hampshire is also generated from the combustion of wood by seven major power plants in New Hampshire. In the Central NH Region, Wheelabrator Concord Company operates a waste-to-energy plant that includes two furnace/boiler systems that processes up to 500 tons of solid waste per day. The plant produces high pressure steam capable of producing around 14 megawatts of electricity annually, close to supplying the electricity for 17,000 homes.

The seven wood-burning plants that generate electricity from wood chips are located throughout the state and produce around 150 megawatts, with none operating in the Central NH Region. The commissioning of the State's largest wood-fired power plant, the Burgess plant in Berlin on the site of the old Frasier Paper Mill, will increase the electrical generation from its current 5% to 7.5%, raising production to close to 225 megawatts.

It is important to note that, with the exception of the 50 megawatt Schiller plant in Portsmouth operated by PSNH, these plants are typically smaller operations with capacities around 15 to 20 megawatt capacity. Most of the other plants were built in the mid-to-late 80s when the utilities were actively pursuing this industry and negotiated 20-year power purchase agreements with them.

Interest in biomass as a source of heating has also been increasing for residential, commercial, and municipal uses, thanks in part to rebate programs and other sources of funding the last few years. New Hampshire's new commercial and industrial rebate program for wood pellet boilers issued 13 rebates in state fiscal year 14; none are located in the Central NH Region. In 2012/2014, five rebates were issued under the residential wood pellet program in the towns of Pittsfield, Warner, Hillsborough, Bow and Canterbury.

Recent data shows that 16 municipal/institutional **wood chip** heating systems have been installed statewide; in the Central NH Region, two systems have been installed, one at the Merrimack Valley School District in Penacook and Pembroke Academy in Pembroke.

Wood Chips/Wood Pellets

Wood pellets are typically composed of low-grade material, harvested during forestry operations or produced as a by-product of lumber and wood product manufacturing (e.g., sawdust). Wood chips can be from the whole tree, bole chips from the woods or chipping plants or pulp quality chip from sawmill or chipping plants. The whole tree chip is normally used in large industrial wood-to-energy facilities and are often re-ground at these facilities for a more effective flow of the supply. Bole chips are most often used for smaller, thermal boilers and they produce less ash and tend to combust more efficiently; pulp chips are usually debarked and are chipped to precise size specifications. Some boilers can switch between the two sources. There are many differences between these two sources, including costs. Wood pellets, on a heat-equivalent basis, are more expensive than wood chips. There are also fewer suppliers for pellets and emissions from chips can be higher if there are no emission controls; the ash is often used as a soil additive by farmers.

Wood pellet appliances are often the best option for residential and small commercial applications. For larger installations, wood pellets are sometimes selected because some wood pellet heating systems are initially cheaper than comparably sized chip systems; however a wood chip heating system at community-scale facilities, such as schools, can have a lower lifetime cost than a wood pellet system. Any proposed installation should be evaluated to determine the best fuel and system for the specific application.

Figure 9.6: Merrimack Valley Schools District Heating Plant

Source: Presentation by NH Wood Energy Council at Local Energy Conference, April 14, 2014

Municipal/Institutional **wood pellet** heating systems in New Hampshire now total over 29 systems, including the following locations in the Central NH Region: the New Hampshire Department of Resources and Economic Development's warehouse in Allenstown; Hopkinton town garage; New England College in Henniker; and New Hampshire Audubon in Concord.

New Program

New Hampshire is one of five states that was recently awarded funds from the U.S. Department of Agriculture to stimulate development of wood energy projects. The New Hampshire Wood Energy Council/Support Team is a diverse group of biomass stakeholders that is launching the program and the North Country Resource Conservation and Development Council is overseeing the effort. The $250,000 grant was received in September of 2013 and will run for three years.

The initiative is intended to help expand institutional and community scale wood biomass thermal energy in NH by providing education to interested community and business leaders and facilitating the exploration and establishment of wood energy projects. The initiative will provide technical expertise (engineering) necessary for facility owners and operators to make more informed, technology decisions on whether heating with wood is a viable option. The group will reach out to a wide number of potential users of wood biomass energy, including but not limited to schools, builders, engineers, architects, financial service providers, local energy committees, health care facilities, building owners, plumbers, and residential developers/managers, with information, case studies, and on-the-road visits to facilities. The project is targeting feasibility assistance for up to 45 potential facility owners, resulting in at least five installations. See the New Hampshire Wood Energy Council's website for information on the rollout of the Program (www.nhwoodenergycouncil.org).

Solar

According to the U.S. Department of Energy, demand for solar is at an all-time high; in the first quarter of 2012, 85% more panels were installed compared to the first quarter of 2011. Once thought of as not practical in northern climates, solar energy has much potential for providing clean, reliable and safe energy. Solar technologies have proven to be successful in New Hampshire and continue to be a viable option both commercially and residentially. As technologies continue to improve and costs lower, solar thermal collectors and photovoltaics are becoming more competitive in the marketplace.

The Cost of Solar Energy

The challenges for solar installation include the installation costs and some of the "soft" costs such as permitting and interconnecting the system to the power grid. However, the cost of solar panels or solar modules has been falling significantly, from $76.67/watt in 1977 to just $.68/watt today (www.costofsolar.com) and is expected to continue dropping in the near future. Grid-tie (connected to your electrical utility company's power "grid") has not only become more mainstream but the decreasing price is attributed to many factors, including technology improvements such as the mini inverter. Each panel in an array has its own on-board inverter which eases the effects of partial shading on the panels. The number of qualified installers has also continued to expand and more electricians are gaining experience in wiring solar installations.

There is also an initiative launched in 2011 by the Department of Energy called SunShot with the goal of making solar energy resources more affordable and accessible for everyone. The target is to reduce the total installed cost of solar energy systems to $.06 per kWh by 2020. For more information on this initiative, follow this link: www.energy.gov/eere/sunshot/sunshot-initiative

The NH Office of Energy and Planning (OEP) is a recent recipient of a grant as part of the New England Solar Cost Reduction Partnership (NESCRP) from the US Department of Energy's Rooftop Solar Challenge II Program. The intent of this grant is to increase implementation of solar photovoltaic (PV) by driving down its associated costs. Under this grant, NH is focusing on the "soft costs" associated with residential permitting, zoning and interconnection. Statewide model permitting and zoning, a guide to the utility interconnection process, and additional educational resources, including training, will be developed for use by municipalities and made available through OEP's website (www.nh.gov/oep).

Solar Energy Use

In 2013, solar installations in the U.S. accounted for 31% of new electricity generation installed. According to the Interstate Renewable Energy Council, (IREC), residential capacity installed in 2013 grew by 68 percent. A total of 145,000 residential PV systems were installed during that year. Growth in this industry is driven by many factors and certainly varies by sector and state. The federal tax credit is still available, installed costs continue to decline and state and utility rebates all are contributing to the solar market growth. By many standards, this is still an industry that is in its relative infancy when you consider that in 1985 annual solar installation demand stood at 21 MW.

In 2005, New Hampshire's largest solar array was the 48kW solar array on the roof of the Stonyfield Farm yogurt factory. It remained the largest in the state until PSNH installed a 51 kW array on their roof in 2009. In 2012, New Hampshire's largest solar array was the 525 kW solar array installed on the top level of the Manchester Airport parking garage. In a recent pilot program, eight solar panels were installed by PSNH on utility poles, four in Nashua and four in Berlin, with the energy generated by each 200 watt panel directed into the local distribution system. The output can be monitored online and the panels were provided at no cost for a period of six months as part of the pilot program.

In the Central NH Region, over 17 commercial and industrial solar rebates have been issued, with the largest number of rebates issued in Concord at six. Other communities with rebates issued include Boscawen, Loudon, Chichester, Warner, Bow and Henniker. Some notable projects in the region include a solar hot water installation that features 12 flat solar collectors that reheat the gas water heater at the Common Man Restaurant in Concord, a solar electric array at the Comfort Inn also in Concord, a 5.76 kw awning mount (also including 2 car charging stations) at Grappone Toyota in Bow, and a ground mount solar hot water installation at Concord's Central Fire Station. With the Peterborough project just getting underway with a grant from the Renewable Energy Fund in 2014, New Hampshire will have a 950 kilowatt solar array installation, the largest such array in New Hampshire to date. The installation will be built by Borrego Solar of Lowell, Massachusetts, and will be located on the site of one of the Town's former sewage lagoons and is expected to generate one megawatt of electricity annually – enough to power the nearby sewage treatment plant and perhaps other municipal buildings.

Figure 9.7: Common Man Hot Water Solar Installation, Concord

Source: Revision Energy

The residential market continues to grow as well with small units being installed in domestic homes to supply a proportion of the household electricity needs. More than 1,200 statewide systems have been installed since the PUC established the rebate program in 2009. A good source of information on solar energy for residential homes can be found at http://www1.eere.energy.gov/solar/pdfs/44792.pdf.

As solar systems become more mainstream, there is developing interest in looking at the role of zoning and land use regulations to ensure that solar renewable energy projects are compatible with existing land use regulations. Looking at ways to support renewable energy projects that are not overly restrictive or contradictory to the installation of the systems within the framework of "sound" community development is important. Some potential considerations by communities include whether the systems are considered an accessory use or a conditional use in certain areas, height and setback limitations, scale, and aesthetics (i.e. glare).

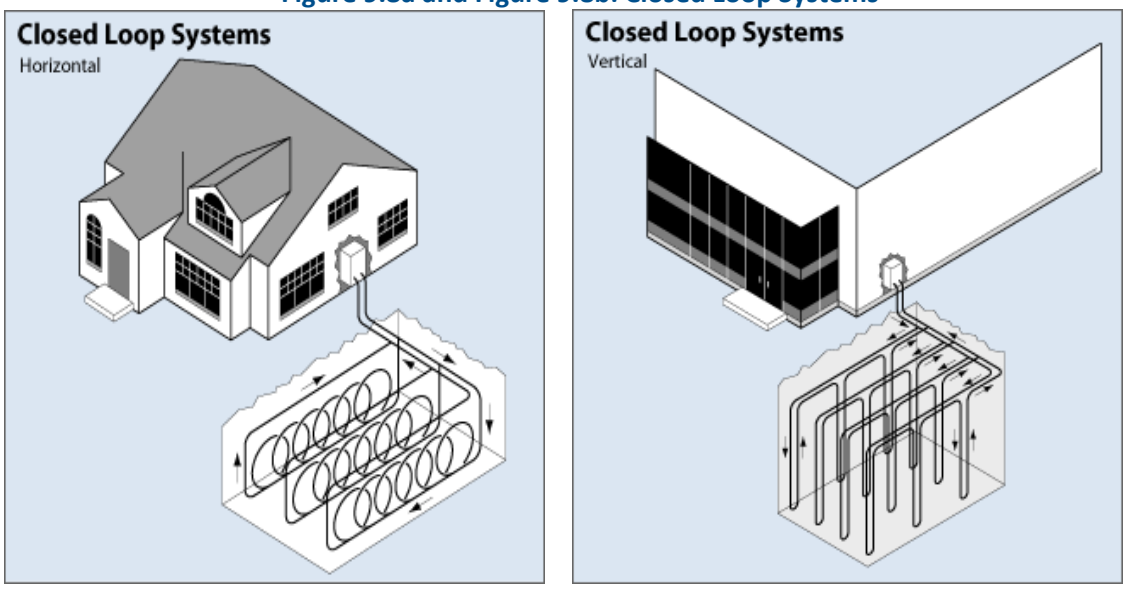
Geothermal

Geothermal energy is defined as two types.

The first utilizes high temperatures of deep bedrock in areas that have strong geologic activity, often the site of hot springs. Water is usually pumped down through deep wells, some as deep as 4 or 5 miles, to access rocks with temperatures around 212°F or higher. The water is heated by the rocks and is drawn back to the surface to produce steam which can then be used to drive turbines and generators to produce electricity. These rather large systems are typically found in the western US; New Hampshire has only one potential site located in the White Mountains area.

The other type of geothermal energy uses the more readily accessible soils where the temperature of the ground is 50 to 55°F at 4 or more feet below the surface (below the frostline). This utilization of energy in the ground is more correctly termed geothermal heat pump system, ground source heating or "geoexchange." There are two main components, the heat pump and the circulation system that is drawing the heat from the ground. Using electricity, heat pumps move a glycol solution through an underground system of pipes. There are typically four basic types of ground loop systems; three are closed-loop systems, horizontal, vertical and pond/lake and the fourth is the open-loop system. One type of residential installation is the horizontal configuration in which the piping is buried in a shallow trench 4 to 6 feet deep alongside a home (see drawing below).

Figure 9.8a and Figure 9.8b: Closed Loop Systems

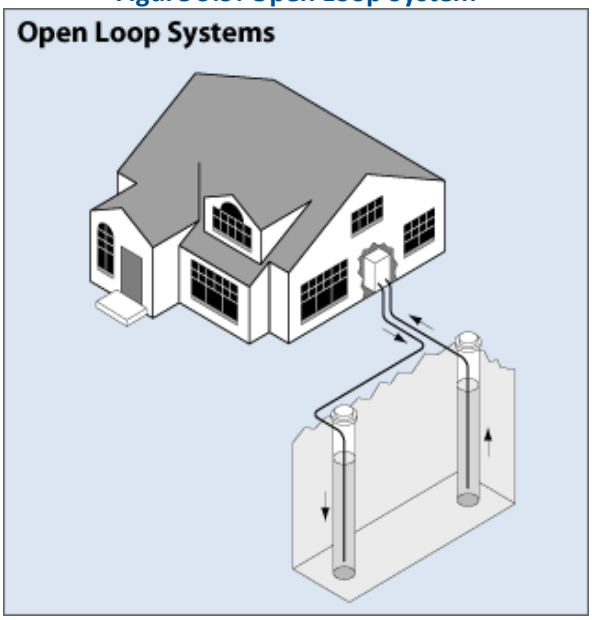


Source: ***www.energy.gov/energysaver/articles/geothermal-heat-pumps***

The vertical system where the piping is enclosed in wells which penetrate deep into the ground is shown above and is often used for commercial building or schools because the horizontal system would simply require too much land area. The advantage with these vertical closed loop systems is that, in these deep wells, the piping can come in contact with the ground water and water is a highly efficient medium for transferring the heat from the ground to the circulating fluid.

The open loop system uses well or surface water as the heat exchange source. Once the circulating fluid has cycled through the system, the water returns to the ground via another well as shown in the diagram below.

Figure 9.9: Open Loop System



Source: www.energy.gov/energysaver/articles/geothermal-heat-pumps

These systems are becoming more popular but they do have some limitations that can restrict their use. The units can be very expensive with upfront costs in the range of $20,000-$35,000 or more. The differences between a closed loop and open loop system for well systems tend to be specific to the site in question and requires careful study of the site characteristics.

There are other hybrid type systems that use several different geothermal resources that won't be discussed here but can be found at: www.energy.gov/energysaver/articles/geothermal-heat-pumps.

In New Hampshire, geothermal systems are regulated by the Department of Environmental Services (DES). The Environmental Protection Agency (EPA) requires states to inventory several classes of injection wells. Open loop wells are considered Class V injection wells which needs to be registered with DES. Closed loop systems also are required to register with DES. For more information, see

www.des.nh.gov/organization/commissioner/pip/factsheets/dwgb/documents/dwgb-22-23.pdf.

Merrimack County Nursing Home: "A Geo Dream"

An example of a large and successful geoexchange project in the Central NH Region is the Merrimack County Nursing Home (MCNH) in Boscawen, NH. This is a nursing facility that, on average, has about 290 residents and a staff of 425, and is roughly 235,000 square feet.

The building is heated and cooled by an all geoexchange mechanical system. The building uses water drawn from 16 standing column wells on the property to circulate through 326 water to air heat pumps which draw the energy out of the 60°F well water in the winter. All 16 wells are located in the nursing home's parking lot. Split up into two well fields, eight wells are located in the upper parking lot, and eight in the lower, with the farthest well 850 feet from point of entry into the building. Each eight-well field is piped to its own supply and return manifold. The caps are protected by manhole covers, and can be found in the green spaces between parking areas. Each well took about six days to drill. The well water, except for a small stream, is returned to the wells at 55°F. This same system provides air conditioning over the summer with a heat pump located in each resident's room where the temperature can be adjusted to between 68° and 75°F.

Suspended above drop-ceiling tiles are either three or four-ton ClimateMaster TS units with copper-nickel heat exchangers. The majority of the units serve two bedroom areas. With the smaller systems, air movement is limited to two rooms, greatly reducing the threat posed by airborne pathogens. "I was skeptical at first," said Sid McDonald, director of facilities at MCNH. "The bugs got worked out the first year the system was in, and ever since then, it's been phenomenal."

Aquifer flow under MCNH was much better than expected. The flow of water in the wells is so steady, easily maintaining design temperature despite the influence of system geoexchange, that there's no need even for a five percent bleed-off of water. The supply of waterborne BTUs is so good that, for eight or nine months of the year, only 10 of the 16 wells are used. So, just to keep things equal in the wells, the system is set up to tap from different wells on a rotating basis year-round.

"It's really amazing how well the system has worked out, almost like a dream," said Skillings, President of Skillings and Sons, the drillers for the project. "By rotating wells, MCNH not only saves even more electric, but conserves pump life and the aquifers as well."

Source: (Based on article by Dan Vastyan, "Geothermal Think Tank Takes on the Extraordinary Job", Energy Systems, September, 2012.)

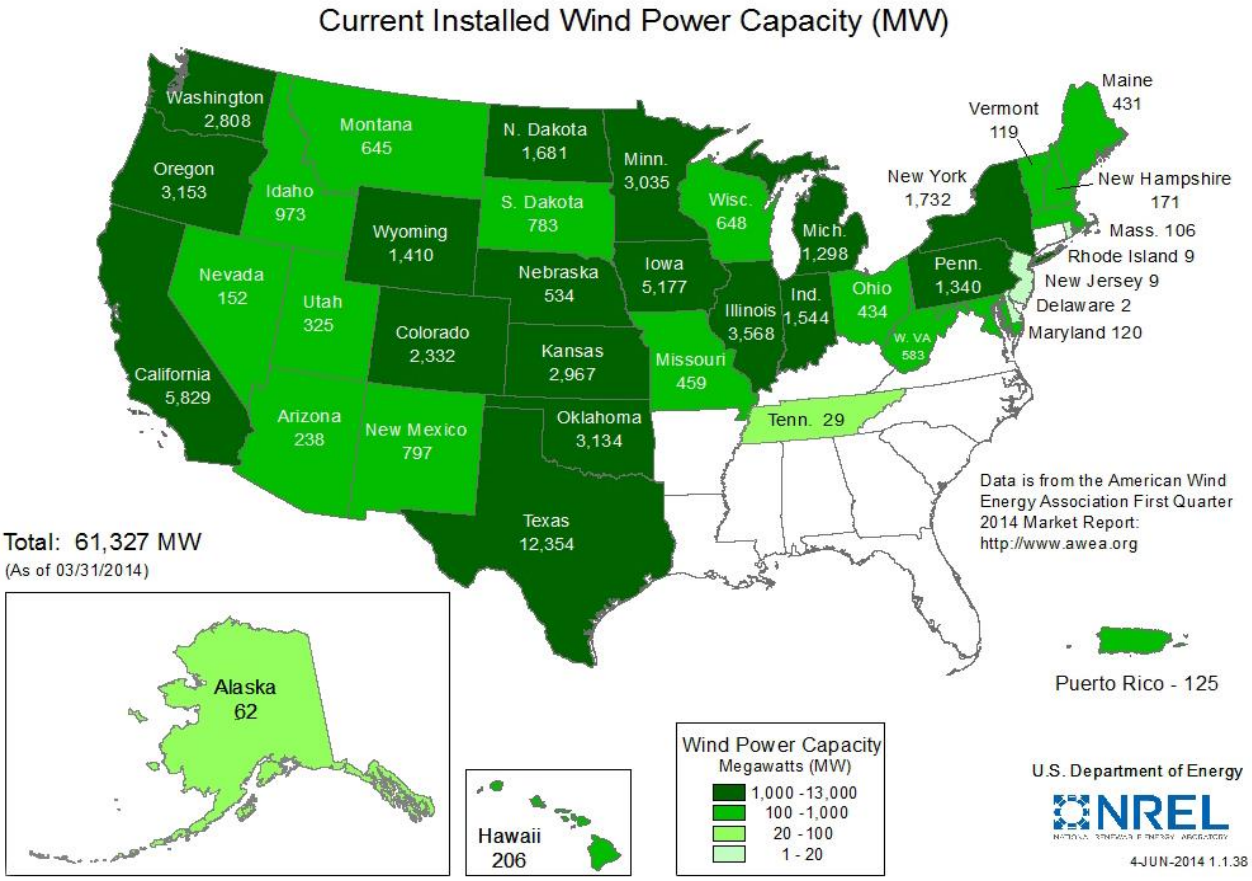
Wind Power

While New Hampshire may not have the wind power capacity or potential of other states (see map below), there have been three major wind projects approved by the state's Site Evaluation Committee (SEC) and others are in the queue. SEC functions as the state's pemitting authority for the review, approval, monitoring and enforcement of compliance in the planning siting, construction and operation of energy facilities. See www.nhsec.nh.gov/index.htm for more information on the Committee.

Most of the US wind power capacity is from Texas up to North Dakota and the west coast. While it is evident from **Figure 9.10** that New Hampshire certainly has wind power potential, viable sites for wind turbines exist mostly between 2,500 and 3,500 feet in elevation. Such locations, particularly those without existing development can be aesthetically or ecologically sensitive. While the "wind farm" development is an intensive undertaking, there have been advances in in community scale wind turbine

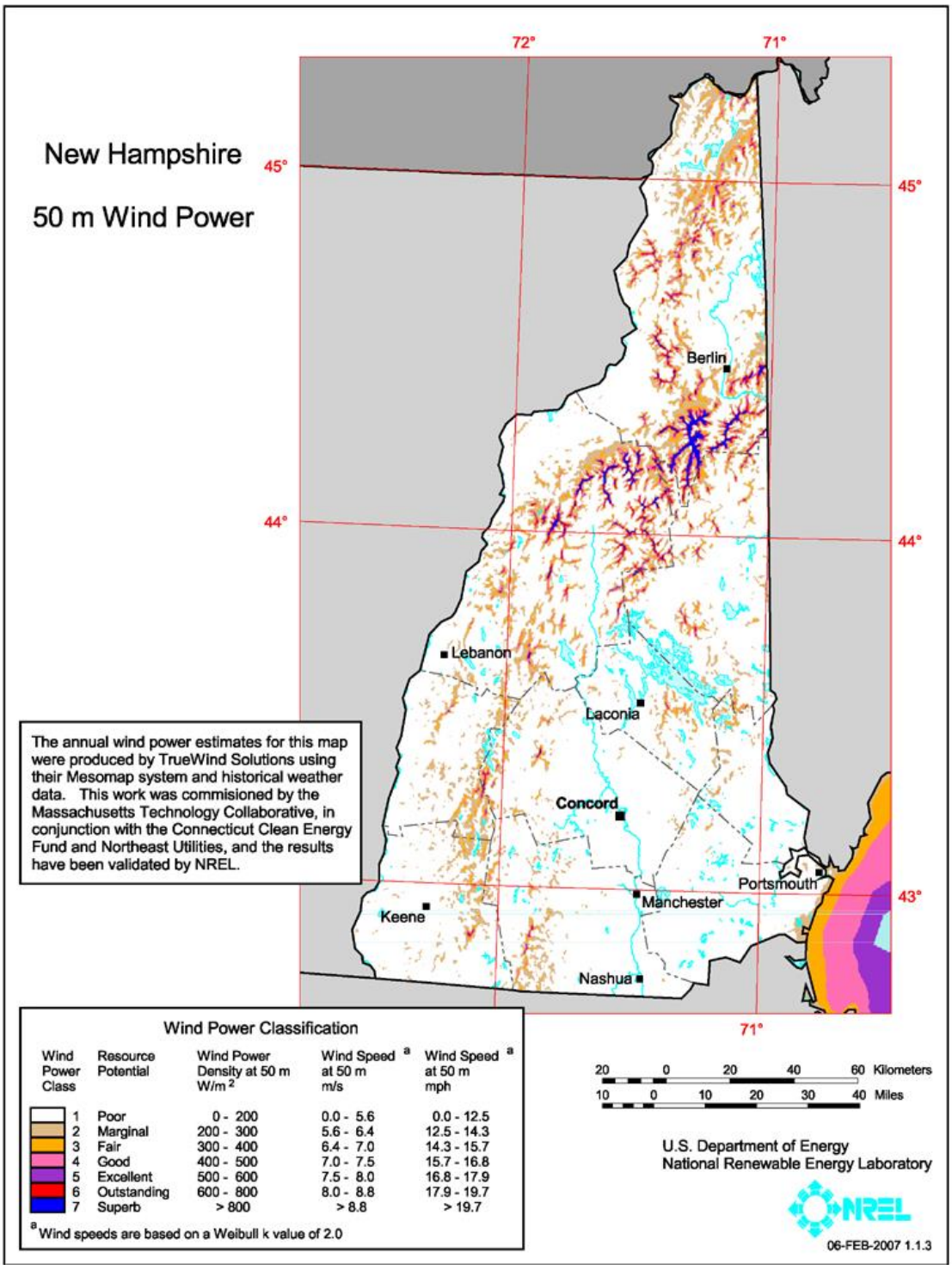
technology and the interest continues, albeit on a limited scale when compared to other renewables such as solar and biomass.

Figure 9.10: Current Installed Wind Power Capacity (MW)



Source: http://apps2.eere.energy.gov/wind/windexchange/wind_installed_capacity.asp

Figure 9.11: New Hampshire Wind Power



Source: http://apps2.eere.energy.gov/wind/windexchange/windmaps/community_scale.asp

Examining **Figure 9.11** above, it is evident that the areas with the most potential for large scale wind projects are in the western part of New Hampshire and in the White Mountains area – one viable reason for the three major wind projects currently in operation being located in Lempster, Groton and Dixville/Millsfield.

Hydropower

Hydropower, or hydroelectric power, is considered to be the most common and least expensive source of renewable electricity in the United States today. According to the U.S. Energy Information Administration, historically, all renewable electricity generated in the United States came from hydropower resources. In NH, close to 30% of renewable electricity is provided by hydropower.

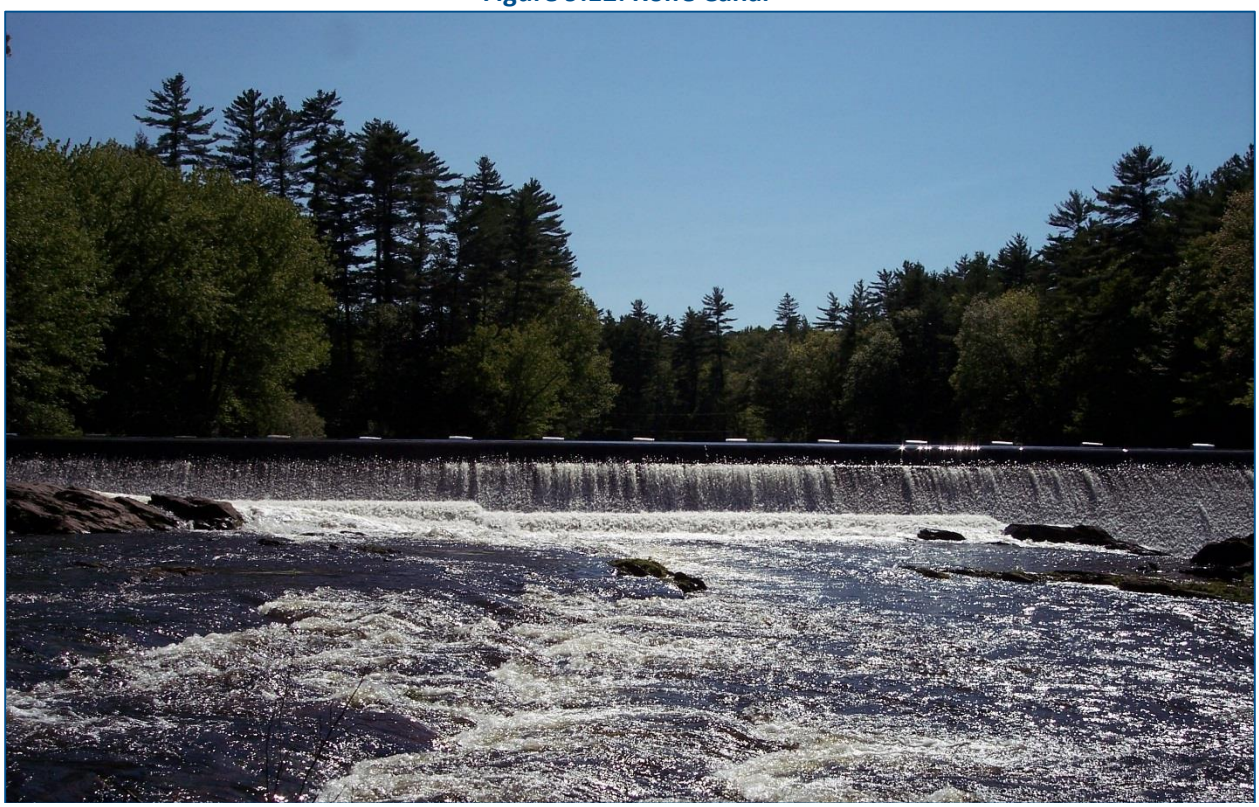
New Hampshire has a hydropower advantage for the simple reason that, broadly speaking, it is a river valley. Sixty-seven percent of the state is drained by the Merrimack River. Hydropower technologies use flowing water to create energy that can be captured and turned into electricity. There is a long history of hydro not only in the state but in the Central NH Region.

Below is a list of the current facilities operating in the Central NH Region.

Penacook – upper and lower falls located on the Contoocook River, operated by Briar Hydro Associates and certified by Low Impact Hydropower Institute (LIHI) through 2015. (2,800 kilowatts)

Rolfe Canal – operated by Briar Hydro Associates and certified by LIHI, the facility is located on the Contoocook River on the north end of Concord. Current certification expires in 2017. (4.28 megawatts)

Figure 9.12: Rolfe Canal



Source: Low Impact Hydropower Institute

Jackman Hydro – operated by Northeast Utilities, the parent company of PSNH, the facility is located in Hillsborough on the north branch of Contoocook River. (3.6MW)

Garvin Falls – operated by Northeast Utilities, the parent company of PSNH, the facility is located on the Merrimack River. (12.4MW)

The LIHI is a non-profit organization that focuses on the reduction of hydropower generation impacts through a certification process. Certification through the LIHI means that the hydropower facility has been found by the Institute to meet or exceed the Institute's Certification Criteria which address eight key areas: river flows, water quality, fish passage and protection, watershed protection, threatened and endangered species protection, cultural resource protection, recreation, and facilities recommended for removal. Certification is designed to provide consumers with assurance that a facility has avoided or reduced their environmental impacts pursuant to the Low Impact Hydropower Institute's criteria. Once certified, the owner or operator can market the power from the facility to consumers as produced by a LIHI Certified Facility. Certification from the Institute may also qualify the power produced for other "green" energy certification programs.

ENERGY STORAGE – the Potential Impact

There are many initiatives currently underway to develop new storage technologies to address the challenge of storing energy from intermittent sources such as solar, hydropower and wind. These new initiatives will eventually lead to better integration of renewable energy sources into the grid. Launched in 2009, the Department of Energy's Advanced Research Projects Agency – Energy (www.arpa-e.energy.gov/) is investing funds to further the study of projects/initiatives ranging from battery storage for transportation to grid-scale energy storage.

One statutory change that is favorable to small hydro facility owners is SB 218 that was signed into law June 19, 2012. The changes in Section 9 of the law allow hydro facilities of one megawatt or less that are connected to the grid to qualify for the state's RPS Program under Class IV (the class for existing small-scale hydropower), regardless of whether or not these facilities have fish passages. The Granite State Hydropower Association (GSHA) estimates that approximately 50 facilities totaling roughly 20 megawatts could potentially qualify statewide.

The Section 9 amendments increase the supply of Class IV RECs, making it easier for suppliers of electricity to purchase these RECs and thus avoid the potentially more expensive form of compliance, alternative compliance payments. The changes also allow more of the money spent on Class IV RECs to go to small-scale hydro facilities in New Hampshire.

ENERGY EFFICIENCY PROGRAMS AND RESOURCES

Many organizations as well as state and federal agencies provide numerous incentives and programs for citizens, businesses and local governments to take advantage of energy efficiency measures. While this list is by no means complete, there is an attempt to create a useful source for information on energy efficiency assistance.

CORE ENERGY EFFICIENCY PROGRAMS (NH Saves)

The CORE Electric Programs were funded initially by a portion of the System Benefits Charge (SBC) on customer's bills. The Programs represent a portfolio of cost-effective electric and gas programs available to all New Hampshire residents, businesses, municipalities, nonprofits, schools and

universities. Recently, the Programs have been supplemented by funds secured by the utilities from the ISO-New England's Forward Capacity Market, and the Regional Greenhouse Gas Initiative (RGGI). Funding for the Natural Gas Utility Programs is through the Local Distribution Adjustment Charge (LDAC) on customer's bills. These energy efficiency programs are administered by New Hampshire's four electric and two natural gas utilities and are intended to assist in making energy efficiency improvements by providing incentives for weatherizing homes, upgrading to more efficient lighting and appliances and purchasing high efficiency gas and hot water systems. Other programs, such as the Large Business Energy Solutions (200 kWh or more; 40,000 therms or more) and a Municipal and Small Business Program, offer incentives for high efficiency electric and gas technologies such as lighting, programmable thermostats, coolers, hot water measures, refrigeration, etc., and are available for businesses and municipalities retrofitting existing buildings, performing retrofits or new construction. There are also education/training opportunities on such topics as the energy code and energy audits.

One program of interest for municipal customers is PSNH' Smart Start Program. PSNH pays the upfront efficiency improvements and the customer pays over time with the savings obtained from the lower energy costs.

Following passage of SB 123 in 2013, the utilities were required to set aside $2 million dollars of the RGGI auction proceeds for a municipal program, including school systems. Following the program's development, letters were sent to municipalities in January, 2014. Utility representatives have contacted all community officials as of the writing of this Plan.

Prior to 2014, the utilities had completed $1.5 million in municipal energy efficient work each year; the dedicated $2 million is allowing them to now do more targeted outreach. The utilities are also supporting the Local Energy Working Group (LEWG), to conduct outreach to municipalities (www.nhenergy.org). Funds are available for municipal customers to assist in hiring a contractor to provide technical assistance to help identify energy efficiency improvement opportunities and to help communities manage a project, if there isn't capacity at the local level. Each utility may have funding via a revolving loan fund to assist municipalities in paying for the improvements. Websites for further information on some of the programs include:

- Energy Code Training: www.nhenergycode.com
- ButtonUp Workshops: www.myenergyplan.net/buttonup/
- Business Seminars: https://www.psnh.com/NewsEvents/Seminars.apsx

Associated Grocers of New England, Pembroke

Associated Grocers of New England (AGNE) was recognized by Food Logistics Magazine as one of the Top Green Providers for an LED lighting project that is saving the company significant energy costs. The project, managed by Leading Edge Design Group (LEDG), used best-in-class LED technology through Digital Lumens fixture upgrades that deliver intelligent light within the 380,000 square foot distribution center located in Pembroke which includes docking, cold storage, maintenance, dry goods and salvage.

The consultant worked closely with AGNE to complete extensive lifecycle and energy cost analysis efforts for the project, enabling AGNE to secure significant energy rebates and assisting them in realizing a one-year return on investment in upgrading from their previous T5 HO fluorescent lighting to the Digital Lumens Intelligent Lighting.

The first phase in the facility's 20,600-square-foot freezer storage was touted as a success, saving $52,000 in costs annually, along with a projected reduction in energy consumption of up to 90 percent.

For the second phase, the facility integrated the Digital Lumens Intelligent Lighting system, replacing fluorescent lighting throughout most of the 380,000-square-foot facility, including the docking, maintenance, dry goods, salvage and cold storage areas.

Energy rebates were granted for the project. LEDG worked with PSNH and the New Hampshire Pay for Performance Program, allowing AGNE to reach close to a one-year return on its investment. See the following statistics on this project:

- Energy Use Reduction: 1,654,000 kWh
- Annual Energy and Maintenance Savings: $190,044
- Annual Carbon Dioxide Reductions: 3.3 million pounds

REGIONAL GREENHOUSE GAS INITIATIVE (RGGI) FUND

In 2012 the General Court voted to modify the RGGI program and its associated revenue stream in New Hampshire. The law redistributes all future RGGI income that New Hampshire receives from the carbon allowance auctions from competitive grant programming administered by the Public Utilities Commission to, in part, ratepayers, with the remaining portion going into the existing CORE programs.

New Hampshire Pay for Performance

The New Hampshire Pay for Performance (NH P4P) is now in its third year of operation and is funded through RGGI. A recent extension of this Program was granted through state fiscal year 15. The goal of this Program is to address energy efficiency needs of the commercial, industrial and municipal sectors. TRC Energy Services administers the Program and has worked with 45 facilities across the state, totaling more than twelve million dollars in construction. Five projects funded in the Central NH Region include the Hopkinton School District with a heating system upgrade and boiler replacement, Pleasant View Center with lighting and heating upgrades, Comfort Inn with boiler upgrades and insulation and air sealing improvements, Associated Grocers of New England in Pembroke (see case study insert) and Bovie Screen Process Printing in Bow with insulation and lighting upgrades. There are many resources

available on the website, particularly in the area of audits that can be used as guidance for other communities seeking to pursue energy improvements/upgrades: www.nhp4p.com

Renewable Energy Fund (REF)

Since its inception in July 2009, the Renewable Energy Fund has established five grant and rebate programs that have seen substantial demand and growth over time. The newest rebate program is for commercial and industrial wood pellet/furnace program for non-residential wood pellet heating systems. For more information on the REF rebates, see www.puc.nh.gov/Sustainable%20Energy/SustainableEnergy.htm.

The REF has awarded 1,614 rebates for renewable energy systems, and provided New Hampshire homeowners, businesses, schools, municipalities, non-profit organizations and other eligible entities with $7,455,536 in funding towards these systems. In addition the PUC's competitive grant program has provided funding for renewable projects featuring technologies from biomass heating systems to hydroelectricity upgrades to photovoltaic, solar hot air, and landfill gas to energy, among others. In 2014, $3.8 million was awarded in grants. The ten projects funded include some of the largest solar projects to date and also include four biomass projects, two hydro, one wind and three solar projects. While none are located in the Central NH Region, they can certainly serve as models for future endeavors in this area. These ten commercial-scale renewable energy projects will move forward with grants ranging from $100,000 for biomass boilers at schools in Walpole and Charlestown to $1.2 million for the installation of a 950 kilowatt solar power array in Peterborough - by far the largest such array in New Hampshire. Among other grants, a $1 million award will help fund an 8.6 megawatt wind farm in Berlin, while a $300,000 grant will fund a biomass district heating system at the Holderness School.

COMMUNITY DEVELOPMENT FINANCE AUTHORITY (CDFA)

Municipal Energy Reduction Fund (MERF) and Better Buildings

These Programs are managed by the Community Development Finance Authority (CDFA) and are available to help municipalities improve the energy efficiency of their municipal buildings and operating systems. CDFA was awarded $1.5 million in funding from the Greenhouse Gas Emissions Reduction Fund, through the PUC to capitalize the MERF fund and to finance energy improvements to municipal facilities and activities.

Loans to municipalities are structured out of energy savings. The savings are calculated based on the last several years of energy usage and several years of future projected usage. The terms of the loans will be flexible and can be structured as a service contract if desired by the municipality. Eligible activities are improvements to HVAC equipment, air sealing and insulation in walls attics and foundations and installation of alternative energy sources.

Enterprise Energy Fund (EEF)

The Enterprise Energy Fund is another program managed by CDFA and is a low-interest, revolving loan fund available to businesses and nonprofit organizations to help finance energy improvements and renewable energy projects in their buildings. CDFA and its partners were initially awarded $3.5 million in American Recovery and Reinvestment Act funding through the New Hampshire Office of Energy and Planning, to capitalize a revolving loan fund, the Enterprise Energy Fund. An additional $3.1 million was approved in November 2010 for use only in commercial businesses. Funds will be loaned to businesses and nonprofits to reduce their energy costs and consumption; loan amounts can range from $10,000 to $500,000.

Examples of eligible activities include:

- Improvements to the building envelope, including air sealing and insulation in the walls, attics, and foundations;
- Improvements to HVAC equipment and air exchange;
- Installation of renewable energy systems;
- Improvements to lighting, equipment, and other electrical systems; and
- Conduction of comprehensive, fuel-blind energy audits.

CDFA administers the funds for medium and large nonprofits and commercial businesses. The Jordan Institute will conduct energy assessments and help borrowers make energy improvement decisions.

NEW HAMPSHIRE BUSINESS FINANCE AUTHORITY (BFA)

Business Energy Conservation Revolving Loan Fund

Administered by the BFA, loans are available to for-profit and non-profit entities to improve energy efficiency in New Hampshire work places. Some of the requirements for the program are a minimum loan amount of $100,000 with a term not to exceed five years. While no minimum collateral coverage is required, the BFA will seek a security interest in all assets being financed.

FEDERAL TAX CREDITS

Available at 30% of the cost, these tax credits are available with no upper limit through 2016 for existing homes and new construction for geothermal heat pumps, small residential wind turbines and solar energy systems. Installation costs on primary and secondary homes, excluding rentals, are eligible. For residential fuel cells and microturbine systems, 30% of the cost is eligible for the tax credit; there is a cap of up to $500 per 0.5 kW of power capacity and only primary residences can apply. All must meet energy star requirements in order to be eligible for the tax credit:

www.energystar.gov/index.cfm?c=tax_credits.tx_index.

USDA RURAL ENERGY FOR AMERICA PROGRAM

The USDA's mission for this program to aid agricultural producers and small businesses in rural areas to reduce their energy use and expand opportunities for renewable energy. The Program awards grants, guaranteed loans, or a combination of the two to a variety of projects. Eligible communities are those of less than 50,000 population and those not contiguous to a community of 50,000 or more. In New Hampshire, all communities would be eligible except Manchester, Nashua and any abutting communities. Recent awardees in New Hampshire include:

- Funspot, Weirs Beach - replaced all lighting for significant savings on electricity consumption
- EZ Steel and Fabrication, Bath - installed a geothermal heating system to replace a propane fired system
- Stuart and John's Sugarhouse, Westmoreland - purchased two reverse osmosis machines to make the production of maple syrup more energy efficient.
- Van Berkum Greenhouse, Deerfield - purchased energy curtain for greenhouse to reduce oil costs by limiting heat loss at night and blocking excessive heat buildup during the day
- Pleasant View Gardens, Pembroke - purchased a wood fired boiler system to replace an oil fired system that eliminated the use of #2 heating oil and provided significant cost savings.

Figure 9.13: Pleasant View's Pembroke Energy Plant

PROPERTY ASSESSED CLEAN ENERGY (PACE)

In 2010, House Bill 1554 was signed into law and allowed municipalities to establish energy efficiency and clean energy districts. Once a district is adopted by a municipality, an innovative financing tool called Property Assessed Clean Energy (PACE) comes into play. PACE enables municipalities to set up programs to fund energy improvements in commercial buildings and allows repayment of the investments through property "tax" assessments. It is important to note that the financing is tied to the property, not the building owner(s) and paying for investment through property taxes can allow for more affordable and longer term paybacks.

Since its adoption in 2010, concerns were raised by federal housing authorities regarding lien positions on residential mortgages. The 2014 amendments to this original legislation address many of these concerns by focusing the program on commercial buildings and clarifying lien positions by requiring agreements between all parties (municipality, mortgage lienholder, property owner and PACE lender). The cap on commercial projects in the original legislation ($60,000) is also revised, now increasing the project size cap to $1 million or 35% of the property and building assessment if the financing comes from the municipality; privately financed projects have no cap. The amendment also allows financing sources to include banks, financial institutions or private investors. It is important to note that municipalities can designate a partner to administer this program as it does have some complexity to it. For more information, see the Jordan Institute's website: www.jordaninstitute.org.

SCHOOL ENERGY EFFICIENCY PROGRAMS

Unfortunately, the New Hampshire Energy Smart Schools Program is now discontinued but the Department of Education will certify buildings should funding be secured from other sources. In New Hampshire, eleven high performance schools have been built. Three of these schools are in the Central NH Region – Mill Brook Primary School, Christa McAuliffe Elementary School and Abbott-Downing Elementary School, all located in Concord.

St. Paul's School, Concord

In 2011, St Paul's School was recognized by the Northeast Energy Efficiency Partnership (NEEP) as an Energy Efficiency Leader in its Leaders Recognition Program. Over the last few years, the School has taken several steps to reduce its electricity and heating costs. Working with Unitil, its energy provider, St. Paul's has undertaken several initiatives that have resulted in a reductions of campus energy use by 1.5 million kilowatt hours since 2006. In 2010, the School expended $150,000 in energy efficiency measures and received over $53,000 in rebates. Some of the improvements include:

- Lighting replacements and associated controls at the Gymnasium, Hockey Center and other athletic facilities.
- Upgrades at the Hockey Center with an innovative refrigeration system that reduces energy use in the building by 30%.
- Retro-fitting the central boiler to now use natural gas as an alternate heating source instead of oil.
- Window replacements in several School buildings and faculty residences.
- The Math and Science Building and Athletic Center were designed to LEED standards; faculty residence renovations have also been designed to these standards.

PRIVATE INVESTMENT FUNDING

Besides reliance on the building owner financing the improvements, there is another type of underwriting for larger commercial buildings/owner through an Energy Services Company (ESCO). ESCOs generally guarantee the energy savings and make the upfront investment in energy efficiency.

ENERGY SERVICES COMPANIES OVERVIEW (ESCO)

With a service contract usually between 7 to 20 years, ESCOs have the responsibility for turn-key project development, as well as the technical and performance risks. In addition, the ESCO may make recommendations for retrofits, maintenance services and training, or other conservation measures.

ESCOs have many different corporate and ownership structures; some are large engineering or equipment manufacturers while others may be subsidiaries of oil and gas companies or non-regulated energy suppliers. It is also common for regulated utility companies to own an ESCO.

ESCOs typically engage clients through Energy Performance Contracting (EPC) where the ESCO assumes performance risk, guaranteeing a minimum amount of energy-use reduction. EPCs address the main issue that tends to prohibit facility owners from investing in energy efficiency projects—an inability to guarantee savings and a return on capital investments. The MUSH (Municipal, Universities, Schools and Hospitals) market has been "fertile ground" for ESCOs for many years and often uses energy performance contracts to implement projects.

When an ESCO undertakes a project, the company's compensation, and often the project's financing, is directly linked to the amount of energy that is actually saved. The comprehensive energy efficiency retrofits inherent in ESCO projects often require a large initial capital investment and offer a relatively long payback period. Debt payments are tied to the energy savings offered under the project so that the

customer pays for the capital improvement with the money that comes out of the difference between pre-installation and post-installation energy use and other costs

THE POWER PURCHASE AGREEMENT (PPA)

Renewable energy projects are typically financed separately from energy-efficiency projects, often involving some form of bonding or other debt obligation. However, ESCOs and other providers are offering another tool for financing renewable energy projects: the power purchase agreement (PPA).

PPAs facilitate the financing and implementation of onsite energy installations. An independent power producer, or provider, and a private entity, or buyer, enter into a contract where the provider finances, builds, operates, and maintains a renewable energy system located on the buyer's property and sells back the generated energy. PPAs are contracts in which the service provider pays for 100% of the costs for purchasing, financing, installing, and operating and maintaining a renewable energy system. The developer or an independent financier will own the system itself, while the client makes regular, contractually defined payments to purchase the measurable output of energy from the system. After a set contract term, ownership of the system typically transfers to the client, with all costs for the system plus profit paid to the provider from the regular payments for the energy.

For an institution with a tight budget, the PPA approach can be attractive. Typically, no down payment is required and the PPA shifts the system's performance risk from the client to the service provider. PPAs can also be considered off-balance sheet investments as the building owner does not hold title to the equipment, and payments are made through the operating budget

One reason for utilizing a PPA structure is to capture financial benefits provided by local utilities and tax incentives provided by local, state, and federal governments. Many of these mechanisms are unavailable to public and non-profit entities as they require taxable income from which to deduct renewable energy system project costs. Therefore, a PPA structure in which a school utilizes a for-profit company as the purchaser, installer, operator, and maintainer of the system allows capture of the tax incentive benefits by the for-profit entity.

STATE ENERGY POLICY INITIATIVES

While many energy issues are outside of the state's direct influence, there are several key areas where the state can focus its attention and impact policy that has a direct connection to energy costs and diversifying fuel supply. Awareness of state policies and how they can influence local energy planning and available program/project development is important as the region and its communities strive to achieve more energy efficiency.

STATE ENERGY STRATEGY (SB191)

An Advisory Council was tasked with developing a revised 10-year statewide energy strategy, the aim of which is to provide forward-looking guidance on electric, gas, and thermal energy strategies and optimize the ready availability of energy supply, energy affordability, the state retention of energy expenditures, jobs, and the use of renewable energy sources and energy efficiency policies, including demand-side policies.

The four main categories that frame the energy strategy are:

- Advance electric grid modernization;
- Increase investments in cost effective energy efficiency;

- Diversify fuel choice; and
- Increase transportation options.

More detail on the recommendations is available at:

www.nh.gov/oep/energy/programs/documents/energy-strategy.pdf

ENERGY EFFICIENCY RESOURCE STANDARD (EERS)

An EERS establishes specific targets for energy savings that utilities or non-utilities must meet through customer energy efficiency programs. Currently, New Hampshire is the only state in the northeast with no EERS or its equivalent. Nationwide, twenty-six states have an EERS with the strongest requirements in Massachusetts, Rhode Island and Vermont, which all require close to 2.5% savings annually. A long standing recommendation of earlier studies in New Hampshire, there is currently a project underway by the PUC to draft an EERS.

OTHER INITIATIVES

NET METERING

The Public Utilities Commission allows net metering which permits homeowners to receive credit for on-site electricity generation such as from a solar photovoltaic (PV) or wind turbine installation when the generation exceeds household or business consumption. This is accomplished by use of an electric meter that can run both forward and backward so that the host is billed only for the net reading on the meter. The 2012 data shows that over 1,000 installations have taken place through the four utilities, with the most by PSNH.

BUILDING ENERGY CODE

The New Hampshire State Building Code for residential and commercial buildings is now the 2009 International Energy Conservation Code (IECC). A part of the overall building code, the energy code establishes minimum requirements for energy efficient design and construction for both new and renovated buildings. By establishing the minimum requirements, the codes set the baseline for energy efficiency in new construction and major renovations to which further design upgrades and strategies may be compared. A structure built to the 2009 energy code requirements will be 14% more energy efficient than one built to the 2006 code. Likewise, the 2012 code represents a 30% improvement in energy performance over the 2006 code. These represent incremental steps toward the goal of net zero buildings by 2030. Only Durham has adopted the stricter 2012 code in New Hampshire.

Reducing energy usage in New Hampshire buildings is the main goal behind the NH Building Code Collaborative. The Collaborative has its roots in the ARRA Program's Energy Code Challenge and is presently still in operation. The goal of the Collaborative is to achieve 90% building code compliance by

Group Net Metering

Recently allowed by the PUC, this is a type of metering that allows a group of customers to combine meters as a single billing and to join together to offset their electric bill as a new metered system. While it works similar to net metering, group metering allows one generating source to share the generation with a group of customers within the same utility service area. The benefit of group net metering is that one resident, who may have the ideal location for solar, can now share the renewable energy, and costs, with others.

2017. It is estimated that New Hampshire is now at <50% compliance. The mission of the Collaborative is to bring training resources to local code enforcement officials- educational programs. There are online resources available at www.nhenergycode.com as well as publicized training events statewide. The PUC also has resources available to help answer questions and functions as a reviewer should a municipality not have a code enforcement official.

In New Hampshire, residential and commercial buildings represent 50% of the state's total energy consumption. New Hampshire buildings use more energy and emit more carbon dioxide than either the industrial or transportation sectors. (Source: New Hampshire Baseline Residential and Commercial Construction Activity and Associated Market Actors Characterization prepared by GDS Associates, March 2011: www.nhenergycode.com/live/code_docs/roadmap/APPENDIX%20A%20-%20NH%20Baseline%20Construction%20Activity%20and%20Market%20Characterization%20Report%20-%20March%202011.pdf.

The following table from the GDS Report on Building Energy Code, March 2011, shows that statewide, hospitals/clinics, retail, and schools/colleges are the greatest contributors to high levels of energy consumption per square foot. Hospitals/clinics are within the top three for eight out of New Hampshire's ten counties. Retail is within the top three for six out of ten, and schools/colleges are present in every county's top three.

Table 9.3: Top Contributors to Increased Energy Consumption, 2006-2009 – by County

County	Total Increase in Energy Consumption (MMBTUs)	Top Contributors to Increased Energy Consumption (percent of county total)
Rockingham	578,269	Retail (24.2%), Hospitals/Clinics (18.2%), Schools/Colleges (12.3%)
Strafford	416,124	Hospitals/Clinics (38.7%), Schools/Colleges (15.1%), Offices (13.0%)
Grafton	373,738	Laboratories (33.3%), Hospitals/Clinics (23.1%), Schools/Colleges (11.6%)
Hillsborough	312,438	Retail (32.3%), Hospitals/Clinics (20.6%), Schools/Colleges (15.9%)
Coos	269,416	Police/Courthouse/Prison (82.3%), Schools/Colleges (7.4%), Retail (6.5%)
Merrimack	228,704	Retail (27.9%), Schools/Colleges (19.2%), Hospitals/Clinics (16.9%)
Belknap	142,963	Hospitals/Clinics (31.9%), Retail (25.9%), Schools/Colleges (17.1%)
Cheshire	117,197	Police/Courthouse/Prison (26.7%), Schools/Colleges (22.5%), Office (11.7%)
Carroll	110,428	Hospitals/Clinics (28.9%), Retail (27.0%), Schools/Colleges (18.5%)
Sullivan	75,770	Retail (17.0%), Hospitals/Clinics (10.4%)

In 2011, GDS surveyed 173 members of the state's building code association to ask a series a questions related to barriers to code compliance. The top three barriers to code compliance that were identified are:

- → Inadequate education and accessibility to resources
- → Lack of accessible training
- → Lack of guidance documents readily available to the building community

Another interesting result of the survey was the collection of information regarding the years of experience for code enforcement officers. Survey results indicated that the majority of code officials (53%) reported having 1-7 years of experience while 21% each reported having between 8-14 years and

more than 15 years' experience. respectively. Around five percent reported less than one year's experience.

2030 Challenge Initiative

The 2030 Challenge Initiative is an initiative that has received the endorsement of the American Institute of Architects (AIA) and its 80,000 member and many organizations, including the National Conference of Mayors. The 2030 Challenge asks the global architecture and building community to adopt the following targets:

- All new buildings, developments and major renovations shall be designed to meet a fossil fuel, greenhouse gas (GHG) - emitting, energy consumption performance standard of 60% below the regional (or country) average/median for that building type.
- At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 60% of the regional (or country) average/median for that building type.

The fossil fuel reduction standard for all new buildings and major renovations shall be increased to:

- 70% in 2015
- 80% in 2020
- 90% in 2025
- Carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate).

These targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy.

ENERGY EFFICIENCY WORK IN AND AROUND THE CENTRAL NH REGION

LOCAL ENERGY COMMITTEES

There are currently eight Local Energy Committees (LECs) in the Central NH Region– Bow, Henniker, Hopkinton, Dunbarton, Concord, Warner, and Webster. The newest Committee just getting started is in Pembroke. Some Committees are working on energy chapters in master plans, inventories or audits of municipal buildings and/or moving forward with specific projects such as wood pellet boilers for public facilities. When more funds were available under the ARRA Program, CNHRPC was engaged in discussions with many LECs in the region as part of the Roundtable that was organized to coordinate the work of the LECs in the region. (See page 10.39 for a summary on the specifics of the Energy Technical Assistance Program – ETAP).

Two communities have moved forward with this earlier work and adopted energy chapters – Warner and Concord. Two other communities currently have draft chapters, and Henniker is pursuing the development of its energy chapter.

LEED CERTIFIED BUILDINGS IN CONCORD

The U.S. Green Building Council's LEED (Leadership in Energy & Environmental Design) Certification program provides third-party verification of green buildings. LEED-certified buildings satisfy prerequisites to achieve different levels of certification. Prerequisites and credits differ for different LEED rating systems.

There are currently ten certified building in the Central NH Region, all located in Concord. They include the SMILE! Building, Primex addition, St Paul's Athletic Center, Audubon Society of NH, Society for the Protection of NH Forests (SPNHF), North Branch Construction headquarters and the federal Readiness Center– check the US Green Building Council's website for more data and the full listing at www.usgbc.org

LOCAL REGULATIONS

→ RSA 72:61-72 enables municipalities to provide exemptions from local property taxes for specific renewable energy installations (solar, wind and wood). The purpose of this law is to remove any disincentives for the property owner to install a renewable energy system.

Close to 50% (9) of the Central NH Region's communities have enacted renewable energy exemptions:

Table 9.4: Communities That Enacted Renewable Energy Exemptions

MUNICIPALITY	SOLAR	WIND	WOOD
Bow	√		√
Canterbury	√		
Chichester	√		√
Deering	√		
Hillsborough	√	√	√
Hopkinton	√		
Henniker	√	√	√
Warner	√	√	
Webster	√		

→ In 2008, the legislature enacted RSA 674:63 that gave authority to municipalities to regulate the construction of small scale wind turbines up to 100 MW. Eight communities in the Central NH Region have small wind turbine ordinances – Boscawen, Bow, Concord, Dunbarton, Epsom, Hillsborough, Hopkinton and Loudon. To date, no applications have been received.

MASTER PLANS

As mentioned previously, 35% or 7 of the communities in the Central NH Region support and encourage energy conservation and efficiency with specific goals and/or policies in their master plans. They include:

Allenstown, 2003

To expand the list of utility providers to create options for Allenstown residents when choosing energy options.

Bradford, 2004

Explore methods to encourage energy efficient housing construction.

Concord, 2008

To promote energy conservation and efficiency of the housing stock including the use of new technology, reduction of demand for heating fuel, electricity, and potable water.

To promote energy conservation and efficiency for economic development including the use of new technology, reduction of demand for heating fuel, electricity, and potable water.

To encourage Concord residents, businesses and institutions to reduce their carbon footprint

To promote regulations and policies that support sustainable land use.

To maximize energy conservation and efficiency in the City of Concord in both the private and public sectors to promote a sustainable future for Concord.

Loudon, 2001

To encourage energy-conservation methods and design for the construction of new homes and for the rehab of existing homes, using solar energy and energy-efficient materials.

Pittsfield, 2009

To address the concerns of energy and transportation costs with creative approaches that address the long range need for municipal transportation.

Salisbury, 2007

To encourage energy conservation construction and design for new homes and for the rehabilitation of existing homes.

Warner, 2011

To support energy-efficient home design and construction, including the use of on-site renewable energy production.

To offer incentives for energy efficient, environmentally sound commercial development.

To look for opportunities to improve energy efficiency and reduce energy costs when making building improvements.

To develop strong regulatory tools that promote energy conservation, efficiency, and renewable energy production.

To encourage land use patterns that minimize energy use, such as denser mixed use nodes and the development of a multi-modal transportation network.

To encourage and provide educational resources for residents to reduce private energy consumption.

To promote Warner as an energy conscious community to attract environmentally responsible commercial and residential development.

WASTEWATER SYSTEMS AND ENERGY EFFICIENCY IN THE CENTRAL NH REGION

There are several wastewater systems in the Central NH Region and these facilities are often a large consumer of energy as part of their operations. According to the Department of Environmental Services (DES), of the seven operating treatment facilities in the region, five have undergone energy audits (see **Table 9.5** for the summary).

Table 9.5: Status of Energy Audits at Wastewater Treatment Plants

Facility	Municipal Serviced	Energy Audit Status	Energy Improvements to Date
Allenstown	Allenstown Pembroke	No audit	VFDs installed, SCADA process control for DO. DO and ORP monitoring conducted.
Concord	Concord Bow	Detailed Process Audit	Lighting, motion sensors, energy management system for HVAC and solar water heater, staff training, process control with DO turndown, energy star roofing, energy efficient boiler
Henniker	Henniker	Lighting, Envelope and HVAC audit	Lighting, VFDs, weatherization and motion sensors. Process level audit next.
Hillsborough	Hillsborough	Lighting and Electrical Audit	No improvements to date
Hopkinton	Hopkinton	Lighting Audit	None to date
Penacook	Concord Boscawen	Detailed Process Audit	Lighting, VFD's on most pumping systems, process control with DO turndown, energy management systems, energy efficient boiler
Pittsfield	Pittsfield	Lighting/HVAC audit	Lighting and weatherization installed; solar mixes in lagoons
Warner Village	Warner	Lighting/HVAC audit	VFD's installed, implementing audit findings

VFD = variable frequency drive
SCADA = supervisory central and data acquisition system
DO = dissolved oxygen
ORP= oxidation-reduction potential

DES offers a loan program available - the Clean Water State Revolving Loan (CWSRF) that offers principal forgiveness as a way to encourage loan recipients to perform detailed process level energy audits at their facilities. Up to $20,000 of principal forgiveness is available for a loan taken out for any eligible project. There is a template for an RFP available on DES's website at: www.des.nh.gov/organization/divisions/water/wweb/grants.htm. There is also a loan forgiveness program available for asset management programs for up to $30,000.

ENERGY TECHNICAL ASSISTANCE PROGRAM IN THE CENTRAL NH REGION

Much of the municipal work on energy efficiency in New Hampshire and the Central NH Region was completed under the ARRA funded Energy Technical Assistance Program (ETAP) administered by the Office of Energy and Planning. It stimulated much interest in energy efficiency projects.

Audits were also conducted through the Local Energy Audit Exchange Program, with Canterbury's Municipal Building, Chichester's Safety Building, Pembroke's Library, Safety Center and Perry Eaton Building and Hopkinton's Middle School.

Energy Technical Assistance Program - ETAP

This was an ARRA funded program that ended in 2012. The goal of ETAP was to offer technical assistance to all New Hampshire communities and counties to improve the energy efficiency of its municipal and county buildings. The program was designed to assist communities in identifying potential energy efficiency projects through energy inventories and building assessments, and to provide specific guidance to move projects forward to initiation and completion. Two million dollars was allocated for this phase of the Program; additional funds were available to implement any identified projects and was administered by OEP. The nine regional planning commissions performed two roles; facilitating the outreach to communities for this grant and providing technical planning assistance, such as writing energy chapters of master plans, conducting regulatory audits and helping municipalities compile inventory data. In the Central NH Region, 16 of 20 communities participated in the ETAP. Statewide, over 50% of communities and counties participated in the Program. Warner and Concord now have adopted energy chapters and two other communities, Boscawen and Allenstown, have draft chapters completed by CNHRPC staff under this Program.

Table 9.6: Communities Participating in in ETAP

Municipality	# of Buildings Assessed	Other Technical Assistance
Allenstown	4	RPC Energy Chapter
Boscawen	5	RPC Energy Chapter
Bradford	2	
Bow	5	
Chichester	1	Building Use Review
Concord		RPC Master Plan Asst.
Deering	2	
Dunbarton		Energy Inventory Tool
Hillsborough		Energy Inventory Tool
Hopkinton	4	RPC Regulatory Audit
Loudon		RPC Master Plan Asst.
Pittsfield		Park and Ride Engineering Study
Salisbury	2	
Webster	2	

ENERGY EFFICIENCY AND PUBLIC SENTIMENT IN THE CENTRAL NH REGION

What we found out from listening sessions, surveys and local master plans:

- At listening sessions, energy efficiency did not register as a stand-alone comment from people providing input on what they appreciate about the region and want to see improved.
- 35% of master plans in the region have goals that support and encourage energy efficiency and conservation.
- A random, statistically-significant UNH telephone survey of Central NH Region and Lakes Region residents indicates 90% of people surveyed want the local and state government to get involved with energy efficiency policies and regulation
- Support for energy efficiency as an investment of public dollars was second only to environmental protection.

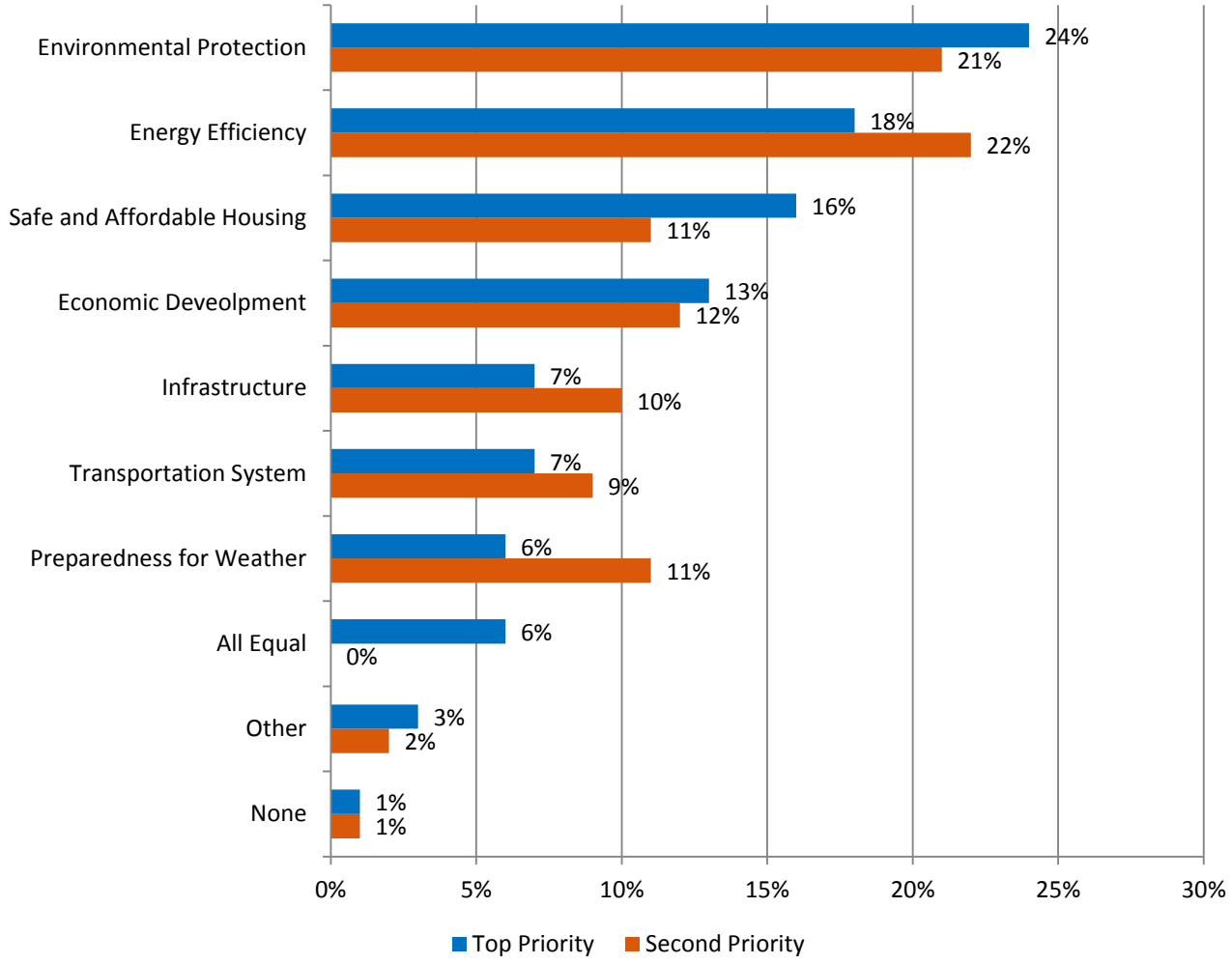
As mentioned above, the extensive public input for the Regional Plan included a 2013 telephone survey conducted by the University of New Hampshire (UNH) Survey Center for the nine regional planning commissions that gauged residents' opinions on a range of issues, including energy.at gauged residents There were some specific questions regarding energy policies and initiatives; two were asked of Central NH Region and Lakes Region residents and one was a statewide question. Overall, the UNH Survey results for the Central and Lakes Region (combined to ensure statistical confidence levels) show results very similar to the statewide results.

Residents view energy efficiency and energy choices as the second most important priority for investing public dollars. Residents are largely in favor of all the proposed energy efficiency and renewable energy projects, except for the concept of having public charging stations made for electric vehicles. Below is a summary of the specific energy related questions.

Investment of Public Dollars

Residents' top priority for investing public dollars is environmental protection (23%), followed by energy efficiency (17%), safe and affordable housing (17%), economic development (13%), transportation (7%), infrastructure (7%), preparedness for weather (6%), all priorities are equal (6%), something else (3%) and none of the above (1%).When the top two responses are combined environmental protection (42%) and energy efficiency (37%) are the two most cited priorities.

Figure 9.14: Priorities for Investing Public Dollars



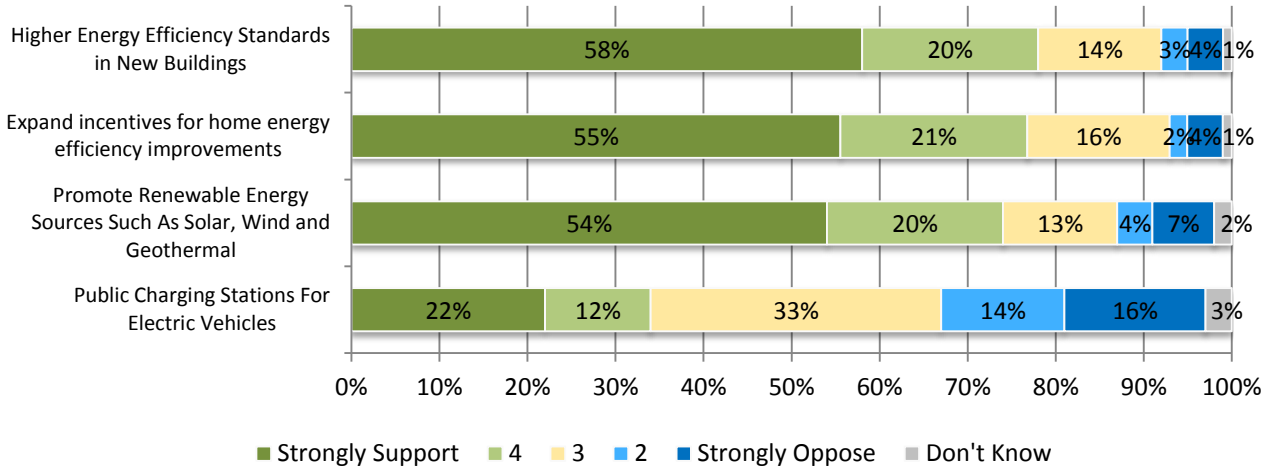
Source: New Hampshire Regional Planning Commissions, A Granite State Future 2013 Statewide Survey Central & Lakes Region Report. July 2013

Energy Policies

A large majority of residents (78%) support higher energy efficiency standards in new buildings (with 58% who "strongly support"), followed by expanding incentives for home energy efficiency improvements (76%), and promoting renewable energy sources such as solar, wind and geothermal (74%). Meanwhile only 34% were in support of public charging stations for electric vehicles.

- Households earning between $40,000 and $59,999 and those aged 60 to 69 and those who work at home are *more likely* to strongly support higher energy efficiency standards in new buildings and incentives for home energy efficient improvements.
- Those with a high school education or less and those who are not employed are *more likely* to strongly support public charging stations for electric vehicles.
- Households earning between $40,000 and $90,000 and those aged 60-69 are *more likely* to strongly support promoting renewable energy sources.

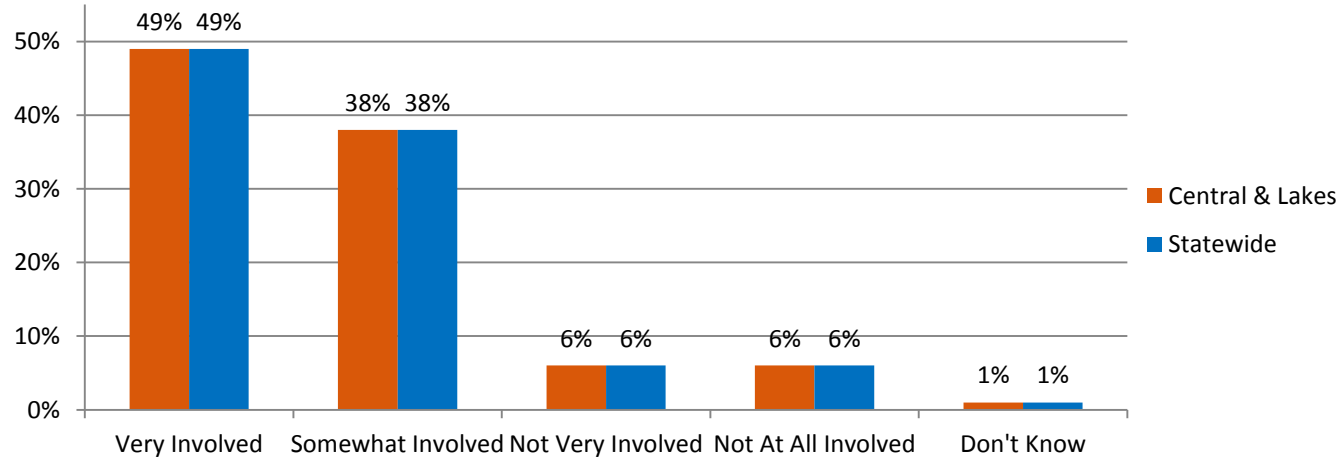
Figure 9.15: Support/Oppose Energy Policy Changes



Source: New Hampshire Regional Planning Commissions, A Granite State Future 2013 Statewide Survey Central & Lakes Region Report. July 2013

Almost half of residents (49%) think that local governments should be very involved in guidelines for renewable energy (such as large wind farms), 38% think they should be somewhat involved, 6% think they shouldn't be very involved, 6% think they should be not at all involved and 1% don't know.

Figure 9.16: How Involved Should Local Governments Be In Guidelines For Renewable Energy?



Source: New Hampshire Regional Planning Commissions, A Granite State Future 2013 Statewide Survey Central Lakes Region Report. July 2013

What we can conclude is that energy efficiency is strongly supported by the local citizens in the region. As a regional planning commission, there are opportunities to support energy efficiency initiatives and planning activities that can create greater awareness and opportunities for local officials and local residents on what can be done to encourage/promote energy efficiency initiatives in our communities.

IMPLICATIONS FOR LOCAL/REGIONAL PLANNING: CHALLENGES AND OPPORTUNITIES

There is strong, broad-based support for energy efficiency in the Central NH Region. This is the most critical cornerstone to building the vision and implementation recommendations for this Chapter.

New Hampshire is known for its tradition of local control in land use development and as such, planning efforts that are sensitive to energy issues have their roots at the local level. Communities that support energy efficiency efforts also support sustaining settlement patterns that reduce transportation infrastructure, conserve natural resources and promote open space protection. Zoning controls the type and density of development and promoting more compact development furthers these efforts.

As stated earlier in this Chapter, transportation is the leading source of energy use in the region. While the region's older villages continue to serve as a node, and a model, for pedestrian friendly designs, residents also feel a strong connection to the rural character of the Central NH Region, often cited by residents as what they value the most. While it is possible to accomplish both compact design and maintaining rural character, there can be challenges that arise and need to be addressed.

There is also the increasing concern for the aging population at both the regional and state levels and its impacts on our abilities to reach destinations - for recreation, health care and social services. This has a direct correlation to the land use patterns and infrastructure of our communities and how we need to get from point A to point B. As New Hampshire's population continues to age, more compact development and transportation challenges also become pressing critical needs in many of our communities. The link between energy efficiency and transportation is a strong one and has a long history of initiatives in the Central NH Region.

Many of Central NH's communities have identified energy efficiency goals in their master plans ranging from supporting energy efficient home design and construction, including the use of on-site renewable energy production (Warner) to addressing the concerns of energy and transportation costs with creative approaches that address the long-range need for municipal transportation (Pittsfield). As renewable energy sources become more accessible, citizens and community officials need to carefully assess the needs for energy and balance this with the prevailing land use patterns in the community. Renewable energy sources presently make up approximately 7% of the electricity used. As tax credits, rebates and other incentives continue to evolve and hopefully stabilize with a consistent funding stream, it is expected that renewable energy installations will become more prevalent. While there are certainly challenges that still need to be addressed, there are also opportunities to improve on the status quo.

> An important point to remember about energy efficiency measure is that, even if individuals aren't actively pursuing energy efficiency improvements or conservation measures themselves, we all benefit from others' efforts as a reduction in energy consumption leads to lower energy rates due to load reduction and deferred investments in transmission and generation.

CHALLENGES AND OPPORTUNITIES

Many of the challenges identified in this Chapter focus on resources and funding. While there are numerous energy efficiency rebate programs, trainings and free software available, it is often difficult for local officials and volunteer board members to wade through the pages of information on numerous websites. There is a need to better align and coordinate programs so that it is easier to understand what the resources are and where to go for incentives, financing and technical assistance. For example, in order to pursue improvements in energy code compliance, a robust training and education program needs to be available consistently

so that there is access to help when issues or problems arise. As mentioned earlier in this Chapter, there is also state level work that needs to be done on overcoming market barriers in the energy efficiency field.

Capacity

The majority of communities and small businesses in the Central NH Region often cite the lack of time and technical resources as obstacles to addressing energy efficiency. Everyone agrees that starting the foundation of improving energy efficiency begins with the development of a plan, but the staff resources needed to take on the tasks associated with this plan are often lacking.

According to the final evaluation conducted for the ETAP project, the technical assistance from regional planning commission staff was identified as the most valued outcome of this effort. Along with technical assistance, the second most valued assistance was the collection of the building energy information for the inventory. Implementation challenges identified from the recommendations was heavily weighted towards the inability to secure funding for the improvements and lack of staff resources to devote to the projects. Additional help from the regional planning commission staff and from others in finding funding was also identified as a critical need.

We need to find creative ways to address this issue. Some of the recommendations at the end of this chapter represent the beginnings of seeking a solution to this issue.

Building Code Education and Enforcement Gaps

As noted earlier in this Chapter, there is a continuing need for more training and education in this area. Many building inspectors are part-time or are at capacity with other demands on their time. Easily accessible, on demand training is needed across the region. Finding ways to support and connect inspectors/code enforcement officials for more peer-to-peer training also needs to be addressed.

Tracking Energy Use: Keeping Municipal Costs Down

Audits, inventories and benchmarking are good places to start when energy efficiency is your goal. Municipal energy use tracking and facility/infrastructure inventories can offer a wealth of information about energy use, types of energy used, and the efficiency of New Hampshire's rich inventory of municipal historic properties and what communities are doing to preserve them.

Tools currently available include the Small Town Carbon Calculator (STOCC) developed by UNH and Clean Air-Cool Planet that can total energy use and costs and the Portfolio Manager developed by EPA that tracks energy trends and reports for buildings and water utilities over multiple years (http://www.nhenergy.org/calculators.html). Many communities struggle with this phase and need consistent assistance in accomplishing this task.

Reducing Transportation Emissions in a Rural Region

Transportation use is one of the biggest consumers of energy in the region. In a mostly rural region, with dispersed settlement patterns outside of villages and downtowns and limited transit service, finding creative solutions to reducing energy usage is a challenge. The transportation sector impacts overall air quality as well as energy consumption. According to the Granite State Clean Cities Coalition (GSCCC), more than 50% of the air pollution in New Hampshire and the northeast is generated by the transportation sector. There are many initiatives currently in operation that work on the reduction of vehicle miles traveled and increased efficiencies in transportation. Programs such as the GSCCC, Commute Green and the Volunteer Driver Program are all necessary and need to continue to grow in order to ensure greater stability for our transportation future.

Financial Incentives

The number of programs/incentives that are available in New Hampshire often is a source of confusion for businesses and residents trying to take advantage of rebates or financing options. While there has certainly been a decrease in funding sources since ARRA funding has expired, the fractured number of programs and no one source for information on funding opportunities and rebates is a challenge.

There is also the concern of sustainable, consistent funding sources and finding more innovative ways to work closer with traditional lenders. The biggest hurdle many communities face is the lack of financial resources to address energy efficiency projects that have been identified.

Technology and Its Impacts

One aspect of energy efficiency that often is difficult to both understand and keep current on is the quickly changing technology in energy efficiency. With lower costs being actively pursued in the solar market and advances in energy storage, there are only positives as we move forward. Even as we see improvements from energy efficiency measures, there is the realization that additional/new facilities due to the impending retirement of current generation facilities is in our future.

Finally, there are two "bigger picture" areas that will directly impact how we obtain our energy in the future and inject more flexibility into the generation of electricity. The discussion surrounding "smart grid" technology and the micro-grid are evolving and need to continue to be monitored. Keeping current and informed on these technologies is important to bring cost efficiencies and resiliency to our communities in the future. The potential for addressing or mitigating future storm related power outages through this technology is of strong interest to our communities and the region.

CENTRAL NH VISION - ENERGY

What we heard from the surveys and public outreach sessions and what we know from research and data analysis/ trends informed the identification of the above challenges. Knowing these challenges is the starting point for crafting a vision statement as the opportunity to address these very challenges starts with the vision.

The following vision for Energy Efficiency in the region is based on all of this work, including the Region's Local Energy Committee Roundtable that met in 2012, the region's master plans and the public outreach results:

"Energy consciousness is a factor in development decisions that reduce energy consumption, improve energy efficiency and encourage renewable energy. The region's communities have sufficient funding and resources to pursue local and cooperative energy projects."

The guiding principles that follow are focused on the refinement of this vision and build the foundation for the action items that are identified at the conclusion of this Chapter. These principles represent how CNHRPC can support the achievement of the vision. These guiding principles translate into the following actions items that also can be found in the Plan's Implementation Chapter.

GUIDING PRINCIPLES

- Encourage compact development, energy efficiency, and responsible management of resources and waste.
- Encourage the adoption of energy efficient approaches to building and site planning to promote efficient use of resources and reduce pollution.
- Strengthen the ability at the regional level to serve as a responsive resource to needs and planning issues at the local level.
- Promote efficient expenditures of public funds for the benefit of the region and its residents.
- Assist efforts to reinvigorate community centers and rural villages to maintain the character of the region's communities, utilize existing infrastructure, and preserve open space.

ACTION ITEMS

- Establish program area on CNHRPCs website that serves as a clearinghouse for energy related activities/initiatives in the region.
- Coordinate and provide ongoing forums for local and regional projects/programs that showcase best practices in energy efficiency/renewables.
- Conduct regulatory reviews for interested communities that identify any barriers to effectively reviewing and regulating renewable energy applications.
- Collaborate with others to provide customized training opportunities for local code enforcement officials to expand understanding and compliance with the state's energy code.
- Provide guidance and technical assistance to communities on the preparation of an energy chapter in master plans that connects efficient land use and energy.
- Encourage and provide guidance to communities on the use of energy audits as the first step in identifying opportunities to improve energy efficiency and reducing municipal energy use.
- Work with other partners on addressing financial and other barriers to successfully implementing energy efficiency initiatives/projects.
- Expand awareness and understanding of rebate and loan programs that can support municipal and regional efforts on energy conservation and efficiency.
- Work with communities to encourage the use of land use principles that include strategies to create connectivity to recreation and services, utilize existing infrastructure and integrate green building measures into project design.
- Forge partnerships with schools to integrate energy related topics into the curriculum and raise awareness of energy use and conservation.
- Ensure that the region is represented in any efforts to address energy efficiency measures and reduce greenhouse gas emissions at the regional and state level.
- Keep up on emerging technology for renewable energy sources and evaluate viability for applicability in the region.

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