Energy

An Energy Chapter of the Master Plan presents a vision and steps to guide the Town's efforts for the next ten years and beyond. This chapter includes a brief introduction to energy related activities implemented since adoption of the 2000 Master Plan and a series of goals and recommendations for achieving the overall vision of a resilient, efficient, and environmentally responsible municipality.

Our Vision

In 2025 and beyond, the Town of Durham, along with commercial property owners and homeowners will realize cost savings while reducing carbon emissions, thereby increasing the town's resiliency and sustainability relative to energy use.

All new construction will be built to higher energy efficiency standards that are linked to current best construction and management practices. A large proportion of existing buildings, including an aging housing stock, will have been retrofitted to minimize heat loss through incentivized weatherization programs.

In this vision of the future, planners will develop recommendations for density/compactness of new and existing neighborhoods; carefully sited and designed greenfield development near the core of the community; and the mixing of uses as a means to reduce energy use for our daily needs. Community and municipal facilities will all be centrally located and linked both to each other and to nearby neighborhoods by a comprehensive network of sidewalks and bicycle paths, separated from roadways where possible. Residents will have easy access to safe, fresh, local food that is more secure from a disrupted supply of energy.[1]

[1] This issue is primarily discussed in the Natural Resources Chapter

Foundation

Through successive Master Plans, Durham's citizens have consistently voiced support for a walkable, bike-friendly downtown, and that same voice came through clearly in the 2011 Master Plan Survey. Suggestions at the Energy Committee's own visioning forums in 2008 and 2009 included "Change the town's configuration," and "Study how the layout of Durham affects our energy use." Some residents see Durham as lacking a secure food supply. Others emphasize that changes in heating fuel prices can be crippling to homeowners dependent on this source of energy for warmth in the winter.

The following is a summary of relevant comments and input submitted during the 2011 Visioning Forum and 2011 Master Plan Survey, completed by the Town of Durham. Results of these engagement opportunities form the foundation of this Energy chapter while providing a lens of public perception and interest surrounding these topics.

2011 Visioning Forum

What Do We Look Like?

- A green town
- Durham's downtown is somewhat walkable – weak links
- Lack of accommodations for pedestrians
- Need more green space/landscaping along streets and facilities
- Durham is not bicycle friendly – system is fragmented
- Need integration with roadways
- Best public transit in NH (Wildcat and COAST)

What Will We Look Like?

- More sustainable and alternative energy
- A community with a fully integrated bicycle system
- Green housing
- Embracing smart growth principles to afford density
- More public transportation
- Multi-modal transportation connecting neighborhoods with downtown

2011 Master Plan Survey

Durham residents show support for:

- Pedestrian and bicycle friendliness
- Re-development of existing structures
- Bike networks connecting key land areas
- Better sidewalks and crosswalks
- Better biking and walking access to the downtown
- Public transportation to downtown
- Public transportation that connects the downtown with recreation opportunities
- Implementation of additional energy conservation measures from municipal facilities
- Development of alternative energy sources for municipal facilities
- Encouraging energy-efficient building construction through Town codes
- Establishment of one or more conveniently placed park-and-ride lots for carpooling

Introduction

As Durham looks to the challenges facing it and its neighboring communities in the next ten, twenty, and fifty years, one of its priorities is to realize a vision of being a sustainable and resilient community. Recent Town Councils have acknowledged this priority in their goals. Progress toward achieving this vision will determine the Town's capacity to thrive in the face of changes in energy supplies, environmental conditions, and the international economic landscape.

Photo 1: Young's Family Restaurant

Durham is not alone. As the town moves further into the 21st Century, it faces a challenge shared across the country; our increasing reliance on fossil fuels has left us vulnerable as that energy source becomes scarcer and more costly. In addition, Durham shares with other small northern New England town two specific challenges: a less densely populated region and a cold climate have historically resulted in high-energy usage for home heating and limited opportunities to build upon economies of scale.

NH RSA Chapter 674, *Local Land Use Planning and Regulatory Powers,* Section 674:2 addresses the purpose and description of the Master Plan. Subsection III lists optional sections of the Master Plan that a municipality may adopt, including:

> (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.

Town of Durham Energy Conservation Policy

"The Town will strive to reduce the environmental and societal burdens of energy consumption by purposefully minimizing its energy requirements and promoting the use of clean, renewable sources of energy."

The purpose of this Chapter is to guide planning decisions driven by the Master Plan—focused on transportation, building design, land use, and economic development—so that Durham may better address these challenges. We may not know exactly how these challenges will play out, but we need to take proactive steps to ensure that our town is energy-resilient.

What You Said: *Source: 2011 Master Plan Survey*

92% of respondents supported additional energy conservation measures for municipal facilities

Establishment of the Durham Energy Committee

Not unlike many communities in the region, Durham's 2000 Master Plan did not have an Energy Chapter or a significant focus on energy consumption and the associated negative impacts of carbon emissions due to the burning of fossil fuels. The establishment of the Durham Energy Committee (DEC) in 2007 provided the catalyst for the Town to take the necessary steps in addressing the reduction of greenhouse gasses and other energy related issues.

On October 1, 2007, the Town Council approved the Committee's mission statement. Within a year, the Durham Planning Board asked the Energy Committee to draft a chapter of the Master Plan to steer future actions of the town with respect to energy.

Mission Statement

To advise the Town Council on energy conservation measures that can be implemented to reduce its energy use and emissions that contribute to climate change.

To recommend alternative and renewable sources of energy for the purpose of working towards local economic security and energy independence.

Boldness, Balance, and Dialogue: A Vision for the Future

Commitment to a bold vision is often the best route to realizing radical goals: witness President Kennedy's challenge to NASA and the country at large "…to landing a man on the moon and returning him safely to earth." In the realm of combating climate change relative to the built environment, an equivalent imaginable but nearly impossible goal might be the Living Building Challenge: to make buildings that are "net zero energy" (i.e., consuming no more energy than they produce), water-independent, non-toxic, and culturally rich. When issued in 2006, the Challenge seemed almost impossible: but today, six buildings have been certified and a dozen others are in the operational phase necessary before certification. Some concepts that today seem "out there" or cutting edge are likely to become standard precisely because they deliver the best solutions. New technology and an open-minded community can work together for significant change.

Geothermal, air source heat pumps, solar, biomass, and district heating (one heating plant that serves many houses or buildings) systems are already making inroads in Durham's commercial and residential housing developments, both for single-family homes and multi-unit apartments. Electric appearing even today on Durham streets will be supported by vehicle charging stations. Bicycle and car share programs will augment single-family vehicle ownership. A bold vision of sustainable building practices; entrepreneurial, synergistic opportunities between the UNH campus and Durham business communities; and a significant improvement in the pedestrian and bicycle infrastructure throughout the downtown core is a vision within the Town's reach.

What You Said: *Source: 2011 Visioning Forum*

"More sustainable green office development – green industry"

A Struggle for Balance

However, the bold path is not always easy. The gains in the coming decades are not without costs and potential points of conflict with other community goals. The efficient flow of commuter traffic and pedestrian and bicycle access downtown is one example of an area where the Town will need to balance competing needs. Financing efficiency measures with 20-year or longer payback periods[2] may bring higher costs to today's taxpayers but savings to taxpayers a decade or more later.

Balance is also needed in the regulatory arena. Strict building and zoning code standards and stringent environmental regulations produce savings over the long term. However, in the short term these regulations could create temporary hardship to builders and property owners. These are areas where Town priorities may conflict and reasonable people may disagree. Such balancing points require comprehensive discussion leading to consensus as the most effective way of achieving the vision of this Chapter.

What are Durham's strengths in this area?

In the face of these challenges, Durham has a number of strengths that make regional and national leadership on energy stewardship a realistic vision. First and foremost, the Town has a tradition of forward thinking, organized action, and efficient governance. Durham has a tight-knit and intimate business community that has shown a remarkable ability to respond creatively to new market conditions and, on its own, has made significant energy efficiency improvements to many properties, including the Town's single industrial facility (Goss International), Young's Restaurant, an iconic community gathering spot, and the Durham Market Place. Student housing developers have voluntarily built housing projects that incorporate significant energy efficient measures, produce meaningful amounts of on-site energy, and incorporate innovative heating systems, e.g., geothermal.

What You Said: *Source: 2011 Master Plan Survey*

85% of respondents support the development of alternative energy sources for municipal buildings

Durham recognizes the potential leverage of its intellectual and entrepreneurial capital, present in the University of New Hampshire (UNH) and in its proximity to the seacoast's and Boston–Manchester's technological industries, to capture new economic opportunities in the growing energy efficiency and renewable energy sectors of the economy. Community members have expressed the hope that Durham will reduce its reliance on traditional energy resources and develop new resources that may generate revenue for the Town.

One way to do that may be through regional cooperation around renewable energy, i.e., solar, wind, and hydro power. While UNH staff and faculty have served on Town committees and governmental bodies, Durham's ability to realize its energy goals would benefit from a closer collaboration between leading energy, science, and engineering researchers on campus and officials, residents, and businesses in the broader community.

[2] Twenty years is a common time frame within which municipal bonds for capital project are paid off.

Economic and Security Benefits of Energy-Focused Planning

The financial benefits of energy planning derive from both direct reduction and avoidance of energy costs.

These benefits can come both from greater efficiency (e.g., better building weatherization = lower heating fuel bills) and from advances in the environmental and alternative energy industries. Price or availability disruptions in our energy supplies reduce the security of our residents and municipality as a whole, and affect residents' and business owners' ability to live, work, and prosper in Durham. High-quality, energy-efficient housing and business establishments will reduce occupants' current and future energy bills and will enhance the stability and growth of Durham's real estate market.

Energy efficiency opportunities and lower costs will also attract business and industry. A vibrant downtown with business and mixed use connected to nearby higher density residential neighborhoods by a network of sidewalks and bicycle paths will reduce the community's greenhouse gas emissions associated with transportation. In addition, studies show that walkable neighborhoods support higher property values, greater civic engagement, and greater resilience in meeting shared challenges (e.g., disaster recovery, for example after 2012's Hurricane Sandy).

In addition to the financial and security benefits, comments and suggestions from community members underscore the value residents place on energy planning that focuses on energy efficiency and conservation as a significant contribution to their quality of life. Energy planning will bolster the diversity and health of Durham's natural and scenic environment. Lower reliance on fossil fuels will provide significant health benefits for citizens, as the decades-held vision of a more walkable and bikeable town becomes a reality.

Photo 2: Downtown Durham

Photo 3: Solar photovoltaic energy raiser in a Durham neighborhood

Quick Fact: Lower reliance on fossil fuels can provide significant health benefits for citizens

State, Regional, and Local Efforts to Date

Readers are urged to turn to this chapter's Appendix for greater detail about the history of New Hampshire's, New England's and Durham's energy initiatives. The Appendix also provides a succinct explanation of the science behind global warming.

Durham Energy Committee's initiatives and key points on energy-focused planning timeline

∴ 2007 – The March 13, 2007 ballot included a New Hampshire Climate Change Resolution. Durham voters adopted the Resolution by 1,447 to 254. The following month, the Durham Town Council passed a resolution creating an Energy Committee. The Committee's mandate is to advise the Council on ways to reduce energy use, develop alternative energy sources, and increase the economic security and energy independence of the Town.

∴ 2008 – The Durham Planning Board asked the Energy Committee to draft an Energy Chapter for the updated Master Plan to guide Town actions with respect to energy, as supported by RSA 674:2(n). The Committee began work on the chapter by holding two public input sessions. It also conducted a greenhouse gas inventory to estimate the amount of energy Durham uses annually and to identify the attendant emissions from fuel consumption. This inventory became the first step in benchmarking efforts to reduce emissions over a longer period. The results indicated that the majority of greenhouse gas emissions are generated by the use of personal vehicles and for heating homes.

∴ 2010 – Advised the town Administrator on the purchase of municipal electric power from sources other than PSNH, which led to an agreement with supplier Constellation NewEnergy that was projected to save the town approximately $40,000 each year.

∴ 2010 – Brought to the Town Council a resolution to designate the Town of Durham in its entirety an "Energy Efficiency and Clean Energy District," thereby paving the way for the initiation of a Property Assessed Clean Energy (PACE) program. With approval of the resolution, Durham became the first such "designated" town in New Hampshire. Unfortunately, the State Legislature subsequently removed the financial guarantees that made PACE economically attractive to Durham homeowners while fiscally safe for the town. Durham's PACE program remains tabled.

Data Source: NH GRANIT

∴ 2011 – Completed a three year profile of Durham's municipal energy use and converted that data into a format that allows the NH Office of Energy Planning to compare the energy usage of New Hampshire communities (Refer to section on Municipal Energy Use for more information).

∴ 2011 -– Initiated an amendment to the Building Construction chapter of the Town Code, approved by the Town Council. Durham thereby became the first jurisdiction in the nation to adopt IECC 2012 building energy codes. The DEC also developed an "Energy Considerations Checklist" designed to help developers, contractors, and homeowners focus more deliberately on energy efficiency through all stages of their project development.

∴ 2011 – Initiated a traffic pattern change and addition of better and extended bike lane striping on Madbury Road from Main Street to Garrison Avenue (from the Middle School).

Photo 4: Solar photovoltaic (PV) installation on the Durham Public Library

∴ 2012 – Completed draft of the Master Plan chapter that was endorsed by the Planning Board.

∴ 2012 – Together with Town officials and a local solar provider, the DEC developed a Power Purchase Agreement (PPA) for municipal solar generation, requiring no capital expenditure and establishing electricity rates equal to or less than currently paid.

∴ 2013 – Solar panel installations to three municipal facilities.

∴ 2014 – Coordinated with the Town Administrator to issue a Request for Proposal for a bike-ped "master" improvement plan focusing on downtown; the plan was delivered in the fall.

∴ 2014 – Conducted baseline survey on transportation and presented results to the Town Council.

What You Said: *Source: 2011 Master Plan Survey*

82% of respondents encourage energy-efficient building construction through Town codes

∴ 2014 – Met with representatives of the four Durham churches to explore financing solar installations to help offset their combined total of 140,000 kWh in electrical usage.

Energy Sources and Uses in New Hampshire

Durham has already evaluated wind and hydropower for their renewable energy potential and has determined that there are insufficient resources to make it a viable option within the Town's boundaries. However, because energy issues extend far beyond the borders of just one community, it is important to provide a snap shot of energy statistics on the state level.

Home-grown: renewable energy

While there are no fossil fuel reserves in New Hampshire, the state's unique landscape offers substantial opportunities for renewable energy potential, including wind power, solar, hydropower, and wood fuel ("biomass") for electricity. The mountain ranges that run the length of the western part of the state are home to Mount Washington, the highest and most prominent peak east of the Mississippi River. This is the site for the second highest wind speed in the world at 231 MPH (1934). In 1980, New Hampshire became the first state in the country to make an attempt to harvest wind resources at a commercial wind farm.

The state also boasts a number of powerful waterways including: the Androscoggin, Saco, Piscataqua, Merrimack, and Connecticut rivers. Both the Merrimack and Connecticut rivers are home to several hydroelectric power plants owned and operated by PSNH, some of which are over a century old and still operating. PSNH operates nine hydro plants throughout New Hampshire. The energy generated on these rivers produce a combined total of 70.5 megawatts of 100% renewable electricity.[3]

New Hampshire is second only to Maine in its percentage of forested land, which provides a source of wood fuel for electric generation. Forest resources also include wood pellets for space heating, and are an important part of the state economy and the backbone of New Hampshire's biomass energy industry. It is important to note that nearly 1 in 12 homes depend on wood products as a primary heat source.

Table 1: 2012 Per Capita Energy Consumption by State (MBTU)

United States (Average)	315
Wyoming (highest in US)	949
Ten Lowest Consuming States in the US	
1. Rhode Island	173
2. New York	179
3. California	201
4. Hawaii	202
5. Connecticut	203
6. Vermont	206
7. Massachusetts	209
8. Florida	210
9. New Hampshire	215
- Arizona	215

Source: US Energy Information Administration, 2012

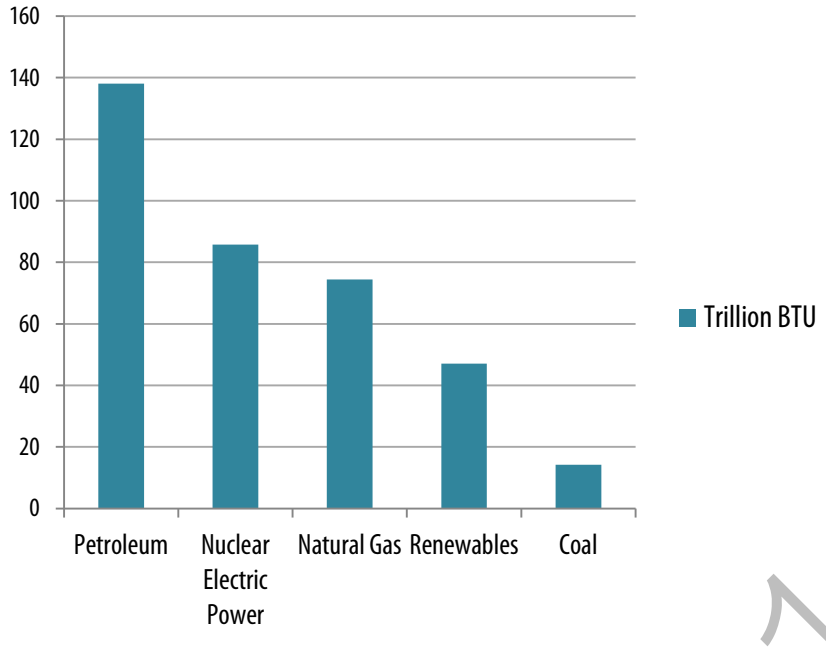
Imported energy and other sources

In 2012, New Hampshire had the ninth lowest (tied with Arizona) per capita consumption of total energy in the United States, according to the US Energy Information Administration (USEIA). This translates to approximately 1,721 gallons of gasoline consumed by New Hampshire resident – every year. By contrast, Rhode Island had the lowest per capita consumption; Wyoming had the highest per capita consumption. Table 1 shows the corresponding statistics for the ten lowest per capita energy consumption states.

[3] Public Service of New Hampshire. Hydroelectric Stations. 2014 (https://www.psnh.com/RenewableEnergy/About-PSNH/Hydroelectric-Stations.aspx)

NH Energy Consumption Estimates, 2012

Source: US Energy Information Administration

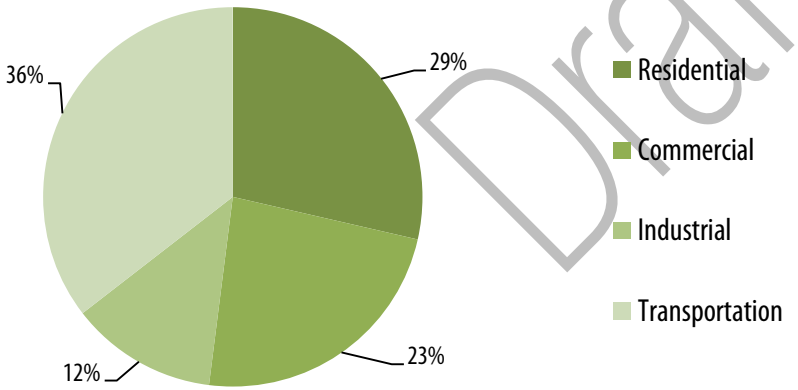


Estimates of New Hampshire's major sources of energy consumption, suggest that nearly 40% (approximately 140 trillion BTU) of the state's energy comes from petroleum, which is neither produced nor refined in the state. Petroleum products include: motor gasoline (excluding ethanol), distillate fuel oil, jet fuel, liquefied petroleum gas, and residual fuels. Motor gasoline is the dominant type and makes up for almost 60% (81.4 trillion BTU) of all petroleum products. Nuclear electric power accounts for approximately 24%of the state's consumption, while natural gas provides 21%, down from a record-high of 37% in 2012. As of this writing, only 13% of New Hampshire's power supply comes from renewable sources, which include: hydroelectric power, biomass (primarily wood), solar, wind, and geothermal. The renewable portion has increased 3.6% since 2010. Finally, coal comprises 4% of the state's energy use with consumption estimates reaching approximately 14 trillion BTU.

Quick Fact: Only 13% of New Hampshire's power supply comes from renewable sources

Energy Consumption by End-Use Sector, 2012

Source: US Energy Information Administration

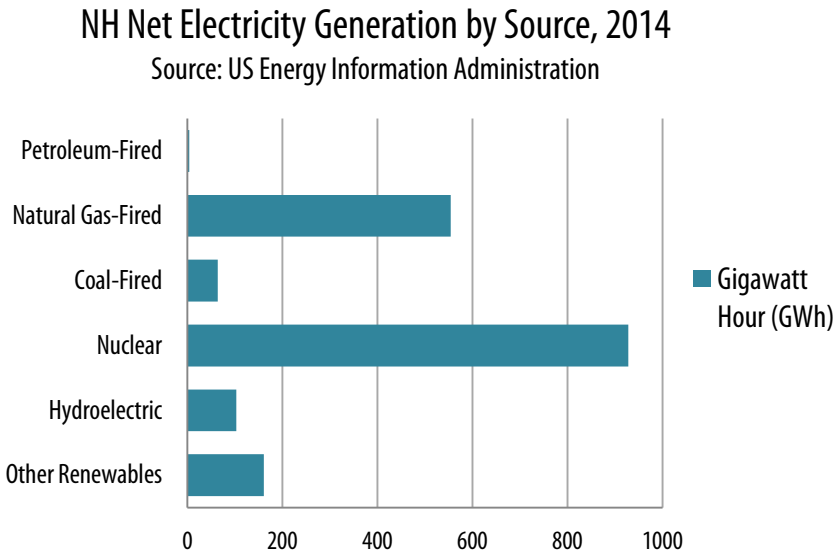


By sector, transportation (cars, trucks, buses, trains, and airplanes) accounts for the largest amount – roughly 36% of all the energy used in the state. Granite Staters consume approximately 101 trillion BTU in transportation, equivalent to roughly 808 million gallons of gasoline. This dependency on gasoline and diesel fuel, which can experience extreme and volatile prices, provides yet another compelling reason to pursue alternative modes of transportation. Residential consumption makes up 29% (81 trillion BTU) of the state's usage and is among the highest per capita by percent in the nation, primarily due to the heavy dependence on heating oil during the winter. Commercial activity makes up 23% (66 trillion BTU) while industrial uses rank at the bottom with the smallest share at 12% (35 trillion BTU) per capita.

Quick Fact: Transportation accounts for 36% of all the energy use in the state

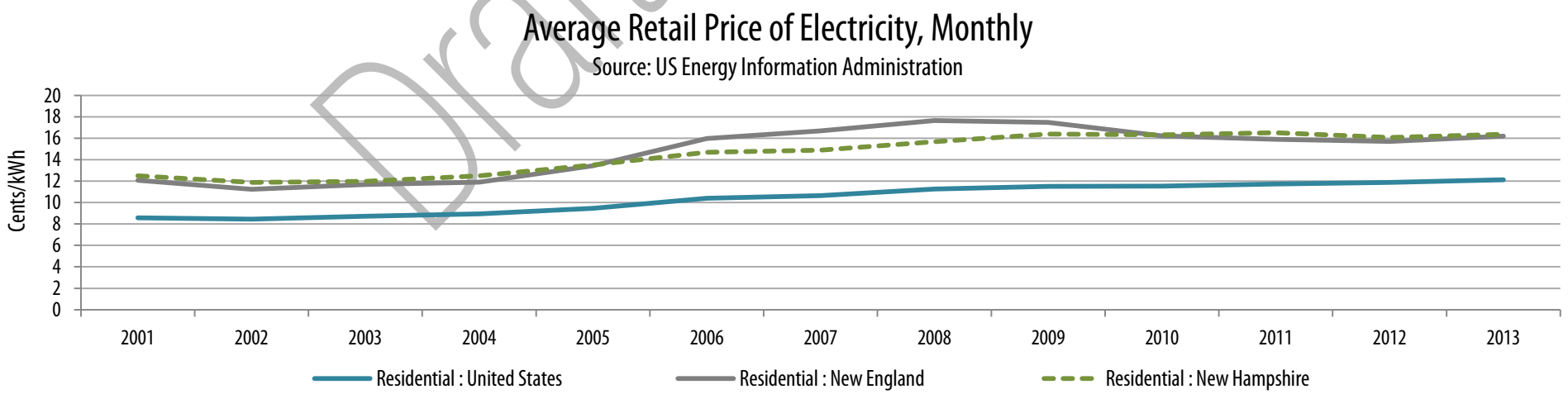
Electricity generation

New Hampshire's electricity generation is dominated by nuclear power, which accounts for nearly 52% (928 GWh) of all energy used to produce electricity in the state. This is no surprise, since up to half of New Hampshire's net electricity generation (in any given year) comes from the Seabrook nuclear plant, the largest station in New England. Offsetting this local generation, the Seabrook plant's fuel is imported to the state, while the electricity being produced is predominately exported out of state. Natural gas is the second-largest generating source of electricity in the state. Usage has increased significantly since 2003, with the commissioning of two large generating stations. In 2014, natural gas provided approximately 30% (554 GWh) of the state's electricity, up from 18% in 2010. Coal provides 4% (64 GWh) while hydroelectric and the other two renewables (wood and wind) contribute nearly 15% (264 GWh) collectively. Note that the state imports roughly 1.0% of its electrical energy and exports over 50% of all the electricity that is generated statewide.



Historic residential electricity rates

Residents in New Hampshire have continued to experience rising electricity prices due to increases in winter rates. In 2001, prices were approximately 12.49 cents per kilowatt hour (¢/kWh) and have continued to climb over the course of the past decade. During 2013's, a particularly cold and long winter, the price of electricity averaged approximately ~17 ¢/kWh. This trend from 2001 to 2013 represents a compounded average increase of 2.5% per year, which is similar to the US inflation over the same period. New Hampshire has generally followed the New England average over the course of the past 13 years; however NH's electricity rates have been about 40% higher than the national average.



A state by state comparison of the average retail prices of electricity to the residential sector shows that New Hampshire's prices are the 7th highest in the US at 17.23 ¢/kWh. New Hampshire's ranking is consistent with the trend that has witnessed nearly all of the New England states having some of the highest electricity prices in the country.

Quick Fact: NH imports roughly 1.0% of its electrical energy and exports over 50% of all the electricity that is generated statewide

The future for residential electricity

Based on a straight line projection of the compounded yearly 2.5% increase per year, New Hampshire residents can expect to be paying upwards of 22.00 ¢/kWh by the year 2025. Given the instability of prices associated with heating costs, as well as the uncertainty of potential impacts from climate change, investment in renewable energy sources for use by homes, businesses, and transportation will be an important issue to address moving forward.

At present, the state does have policies in place to increase the use of renewable energy, including the Renewable Portfolio Standard (RPS), which was established in May 2007. The RPS requires that 24.8% of electricity sold in-state by the state's electricity providers -- with the exception of municipal utilities – be from renewable energy.[4] As of 2014, 15% of New Hampshire's net electricity came from renewable energy.

In 2012, New Hampshire became the first state to offer renewable portfolio standard credits for renewable thermal projects, including new or expanded biomass, solar, and geothermal resources, which deliver their energy as heat instead of electricity. The Database of State Incentives for Renewables & Efficiency website provides information on NH's authority for renewable energy.

Table 2: 2014 Average Retail Price of Electricity to Residential Sector (¢/kWh)

United States (average)	12.12
Washington (lowest in US)	8.96
Top 10 highest electricity prices in the US	
1. Hawaii	38.42
2. Alaska	20.59
3. New York	20.31
4. Connecticut	19.45
5. Vermont	17.93
6. California	17.67
7. New Hampshire	17.23
8. New Jersey	16.52
9. Massachusetts	16.27
10. Rhode Island	15.85

Source: US Energy Information Administration, 2014

What You Said: *Source: 2011 Visioning Forum*

"Improve walkability"

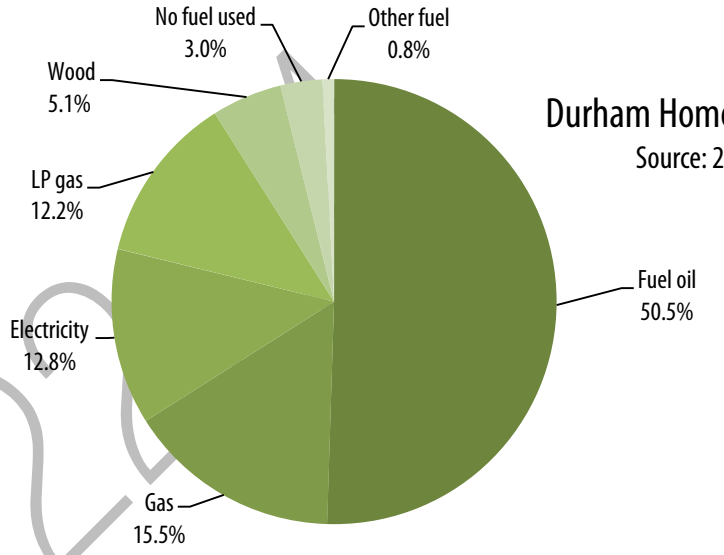
[4] Database of State Incentives for Renewables & Efficiency. New Hampshire Renewables Portfolio Standard.2014. http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NH09R

Energy Use in Durham

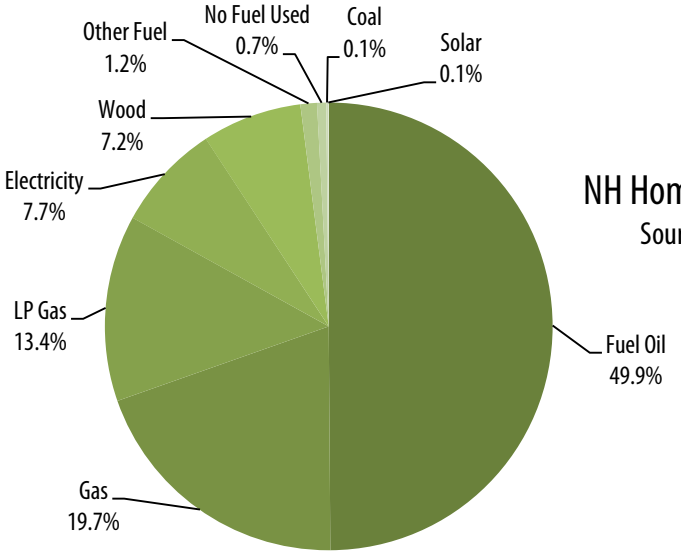
Energy consumption sectors include: residential, commercial, industrial, and governmental (municipal[5] and state) accounts. Determining an accurate depiction of the energy use in Durham is difficult, due to insufficient information. The community receives electricity from three providers; Public Service of New Hampshire (PSNH) serves as the primary source, New Hampshire Electric Cooperative (NHEC) provides electricity to a limited number of residential customers, and Town facilities are also served by Constellation NewEnergy. Unitil provides natural gas service to Durham's residents. Using data provided by these service suppliers, this section attempts to detail the amount of overall gas and electricity consumption by homes, businesses, and state institutions in Durham.

The U.S. Census American Community Survey estimates that 50.5% of Durham's households use fuel oil to heat their homes and 15.5% use natural gas. Other heating sources, which include electricity, liquid propane, and wood, make up approximately 31%. The remaining 4% captures households that do not use fuel and all other miscellaneous fueling types. Durham's primary heating source closely mirrors the statewide trend. According to the NH Office of Energy and Planning, fuel oil is the most widespread form of heating source in the state, it is also one of the more expensive fuel types available. As of December 2014, the statewide average price for a gallon of home heating oil was $3.19.[6]

Durham's home heating energy use differs significantly from the country as a whole; nationwide, only 6.5% of homes use fuel oil as the primary source of heat. The general low use of fuel oil seen throughout the country may partially explain the relatively high cost experienced by residents in Durham and most of New England.



Durham Home Heating Sources
Source: 2007-2012 ACS



NH Home Heating Sources
Source: 2007-2012 ACS

[5] The New Hampshire Energy Technical Assistance & Planning Program (ETAP) completed an energy audit of Town-owned facilities in 2011.
[6] New Hampshire Office of Energy and Planning. Fuel Prices. December 2014. http://www.nh.gov/oep/energy/energy-nh/fuel-prices/index.htm

Primary Local Energy Supplies

Unitil – waiting on data

Public Service of New Hampshire – waiting on data

NH Electric Cooperative is the secondary provider of electricity Durham, estimates that there are approximately 10 residential customers located on Wednesday Hill Road and Lee Hook Road. Due to the relatively small number of consumers, the amount of electricity (kWh) being used at the local level could not be determined.

Power Generated in Durham

While Durham does not have any major power generators, the University of New Hampshire operates a cogeneration (COGEN) plant[7], the primary source of electricity and heat for the five-million square foot campus. In operation since 2006, UNH's cogeneration plant captures waste heat normally lost during the production of electricity and uses this energy to heat campus buildings, thus reducing sulfur dioxide and nitrous oxide emissions. Over the first full academic year (AY) of its operation (AY 2006) greenhouse gas emissions for the campus dropped by 21% from the previous year (AY 2005).

In 2009, UNH completed its Ecoline project, which purifies methane gas from private company Waste Management's Turnkey Recycling and Environmental Enterprise (TREE) in Rochester, making it the nation's first major university to use landfill gas as its primary fuel source. Once purified, the landfill's naturally occurring methane gas is piped nearly 13 miles to the cogeneration plant, where it now provides up to 85% of the University's energy needs.

Photo 5: Processing Plant at Waste Management Turnkey Recycling and Environmental Enterprise (TREE)

[7] Cogeneration is the process whereby a single fuel source, in this case methane gas, is used to produce both electrical and thermal energy

Solar Power in Durham

Durham is the site of over 30 local photovoltaic (PV) installations, encompassing both municipal and residential systems. Putting that number in context requires looking at state and national data. The National Renewable Energy Laboratory (NREL) is recognized as the U.S. Department of Energy's primary national laboratory for renewable energy and energy efficiency research and development. The lab created an online tool to develop a comprehensive registry of all PV installations in the United States. As of late 2014, over 200,000 PV owners across the country had registered their systems in this Open PV Project database. The Open PV Project ranks New Hampshire 21st in the country in the number of PV systems installed, below Massachusetts, Vermont, and Connecticut. Durham's PV installations, a sign of its leadership and commitment to embracing renewable energy and new energy efficient technologies, make up more than 5% of the state's 591 installations.

Municipal Solar Energy Generation Systems

As of late 2014, approximately 100 kWh of the Town's energy use has been generated locally by solar panels installed on the Police Station, the Public Library, and Churchill Rink. The Solectria website (manufacturer of the systems' inverters) offers a real-time monitor showing energy production for each of these solar generation systems.

Photo 6: Solar Photovoltaic installation at the Public Library

Residential and Commercial Solar Power

By late 2014, approximately 28 single-family homes had registered their solar energy systems with the Open PV Project. In addition, the Durham Boat Company on Newmarket Road hosts a large set of solar arrays on its roof.

Municipal Energy Use

Durham municipal buildings use electricity, oil and natural gas as the primary utility supply, but its wastewater treatment plant also uses propane to heat the dewatering building.

Beginning in 2011, Durham started taking steps to identify and track the energy use at all of its facilities to assess areas where management or efficiency improvements could lower the Town's energy use. The Durham Energy Committee provided assistance in compiling this data with the help of University of New Hampshire graduate students, the Strafford Regional Planning Commission and the New Hampshire Energy Technical Assistance & Planning Program (ETAP). In addition, an energy audit at Town-owned facilities was performed through the ETAP program. A report based on the audit "Energy Efficient Opportunities for Town Buildings in Durham, New Hampshire," was published in February 2012.

Summary of Town-Owned Facility Usage and Costs

The two Town facilities that use the most energy by far are the wastewater treatment facility and the Churchill Rink. While energy is needed to pump and treat the waste treated at the wastewater treatment facility compared with other wastewater facilities, Durham is doing well; the Town's plant uses only 13% of its overall operating budget for this component, versus an industry average of 30%. The recent replacement of the facilities blowers with high efficiency units has helped to reduce usage. The Churchill Rink is also a large user of electricity. Exploring opportunities to reduce its energy consumption could have merit.

The former Town Hall at 15 Newmarket Road was the Town's largest user of heating oil. The new Town Hall at 8 Newmarket Road, designed to LEED standards, is anticipated to be significantly more energy efficient to operate.

Table 3: Municipal Facility Energy Usage, 2011

Facility	Electric kWh(s)	Electric Cost	Oil Gallons	Oil Cost	Gas Therms	Gas Cost	Propane Gallons	Propane Cost
Old Town Hall*	3,606	$1,066	3,915	$12,378	-	-	-	-
District Court	10,054	$1,726	1,745	$5,465	-	-	-	-
Street Lights	61,037	$8,309	-	-	-	-	-	-
Public Works	68,534	$8,725	-	-	6,815	$9,440	-	-
Transfer/Recycling	18,919	$3,679	1,503	$4,624	-	-	-	-
Wastewater Treatment	1,454,800	$157,698	-	-	-	-	4,870	$10,853
Wastewater Pump Station	12,075	$2,594	-	-	-	-	1,306	$2,891
Lee Water Well	117,342	$17,518	-	-	-	-	-	-
Water Boost Pumps	24,105	$3,755	-	-	-	-	-	-
Water Tanks	7,656	$1,523	-	-	-	-	-	-
Police Station	4,919	$912	-	-	2,457	$3,317	-	-
Hockey Rink	221,116	$31,059	-	-	-	-	-	-
Misc. Facilities**	25,306	$5,090	-	-	-	-	-	-

* Some electrical use data is missing from the old Town Hall

**Miscellaneous facilities include; 11 School House, Smith Chapel Fund, Wagon Hill, Metered Parking Lot, Flashing street light, and the Library (the current Library only pays for electricity, heating is included in the lease agreement).

Source: Durham Energy Committee, 2012

Energy Efficiency Opportunities for Other Durham Municipal Facilities

In 2011, the Peregrine Energy Group performed an Energy Opportunity Assessment to guide the Town in developing and implementing an energy reduction strategy. The assessment included specific recommendations and next steps to reduce energy use and increase energy efficiency. It also provided summary information on the buildings with recommendations that can provide a starting point for securing bids from installation contractors for suggested projects. Peregrine estimated that several specific improvements would result in energy reductions and that those improvements would save the Town approximately $8,000 per year.

A copy of this Assessment was presented to the Town in February 2012. The Town may wish to pursue the report's recommended upgrades. Routine maintenance items should be done as soon as possible. Upgrades that will take more time and funding should be included in future Town budgets or its capital improvement program.

Photo 7: Churchill Rink (Churchill Facebook page)

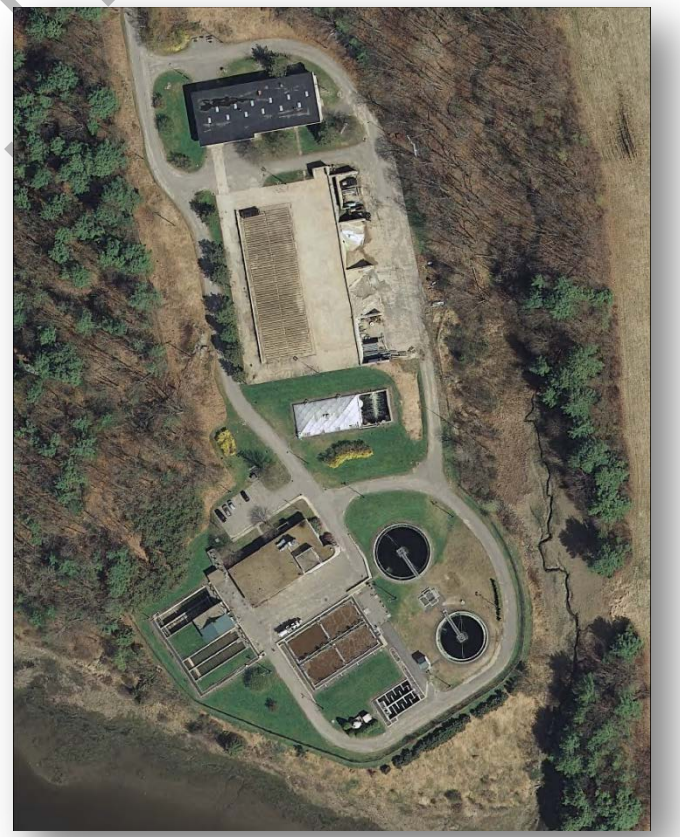


Photo 8: Durham's Wastewater Treatment Facility

Quick Fact: The two largest energy users are the Wastewater Treatment Facility and Churchill Ice Rink

Leadership in Energy and Environmental Design (LEED) Buildings

As of late 2014, only seven buildings in the region had been certified, or were in process of being certified, as Leadership in Energy and Environmental Design (LEED); Durham is home to three of the seven (refer to Table 4 for more information on LEED certified buildings in the region).

The UNH campus houses two LEED Gold buildings: James Hall on Colovos Road and the Peter T. Paul College at Main Street and Garrison Avenue. Durham's new Town Hall at 8 Newmarket Road is being evaluated for LEED certification.

Photo 9: Durham Town Hall at 8 Newmarket Road

Changes to the Town Code

Building Construction Meets the 2012 International Energy Conservation Code (IECC)

Durham is regarded as a State leader in energy efficiency standards. The Town has worked to reduce the community's energy demand through its building code and permit process.

In 2011, the Town Council approved a change to Chapter 38 of the Town Code, "Building Construction" that resulted in Durham becoming the first municipality in the country to adopt the 2012 International Energy Conservation Code (IECC). This action beat by three years the deadline for compliance and set the bar for other communities in New Hampshire and throughout the country to adopt these significant changes (it should be noted that Durham committed to basing its energy code construction on "the current printed edition of the International Energy Conservation Code," not the 2012 version, per se).

Table 4: LEED Certified Projects in the Region

Name	Municipality	Certification Level	Year
Turbocam	Barrington	In progress	N/a
Liberty Mutual	Dover	Gold	2008
Children Museum of NH	Dover	Silver	2009
James Hall	UNH	Gold	2010
Peter T. Paul College	UNH	Gold	2013
Town Hall	Town of Durham	In progress	N/a
Cocheco Well Water Treatment Plant	Rochester	Certified	2011

Source: US Green Building Council, 2014

Local decision-makers unanimously agreed that the code change would result in the improvement of the overall energy efficiency of Durham's building construction by bringing the Town up to par with those sections of Vermont and Maine at Durham's same latitude. The Town Council's approval of the code was also keyed to a goal that, despite an increase in upfront costs, residents would benefit from cost savings over time due to the higher standard of efficiency and lowered operating cost.

What You Said: *Source: 2011 Visioning Forum*

"More sustainable and alternative energy"

Each revision of the International codes sets higher standards for greater energy efficiency performance and recommended renewable energy guidance. The 2012 IECC required more insulation, a tighter envelope, tighter ducts, better windows, and more efficient lighting than the prior 2009 version.

In April 2013 the Council approved amendments to Chapter 97, "Plumbing Code and Regulations," of the Durham Town Code to codify the Town's support for water conservation and water-efficient plumbing relative to public water and sewer systems. The amended code now requires lower-flow water-using fixtures (e.g., faucets, shower heads, toilets) in new construction and other projects that require building permits. The Energy Committee and Conservation Commission supported these amendments acknowledging a link between water and energy consumption.

Chapter 38, Durham's "Building Construction" code, excerpt:

"All construction in the Town of Durham shall conform to the current Life Safety Codes, National Electrical Codes and applicable state laws and NFPA & ICC adopted codes and to current applicable town ordinances and construction requirements. The current printed edition of the International Energy Conservation Code (IECC) shall be used for all energy code construction in the Town of Durham based on all Climate Zone 6 design criteria."

Durham's Three Guiding Principles on Energy Planning and Action

In 2008 and 2009 the Energy Committee sponsored a series of public discussions on the question of how Durham could improve its economic vitality, ensure its energy stability, and reduce its environmental impact to guide development of the Master Plan chapter.[8] The Committee identified three guiding principles that emerged from the community discussions as a way for the Town to organize energy planning and actions. These principles serve as the building block in supporting the overarching message of this Chapter and underlying foundation from which the goals and recommendations were developed.

Principle I: Building Design and Land Use

Land use regulations and incentives

As the Town courts new businesses, reviews land use and development plans, approves building permits, and revises zoning and building codes, it should seek ways to maximize energy efficiency, contribute less environmental pollution, and reduce the need for motorized vehicles for daily activities.

Photo 10: Jenkins Court

Durham can significantly reduce the number of miles traveled by residents in private vehicles through its land use regulations, and by using mandates and/or incentives. This will provide the Planning Board with a toolkit of energy efficiency measures to guide new development. These tools would help the Board:

- ∴ site new development close to already developed areas
- ∴ increase density and mixed uses, which reduces the need to travel for goods and services
- ∴ expand access to pedestrian and bicycle routes that link to the downtown
- ∴ require amenities (such as bus shelters) that support mass transit
- ∴ embrace Innovative and emerging technologies, including green building technologies that seek to not only minimize damage to the environment but result in net benefits
- ∴ expand and create traditional neighborhoods[9] near the core of the community. These hold promise for energy savings as well as support for a vibrant downtown
- ∴ balance conservation and open space goals with the improved energy and resource efficiency of smaller, denser development close to the community's core.[10]

[8] See the Appendices for the flier that announced the forum.

[9] Traditional Neighborhood Development (TND) "is a planning concept that calls for residential neighborhoods to be designed in the format of small, early 20th century villages and neighborhoods. Those traditional formats were characterized by one-family and two-family homes on small lots, narrow front yards with front porches and gardens, detached garages in the backyard, walkable "Main Street" commercial areas with shops lining the sidewalk, and public parks, town greens, or village squares." (http://www.crcog.org/publications/CommDevDocs/TCSP/Ch06_FactSheet_TND.pdf accessed 7/1/13)

Building and construction code

The Town's building and construction code (see above) can be a powerful tool in encouraging energy efficiency "best practices" in architecture and construction. In New England the largest portion of energy consumption, second only to transportation, goes to heat homes and businesses. Much of this heat comes from fossil fuels, including relatively inefficient and costly heating oil.

Principle II: Transportation

Transportation[11] accounts for a large portion of energy use across the country. For Durham, it accounts for the largest single portion of the town's annual residential and municipal energy use and cost. In 2008, Durham's Greenhouse Gas Emission inventory determined that approximately 43% of the Town's emissions primarily come from residents driving personal vehicles. Reducing transportation costs and carbon emissions and enhancing the quality of residents' lives is within Durham's reach.

Photo 11: Shared lane marking example – "Sharrow"

Many of Durham's transportation patterns are rooted in its fundamental suburban, semi-rural (i.e., less population-dense) setting, and its regional economy. The Transportation section focuses on aspects of this complex issue that are amenable to change over time through municipal planning and public education. The recommendations in this Principle provide a roadmap to achieving a lower overall consumption of resources in the transportation sector through closer proximity of residents to work, school, goods, and services, along with other strategies for long-term gains in efficiency.

Laying out the problem: short-length car trips

Short car trips – less than two miles – are costly in terms of fuel, carbon emissions, and downtown vehicular congestion.

It is unlikely that public, or mass, transit—a solution to the high cost of transportation available to city dwellers—will become a viable transportation option for most Durham residents. An ancillary result is downtown traffic congestion, leading to frustration by those who depend on cars. On the other hand, bicycling and walking are healthy, low cost modes of travel available to many in the community, including the thousands of UNH students who live within municipal boundaries.

[10] Compact residential development makes efficient use of the site with smaller lots and buildings that often have a smaller footprint on the property than a more sprawling pattern that covers more surface area. Building "compactly" often creates a more walkable neighborhood.

[11] See discussion of in the Transportation in the Appendix.

The cumulative impact of replacing short-distance car trips and bicycling or walking has the potential to reduce in-town collective driving by approximately 900,000 miles per year. This would save Durham residents on the order of $500,000 in collective driving costs[12], reduce greenhouse gas emissions by 390 metric tons, and support the Town's vision for a vibrant, pedestrian environment in the downtown.

Both the Town and UNH have taken some steps to address the problem, e.g., adding bicycle lanes and trails, improving walkways and crosswalks, and calming traffic with stop signs and speed tables.

UNH has grabbed the horns

In 2003 the University of New Hampshire adopted a traffic demand management (TDM) approach to addressing the challenge of off-campus student and commuter employee transportation. Since then, parking permit demand has been flat to down, and transit ridership has increased dramatically. The University has made a commitment to reinforce the walking campus, limit parking capacity expansion, and enhance transportation options (intercity rail, cycling infrastructure, car-sharing) which reduce the need for private vehicle use and parking

Transit

The university operates Wildcat Transit, which serves nine regional communities, and the Campus Connector, which serves Durham. Combined, these two public systems are the largest transit system in the state. In FY 2014, the two route systems carried over 1.2 million passenger trips, reducing an estimated four million private vehicle miles from the regional roadway system.

[12] Calculation based on Federal Standard Mileage Rates for 2013, as of November 21, 2012 (http://www.irs.gov/uac/2013-Standard-Mileage-Rates-Up-1-Cent-per-Mile-for-Business,-Medical-and-Moving)

Approximately 45% of the Wildcat Transit fleet runs on compressed natural gas (CNG), and the balance of the fleet runs year-round on B20 biodiesel.

The Amtrak Downeaster train serves Durham and the UNH campus, connecting us to Boston and Portland-Freeport-Brunswick. In 2013 over 61,000 passengers rode the Amtrak Downeaster to/from Durham, according to Northern New England Passenger Rail Authority (NNEPRA) ridership reports.

Photo 12: Rail Station – Downeaster (UNH Photographic Services)

The campus also features ZipCar car-sharing, open to community and campus members who join ZipCar.

Parking

On-campus vehicular parking demand has decreased, with "flat to consistent decline in permit sales at a time of slight campus growth but substantial student residential growth."[13] Over the past decade, the number of commuter student parking permits issued has declined 34%, and resident student permit sales have declined 5%. This exceeds national demographic trends of reduced car ownership rates in 16-25 year old population.


Photo 13: Art Bikes (UNH Campus Planning)

The demand for bicycle storage, on the other hand, has increased. UNH Housing has an informal benchmark of one outdoor bike rack storage space for every four beds at non-core-campus settings like the Gables apartments. (In comparison, Gables provides parking for approximately 1 auto space for every 2 beds, which has been more than adequate in recent years. In contrast, off-campus private development outside the downtown core typically provides at least one auto parking space per bed.) By late 2014, UNH provided additional non-residential location storage capacity for nearly 3,000 bikes on campus for general use), an increase of approximately 19% since 2011.[14]

In 2014, UNH's ArtBike program installed public art that enlivens the campus while highlighting provided bicycle parking. The cooperative program between the College of Liberal Arts and UNH facilities resulted in a series of installations created by metal sculpture students. The program's students creating bike racks bearing names such as "Space Elephant Protein," "Freedom," "Reclaimed," and "Helix."[15]

[13] Transportation Policy Committee, Transportation System Data Check, revised final, March 2012 http://www.unh.edu/transportation/tpc/docs/datacheck_2012.pdf
[14] Email dated December 12, 2014 from Steve Pesci, Campus Planning, to Robin Mower, Town Council
[15] UNH Campus Journal, "Sustainable, Functional Art," by Jody Record, December 04, 2013 http://www.unh.edu/campusjournal/2013/12/sustainable-functional-art and "The Fine Art of Bike Racks," College Letter, 9/14 http://cola.unh.edu/thecollegeletter/2014-09/fine-art-bike-racks

Durham and its private developments slower to catch on

Efforts by the Durham Energy Committee to convince the Planning Board to require or persuade private developers to install secure bicycle facilities, e.g., bike racks, bike storage rooms, have had mixed results.

On the west edge of town, Capstone's "Cottages of Durham," which opened its doors in 2012 and is home to at least 619 residents, provides no bike storage. On the other hand, Peak Campus Developments' "Lodges at West Edge" represents a scenario of the "build it and they will come." Home to at least 460 residents, the site provides rack storage for 105 bicycles; visitors to the site can see they are well used.

Downtown, "Madbury Commons," slated to open in 2015 and provide beds for 525 residents, will provide "parking/storage for a minimum of 60 bicycles outside and a minimum of 75 bicycles inside the building" (for 25.7% of approved occupancy)[16].

Improvement still needed

Durham falls short of being the bicycle- and pedestrian-friendly community overwhelmingly supported by several previous Master Plans and by the Master Plan Survey conducted in 2011. The anticipated influx of thousands of new downtown residents arriving in the fall of 2015 underscores the need for improved bike-ped facilities.

Table 5: Town Owned Bike Rack Locations and Capacity

General Location	Specific Site	Capacity
Main Street	Ballard Park	2
Main Street	Town and Campus	2
Main Street	Young's Restaurant	2
Main Street	Candy Bar	2
Main Street	House of Pizza	2
Main Street	Campus Convenience	2
Main Street	Memorial Park	4
Pettee Brook Lane	Metered Lot	2
Newmarket Road	Town Hall	12
Old Landing Road	Jackson's Landing	8
Old Landing Road	Old Landing Park	2
Fogg Drive	Woodridge Recreational Areas	8
Stone Quarry Drive	Public Works	6
Dover Road	Police Station	2
Madbury Road	Library	16
Dennison Road	Oyster River Middle School	56
Coe Drive	Oyster River High School	24

Source: Durham Department of Public Works, 2014

Since municipal property taxes fund a good portion of Durham's roadway maintenance and improvements, roads should accommodate all the different ways that Durham residents choose to travel. Durham should continue to upgrade its transportation infrastructure to improve bicycling and walking opportunities.

[16] Notice of Decision, February 12, 2014] In contrast, the Orion student housing project at 25–35 Main Street, future home of up to 197 residents, will accommodate 12 bicycles in outdoor racks and interior storage for up to 15 bicycles (13.7%)

Principle III: Alternative and Renewable Energy Resources

Durham has endeavored to "brand" itself as a leader in municipal best practices for land use, conservation, and energy efficient zoning and planning. Apart from reflecting many residents' values, this branding is seen as one way to attract desirable economic activity and new residents to Durham. Improving Durham's transportation network, land use patterns, and building construction practices is also essential to reducing the Town's energy consumption. Such steps reduce the need for energy outright and offer the best payback and environmental gains. As noted above, a key way that Durham can reduce its consumption of energy – its demand – is through thoughtful planning and zoning for new, renovated, and expanded housing in existing neighborhoods.

Yet demand provides only one half the picture, the best energy efficiency and conservation measures can only reduce, not eliminate, total energy demand to provide heat and the power to move vehicles. The gap between supply and demand must be filled by non-local energy sources. The balance between reduction in demand and new forms of renewable or sustainable supply will have a profound effect on the affordability, environmental sustainability, and security of Durham over the coming century.

Durham must take action on a municipal level to reduce consumption of fossil fuels, increase reliance on alternative and renewable energy sources, stabilize energy expenditures, and hedge against increasing fuel prices. The Town can encourage residential use of alternative energy, leading by example, via educational and municipal finance activities.

The presence of UNH, which is engaged in research in energy issues and technologies, provides Durham a comparatively unique opportunity to further research and commercialization of emerging energy technologies, reinforcing the Town's reputation for innovation and opportunity for economic development.

Renewable or sustainable energy sources:

- ∴ Solar
- ∴ Wind
- ∴ Hydro
- ∴ Biomass fuels from sustainably harvested operations

Alternative energy solutions:

- ∴ District heating
- ∴ Combined heat and power (CHP), commonly known as "cogeneration" - solutions

Key Conclusions

The following key conclusions have been organized to correspond with Durham's three guiding principles.

Principle I: Building Design and Land Use

1. Durham's building stock and municipal equipment is aging and energy inefficient.
2. Low-density central neighborhoods and significant distances between neighborhoods and the center of town can encourage vehicle use.
3. According the U.S. Census American Community survey, 50.5% of Durham's households use fuel oil to heat their homes.
4. Roughly only 15.5% of households use natural gas to heat their homes.
5. Durham has three of the seven LEED certified structures in the Strafford Region.
6. Durham was the first municipality in the country to adopt the 2012 International Energy Conservation Code

Principle II: Transportation

7. Increased pedestrian activity and bicycle usage in Durham are impeded by a lack of safe and attractive network of routes, sidewalks, trails, and paths.
8. Durham has limited access to convenient year-round service of regional public transit.
9. Today's vehicles are relatively energy inefficient, produce high levels of emissions, and rely almost exclusively on fossil fuels.
10. In 2008, Durham's Greenhouse Gas Emission inventory determined that approximately 43% of the Town's emissions primarily come from residents driving personal vehicles.
11. Short car trips are costly in terms of fuel, carbon emissions, and vehicular congestion in the downtown area.
12. The cumulative impact of replacing short-distance car trips with bicycling or walking has the potential to reduce in-town collective driving by approximately 900,000 miles per year. This would save Durham residents on the order of $500,000 in collective driving costs and reduce greenhouse gas emissions by 390 metric tons.
13. Transportation accounts for roughly 36% of all energy used in the state.

Principle III: Alternative and Renewable Energy Resources

14. In New England the largest use of energy, second only to transportation, is for heating homes and businesses. Much of this heat comes from fossil fuels, including relatively inefficient and costly heating oil.
15. Petroleum prices are volatile and are likely to rise over the long term due to peak oil[17], but alternative energy has high upfront costs.
16. The burning of fossil fuels is detrimental to human health and the environment.
17. Renewable energy or sustainable energy sources include solar, wind, and hydro sources as well as biomass fuels from sustainably harvested operations.
18. Nearly 1 in 12 homes depend on wood products as a primary heating source.
19. New Hampshire had the ninth lowest (tied with Arizona) per capita consumption of total energy in the United States, at 215 million BTUs.
20. Nearly 40% (roughly 140 trillion BTU) of the state's energy comes from petroleum
21. Motor gasoline is the dominate type of petroleum and makes up for almost 60% (81.4 trillion BTU) of all petroleum products.
22. Only 13% of New Hampshire's power supply comes from renewable sources.
23. New Hampshire's electricity generation is dominated by nuclear power, which accounts for nearly 52% (928 GWh) of all energy used to produce electricity in the state.
24. In 2014, natural gas provided approximately 30% (554 GWh) of electricity for the state.
25. In 2013, NH residents experienced an average of $0.17 c/kWh.
26. NH electricity rates have been about 40% higher than the national average.
27. New Hampshire's electricity prices to the residential sector are the 7th highest in the U.S. at 17.23 c/kWh.
28. As of 2014, 15% of New Hampshire's net electricity came from renewable energy.
29. In 2012, New Hampshire became the first state to offer Renewable Portfolio Standard Credits (RPSCs) for renewable thermal projects.
30. As of 2014, the statewide average price for a gallon of home heating oil was $3.19.
31. The cogeneration plant at the University of New Hampshire provides 85% of the university's energy needs.
32. The two Town facilities that use the most energy are the wastewater treatment facility and Churchill Rink.

[17] Peak oil is the point in time when global production of oil will reach the maximum rate, after which production will gradually decline

Goals and Recommendations

This section outlines the goals and recommendations associated with the key conclusions of this chapter that are intended to strategically guide the Town's energy efforts over the coming decade. It's important to note that the goals and recommendations below are not prioritized. Below each goal you will find related key conclusions from the previous section of this chapter that form the respective goal's foundation.

Take steps to rebuild, renovate, redesign, and/or replace municipal facilities to reduce energy use by 30% from 2014-2025

Key Conclusions References: Principle I – 1-6; Principle III – 14-32

1. Conduct detailed energy audits on all buildings and implement recommendations. Prioritize energy-inefficient municipal buildings using the energy audit and make an action plan to weatherize. Use energy benchmarks to guide informed decisions.
2. Use the Capital Improvements Program to identify energy efficiency opportunities and to set priorities and timeframes for investments.
3. Pursue grant opportunities, rebate programs, and financing mechanisms for replacement and retrofitting inefficient equipment and structures.
4. Identify and implement innovative technologies that lead energy savings and ancillary benefits. Amend land use regulations and Town codes, if necessary, to allow for their use.
5. Team up with UNH for collaborative energy challenge programs.

Encourage residential energy conservation

Key Conclusions References: Principle I – 1-6; Principle III – 14-32

1. Survey Durham home energy usage, heating technology, and attitudes toward home weatherization.
2. Work with utilities and fuel companies to help homeowners collect residential usage information and track change over time.
3. Work with private and nonprofit organizations to establish an ongoing community-wide home weatherization program. (See Integrated Education, Outreach, and Workforce Training Measurements and Benchmarks sections below.)
4. Inventory and showcase energy efficient model homes in Durham and those that use alternative energy generation to promote energy efficiency cost savings and to provide a local model for retrofits. Provide homeowners with regionally-relevant models for retrofits.
5. Work with state legislators to initiate and promote (a) municipal and private funding mechanisms for energy efficiency programs and (b) state energy efficiency incentive and grants programs.

Encourage property owners to increase energy efficiency by requiring best management and energy efficient building practices for both new construction and renovation

Key Conclusions References: Principle I – 1-6; Principle III – 14-32

1. Regularly review changes in national and regional building code standards. Initiate amendments to Chapter 38 if necessary to ensure that Durham remains progressive regarding energy efficiency construction, allowing proven innovative energy efficient technologies, methods, and materials, subject to approval by the Director of Zoning Building Codes and Health.
2. Prohibit new homeowner associations from establishing covenants that restrict energy options, including energy efficient measures, such as outdoor clotheslines, and energy renewable measures, such as and solar panels.
3. Promote well-sited, energy efficient homes by:
    a. Conducting an inventory of high efficiency homes and other buildings through a review of building permits and self-reporting. Track and report trends in those numbers over five years in the Town's Annual Report.
    b. Creating an online survey tool to provide information about building practices as part of building permits and Planning Board processes.
    c. Placing articles about energy efficient buildings in Durham's "Updates."

Develop regulations and incentives to create energy efficient municipal, residential, commercial, and industrial development

Key Conclusions References: Principle I – 1-6; Principle III – 14-32

1. Require the Director of Zoning, Building and Codes, and Health to be certified as a residential energy inspector and receive annual International Code Council Energy Certification as a residential energy inspector.
2. Regularly review the educational "Energy Considerations Checklist" ("the Checklist") and update as needed.
3. Work with the Planning and Zoning Department to identify items on the Checklist that could be required, rather than suggested.
4. If supported by state-enabling legislation, work with Town officials to introduce an energy tax or surcharge to discourage the construction and use of excessively large or energy wasteful structures.
5. Provide density bonuses or other available incentives to encourage net-zero or ultra-high efficiency building techniques for structures sited within a specified distance of the community's core.

Reduce the distance between new development and the community core and promote higher density in nearby neighborhoods in conjunction with conservation with open space and shared infrastructure (roads, driveways, septic systems, district heating)

Key Conclusions References: Principle I – 1-6; Principle III – 14-32

1. Advocate for the development of Traditional Neighborhood Development ("TND")v near downtown and existing neighborhoods, working with Town officials to amend land use regulations.
2. Plan for an interconnected network of sidewalks and bicycle paths in future downtown redevelopment.
3. Require dedicated bicycle lanes, pedestrian walkways, and connections to main networks in new subdivisions, when feasible.
4. Amend zoning, subdivision, and site plan regulations to reflect the direct impact of developments on road maintenance, infrastructure, and other municipal expenses.
5. Advocate for small lot sizes for properties served by Town water and wastewater services.

Significantly increase the number of Durham residents and UNH staff and students who walk to destinations in Town and between neighborhoods

Key Conclusions References: Principle II – 7-13

1. Prepare a sidewalk inventory, conduct a survey to identify opportunities for new sidewalks or walking paths, and develop a maintenance and improvement plan
2. Work with the schools to encourage students to walk to and from school and reduce the use of individual family cars.
3. Establish an alternative traffic pattern in downtown both to increase walkability and safety and to alleviate traffic congestion.
4. Expand Durham's network of inter-neighborhood pedestrian pathways (such as the Faculty Neighborhood path between the Mill Plaza and Thompson Lane) to reduce pedestrian travel distances.
5. Dedicate a portion of funding for all future roadway projects to pedestrian infrastructure.
6. Leverage long-term improvement of pedestrian infrastructure through regional partnerships and cooperative initiatives, in particular with UNH.
7. Improve information on pedestrian pathways and trails on the Town's website.

Significantly increase the use of bicycles for commuting and person transportation

Key Conclusions References: Principle II – 7-13

1. Survey downtown and nearby residential neighborhoods to identify opportunities for new bicycling paths.
2. Work with the schools and UNH to encourage bicycling by students and employees.
3. Using best practices and context sensitive design[18], expand dedicated bicycle lanes and road striping throughout Durham and in coordination with UNH.
4. Increase signage and education about "sharing the road," i.e., respecting users of other modes of transport.
5. Improve bicycle convenience and security by providing and maintaining bike racks for public use in prominent locations at all major municipal properties, sheltered from the elements when possible, and by requiring bicycle racks as part of new development permits.
6. Dedicate a portion of funding for all future roadway projects to bicycle infrastructure.
7. Leverage long-term improvement of bicycling infrastructure through regional partnerships and cooperative initiatives.
8. Develop a comprehensive network of bicycle paths connecting neighborhoods and nearby towns that are destinations for Durham residents, including linkages to existing and planned regional bicycling networks and integrating with UNH's pedestrian, bike, and transit system.
9. Improve information on bicycle pathways and trails on the Town's website

Improve access and convenience of public transit, particularly for commuters

Key Conclusions References: Principle II – 7-13

1. Improve comfort, safety, and convenience of existing bus stops throughout downtown and surrounding neighborhoods.
2. Improve awareness of public transportation options and schedules through links on the Town's website, notices on our public access television channels (DCAT), and by locating a transportation information kiosk downtown directing pedestrians to nearby train, bus, short-term rental, and ride share programs.
3. Support and promote Amtrak Downeaster train service in Durham in conjunction with efforts of the Economic Development Committee.
4. Support and promote public transit for UNH and other commuters within and between Durham and to popular regional destinations such as Dover, Portsmouth, Rochester, Manchester, Boston, and New York City. Bus service to and from Concord and Manchester, an east-west transit corridor, is particularly needed, including to the Manchester airport. Identify towns, such as Rochester, where significant numbers of UNH community members live and work, to expand commuter bus service between the towns. Increase awareness of availability of public transportation.
5. Encourage coordination of train/bus service schedules. Stimulate demand by increasing funding to improve convenience and infrastructure to enhance comfort (e.g., provide comfortable waiting and seating areas and protection from inclement weather).

[18] The Minnesota Department of Transportation **(www.cts.umn.edu/education/csd/index.html)** defines context sensitive design (CSD) as "the art of creating public works projects that meet the needs of the users, the neighboring communities, and the environment.

Increase use of highly fuel efficient and low-emission vehicles in the community

Key Conclusions References: Principle II – 7-13

1. Measure the fuel consumption of municipal vehicles ("fleet") using the Town's energy inventory tools to provide objective data that can be used to aid purchasing decisions.
2. Require Town departments to develop a plan to reduce fleet energy use by 30% within 10 years.
3. Provide data and other educational material to Town staff members who use the municipal fleet.
4. Encourage the Town Council to adopt a purchasing policy that requires newly purchased vehicles to be as energy efficient and clean as possible, given budgetary, intended use, and market limitations. When purchasing or replacing municipal vehicles, acquire vehicles that qualify as lower emission vehicles, such as those that meet California Low Emission Vehicle (CALEV) Standards and/or that use cleaner, alternative fuels such as electricity generated in total or in part from renewable energy.
5. Consider purchasing vehicles that use compressed natural gas. Continue to work with UNH to expand access to and use of its compressed natural gas fueling station.
6. Create incentives for high fuel economy and electric and alternative fuel vehicles (e.g., dedicated parking spaces, property tax discounts, registration fees).
7. Establish transportation hubs with Park & Ride and ride share options on the east and west sides of Town in close proximity to major commuter routes.
8. Create additional parking and carpooling solutions, targeted to key commuter routes. Establish a commuter page on the Town's website to coordinate free commuter parking, ride sharing, and other carpooling services.
9. Encourage short-term car rental, bicycle rental, and ride share services to reduce the overall number of cars operated and maintained by the Town and residents.
10. Institute a town-wide no-idling policy with a special focus on schools, municipal offices, and downtown. Install and publicize no-idling signs and support this recommendation through educational outreach. (See Integrated Education, Outreach, and Workforce Training section below.)

Reduce Durham's municipal vulnerability to energy price volatility

Key Conclusions References: Principle III – 14-32

1. Evaluate current Town energy suppliers (and those being considered) based in part on their renewable energy portfolio and stability of price offerings. Lock in rates through longer-term contracts with innovative suppliers of energy.
2. Enter into "power purchase agreements" (PPAs)[19] where appropriate, working with a vendor that installs its equipment on Town sites under lease-purchase arrangements. This will allow the Town to produce some of its own energy through renewable sources at little or no additional cost to taxpayers in the short term and less cost and more security in the long term. Seek partnerships with renewable energy suppliers to further reduce the Town's dependence on fossil fuels.
3. Seek grant and rebate funding for municipal renewable energy projects.

[19] A Solar Power Purchase Agreement (SPPA) is a financial arrangement in which a third-party developer owns, operates, and maintains the photovoltaic (PV) system, and a host customer agrees to site the system on its roof or elsewhere on its property and purchases the system's electric output from the solar services provider for a predetermined period. This financial arrangement allows the host customer to receive stable, and sometimes lower cost electricity, while the solar services provider or another party acquires valuable financial benefits such as tax credits and income generated from the sale of electricity to the host customer." See http://www.epa.gov/greenpower/buygp/solarpower.htm (6/13)

4. Develop municipal, "clean energy district" financing mechanisms to help property owners install renewable energy projects.
5. Provide municipal financing for the upfront investment of renewable energy systems through funding mechanisms such as Property Assessed Clean Energy (PACE)[20], which enables property owners to finance energy efficiency and renewable energy improvements using low-interest bonds arranged by their municipalities as they become available.
6. Participate in the development of regional energy cooperatives.

The Town, its residents, and business owners will choose energy options with low environmental impact

Key Conclusions References: Principle III – 14-32

1. Encourage developers to build common utilities such as district heating or common photovoltaic (PV) systems.
2. Encourage the use of PV and solar thermal hot water in both new construction and retrofits and the integration of passive heating and cooling techniques and measures.
3. Work with the Economic Development Committee and Town officials to attract green fuel and recharging businesses to Gasoline Alley.
4. Work with heating fuel companies that serve Durham, the state, and nonprofit interests to help shift fuel companies' focus to provide an array of heating options.
5. Create a public outreach program to promote public awareness about renewable energy options. (See Integrated Education, Outreach, and Workforce Training section below.)
6. Offer consultations and educational resources on renewable energy through the Energy Committee and other local resources.

[20] Property Assessed Clean Energy (PACE) programs allow property owners to finance energy efficiency and renewable energy improvements, whether retrofits or new technology, using low-interest bonds arranged by their municipality. PACE bonds can be issued by municipal financing districts or finance companies and the proceeds can be typically used to retrofit both commercial and residential properties. Bond proceeds are lent to commercial and residential property owners to finance energy retrofits (efficiency measures and small renewable energy systems) and who then repay their loans via an annual assessment on their property tax bill paid over the life of the improvement – usually 15 to 20 years – by whoever owns the property during that assessment period. Property tax obligations transfer with the property when it is sold. Seehttp://www.pacenow.org/ (6/10)

Commit to an integrated education, outreach, and workforce training program

Key Conclusions References: Encompasses all conclusions (1-32)

1. Develop a comprehensive energy efficiency and renewable energy outreach and education plan.
2. Partner with Oyster River Cooperative School District (ORCSD) administrators, parent organizations, Oyster River Sustainability Committee, and student groups to survey bicycle infrastructure at all school locations, review safety of routes to school, and encourage bicycle use and carpooling.
3. Provide information about the purpose and value of a town-wide no-idling policy and encourage compliance.
4. Encourage use of alternative energy production by sponsoring open houses, regularly contributing notices to the Town weekly newsletter, and profiling existing and new renewable energy installations for posting to the Town's website.
5. Create an energy efficiency and sustainable energy systems website.
6. Support regional and national actions to reduce greenhouse gas emissions.
7. Consider establishment of an Energy Commission with regulatory authority to provide a mechanism for raising and expending funds in support of energy efficiency goals.

Encourage the integration of solar access[21] into local development regulations

Key Conclusions References: TBD

1. Support the Planning Board in updating the Town's site plan regulations to address solar access.
2. Need more input from the Durham Energy Committee.

[21] Solar access is the ability of sunlight to strike a solar energy system

Measurements and Benchmarks

Each Chapter of this Master Plan identifies ways to benchmark and collect measurements in order to track progress toward the goals over the next ten years or so (until the next Master Plan is prepared).

Measurements need to be more quantitative to track progress over time.

Table 6: Energy Chapter Measurements and Benchmarks

Measure	2015 Master Plan Measurement	2025 Measurement Goal
Measure and report annual energy use (heating fuel, electricity) in municipal buildings in the Town's Annual Report, detailed by facility (individual buildings and vehicles). Include historical trends for municipal buildings		
Survey Durham home energy usage, heating technology, and attitudes toward home weatherization.		
Inventory both municipal and private renewable energy systems in the Town and track change over time in two-year increments		
Reduce energy use in municipal facilities by 30% between 2015-2025		
Survey most frequently used and highest visibility sidewalks, neighborhood paths and non-vehicular safety every two years to measure progress and identify opportunities for improvement		
Require Town departments to develop a plan to reduce fleet energy use by 30% within ten years		
Track the use of commuter and ride share parking lots and services on an annual basis to evaluate effectiveness of efforts		
Survey bicycle use every two years to gauge ridership levels and measure change over time		
Survey Durham residents every two years on commuting, home office, and public transportation usage to measure progress over time		

Pointers to Other Sections

Energy concerns cut across all aspects of the Town's plans for the future. Thus, they help to shape other chapters of the Master Plan. The considerations raised in this Chapter echo throughout this document, but see especially the following chapters for linkages and/or discussion to:

1. Downtown and Commercial Core:
    a. Improve condition and safety of sidewalks and their linkages with nearby neighborhoods
    b. Create and/or mark bicycle paths with improved linkages to downtown
    c. Create alternative travel patterns to improve pedestrian safety and mobility
    d. Improve comfort, safety, and convenience of bus stops

2. Economic Development :
    a. Create greater density in/near downtown
    b. Support train service improvements
    c. Work with UNH on opportunities to commercialize UNH energy research initiatives
    d. Brand to attract like-minded businesses to the community

3. Housing:
    a. Offer density bonuses or other incentives for net-zero/ultra-high efficiency buildings within a specified distance of the community core
    b. Create a weatherization program
    c. Promote well-sited, green homes

4. Natural Resources for linkages and/or related discussion of:
    a. Mitigate impacts of climate change
    b. Reduce impacts on environment from reduced fossil fuel usage
    c. Access to local foods to address issues of energy use and food security
    d. Promote understanding of energy impacts of organic vs conventional agriculture

5. Land Use :
    a. Encourage increased density in neighborhoods near the community core, including pocket neighborhood and cottage-style developments
    b. Encourage traditional neighborhood developments as the style of new neighborhoods near the community core
    c. Encourage planned unit developments as the style of new neighborhoods elsewhere
    d. Encourage additional mixing of uses in neighborhoods to serve local residents daily needs
    e. Prevent restrictions by homeowner associations on energy options
    f. Allow alternative fueling stations in Gasoline Alley and near employment centers
    g. Develop regulation to allow and manage residential scale wind generation
    h. Require energy certification training for Code Officer

6. Agriculture:
    a. TO COME

Qualifications

This Energy chapter is intended to provide an analysis of trends related to energy consumption, power generation, energy focused planning initiatives, and basic energy characteristics. Comparative analyses between the Town of Durham, Strafford Regional Planning Commission planning region, and State of New Hampshire are provided as a contextual tool for informing readers. While this chapter provides a snapshot view, it is not a comprehensive study.

Findings are based largely from data extracted from the US Energy Information Administration. However, some data was derived from the Durham's 2011 Municipal Energy Usage Report, Master Plan Visioning Forum, Master Plan Survey. Localized energy usage was derived from service providers including: Unitil, Public Service of New Hampshire, and NH Electric Cooperative. Other information was based on 2010 Census 100% Count, with support from American Community Survey 2012 5-Year Estimate (2007-2012). American Community Survey Estimates, as a sample-derived dataset, present margins of error and limited accuracy. However, in many instances these data represent the best available information, and are therefore the basis for many elements of analysis within this chapter.

Additional datasets that were referenced during the development of this chapter include those from: the Database of State Incentives for Renewables & Efficiency; the Energy Bureau at the NH Department of Environmental Services; New Hampshire Local Energy Solutions; and the US Green Building Council.

This chapter is intended to provide Durham's decision makers with the best available information. The above qualifications represent why that may be neither precise nor accurate enough to lead to definite and/or conclusive results. A certain interpretation of the datasets must be considered when reviewing this chapter.