

Chapter 7 – Energy Chapter Master Plan Rye, New Hampshire

May 2012

Developed by the Rye Energy Committee

with assistance from the Rockingham Planning Commission

Funding provided by the
NH Office of Energy and Planning, Energy Technical Assistance Program
through the American Recovery and Reinvestment Act

1.0 INTRODUCTION AND VISION

The use of energy - and its link with land use and resource protection - influences many facets of life in Rye today. Energy can affect municipal costs and operations, influence job growth and the local economy, and impact the natural resources and quality of life that are so important to Rye residents.

The overall vision for Rye is a community that supports and preserves its rural character while simultaneously embracing 21st century technology, environmentally progressive strategies, and local business opportunities. Rye's energy policies will play a significant role in achieving this vision. Rye residents, land owners and business owners can benefit greatly by the Town becoming a more energy secure and sustainable community. Environmentally progressive policies with respect to energy generation, building standards, land use patterns, and transportation are critical to Rye's long term sustainability. Thus comprehensive policy decisions should be evaluated through the lens of energy and focused on efficiency, conservation and security.

Energy Efficiency and Conservation

Energy efficiency and conservation focuses on one main objective - reducing overall energy consumption across all sectors thus reducing energy costs and environmental pollutants. Communities can achieve reductions in energy consumption by addressing the following:

- Efficiency for both existing and new buildings
- Community awareness and participation
- Transportation systems, choices and alternatives
- Access to clean fuel choices
- Street and outdoor lighting
- Recycling, composting and reuse programs
- Consumerism of local products and services
- School and classroom education programs
- Healthy and locally grown food

Chapter 1 of the Rye Master Plan states, "*Our desires to see Rye altered are few.*" In order to preserve the quality of life in Rye, it is important to understand and plan for our future energy use. Not only do rising energy costs affect our town's budgets and its economy, the use of non-renewable energy sources can adversely influence air and water quality and the health of –Rye's residents. New Hampshire as a state is heavily dependent on the use of petroleum, coal, natural gas, and nuclear energy to generate electricity, heat our homes and businesses, and fuel our vehicles. According to the New Hampshire Office of Energy and Planning, 91.1% of our gross energy inputs came from these non-renewable sources in 2008. Because New Hampshire has no fossil fuel and uranium resources, the money to purchase these materials leaves the state and sometimes the country. As energy costs rise, Rye can strengthen our local economy and preserve our environment by focusing on making better use of energy conservation, energy efficiency, our region's renewable resources, locally grown food, and sustainable land and water use.

This Energy Chapter of the Rye Master Plan was conceived to provide the guidance and tools required to increase energy efficiency and conservation, reduce the use of non-renewable fuels,

lower greenhouse gas emissions, and reduce energy costs in Rye. The technology, equipment, and techniques to drastically reduce energy use are now readily available for our buildings, street lighting, and our transportation. By reviewing all municipal decisions for energy efficiency and sustainability, Rye will not only reduce its operating expenses and lower its greenhouse gas emissions, but it will set an example for residents and business owners.

This Chapter serves as an important first step to help the Town begin examining its energy usage, and develop and implement strategies to assist it in becoming a more secure and sustainable community. The overall vision of the energy chapter is to reduce the town's carbon footprint and to increase the town's energy security. This is accomplished through establishing a town policy of energy-conscious decision making in every phase of municipal operations and by encouraging businesses and residents to do the same.

This Chapter supports the following vision statements relating to community energy security and planning.

- Provide outreach and assistance to homeowners and businesses on energy efficiency and reduction of carbon emissions
- Provide local examples as models for energy efficiency and improvement
- Promote proper disposal of CFL's and other consumer energy expendables such as batteries.
- Promote useable public transportation for youth, seniors and local commuters.
- Promote use of bikes and walking for local errands and commuting
- Promote establishment and support of local meeting places and businesses to save on auto travel
- Promote building codes that include energy efficiency and smart growth principles
- Promote locally grown fruits and vegetables, locally raised meats, and locally caught seafood.
- Encourage organic gardening and lawn care using locally obtained soil amendments.

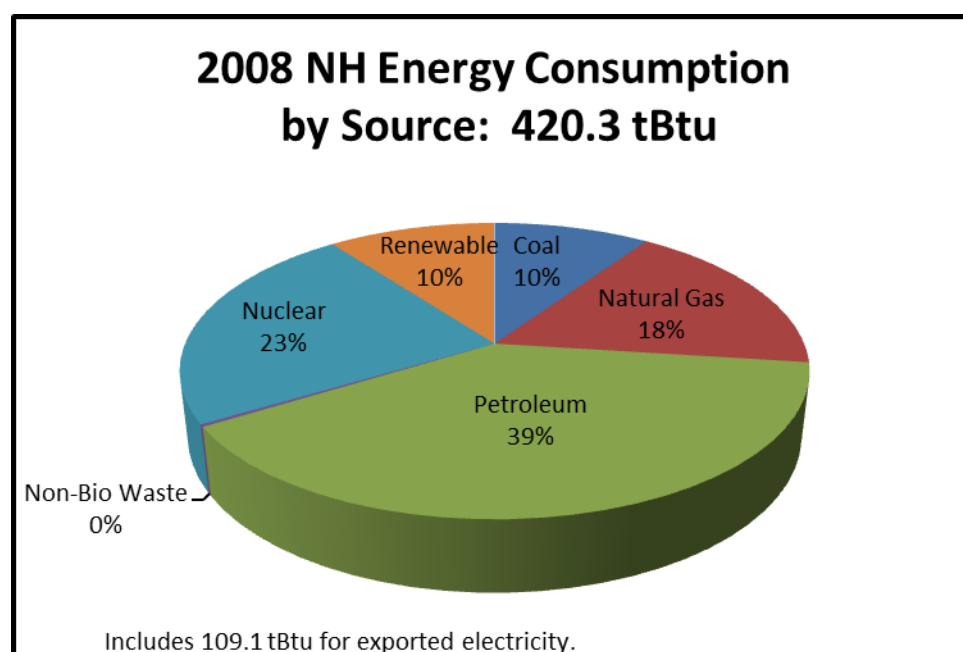
Priority Long Term Goals for the Community

1. Encourage actions that support energy efficiency, conservation, security and cost savings.
2. Reduce municipal and/or community energy use by _10_% within first year, and targets for subsequent years.
3. Align municipal goals with state goals per the NH Climate Action Plan (80 percent reduction below 1990 levels by 2050).
4. Plan for efficient growth and development patterns and transportation systems using principles of Smart Growth and Sustainability.
5. Encourage public and private participation in technical and financial assistance programs to reduce energy costs and consumption.
6. Encourage business owners and residents to develop energy efficiency improvement plans.
7. Provide information to the community on energy efficiency resources and conservation methods, and encourage participation in stewardship and voluntary service initiatives.

2.0 OVERVIEW/RATIONALE

Overview of Energy Use in NH

In 2009 New Hampshire spent nearly \$4.9 billion on energy.¹ The pie chart below (Figure 1) shows the types of energy the state used in 2008 to heat buildings, generate electricity, and fuel vehicles and equipment. Of the 420.3 tBTU (trillions of British Thermal Units) consumed in the state, 90% came from imported non-renewable energy sources, such as petroleum, coal, natural gas, and uranium for nuclear reactors.² Wood and other biomass and hydropower make up the majority of renewable energy used in the state, with tiny amounts from geothermal, solar, and wind. New Hampshire energy security can be enhanced by obtaining a larger proportion of energy from native renewable sources. NH can capitalize on its abundant wind and biomass potential and adequate solar and geothermal resources to improve its energy profile.



¹2009 NH information from the U.S. Energy Information Administration

Figure 1 –2008 NH Energy Consumption

\$4.9 billion spent on energy in NH, broken down by -source

http://www.eia.gov/state/seds/hf.jsp?incfile=sep_prices/total/pr_tot_NH.html&mstate=New Hampshire.

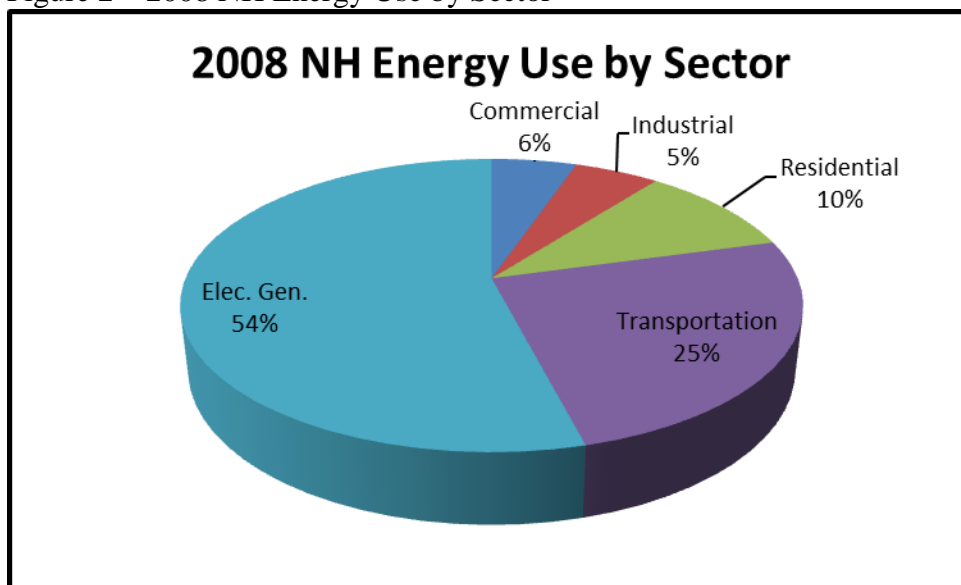
²www.nh.gov/oep/programs/energy/nhenergyfacts/index.htm

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The chart below (Figure 2) shows how much energy various sectors in New Hampshire used. Seventy-nine percent of energy was consumed by transportation and electricity generation, with 88% of this energy imported. The residential sector, which accounts for 10% of energy use, used heating oil (56%), natural gas (17%), propane (21%), kerosene (2%), and wood (5%) to heat

homes. The commercial sector accounts for 6% of state energy use and the industrial sector represents 5%. However, the commercial, industrial, and residential sectors all account for much of the transportation and electricity consumption in the state.

Figure 2 – 2008 NH Energy Use by Sector



Regional Greenhouse Gas Initiative (RGGI)

The NH Department of Environmental Services and the State of New Hampshire are participating in the Regional Greenhouse Gas Initiative (RGGI) with other Northeast and Mid-Atlantic States. RGGI is a regional plan to implement a flexible, market-based program to reduce carbon dioxide (CO₂) emissions – a major cause of global warming – from power plants in the Northeast and Mid-Atlantic states. New Hampshire and nine other states have adopted laws and/or regulations to establish a framework for implementing RGGI in their respective states. To reduce emissions of greenhouse gases, the RGGI participating states are using a market-based cap-and-trade approach that includes:

- Establishing a multi-state CO₂ emissions budget (cap) that will decrease gradually until it is 10 percent lower than at the start;
- Requiring electric power generators to hold allowances covering their emissions of CO₂;
- Providing a market-based emissions auction and trading system where electric power generators can buy, sell and trade CO₂ emissions allowances;
- Using the proceeds of allowance auctions to support low-carbon-intensity solutions, including energy efficiency and clean renewable energy, such as solar and wind power; and
- Employing offsets (greenhouse gas emissions reduction or sequestration projects at sources beyond the electricity sector) to help companies meet their compliance obligations.

Quarterly RGGI auctions have been conducted for two full years, smoothly and professionally. The state has received over \$26,000,000 to date in allowance auction revenues for energy efficiency. Total revenues collected for consumer benefit in the ten RGGI states have exceeded \$729 million.

New Hampshire's "25 x '25" Renewable Energy Initiative

Governor John Lynch announced the *25 x '25 Renewable Energy Initiative* in August of 2006. The Initiative's goal is for New Hampshire to obtain 25 percent of its energy from clean, renewable sources by the year 2025.

In August 2006, Governor Lynch joined governors of both parties and business leaders from across the nation in endorsing 25 x '25, a national effort aimed at producing 25 percent of the energy consumed in the United States from clean, renewable power by the year 2025.

"It's time to use our know-how and resources here in New Hampshire to reduce our dependence on foreign oil and to build a stronger economy by leading the world in the creation of new, clean energy. It is time for New Hampshire to act to help secure our energy future," Governor Lynch stated.

New Hampshire's 25 x '25 Plan is being developed by the Office of Energy and Planning and the Department of Environmental Services. New Hampshire's renewable electricity is generated from a number of sources, mainly hydropower, wood-fired power plants, and landfill gas-fired generating stations.

How does renewable energy benefit New Hampshire?

Renewable energy helps to:

- Decrease our dependence on oil from unstable parts of the world;
- Enhance national security;
- Diversify New Hampshire's energy supply;
- Stabilize and reduce energy prices;
- Combat climate change by reducing emissions of greenhouse gases;
- Boost the state's economy by creating new jobs and industries;
- Keep more energy dollars in the state's economy;
- Reduce harmful emissions from power plants.

Climate Change

Although this chapter is not specifically about climate change, its impact could affect quality of life in New Hampshire. Alterations to our climate will result in adaptive changes or decline in certain sectors of the regional economy, including winter tourism, agriculture, maple syrup production, coastal real estate values due to sea level rise and increase in storm intensity, and health costs associated with respiratory health and heat related illnesses. With respect to local hazard mitigation planning, it is important to consider the potential future impacts of climate change including sea level rise, flooding, coastal erosion, increased intensity and frequency of storms, and the effects of changes in temperature and precipitation.

Our state's economy is linked to both summer and winter recreational activities based on its natural resources. If these suffer, the economy will also suffer. Less snowfall would result in decreased opportunities for skiing, snowshoeing, ice skating, snowmobiling, ice fishing, and other winter recreation activities. Increased frequency and severity of damaging storm events and droughts could cause financial and personal hardships. Decreased quality and production of forestry and agriculture products could also have a significant impact on the economy and quality of life.

NH Climate Action Plan

Assigned by Governor Lynch, the Climate Change Policy Task Force developed - the New Hampshire Climate Action Plan in 2008. The Plan aims at achieving the greatest feasible reductions in greenhouse gas emissions while also providing the greatest possible long-term economic benefits to the citizens of New Hampshire. The most significant reductions in both emissions and costs will come from substantially increasing energy efficiency in all sectors of the economy by continuing to increase sources of renewable energy, and designing our communities to reduce reliance on automobiles for transportation. The NH Climate Action Plan calls for a reduction in emissions of 20 percent below 1990 levels by 2025, and 80 percent below 1990 levels by 2050. In order to meet these reduction goals statewide, NH communities must engage in local energy planning that includes strategies for decreasing their emissions overall. The Climate Change Policy Task Force also recommends 67 specific actions to achieve the following goals:

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

It is envisioned that with participation from all communities, the New Hampshire Climate Action Plan will benefit the economy, increase state and regional energy security, and improve environmental quality.

Sustainability

Implementation of sustainability principles provides a framework under which communities can use resources efficiently, create efficient infrastructures, protect and enhance quality of life, and create new businesses to strengthen their economies. Fostering sustainable approaches to community development helps strengthen the capacity of communities to take integrated action toward improving environmental, social, and economic conditions.

The built environment has a profound impact on our natural environment, economy, health and productivity. Sustainable development is a pattern of resource use that aims to meet the needs of the community today and protect its needs of the future, while preserving the environment. Sustainable development ties together concern for the carrying capacity of natural systems with the social challenges facing individuals and communities. Communities can achieve sustainable development by integrating land use and resource based strategies with economic development approaches that benefit the local environment and quality of life.

In the United States, buildings alone account for:

- | | |
|------------------------------------|--|
| - 72% of electricity consumption | - 38% of total carbon dioxide (CO ₂) emissions |
| - 39% of energy use | - 40% of raw materials use |
| - 14% of potable water consumption | - 30% of waste output (136 million tons annually) |

Sustainable development provides a framework under which communities can use resources efficiently, create efficient infrastructures, protect and enhance quality of life, and create new businesses to strengthen their economies. Fostering sustainable approaches to community development helps strengthen the capacity of communities to take integrated action toward improving environmental, social, and economic conditions. Implementation of sustainable approaches can help communities adapt to and mitigate potential adverse impacts of climate change on water supply, food production, weather, the built environment and ecosystem services.

The New Hampshire Sustainable Communities Initiative - funded through a grant from EPA, DOT and HUD - will help the state to create coordinated, sustainable regional plans, establish a consistent planning and policy framework, and coordinate local plans into a statewide strategy. The Initiative will encourage regional planning efforts that integrate long term planning for housing, land-use, economic and workforce development, transportation, infrastructure and environmental issues. The program will place a priority on partnerships, including the collaboration of local views and opinions, arts and culture, philanthropy, and innovative ideas to the regional planning process.

Energy Emissions – Environmental and Public Health

The increasing trend of carbon dioxide emissions to our atmosphere in recent decades has caused concern over its effect on public health, environmental ecosystems and climate worldwide. Concentrations of carbon dioxide, a byproduct of the burning of fossil fuels, have increased rapidly in the atmosphere as consumption of fossil based fuels has also increased. Alterations to our region's climate will result in changes or decline in certain sectors of the economy, including winter tourism, agriculture, maple syrup production, coastal real estate values (due to sea level rise and increased storm intensity), and health costs associated with respiratory health and heat related illnesses.

NH Enabling Statutes

NH statutes establish the purpose for implementation and the authority given to municipalities to pursue planning initiatives and adopt land use regulations relating to energy.

RSA 674:2.III(n)

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

RSA 672:1 III

“Proper regulations enhance the public health, safety and general welfare and encourage the appropriate and wise use of land;”

RSA 672:1 III-a

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

RSA 38-D Ch. 275 (effective September 27, 2009)

Enables the appointment of an energy commission by either the local legislative or the local governing body of 3-10 members with staggered three-year terms. The purpose of an energy commission is “...for the study, planning, and utilization of energy resources for municipal buildings and built resources of such city or town”, to research municipal energy use, and recommend to local boards pertaining to municipal energy plans and sustainable practices, such as energy conservation, energy efficiency, energy generation, and zoning practices.

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

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

3.0 RYE ENERGY COMMITTEE

There continues to be strong support for energy efficiency planning and implementation among Rye residents. In support of an effort lead by the Carbon Coalition in 2007-2008, 164 municipalities – including the Town of Rye - adopted the New Hampshire Climate Change Resolution that calls on the federal government to prioritize climate change policy and enables the formation of a local energy committee (LEC) to address energy efficiency and conservation, emission reductions, and other energy related issues.

Establishment of the Rye Energy Committee was approved by Town vote in March 2007 and was established by the Selectmen in July, 2007 as *"a voluntary energy committee to recommend local steps to save energy and reduce emissions."*

What has the committee done or is doing?

1. Summary of Energy Committee Activities:

- Work with town officials to have comprehensive performance assessments done of all major town buildings-
- Partner with the Rye schools to run a Carbon Challenge resulting in an annual savings of over 600,000 lbs of CO₂ in 64 households.
- Annual art/energy projects as a means to promoting energy awareness.
- Sponsor talks on energy related topics by UNH professors John Carroll, Cameron Wake (two events) and environmental activist Bill McKibben.

2. Education, Outreach, Public Awareness and Participation:

- Provides quarterly outreach seminars on energy related topics including book discussions, films, and programs. Recent programs include: Stay Warm, Save Money about how homeowners can do energy audits and improve energy efficiency in their home, or build a new home that saves energy and money.
- Initiated the Rye Farmer's Market in 2008. The Market is held every Wednesday during the summer and fall in the parking area between Town Hall and the Rye Congregational Church.
- Produced the Town of Rye 2011 Municipal Energy Report, which is professional, detailed and specific to Rye.

3. Energy Committee Partnerships:

Board of Selectmen - the Executive body charged with carrying out town policies.

Planning Board - Develops and helps to implement the Town's Master Plan, including its Energy Chapter, which reflects the vision of residents for growth, development and planning.

Conservation Commission - a voluntary citizen's commission, appointed by the Board of Selectmen, who works to preserve, protect, and enhance the Town's scenic, recreational, open space and natural resources, as well as its environmentally sensitive areas, and where appropriate, to encourage the enjoyment thereof.

Open Space Committee - a voluntary citizen's committee working to preserve natural resources and rural character.

PSNH – local electric utility provider; provides technical assistance and lighting programs to increase efficiency.

4. Past facility, building, lighting and vehicle audits
 - Members of the committee are completing an energy use survey and evaluation program to help understand and improve energy efficiency in town buildings, utilities, and public areas.
5. Completed energy efficiency upgrades
 - Worked with town officials to secure grants to fund energy efficiency in municipal buildings
6. Worked with Conservation Commission on the Goss Community Farm initiatives and to establish a Community Supported Agriculture program.

4.0 ENERGY PROFILE OF MUNICIPAL FACILITIES

Why is it Important to Keep Track of Energy Use?

Although the energy used in municipal operations is fairly small compared to that of the residential and commercial sector, Rye can lead by example and reduce the energy used in its buildings and vehicle fleet. Energy improvements will save tax payer dollars, will create a model for businesses and residents to adopt, and will help to create the infrastructure needed for certain technologies to be viable.

Over a period of years, community energy profiles can offer a long term view of municipal energy use and costs. Because Rye has only recently begun collecting energy use data for municipal facilities, the energy use inventory contains snapshots of a few years of data from which a baseline will be developed to compare energy use of subsequent years and as efficiency improvements are made to individual facilities.

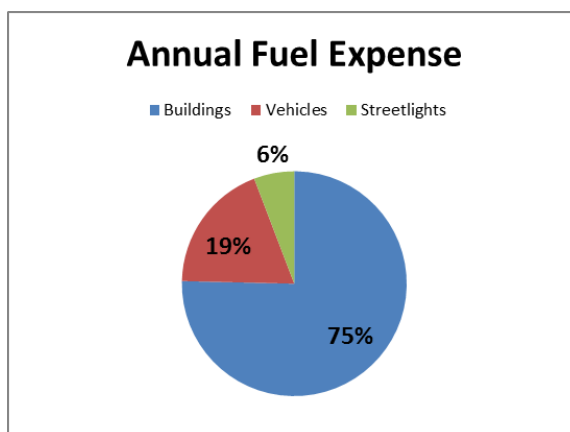
Summary of Municipal Energy Use

While it is difficult to quantify residential and commercial energy use in town, we have an accurate record of the town's municipal energy usage. The Town of Rye uses fuel oil and propane to heat its buildings, electricity for outdoor lighting and indoor electric equipment, and gasoline and diesel for its vehicles. The Rye municipal sector's energy cost, emissions, and usage for buildings, vehicles and streetlights is presented below. The municipal sector of Rye spent roughly \$-424,273 on energy in 2011, and emitted -15,029 lbs. of carbon dioxide into the atmosphere. Seventy-five percent of Rye's fuel expenses were for buildings, 19 percent for vehicles and 6 percent for streetlights.

Table 1. Rye Municipal Energy Use Summary (2011)

	Buildings		Vehicles		Streetlights		
	#	% of total	#	% of total	#	% of total	Grand Total
Annual Fuel Expense	\$319,774	75%	\$79,849	19%	\$24,650	6%	\$424,273
Annual CO2 Emissions (lbs)	2138720	79%	518881	19%	54252	2%	2711853
Annual Energy Use (MMBtu)	11556.9	77%	3272.5	22%	199.5	1%	15028.9

Figure 3. Municipal Energy Costs by Sector (2011)



Buildings

In 2011, Each of Rye's town buildings used energy as shown in Table 2. The buildings with the highest energy usages (Elementary and Middle Schools, Public Safety, Public Library, Town Hall and Public Works) and the Recreation Building have had an energy audit done during the last 4 years.

Table 2. 2011 Rye Energy Usage and Intensity - Buildings

<i>Building/Department</i>	<i>Square Feet</i>	<i>Electricity (kWh)</i>	<i>Fuel Oil (Gal.)</i>	<i>Propane (Gal.)</i>	<i>CO2 Emissions (lbs)</i>	<i>Total Annual Cost</i>	<i>Energy Intensity (kBtu /ft)</i>
Jr. High School	52,155	221,760	22,999		698,418	\$90,821	107
Elementary School	50,467	280,720	18,716		651,356	\$89,939	111
Public Safety	19,818	148,480	6,323		264,466	\$37,196	130
Public Library	11,097	71,480	3,365		134,498	\$20,521	103
Town Hall	5642	33,590	1,945		71,335	\$10,906	112
Public Works	6596	36,570	810		48,409	\$8,737	79
Recreation	2452	5,820		947	16,814	\$3,853	70
Recycling		9,240			7,650	\$1,811	
Swap Shop		1,680			1,391	\$614	
Snack Shack		325			269	\$216	
Water Dept. Office				1,644		\$4,260	
Sewer Pump Houses				716		\$2,452	
Rye Beach Precinct			1,400			\$4,900	
Totals		809,665	55,558	3,307	1,894,626	\$276,227	

Water and Sewer Pumps

Pumping water and sewage is energy intensive. Energy savings can be achieved by installing - highly efficient pumps (i.e. correct sizing, variable speed, brushless DC motors). The Energy Committee has talked with various town departments about these possible changes. The town's 2011 energy use for water and sewer pumps is summarized below.

	Propane	Electricity	CO2 Emissions	Total Annual
Service	(gal.)	(kWh)	(lbs)	Cost
Water District pumps		153,532	127,117	\$28,549.54
Water District heat	1644		20,827	\$4,260.00
Sewer District Pumps		55,652	46,077	\$8,406.50
Sewer Pumps - heat	716		9,072	\$2,452.00
TOTALS	2360	209,184	203,093	\$43,668.04

Table 3 – Pump Usage for the Town of Rye in 2011

Vehicles/Transportation

Town vehicles use diesel fuel and gasoline as shown in Table 3, broken down by department.

Table 4. Rye Energy Use – Vehicles

Department	Gasoline (gallons)	Diesel (gallons)	Co₂ Emissions (lbs)	Total Annual Cost
Police	8,817		172,488	\$27,940
Public Works	559	8,810	208,141	\$30,933
Fire	847	911	36,971	\$5,701
Ambulance		1,220	27,300	\$4,037
Cemetery	416		8,141	\$1,319
Beach Precinct		116	2,592	\$383
Transfer Station		75	1,668	\$247
Water Dept.	2,956		57,822	\$8,681
Miscellaneous	192		3,760	\$609
Totals	13,787	11,131	518,882	\$79,849

Street and Outdoor Lighting

Outdoor lighting influences the nighttime character of Rye and affects its energy costs. As a semi-rural town, it is important to be cognizant of the effects of outdoor lighting for our residences, businesses, municipal buildings, streets and parking lots. Good lighting design not only saves energy, it protects wildlife and preserves our view of the night sky.

The NH Office of Energy and Planning's 2007 technical bulletin on Outdoor Lighting examines the subject of outdoor lighting in New Hampshire in great detail.

(http://www.nh.gov/oep/resourcelibrary/technical_bulletins/documents/outdoor_lighting.pdf)

The bulletin says,

“Effective outdoor lighting benefits us in many ways. It can be used to increase pedestrian and vehicular safety, enhance a community’s night time character, advertise commercial businesses and provide security. Appropriately designed and properly installed, outdoor lighting contributes to the safety and welfare of residents and visitors alike. However, inappropriate outdoor lighting applications in rural and urban areas of New Hampshire result in glare, over-lighting, light escalation, sky glow and wasted energy. Light pollution, a relatively new term describing the cumulative effects of inappropriate outdoor lighting, is an increasing concern as the landscape continues to be developed. While light pollution is something that few of us may have given much thought to, it is important to remember that light pollution alters the “rural character” so frequently referenced in community master plans.”

According to the U.S. Department of Defense, satellite images of New Hampshire show the highest concentration of light pollution is presently within the Seacoast area and along the Route 93 and Route 3 corridors. NH OEP Outdoor Lighting, 2007

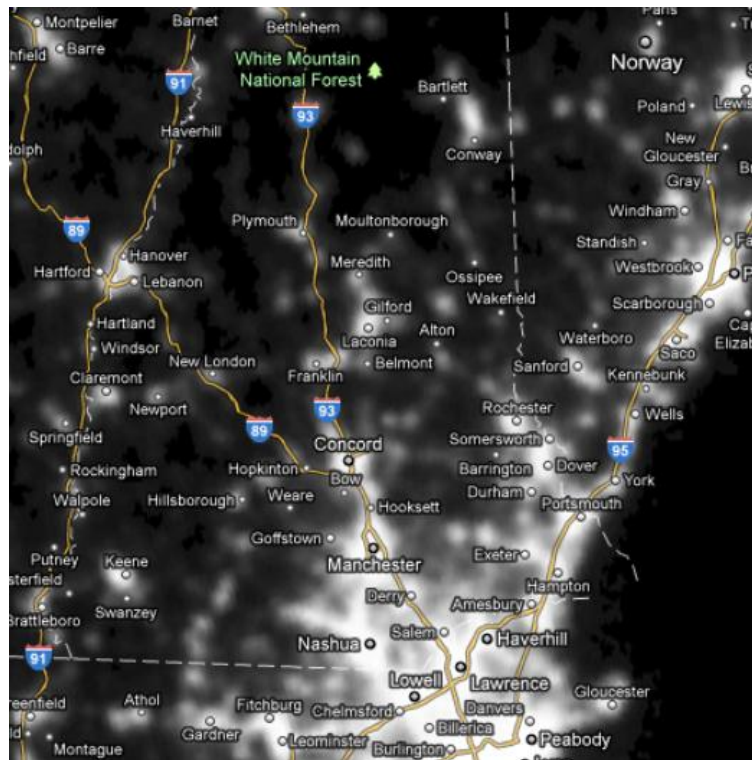


Figure 4. Satellite image of southern New Hampshire showing nighttime lights in 2010. From <http://www.blue-marble.de/nightlights/2010>

Lighting design issues that waste energy and affect the environment include:

- **Glare** – excessive brightness cast directly into the observer’s eyes.
- **Over-Lighting** – businesses ratchet up lighting levels to appear brighter than their neighbors.
- **Light Trespass** – light that projects onto an adjacent property.
- **Sky Glow** – light pollution that obscures the night sky, especially problematic when there is snow cover on the ground reflecting the light.

Energy can be saved and many of the above issues can be avoided by choosing efficient lighting fixtures with full cutoff design. These fixtures shine light in the only direction it is needed – downward – not sideways or upward. The International Dark Sky Association website, www.darksky.org is an excellent resource for finding efficient, full cutoff fixtures. Below are photos of the Plaistow Library, an excellent example of good lighting design, during day and night. The effect of the full cutoff parking lot lights and zero glare façade lights can be clearly seen.



Plaistow, NH Public Library day and night images

From NH OEP *Outdoor Lighting* Technical Bulletin, Spring 2007

Although only 6% of Rye’s 2011 municipal energy budget was spent on outdoor lighting and streetlights, much of the \$24,965 spent can be saved by using more efficient lighting technology. Many of Rye’s lamps are the mercury type, which are lower efficiency and contain hazardous material. PSNH has financial incentives to switch to more efficient metal halide or high pressure sodium lamps, and in 2013, they expect to add an LED program. LED lamps use up to 90% less energy and last 20 times longer than incandescent. Although the initial cost of LED fixtures can be high, the cost has been dropping quickly for the past few years. The PSNH programs allow the cost of switching to more efficient lamps to be paid for over time with the electricity savings.

One of the least efficient fixture types is the globe light, which cast light in all directions causing light pollution and glare. These can be found in Rye on the post lamps lining the streets of Rye Beach Village. The Jenness Beach District has a high concentration of streetlights, with 69 streetlights lining its streets, most of which are the mercury vapor type. The Rye Water District has fewer streetlights and area lights, but most of these could be more efficient. Many of the outdoor lights in Rye are on the PSNH OL (Outdoor Lighting) rate. Rye may want to consider switching some of their outdoor lights to the EOL (Efficient Outdoor Lighting) rate or the EOL-Midnight rate, which shuts the light off at midnight. The EOL rates can as much as 50% in electricity costs.

Here are questions to ask when taking steps to reduce outdoor lighting costs:

- Is the outdoor light necessary for safety or security? Can we try shutting it down for 1-3 months to test?
- If necessary, can it be shut off from midnight to 6 without compromising safety?
- Is a lamp with a lower lumen output (light level) sufficient?
- Can a more energy-efficient lamp/ballast (lower wattage) be used?
- Should this outdoor light be metered (intermittent use) or on the PSNH OL program (used every night)? Compare costs under each program.
- Consult PSNH for financial incentives to switch to more efficient lighting (EOL rate).

There are two sample lighting ordinances in the OEP Outdoor Lighting Technical Bulletin, one simple for a smaller town, and one more complex for an area with large amounts of development. Rye may want to consider these documents when updating its outdoor lighting ordinances.

Energy Star Electronics and Appliances

Energy Star is a joint effort between the U.S. Dept. of Energy and the EPA to help consumers “save money and protect the environment through energy efficient products and practices.” (www.energystar.gov) An item with the Energy Star rating uses at least 20 percent less energy than one without the rating. The website www.energystar.gov lists the energy use by model number of thousands of electrically and fuel-driven products. Computers, copiers, and electronic equipment, household appliances and HVAC equipment, and commercial equipment are available with the Energy Star rating. A partial listing of items available with the ES rating

- Refrigerators and freezers, residential and commercial
- Furnaces, boilers, heat pumps, dehumidifiers, air conditioners
- Computers, printers, copiers, scanners
- Light fixtures, light bulbs, and ceiling fans
- Clothes washers and dishwashers
- Windows, doors, and other building products
- Televisions, set-top and cable boxes, and audio/visual equipment
- Water heaters
- Battery chargers for appliances, power tools, personal care items, and yard care
- Room air cleaners and water coolers
- Homes

Energy bills can be substantially reduced through strict use of Energy Star products. Items can be replaced with Energy Star-rated products upon failure. Sometimes it pays to replace a piece of equipment, such as an old refrigerator, before the end of its life.

Renewable Energy

In 2008, only 8.9 percent of energy used in NH came from renewable energy. Renewable energy systems can greatly reduce greenhouse gas emissions and provide energy security. However, there are many more affordable actions to improve the energy efficiency of buildings, and these should be considered before investing in renewable energy. Savings from these energy efficiency improvements can then be combined with state and federal incentives to help fund renewable energy projects.

Several renewable energy options are practical for Rye residences and businesses. Many of Rye's buildings are well-positioned with good southern exposure to benefit from solar photovoltaic (electric), solar thermal (hot water), and solar heating systems. Designing buildings to maximize passive solar heating and day lighting can reduce the structures energy costs by up to 50% at little extra cost. Areas of the coastline may have a high enough average annual wind speed to benefit from electricity provided by a wind turbine. Many structures already take advantage of wood and wood pellet systems for heating. Geothermal systems can be up to 400% efficient and can greatly reduce heating costs.

Renewable energy incentives are available at the local, state, and federal levels to encourage the adoption of these systems. The town of Rye offers a renewable energy property tax exemption for the value of the system. The state, through the Public Utilities Commission (PUC), has developed a rebate program for residential renewable electric generating systems rated less than 5kw generating capacity. The rebates are available for residential photovoltaic and wind systems, solar water heating systems, and wood pellet central boilers or furnaces. Commercial and industrial rebates are also available. See <http://www.puc.nh.gov/Sustainable%20Energy/RenewableEnergyRebates.html>. Additionally, the federal government offers a 30% tax credit for renewable energy systems. All of these financial incentives can be combined.

NH average solar energy intensity is 4.0-4.5 kWh/m²/day, enough to power solar photovoltaic and solar thermal systems in the state. The costs of solar energy systems have been steadily dropping during the past few years, currently below \$5/watt for PV systems. These lower costs combined with the incentives described above can make solar energy systems economically feasible for residents and businesses. Power Purchase Agreements (PPA) are now available for municipalities, businesses and residents who would like to benefit from a solar energy system on their property with no up-front cost. Through PPAs the cost of the system is paid over time with the monthly energy savings.

About two-thirds of electricity produced at a power station is lost in waste heat during transmission to the users. For this reason, electricity produced on site is far less energy-intensive than purchasing grid-supplied electricity from a utility. Furthermore, energy produced onsite and exported to the grid through net metering displaces three times as much energy for electricity production at the utility.

Building Codes

Rye's building codes can greatly influence energy efficiency in its buildings. Building to code is the minimal level of energy efficiency required by the law. Rye's building codes can require greater energy efficiency by being more stringent than the state code. The Rye code can

encourage homeowners and builders to install greater levels of insulation in roofs, walls, and basements and to use high efficiency exterior doors and windows to reduce heating and cooling losses through conduction. It can set minimum levels for air leakage, tested by a blower door test, to reduce heating and cooling losses through convection. It can require maximizing passive solar heating and daylighting for the site. Moreover, it can encourage homeowners and builders to conduct energy efficiency computer modeling for all new construction and significant remodeling projects to evaluate whether additional energy cost savings measures are feasible. The code can encourage the use of Energy Star products wherever possible and suggest the construction of an Energy Star or LEED certified building. Finally, the building inspector's office can provide information to builders and owners on how to achieve these goals. -

5.0 LONG-TERM PLANNING FOR ENERGY SECURITY AND SUSTAINABILITY

Sustainable Community

Sustainability is the ability to provide for present needs without damaging the ability of future generations to provide for themselves. The primary philosophy of sustainable growth and development is that new development and redevelopment can be done in such a way that they provide environmental, economic, and quality of life benefits to all members of the community. Without proper attention to the effects of unmanaged growth, communities are at risk of exhausting their environment of what makes them unique and desirable places to live, work and visit. There are several indicators of “sustainability” and *a sustainable community is one that is consistent with all of these*. Indicators of sustainability are summarized in the table below.

Table 5. Sectors and Indicators of Sustainability.

<i>Sector</i>	<i>Indicators of Sustainability</i>
<i>Environment</i>	Conservation Development Water Resource Protection Sustainable and Natural Landscapes Community Character Historic Preservation Green Infrastructure
<i>Economy</i>	Energy Efficiency and Conservation Renewable and Alternative Energy Recycling and Reuse of Materials Livable Communities Green Building
<i>Equity</i>	Housing Choices Transportation and Mobility Access/Options Open Space, Parks and Recreation

The built environment has a profound impact on our natural environment, economy, health and productivity. Sustainable development is a pattern of resource use that aims to meet the needs of the community today and protect its needs of the future, while preserving the environment. Sustainable development ties together concern for the carrying capacity of natural systems with the social challenges facing individuals and communities. Communities can achieve sustainable

development by integrating land use and resource based strategies with economic development approaches that benefit the local environment and quality of life.

6.0 RELATIONSHIPS BETWEEN ENERGY AND COMMUNITY PLANNING

The infrastructure for energy use and delivery can influence land use decisions about where growth occurs and where we live, work and recreate. NH State law encourages energy efficient patterns of development through zoning that does not unreasonably limit development of alternative and renewable sources of energy. Reductions in energy consumption can also be achieved through implementation of conservation measures, smart growth, and development of alternative transportation systems. These concepts are described in the table below.

Table 6. Integrating Energy Planning with Community Planning.

Energy Conservation Measures	<ul style="list-style-type: none"> ▪ Energy efficiency in buildings, fixtures and infrastructure. ▪ Behavioral changes including trip consolidation, ride sharing, reduction in lighting and appliance use, efficiency in equipment and other products, recycling and composting (post-consumer waste)
Smart Growth Principles	<ul style="list-style-type: none"> ▪ Incorporate a mix of uses to provide a variety of housing, employment, shopping, services, and social opportunities for all members of the community. ▪ Preserve working landscape by sustaining farm and forest land and other rural resource lands to maintain contiguous tracts of open land and to minimize land use conflicts. ▪ Provide choices and safety in transportation to create livable, walkable communities that increase accessibility for people of all ages, whether on foot, bicycle, or in motor vehicles. ▪ Protect environmental quality by minimizing impacts from human activities and planning for and maintaining natural areas that contribute to the health and quality of life of communities. ▪ Involve the community in planning and implementation to ensure that development retains and enhances the sense of place, traditions, goals, and values of the community. ▪ Manage growth respecting the local community tradition, but work with neighboring towns to achieve common goals and address common problems more effectively.
Alternative Transportation	<ul style="list-style-type: none"> ▪ Public transit infrastructure including access, convenience, and competitive pricing ▪ Voluntary actions such as carpools, rideshare programs, and park and ride facilities ▪ Accommodations for bicycles and pedestrians.

Sustainable Principles

Sustainable development principles cut across all dimensions of sustainability: environmental, economic and societal.

Table 7. Summary of sustainable principles and practices.

<i>Principles</i>	<i>Sectors</i>	<i>Practices</i>
Efficient use and production of alternative energy	WATER	<i>Indoor</i> Water Conservation Water Efficient Appliances and Fixtures Water Budget
Efficient use of water and other water resources		<i>Outdoor</i> Pervious Materials Xeriscape Greywater Irrigation Harvested Rainwater
Protect quality of the air, water, land and other natural resources		
Reduce waste, pollution and environmental degradation		<i>Construction</i> Passive Solar Design Solar Hot Water Geothermal Heating and Cooling Systems Photovoltaic Systems Programmable Thermostats
Protect human health and safety	ENERGY	<i>Outdoor</i> Energy Efficient Lighting and Landscaping
Minimize impacts on local and worldwide ecosystems		
Local Food Production	BUILDING MATERIALS	Reduce, Reuse, Recycle Purchase local and regional materials
	SOLID WASTE	Recycling and Compost Systems Construction Waste Recycling
	FOOD	Community and Backyard Gardens Farmers Markets Locally sourced products

Planning for sustainability promotes responsible development and includes the following processes, practices, and outcomes.¹

Sustainable Practices

Sustainable practices are aimed at guiding how new development is constructed to attain energy efficiency and conservation, and to promote use of sustainable materials and energy.

- Performance based standards and building codes will ensure that all new buildings are constructed to a minimum efficiency level, for example using LEED standards or EPA Energy Star standards.
- Construction standards can ensure energy efficiency, use of products that provide long term durability, and use of sustainable and recycled materials (including salvaged, refurbished or reused materials).
- Site design techniques that take advantage of sun exposure, differences in microclimate, and landscaping reduce a development's energy demand and overall energy consumption.

¹ American Planning Association, *Policy Guide on Planning and Sustainability* (2000)

- Energy efficient planning principles and provisions to allow for renewable energy generation can be implemented through subdivision and site plan review regulations, zoning ordinances and building codes.
- Incentives in the form of tax credits, deferments, deductions or abatements can help lessen the initial cost burden of investing in energy efficient systems.
- Incentives to redevelop brownfields and abandoned sites, and develop infill projects on underutilized sites.

Energy Conservation and Renewable Energy

Energy is central to sustainable development efforts. It affects all aspects of development -- social, economic, and environmental -- including livelihoods, access to water, agricultural productivity, health, population levels, and education. Energy efficient design and planning techniques can be used in constructing housing and non-residential developments, prescribing density limits, integrating land uses, and designing transportation systems and infrastructure.

Environment

Ecologists recognize that there may be limits to sustainable growth and offer the alternative of a “steady state economy” in order to address environmental concerns such as resource consumption, energy production, and land conservation.

Building Efficiency

Green building practices offer an opportunity to create environmentally-sound and resource-efficient buildings by using an integrated approach to design and efficiency. Green buildings promote resource conservation, including energy efficiency, renewable energy, and water conservation features; consider environmental impacts and waste minimization; create a healthy and comfortable environment; reduce operation and maintenance costs; and address issues such as historical preservation, access to public transportation and other community infrastructure systems. The entire life cycle of a building and its components is considered, as well as the economic and environmental impact and performance.

7.0 RECOMMENDATIONS

In summary we offer the following recommendations for incorporation of energy efficiency and energy conservation into planning, community education and outreach, and municipal management practices.

Recommendations for Planning and Community Based Actions

1. Adopt minimum energy efficiency standards for exterior and interior lighting as part of the Site Plan Review Regulations and municipal building code.
2. Offer CFL bulb exchanges at the transfer station, town offices, and other convenient locations in the community.
3. Develop a funding source for bulk purchase of programmable thermostats, CFL bulbs, and home weatherization materials for eligible residents. Organize an ‘energy corps’ of volunteers to install hardware for eligible residents.

4. Provide energy efficiency education opportunities to residents and area businesses through educational materials or presentations. Continue to provide information about programs for making residences and businesses more energy efficient (Home Performance with Energy Star, Energy Star Homes, LEED, zero energy homes, Passive House).
5. Partner with LEC to provide home energy efficiency and weatherization tips for residents with property tax mailings. Utilize outreach materials from Clean Air-Cool Planet's "MyEnergyPlan.net" and NH Office of Energy and Planning's "Button Up" program.
6. Partner with LEC to research bid specifications for all future RFPs for capital improvements relating to energy efficient building and infrastructure.
7. Encourage local businesses to take advantage of energy efficiency loans to upgrade buildings and infrastructure.
8. Promote energy efficient patterns of development (per RSA 672:1 III-a).
9. Promote ride-sharing and carpooling on municipal web-sites and other information sources in the community (i.e. using NH Rideshare or GoLoco).
10. Complete an audit of the zoning ordinance, land development regulations and Master Plan to identify barriers and existing incentives that support implementation of energy efficiency measures.
11. Increase the town's recycling in both municipal and residential areas including the consideration of "single-stream" collection.
12. Encourage all types of renewable energy through tax incentives.
13. Encourage the use of fuel efficient vehicles through tax/fees incentives and discourage the use of less efficient vehicles.
14. Promote the production of healthy and locally grown foods with access to all by offering opportunities such as community garden plots, Community Supported Agriculture (CSA), a town run farmer's market, and workshops on raising and growing our own foods.
15. Study a public transportation system that would connect Rye residents to the greater seacoast community.
16. Develop a plan of action such that new residential and commercial construction and renovation exceed the town's 2011 energy efficiency standards.
17. Strive to meet and exceed the state's energy goals in the NH Climate Action Plan.
18. Identify strategies for reducing Vehicle Miles Traveled (VMT) per household.
19. Encourage compact and mixed-use development.
20. Propose requiring energy modeling of each new or remodeled structure.

Recommendations to Improve Efficiency of Municipal Infrastructure

1. Continue to compile annual municipal energy use inventory and produce an annual municipal energy use report. Use the report to identify additional energy use/cost savings.
2. Replace halogen and incandescent bulbs in all municipal facilities and lighting sources with CFL and LED bulbs.
3. Identify further municipal cost saving opportunities through changes to building construction, operation and maintenance
4. Develop a strategic plan to prioritize implementation and funding for building and infrastructure improvements and new construction projects. Incorporate recommendations from the strategic plan into the Capital Improvements Plan.
5. Utilize waste oil from municipal operations and collected at the Transfer Station to produce energy for municipal use where possible.

6. Analyze opportunities and the feasibility of using renewable and alternative energy sources for municipal facilities (wood, biofuels, wind, solar, etc.).
7. Extract recommendations for each building from each energy audit and summarize priorities for energy reduction in Rye’s municipal buildings. Publish findings in a “Building Improvement Plan” report to the Board of Selectmen.
8. Identify strategies for increasing the efficiency of the municipal fleet.
9. Outreach to Rye Beach Precinct and Jenness Beach Precinct to improve efficiency.