NEW HAMPSHIRE
10-YEAR STATE ENERGY STRATEGY

New Hampshire Office of Energy & Planning
September 2014

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Many of the recommendations in this Strategy build upon previous reports and we thank the authors of those reports for laying important groundwork. Those efforts include:

- Additional Opportunities for Energy Efficiency in New Hampshire –GDS Associates, Inc., 2009
- NH Climate Action Plan -Climate Change Policy Task Force, DES, 2009
- Independent Study of Energy Policy Issues -VEIC, JHTA, & Optimal, 2011
- Increasing Energy Efficiency In New Hampshire: Realizing Our Potential -VEIC, GDS, & JHTA, 2013
- 2002 NH State Energy Plan- OEP

ACRONYMS

ACEEE	American Council for an Energy Efficient Economy
ACP	Alternative Compliance Payment
AEO	Annual Energy Outlook
AFV	Alternative Fuel Vehicle
AMI	Advanced Metering Infrastructure
ARRA	American Recovery and Reinvestment Act
BEA	Bureau of Economic Analysis
BTU	British Thermal Unit
CAFÉ	Corporate Average Fuel Economy
CAGR	Compound Annual Growth Rate
CA-LEV	California Low Emission Vehicle standards
CELT	Capacity, Energy, Loads and Transmission
CHP	Combined Heat and Power
CNG	Compressed Natural Gas
CO2	Carbon Dioxide Emissions
C-PACE	Commercial Property Assessed Clean Energy
CSP	Concentrated Solar Power
DER	Distributed Energy Resources
DES	New Hampshire Department of Environmental Services
DG	Distributed Generation
DOE	US Department of Energy
DOT	Department of Transportation
DPU	Department of Public Utilities
DR	Demand Response
DSIRE	Database of State Incentives for Renewables and Efficiency
ECP	Eastern Canadian Premiers
EERE	Office of Energy Efficiency and Renewable Energy
EERS	Energy Efficiency Resource Standard
EGS	Enhanced Geothermal Systems
EIA	Energy Information Administration
EPA	Environmental Protection Agency
EV	Electric Vehicle
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
GDP	Gross Domestic Product
GHGERF	Greenhouse Gas Emissions Reductions Fund
GSCCC	Granite State Clean Cities Coalition
GW	Gigawatt
HB	House Bill
HHO	Home Heating Oil
HPwES	Home Performance with Energy Star
HVAC	Heating Ventilation and Air-conditioning
IECC	International Energy Conservation Code
ISO-NE	Independent System Operator of New England
KW	Kilowatt; a unit of energy
LDAC	Local Distribution Adjustment Charge
LPG	Liquefied Petroleum Gas
MERF	Municipal Energy Reduction Fund
MPG	Miles Per Gallon
MPGe	Miles Per Gallon Equivalent
MT	Metric Ton
MW	Megawatt
NEG	New England Governors
NHEC	New Hampshire Electric Co-op
NHSTA	National Highway Traffic Safety Administration
NOx	Nitrogen Oxide Emissions
NREL	National Renewable Energy Laboratory
OEP	Office of Energy and Planning
PACE	Property Assessed Clean Energy
POM	Portfolio Optimization Model
PPA	Power Purchase Agreement
PSNH	Public Service of New Hampshire
PUC	Public Utilities Corporation
PV	Photovoltaic
PZEV	Partial Zero Emissions Vehicle
REC	Renewable Energy Credit
RGGI	Regional Greenhouse Gas Initiative
RPS	Renewable Portfolio Standards
RTO	Regional Transmission Organization
SB	Senate Bill
SBC	System Benefits Charge
SEC	Siting Evaluation Committee
SOx	Sulfur Oxide Emissions
SREC	Solar Renewable Energy Credit
T&D	Transmission & Distribution
TOU	Time of Use
VEIC	Vermont Energy Investment Corporation
VMT	Vehicle Miles Traveled
ZEV	Zero Emission Vehicle

EXECUTIVE SUMMARY

New Hampshire's energy landscape is in an exciting and challenging time of change. Our energy sources are increasingly interconnected, and we have more choices than ever before. Technological innovations are helping consumers to reduce usage and costs, and allowing us to produce our own energy. However, we remain susceptible to volatile international fuel markets and severe weather patterns that can disrupt our energy supplies in an instant. Increasing our resilience and our security by modernizing our infrastructure, enhancing our efficiency, and diversifying our fuel and transportation choices will help us meet our energy goals while providing economic opportunities to the state.

Implementing the changes necessary to develop modern and responsive energy systems will require a fundamental re-thinking of the ways we plan and regulate our energy systems. It will also require a willingness to invest now in order to create long-term savings, independence, and security.

This Strategy aims to be a resource for decision-makers facing choices about the future of New Hampshire's energy policies and programs. It contains specific recommendations organized in four main categories as described below.

All of these recommendations will take effort and resources to implement. Some require state agency activity, some require legislation, others require private market activity, and many require a combination. The time for action is now.

THE ELECTRIC GRID OF THE FUTURE

We need a more flexible and resilient electric grid to support new technologies, increase consumer participation in energy management, and fortify our resiliency in the face of price and supply volatility and extreme weather events.

OPEN A PUC DOCKET ON GRID MODERNIZATION

The electric grid is aging, and changing consumer use patterns, a new generation mix, and increased threats from severe weather events require a more modern system. The New Hampshire Public Utilities Commission should open a docket to determine how to advance grid modernization in the state. In light of the potential breadth of the topic,[1] which could include dynamic pricing, better consumer access to technology, and even rethinking the role of utilities, an investigation or information-gathering proceeding may be an appropriate first step. This less formal proceeding would give all stakeholders a chance to learn about grid modernization and could inform the specific areas that should be pursued within future dockets. This would allow the PUC and stakeholders to determine which approaches will benefit New Hampshire consumers, and when and how they should be implemented. New Hampshire can benefit from several other states currently undertaking similar efforts, as discussed in Section 3.

[1] See http://www.cleanenergycouncil.org/files/NECEC_Leading_Next_Era_Electricity_Innovation.pdf.

INCREASE INVESTMENTS IN COST EFFECTIVE ENERGY EFFICIENCY

Energy efficiency is widely understood to be the cheapest, cleanest, most plentiful energy resource. Investments in efficiency reduces the state's reliance on imported fuels, provides a boost to the state's economy by creating in-state jobs, and lowers energy costs for consumers and businesses. Efficiency improvements also raise the quality of New Hampshire's building stock and have environmental benefits. Action in this area is necessary to reduce the widening gap between New Hampshire and surrounding states, which have realized the cost savings and economic benefits of efficiency and are out-pacing New Hampshire in investing in this area. A 2013 study found that if all buildings in the state were improved to the highest level of cost-effective energy efficiency, consumers would save $195 million each year and an additional $160 million would be added annually to the New Hampshire Gross Domestic Product (GDP).[2]

SET AN ENERGY EFFICIENCY GOAL

In order to reduce energy costs by implementing more cost-effective efficiency programs, the State must set specific efficiency goals and metrics to measure progress. The Public Utilities Commission should open a proceeding that directs the utilities, in collaboration with other interested parties, to develop efficiency savings goals based on the efficiency potential of the State, aimed at achieving all cost effective efficiency over a reasonable time frame.

The Legislature should also adopt an overarching policy directive that all State actions should be guided by the goal of capturing all cost effective energy efficiency savings.

ADDRESS UTILITY DISINCENTIVES

Utilities are a key partner in efficiency work, and achieving New Hampshire's full efficiency potential will require strong collaboration. However, current regulatory structures mean that utilities lack incentives to increase efficiency, as it reduces their sales. Realigning utility incentives to reward utilities for investing in efficiency is a necessary part of any effort to increase efficiency in New Hampshire. Twenty-four states nationwide now have implemented these changes, and New Hampshire can learn from their experiences.[3]

IMPROVE COORDINATION AND DESIGN OF EXISTING EFFICIENCY PROGRAMS

New Hampshire's current efficiency offerings are scattered and inconsistently offered, confusing consumers and businesses and preventing widespread market transformation. The programs should be better coordinated, and offer consumers a one-stop shop that provides trusted, accessible information about all of the programs to support actions to save energy.

[2] Increasing Energy Efficiency In New Hampshire: Realizing Our Potential ("2013 EERS Report"), available at: http://www.nh.gov/oep/resource-library/energy/documents/nh_eers_study2013-11-13.pdf.
[3] http://www.c2es.org/us-states-regions/policy-maps/decoupling.

In addition, the current design of the CORE programs may not support scaling up and encouraging market-based approaches to funding efficiency. The recommendations made in a 2011 study of efficiency program design changes should be reviewed,[4] in concert with a comprehensive evaluation of the programs to inform program improvements.

IMPROVE CONSUMER ACCESS TO FINANCING

One of the barriers to efficiency investments is access to capital. Attracting private financing can expand the reach of limited public funds and spur market activity as more consumers implement efficiency projects and lenders see value in efficiency financing. Similar to a 'one stop shop' for efficiency program information, efficiency financing should also be grouped under a single entity or umbrella. This would allow financing offerings to be easily accessed by consumers and businesses.

Regardless of the financing approach chosen, it should seek to leverage public funds to attract additional private capital and build the market for such products. Financing offerings should be clearly defined and coordinated to make them easy to access, and they should be tied to measurement and verification of energy savings.

DO MORE TO REDUCE COSTS FOR OUR LOW INCOME NEIGHBORS

New Hampshire's low income residents are the most vulnerable to high energy costs, as they spend a higher proportion of their income on energy yet have the least access to funding to make efficiency improvements to reduce those costs. Estimates show that more than 80,000 low income homes are in need of weatherization, but current funding sources are sufficient to weatherize only approximately 1,000 homes annually. The State should consider mechanisms to increase funding to better meet this need, in cooperation with other programs that could have synergies in delivery.

FUEL DIVERSITY AND CHOICE

Like other states in the Northeast, New Hampshire imports all of the fossil fuels used in the state. As the sources and supply chains for these fuels become increasingly global, the state has seen considerable volatility in both price and supply. The New England region is more susceptible to these volatile conditions because it is at the end of fuel distribution networks. As demand for all fuels increases on a global scale, these challenges are not expected to ease, and overall prices are predicted to continue increasing. Now more than ever there is a need for focused efforts to reduce New Hampshire's vulnerability to price volatility and supply disruptions, and to expand our ability to be more flexible and resilient. Diversifying our fuel portfolio and increasing the use of in-state resources are critical tools in achieving those goals.

[4] *Independent Study of Energy Policy Issues* ("2011 EESE Board Report"), available at: http://www.puc.nh.gov/Sustainable%20Energy/Reports/New%20Hampshire%20Independent%20Study%20of%20Energy%20Policy%20Issues%20Final%20Report_9-30-2011.pdf.

Better utilizing New Hampshire's in-state resources will also provide an important economic boost, as it will allow more energy dollars to be retained in state rather than spent on imported fuels, and the industries associated with building and installing these systems increase economic activity.

STRENGTHEN AND STABILIZE THE RPS

One of the most effective policies to increase deployment of in-state resources already exists—the Renewable Portfolio Standard (RPS).[5] Frequent changes to the RPS in recent years have disrupted the market's development, and the Business As Usual forecast (see Appendix A) projects that New Hampshire will not meet its RPS goal of 25% by 2025. To realize the full economic and security benefits of in-state energy, the State must to recommit to a strong and stable RPS. As noted by the National Renewable Energy Laboratory, "RPS targets should be stable, ramp up steadily over time and not be subject to sudden or uncertain shifts."[6]

New Hampshire also needs to adjust its cost-containment mechanism (Alternative Compliance Payments) to be more consistent with those in surrounding states. At present, New Hampshire's ACP prices are substantially lower than others in the region, leading energy developers to focus on those states, which reduces the availability of RECs in New Hampshire.

ENCOURAGE DISTRIBUTED GENERATION

Distributed Generation (DG) refers to producing electricity and/or thermal energy through dispersed, smaller scale generation facilities rather than relying on large centralized power plants. DG includes sources from residential rooftop solar photovoltaics (PV) to large combined heat and power (CHP) systems. DG supports a system that is more resilient, flexible, and efficient. Small scale energy projects also enhance New Hampshire's economy, as installation of these projects creates jobs that are difficult to outsource, and money spent on the projects circulates within the state's economy.

Despite these benefits, DG remains under-developed in New Hampshire because it is difficult for many residents to pursue. New Hampshire should work to improve access to renewable generation for homes and businesses.

ATTRACT PRIVATE FINANCING

One of the barriers to small scale energy development is access to capital. Traditional financing products are poorly suited for many installations, and many lenders have not yet fully embraced the potential of renewable energy loans. One way to increase access to financing is to use a portion of the Renewable Energy Fund to attract private financing. Developing a collaborative approach could provide certainty to lenders and help coordinate lending options, providing consumers and businesses access to clean energy financing.

[5] http://www.puc.state.nh.us/Sustainable%20Energy/Renewable_Portfolio_Standard_Program.htm.
[6] http://www.nrel.gov/tech_deployment/state_local_governments/basics_portfolio_standards.html.

EXPAND USE AND SCOPE OF RENEWABLE PROPERTY TAX EXEMPTIONS

Towns should be encouraged to adopt Renewable Energy Property Tax Exemptions, as allowed under current statute (RSA 72:61 - 72). The State should consider expanding the technologies eligible for the exemption so that the statute is flexible enough to allow property owners to take advantage of any beneficial new technologies. It may be simpler for RSA 72 to reference the RPS statute (RSA 362-F), which already defines renewable energy.

INCREASE TRANSPORTATION OPTIONS

The State's transportation system is more than just roads and bridges. A connected multi-modal system will be necessary to meet the needs of all citizens and provide for movement of goods and people through and within the state. The transportation sector accounts for 35% of New Hampshire's energy consumption[7] and as noted in the Business As Usual forecast (see Appendix A), comprises 46% of total energy expenditures. Motor vehicles are also responsible for a range of harmful emissions. Vehicles are the main contributor to ground-level ozone, which is the primary component of smog and can cause significant health issues, particularly in the young and elderly.

Reducing transportation energy use also provides economic benefits as the majority of transportation energy dollars immediately leave the state's economy to pay for imported fossil fuels. Increasing vehicle energy efficiency, increasing access to alternatives, decreasing vehicle miles traveled (VMT), and improving the flow of traffic can generate large energy and cost savings. In addition, the increasing electrification of the transportation sector, especially for single occupancy vehicles, will have impacts on our electric grid. This poses both challenges and opportunities, and requires that we consider transportation energy issues in future energy planning.

ENABLE AND ENCOURAGE ADOPTION OF PLUG-IN ELECTRIC VEHICLES

Electric vehicles are an important part of New Hampshire's strategy to reduce reliance on imported fuels as the electric mix shifts to distributed renewable sources. They can provide significant cost savings to consumers as compared to traditional fuel vehicles, and with reduced emissions they provide local air quality and health benefits.

CREATE A STRATEGIC PLAN FOR EV CHARGING INFRASTRUCTURE DEVELOPMENT

One of the largest barriers to widespread EV adoption is the lack of a charging infrastructure—consumers are unwilling to purchase vehicles that cannot travel where they need to go. In order to ensure the availability of widespread charging infrastructure, the State should develop a strategic plan to guide infrastructure investments. The State should also continue to work with regional partners to plan for EV charging infrastructure to enable travel by EVs throughout the mid-Atlantic/Northeast/Eastern Canadian region. These efforts can help inform which locations to focus on for expansion of charging infrastructure.

[7] http://www.eia.gov/state/?sid=NH.

INCENTIVIZE INDEPENDENT DEVELOPMENT OF EV CHARGING INFRASTRUCTURE

Once priority locations have been identified, the State must find ways to foster development. One approach is to offer tax credits for businesses that install public charging stations. This approach has been implemented successfully in other states, though other mechanisms should be explored as well.

With or without incentives, business owners who install charging infrastructure for their customers and employees will need support in determining whether and how to charge for its use. The State (particularly the Public Utilities Commission and Department of Revenue Administration) will need to be partners in this effort to ensure that this issue is addressed appropriately.

INCREASE CONSUMER ACCESS TO LEVS AND ZEVS

All other New England states, and a total of fourteen states across the country, have adopted the California Low Emission Vehicle (LEV) standards and Zero Emission Vehicle (ZEV) standards. These standards create an incentive for auto manufacturers to sell low and zero emission vehicles in participating states. The State should consider participating in these programs to ensure that New Hampshire consumers have access to alternative fuel vehicles and can benefit from lower transportation costs and fewer transportation emissions.

While providing additional vehicle choice to consumers will be an important step, real market transformation will also require building consumer confidence. The State needs to work with dealers to share information about the benefits of EVs. Consumers and dealers will need to be able to quickly find out where public charging locations exist,[8] any available rebates (such as the $7500 federal tax credit) should be well-publicized, and any special at-home electric rates that the utilities/Public Utilities Commission decide to offer should be clearly explained. Lessons can be taken from the surrounding states, which are ahead of New Hampshire on EV adoption.

STATE LEAD BY EXAMPLE IN TRANSPORTATION

As the largest fleet, State-owned vehicles represent a prime target for EV adoption, providing important leadership to other fleet owners as well as to individual consumers. Additionally, State investment in charging stations can make a significant contribution toward creating a widespread publically available charging infrastructure. The State should create a goal for plug-in electric vehicles in the fleet and install charging infrastructure at large State office complexes, in partnership with private employers or other institutions where shared access is possible. The State should also reexamine its vehicle ownership policies and look at creating a centralized fleet to reduce the overall number of vehicles and to increase vehicle utilization rates. Such an effort has the potential to reduce costs while enabling the State to adopt the newest, most efficient vehicles on a more regular basis.

[8] The US Department of Energy collects and publicizes charging station locations, and the State can share that resource: http://www.afdc.energy.gov/locator/stations/.

IDENTIFY SUSTAINABLE TRANSPORTATION FUNDING MECHANISMS

The state's current funding mechanisms for transportation do not support a modern transportation system. For the last decade, short-term fixes have been used to keep the Department of Transportation operating as significant increases in the cost of materials—the cost of asphalt cement has increased by 460% over the past two decades – and falling revenue has left the department as a whole under-funded.[9,10,11] This challenge is being experienced by states around the country, and creative solutions such as per-mile usage policies[12] and public-private partnerships[13] are emerging. However, even with significant leveraging of private dollars, some level of public funds is needed to support a modern transportation system, and NH Department of Transportation budget constraints are limiting the ability of the state to pursue grant opportunities (which require matching funds) and other creative funding partnerships. The end result is a slowing of New Hampshire's transition to a more modern, accessible, and affordable transportation system.

One issue of particular importance that is being experienced nationwide is the adequacy of the gas tax as a source of revenue as vehicles become more efficient. There are a number of alternative ways to provide funding for transportation,[14] and New Hampshire should review how other states have addressed funding issues and determine whether any of those approaches could work here.

EXPAND AND COORDINATE MASS TRANSIT

Expanding mass transit options including local, inter-city, and regional bus lines is a critical step in meeting New Hampshire's energy goals. It also helps to enable the life style choices preferred by young workers and students and provides mobility to the state's older residents. More robust mass transit can also allow visitors to move around the state without relying on a car, which can broaden the state's tourism appeal.

In the short term, mass transit options will continue to be advanced by private companies, which can present a coordination challenge for riders. The State can help build awareness of and demand for transit by requiring all operators that benefit from state or pass-through federal funds to adopt the General Transit Feed Specification. This open-access software tool enables potential riders to see transit options on services such as Google Maps and will also enhance the ability of private operators to coordinate routes and schedules between their services.

In addition, although mass transit in the state is expected to be largely privately operated, public funding is often necessary for start-up. As described above, in the absence of that public funding, the state misses the opportunity to leverage available private funds and seek grant funding, delaying its ability to realize the benefits of reducing congestion and pollution and helping residents save time and money.

[9] http://www.nh.gov/dot/media/documents/newsletter-spring2014.pdf.
[10] http://itep.org/itep_reports/2013/09/a-federal-gas-tax-for-the-future.php.
[11] http://www.nh.gov/dot/org/commissioner/documents/roads-to-nh-future.pdf.
[12] http://www.fhwa.dot.gov/ipd/revenue/road_pricing/defined/vmt.aspx.
[13] http://www.fhwa.dot.gov/ipd/p3/defined/.
[14] http://www.transportationinvestment.org/wp-content/uploads/2014/01/State-Transportation-Funding-Mechanisms.pdf.

SUPPORT EFFORTS TO MAINTAIN & EXPAND RAIL USE

Rail is one of the most efficient methods of transportation, as it uses significantly less fuel per mile than alternatives such as long-haul trucking and individual passenger vehicles. The industrial sector is particularly dependent on rail, and strengthening the rail network will be critical to bringing additional industry to the region and strengthening New Hampshire's economy. Additionally, rail can significantly improve quality of life for commuters.

The State should continue supporting efforts to bring additional rail to New Hampshire. As part of those efforts, the State should continue to acquire and hold abandoned rail lines for use as either future railroads or to support active transportation options.

EXPAND RIDE-SHARE PROGRAMS AND PARK & RIDE OPTIONS

With New Hampshire's rural character, it is unlikely that mass transit will be able to serve every community. However, residents can, and do, travel to a nearby park & ride to take advantage of bus services offered at those facilities or to carpool. The state should re-institute the Department of Transportation's Ride Share Coordinator position and develop a plan for creating additional park & ride locations. The state should also explore ways to coordinate New Hampshire's ride-share program with those in neighboring states. Today each New England state uses different, incompatible software for their ride share programs. Pooling resources to purchase a single software platform could save each state money and make it easier for commuters to connect across the region.

In establishing new park & ride locations, the state should look for ways to leverage private funding, such as the public-private partnership models that have been successful in other states.[15] Nearby businesses can benefit from the establishment of a park & ride and are often willing to share in the investment.

ENABLE ACTIVE TRANSPORTATION THROUGH COMMUNITY PLANNING

Designing communities in a way that encourages biking, walking and enables transit (Complete Streets policy) will be important for meeting energy goals and attracting a younger demographic that increasingly expresses a preference for walk-able communities, short commutes, and public transportation options. This can have health benefits while also helping communities meet the needs of aging citizens who may find themselves house-bound in the absence of such options.[16] The State can support communities in these efforts by sharing model zoning ordinances with local planning staff and incorporating Complete Streets designs in state transportation projects. The change needed to create these types of mixed-use communities will in many cases be significant and occur over time. These efforts will require sustained support along with a clearly defined long-term plan. Modification of the state's existing Smart Growth statute (RSA 9-B) to include the use of a Complete Streets approach could be one way to institutionalize

[15] http://www.fhwa.dot.gov/ipd/project_profiles/.
[16] http://switchboard.nrdc.org/blogs/kbenfield/data_summaries_show_walkable_c.html.

support for such efforts. Regional Planning Commissions (RPCs) and state agencies are also key partners in this effort and should help ensure that various groups working on transportation are coordinating.

REDUCE UNNECESSARY IDLING

Fuel used on vehicle idling does not contribute to the movement of people or goods and is therefore wasted. Reducing this waste is a simple and immediate way to reduce New Hampshire's dependence on imported fuel and to decrease costs for consumers, businesses, and state and local government. Reducing idling also has important air quality and health benefits, particularly around institutions such as schools, hospitals, and nursing homes where vulnerable populations reside.

INCREASE EDUCATION, OUTREACH, & ENFORCEMENT

The State should adopt legislation that would establish vehicle idling limits that could then be enforced by state and local law enforcement officers. Targeting education and enforcement in highly visible areas such as school drop off zones, public building parking areas, shopping areas and health care facilities can be a way to increase awareness quickly.

ENCOURAGE USE OF SMART TRAFFIC CONTROLS

Traffic signal synchronization and the use of software that allows blinking or quick-cycle lights during low traffic hours can reduce wait times and limit vehicle idling. Other intersection controls, such as roundabouts, can allow traffic to flow smoothly through an intersection, reducing fuel use as compared to stop-and-go driving. This can also result in quality of life benefits when traffic congestion, wait times, and pollution can be reduced.

1 PREFACE

The purpose of this Strategy is to inform decisions about the state's energy future. It focuses on the state's economic potential for action in three areas: energy efficiency, fuel diversity, and transportation options. The Strategy recommends actions in each area to help the state save money, increase choices for our citizens and businesses, and strengthen investment in local communities and the state's economy. The Strategy also focuses on actions that the state can take to modernize our electric infrastructure so that it is more resilient, reliable, and able to support the energy systems and sources of the future. All of the recommendations for action are intended to be implemented in the short term, but many will require continued long-term efforts as well.

Legislators, state agencies, municipalities, institutions, citizens, and businesses must work together to implement the recommendations in ways that make sense for New Hampshire.

1.1 LEGISLATIVE CHARGE

SB191 of 2013, codified in RSA 4:E, directed the Office of Energy and Planning (OEP), in consultation with a State Energy Advisory Council, to develop a 10 year Energy Strategy for the state.[17] The Strategy is to provide forward-looking guidance on electric and thermal energy in order to optimize the use of readily available energy resources while minimizing negative impacts on the economy, the environment, and the natural beauty of the state. The Council consisted of the following members:

- Director of the Office of Energy and Planning Meredith Hatfield
- Public Utilities Commission Chairman Amy Ignatius
- Department of Environmental Services Commissioner Tom Burack
- Senator Martha Fuller Clark
- Senator Bob Odell
- Representative Beatriz Pastor
- Representative Charles Townsend
- Representative Herbert Vadney

The legislation requires that the Strategy must be updated at least every three years beginning in 2017.[18]

1.2 STRATEGY DEVELOPMENT PROCESS

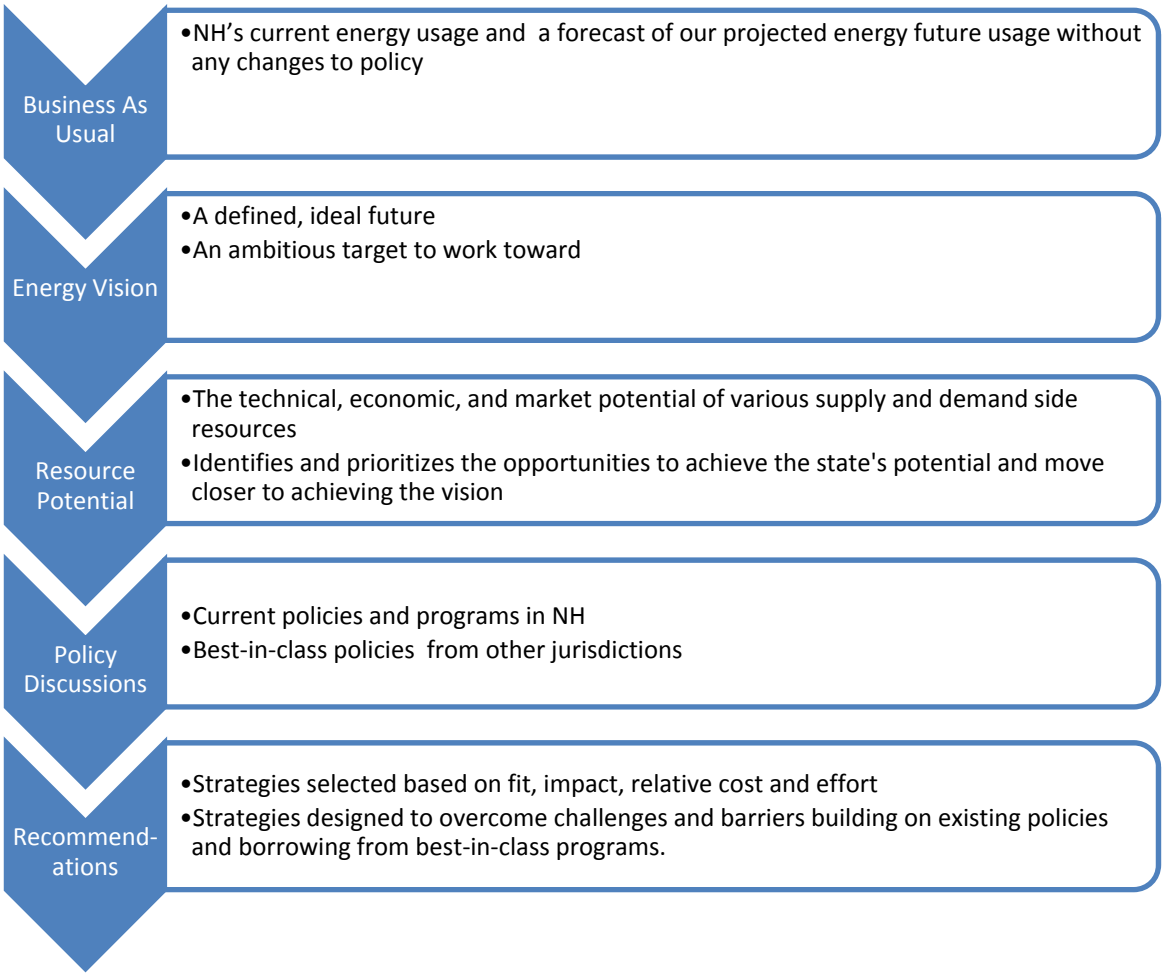
Navigant Consulting Inc. (Navigant) was engaged by OEP to assist with gathering public input and developing the energy strategy. In order to do so, Navigant followed the process outlined in Figure 1: Strategy Development Process.

[17] http://www.gencourt.state.nh.us/legislation/2013/SB0191.pdf.
[18] RSA 4-E:1, http://www.gencourt.state.nh.us/rsa/html/I/4-E/4-E-mrg.htm.

Well over one hundred members of the public and stakeholders participated in the Council's meetings, attending a public hearing on the Draft Strategy, or submitted public comments. All written comments received are available at http://www.nh.gov/oep/energy/programs/sb191-resources.htm.

Following the process illustrated below, Navigant developed a forecast for the projected consumption of electricity, natural gas and other fuels, taking into consideration the existing infrastructure, expected facility retirements, and the possibility of alternative resources. With input from the Advisory Council and the public, Navigant then developed an Energy Vision to guide strategy recommendations. Navigant then evaluated the potential for energy efficiency, renewable energy, alternative fuels, distributed energy resources including storage, demand response, and transportation options across New Hampshire. Navigant also analyzed the state's existing policies, compared them to examples of best-in-class policies from other states, and synthesized this data to inform recommendations for action.

Figure 1: Strategy Development Process



1.3 THE ENERGY VISION

The Energy Vision describes an ideal energy future for New Hampshire, which defines an ambitious yet realistic path for New Hampshire that helps guide recommendations in the Strategy. The Vision Summary states:[19]

> In 2025, consumers are empowered to manage their energy use by taking full advantage of the information, market mechanisms, energy efficient technologies, diverse fuel sources, and transportation options available to them. These services extend from the city centers and coastal areas of Southern New Hampshire to the rural corners of the Western regions and the North Country - closing the gap in disparity of energy services across the state. The results of these widespread consumer empowerment initiatives are lower energy bills, greater choice for the consumer, increased self-reliance, and a cleaner, more sustainable and resilient energy system.
>
> From an economic perspective, New Hampshire's stable energy policies leverage public funds ten to one – inspiring investor confidence, creating high quality jobs, and attracting new residents and businesses to the state. Efficient transit systems help make New Hampshire tourist friendly and the state's high efficiency building stock, skilled workforce, and well managed natural resources make it regionally competitive and help keep dollars in state. As an active participant in New England's broader energy economy, in-state suppliers of energy services receive the proper signals to drive their business decisions toward creating an efficient and secure energy system that delivers cost-effective, clean energy to all.

Achieving this vision will require action and resources, and the recommendations in the Strategy are designed to move New Hampshire toward this future in the short term.

1.4 BASELINE/"BUSINESS AS USUAL" FORECAST

While New Hampshire's overall demand for electric and thermal energy is relatively constant during the forecast period, decreasing demand for energy in the transportation sector contributes to an overall decline in total energy demand and emissions across the state. However, the costs of all fuels are rising, and that increase more than offsets the decline in demand, leading to higher overall expenditures for consumers, government and businesses. In addition to the general upward trend in fuel prices, price volatility poses another challenge as New Hampshire's constrained supply infrastructure, aging building stock, and dispersed population make the state especially vulnerable to short-term price spikes and supply disruptions. Rising costs and vulnerability to rapid market changes make the goals identified in the Energy Vision all the more pressing for New Hampshire. The Business As Usual forecast is presented in Appendix A.

[19] The full Energy Vision is available in Appendix B.

1.5 RESOURCE POTENTIAL AND GAP ANALYSIS

Following the development of the Energy Vision, Navigant analyzed thirty-two separate demand and supply side resources to help identify the most promising means to bridge the gap between the future projected in the Business As Usual forecast and the future defined in the Energy Vision. This analysis informed discussions of policy initiatives by focusing attention on the biggest opportunities for change that are both economically justified and technologically feasible. The resources considered span three broad categories covering energy efficiency, thermal & transportation fuels, and power generation & energy infrastructure. The full Resource Potential study is presented in Appendix C, and the major results are summarized below.

- Building Efficiency & Heating Technologies
    - Significant economic opportunities for thermal efficiency exist in both the residential and commercial sectors.
    - Substantial opportunities exist for ground and air source heat pump technologies in the residential sector.
    - Air source heat pumps also have technical and economic potential in the commercial sector. This is especially important given the anticipated shift in New Hampshire's economy from manufacturing industries to commercial businesses and information technology.
    - Biomass remains a key resource for the State, especially for residential applications and combined heat and power.
    - Conversion to natural gas is economic for those on an existing main, and trucked CNG will provide opportunities for natural gas to off-main industries.
- Electric Generation
    - The economic potential for both utility scale and rooftop solar PV is large and makes expansion of those technologies a near-term priority.
    - The magnitude of technical potential for utility scale PV and offshore wind makes them especially attractive long-term solutions, as the costs of those technologies come down.
    - The remaining economic potential for electricity generated from terrestrial wind is higher than from any other source, making continued development of these resources the most economically viable opportunity to expand in-state renewable power generation in the near term.
    - The technical and market potentials for in-state hydroelectric power are small in comparison to other resources.
- Transportation
    - The technical potential of both light-duty fuel economy and vehicle miles traveled (VMT) reduction strategies make these the most promising long-term solutions to promote energy efficiency in the transportation sector and suggest a tremendous opportunity for savings amid rising fuel costs.
    - While biofuels offer a more economical alternative than natural gas or electricity at present, the much greater technical potential for natural gas and electric vehicles makes them more attractive in the longer term.

1.6 THE ENERGY STRATEGY RECOMMENDATIONS

This report synthesizes the results of the Business As Usual forecast, Energy Vision, Resource Potential, and Gap Analysis into recommendations for action. It recommends a series of policy and programmatic actions that can be implemented in the short term by the Legislature, state agencies, municipalities, private businesses, non-profits, and individuals. Recommendations may be unique to New Hampshire in some instances, while others were informed by regional and national successes.

The legislation requiring this Strategy did not set a specific goal to work toward. As a result, this process included identifying priorities, analyzing potential resources, and providing strategic recommendations for action. More work is needed to develop implementation plans in order to move forward on many of the specific recommendations.

Throughout the Strategy drafting process, the Office of Energy and Planning received over 100 written comments and benefited from significant public participation, reflecting the views of New Hampshire businesses, non-profits, industry, government entities, and individual citizens. New Hampshire citizens have demonstrated high levels of engagement and investment in the state's energy future, which will be critical to implementing the recommendations in this Strategy. Many of the ideas included in the comments will inform the implementation of the recommendations in this Strategy.

1.7 THE WORK AHEAD

While the efforts that went into producing this document were significant, the real work lies ahead. All of the recommendations in the Strategy include short-term activities that could be completed, or at least advanced, by the first Strategy update in 2017.

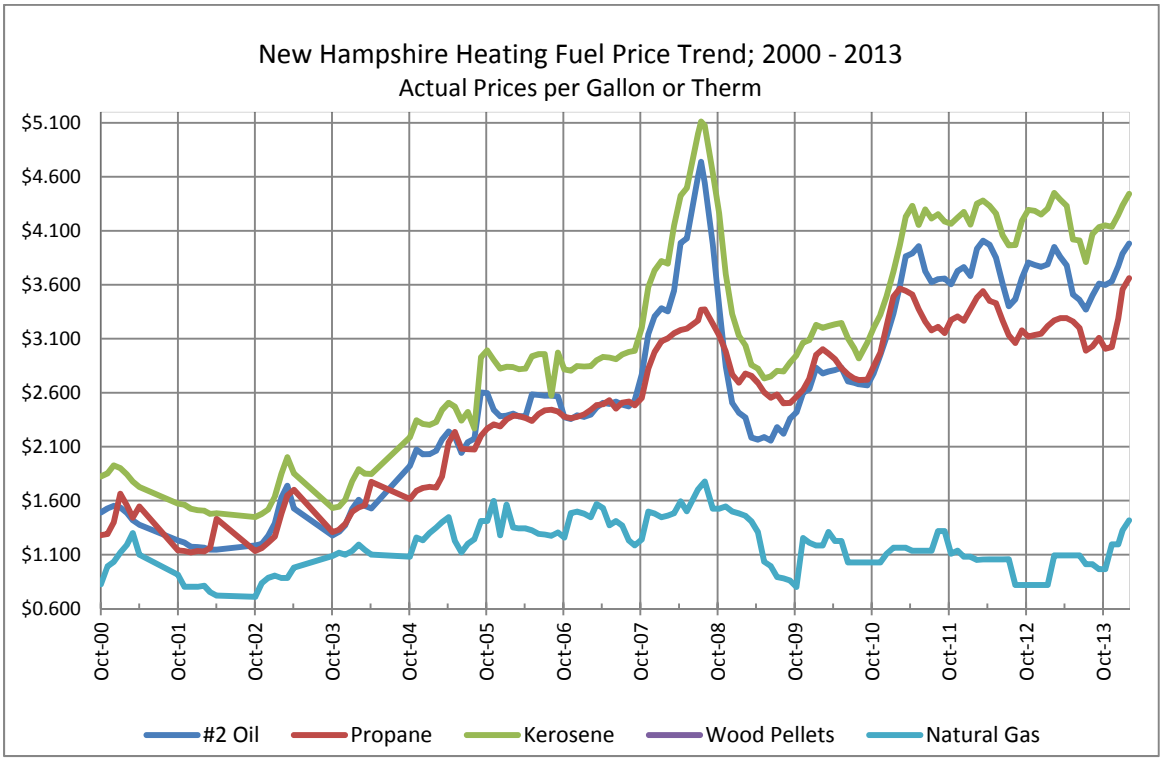
Many of the recommendations in this Strategy require further analysis, planning and consensus building so that they can be implemented in a way that makes sense for New Hampshire. It is our hope that this document will be a useful tool that supports that work and moves the State forward on important energy issues.

2 ENERGY OVERVIEW

Energy is one of the most fundamental ingredients of modern life. We rely on it to power our daily lives and expect it to be available when we need it. Affordable energy sources are important to families and businesses, and are critical to a thriving economy.

New Hampshire last developed a state energy plan in 2002, and much has changed since then. As a result, the Legislature in 2013 charged the Office of Energy and Planning (OEP) and a new State Energy Advisory Council with developing a new 10-year Energy Strategy for the state. The legislation was motivated by the need for strategic direction to help guide important energy policy decision-making, and continuing recognition of the important role that energy plays in the state's economy and environment.

In recent years, energy affordability and reliability have experienced concerning trends. In 2012, New Hampshire ranked 23rd nationally for energy expenditures per capita, yet ranked only 42nd for consumption per capita, indicating a disproportionately high cost per unit of energy. Energy consumes between 10-50% of our household incomes, and in 2013 we spent nearly $5.9 billion on energy, which is approximately 9% of State GDP. Much of that money left the state to pay for imported fuels, rather than being circulated in the State's economy. During the winter of 2013-2014, constraints in both the deliverable (oil and propane) and regulated (natural gas) fuel sectors caused price spikes that resulted in significant cost increases for consumer and businesses. These events are a reminder of the state's vulnerability to national and world events that impact both the supply and the price of energy, and reminders of the need to focus on reducing our vulnerability.



Our desire for energy independence also informs our energy policies. Increasingly, states are seeking to utilize local sources of energy to keep energy expenditures within their economies and to produce local jobs. This reduces our dependence on imported sources of energy and can decrease our vulnerability to supply and price volatility. In addition, because all of New Hampshire's local sources are renewable, increasing the use of in-state energy resources also provides air quality, health, and fuel diversity benefits.

Environmental and health concerns are increasingly impacting our energy supply, and driving new requirements for fossil fuels in order to protect air, water and public health. One example that will impact New Hampshire's fossil energy generation sources is the US Environmental Protection Agency's (EPA's) draft rules on carbon emissions, known as the 111(d) rules.[20] These rules will reward New Hampshire for its renewable energy investments and its progress on energy efficiency. However, further clean energy achievements, along with fossil fuel emissions reductions, will be required when the rules are expected to go into effect later in this decade. Fossil fuel-fired plants in New Hampshire face other air and water quality pollution issues as well.

2.1 DEMOGRAPHICS & GEOGRAPHY

One of the challenges that New Hampshire faces in planning for its energy future is the rural nature of the state. With a population density of 146 people per square mile, New Hampshire ranks 21st in the nation for population density.[21] In addition, much of the population is clustered in the southern part of the state, creating an greater challenge in the more rural regions of the state. Availability of thermal fuels can be a challenge in those areas, given distribution limitations for deliverable fuels (oil, propane, kerosene), and the high cost of expanding natural gas distribution systems within the state. This accounts for the state's high use of heating oil—47% of homes still use oil as their primary source of heat.[22] Transportation solutions such as mass transit face similar challenges and must be creatively designed in order to provide the right fit for New Hampshire.

New Hampshire's geography also leads to challenges in securing energy supplies. New England is at the end of the energy pipeline, and during times of high demand the infrastructure may not have the capacity to meet demand. Natural gas supply has been particularly challenged for the last several years, as thermal (heating) and electric generation sectors have become increasingly reliant on the fuel. Similarly, tight propane supplies in the Midwest during the winter of 2013-2014 was exacerbated by limited rail transport availability and led to an expensive winter for many Northeast residents. Although this may be a short term issue, in the longer term New Hampshire residents might find themselves competing for fuel with international markets hungry for development and willing to pay. This makes increasing in-state sources of fuel ever more important.

[20] http://www2.epa.gov/carbon-pollution-standards.
[21] https://www.census.gov/compendia/statab/2012/tables/12s0014.pdf.
[22] 2012 American Community Survey, U.S. Census Bureau: https://www.census.gov/acs/www/.

2.2 ENERGY GENERATION AND USE

As noted above, New Hampshire has limited in-state energy resources, and imports the vast majority of fuels used by businesses, residents, visitors and the public sector to heat and cool our buildings and to power our activities. Nearly 100% of petroleum products[23] and an estimated 82% of the base fuels for electricity production are imported.[24] Most of the dollars spent on those imported fuels quickly leave the state, resulting in lost opportunities for investments in the state's economy. New Hampshire's leading energy sources are nuclear energy (accounting for 30% of total usage on a BTU basis) and motor fuels (nearly 29% of total). In 2012, more than 2 million gallons of fuel were purchased in the state every day, at a daily cost of over $8 million.[25]

The electric sector has seen a significant shift in generation fuels over the last decade, moving from coal and oil to natural gas. The renewable sector has also seen growth regionally, largely in wood biomass and wind. Although New Hampshire generates more electricity than it uses on an annual basis,[26] making it a net exporter of electricity, the state imports most of the fuels used to make electricity as noted above.

2.3 STATE REGULATION AND OVERSIGHT OF ENERGY

The Public Utilities Commission (PUC) is the regulatory agency tasked with ensuring that customers of regulated utilities receive safe, adequate, and reliable service at just and reasonable rates.

2.3.1 ELECTRIC AND GAS UTILITIES SERVING NEW HAMPSHIRE

New Hampshire customers receive electricity from three regulated investor owned utilities, one electric cooperative, and several municipally-owned electric companies;[27]municipal utilities are not regulated by the PUC.

Public Service of New Hampshire (PSNH) is the state's largest electric utility. PSNH is a subsidiary of Northeast Utilities, a utility holding company based in Connecticut. PSNH's service territory spans much of the state, serving communities from Nashua to Colebrook. PSNH's affiliates include Connecticut Light & Power, Western Massachusetts Electric, and NSTAR.

The New Hampshire Electric Cooperative (NHEC), founded in 1939 by a group of farmers in Concord, is a nonprofit electric utility serving members in 115 towns across the state. An elected 11-member Board of Directors runs NHEC and is largely exempted from state public utility regulation.

[23] While there are a few small bio-diesel operations in the state, their contribution to overall petroleum usage is statistically insignificant at present.
[24] Assuming that 100% of biomass is sourced in-state, and uranium is considered an imported fuel. Based on data from http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_sum/html/sum_btu_eu.html&sid=NH.
[25] http://www.fhwa.dot.gov/policyinformation/statistics.cfm.
[26] During some times of the year, due to conditions such as weather or maintenance of generation fleets, New Hampshire does *import* electricity.
[27] The towns of Ashland, Littleton, Wolfeboro, and Woodsville have municipal utilities.

Unitil Energy Systems serves both electric customers and natural gas customers in the Seacoast region of New Hampshire, and serves electric customers in the Capitol region. Unitil's affiliates include Fitchburg Gas & Electric in Massachusetts and Northern Utilities, a gas utility in Maine.

Liberty Utilities serves gas customers in the Merrimack Valley from Nashua to Laconia, and electric customers in two areas (Upper Valley and Salem area). Liberty serves water, gas and electric customers nationally through its other affiliates in the U.S. and Canada.

2.3.2 RESTRUCTURING AND ELECTRIC CHOICE IN NEW HAMPSHIRE

New Hampshire's electric industry is partially restructured. This means that the ownership of electric generating plants has largely been separated from the distribution of electricity; in fully restructured states utilities no longer own electric generating plants. This separation allows customers to choose an electric supplier while continuing to receive electricity from a regulated distribution utility that has a monopoly within a franchised service territory. The same is true for natural gas, though gas choice has not reached customers beyond the largest users such as manufacturers. Background on the development of the electric industry is provided below as context for New Hampshire's unique position as a partially restructured state.

The Electric Industry Begins

New Hampshire's electric industry began just after the turn of the century, when the first electric companies in the state generated power and delivered it to local homes and businesses. Often more than one provider of electric service operated in the same area, and those operations were virtually unregulated.

In response to unreasonably high rates and in recognition that it was both unsightly and inefficient for competing companies to build duplicative electric wires and poles around the state, the Legislature established the Public Utilities Commission in 1911. The PUC granted franchises to monopoly utilities to establish service areas, within which individual companies would be responsible for providing electric service in exchange for reasonable rates of return.

Rising Electric Rates

The oil crisis of the 1970's forced the country to reconsider energy policies. One new law, the Public Utilities Regulatory Policy Act (PURPA), encouraged development of alternative generation and required utilities to purchase electricity from small power producers (SPPs). The role of independent power plants – which in New Hampshire included small wood-fired power plants – laid the foundation for competition in the generation of electricity in future decades.

Restructuring to a Competitive Electric Market

With the changes in the electric industry in the 1970's and into 1980's, as well as the deregulation of other industries, the idea of a competitive electric market took hold throughout the U.S. during the 1990's.

In 1996 the Legislature passed the Electric Industry Restructuring Act (RSA 374-F), which directed the Public Utilities Commission to oversee the separation or restructuring of the traditional utility functions of generation and distribution, and to "aggressively pursue . . . increased consumer choice." As a result, instead of utilities generating, transmitting and distributing electricity, the law separated the generation of energy from the transmission and distribution functions. A consumer's utility still delivers the electricity, but customers can choose their energy supplier. The law maintains the monopoly on the delivery of electricity, avoiding the duplication of wires and poles.

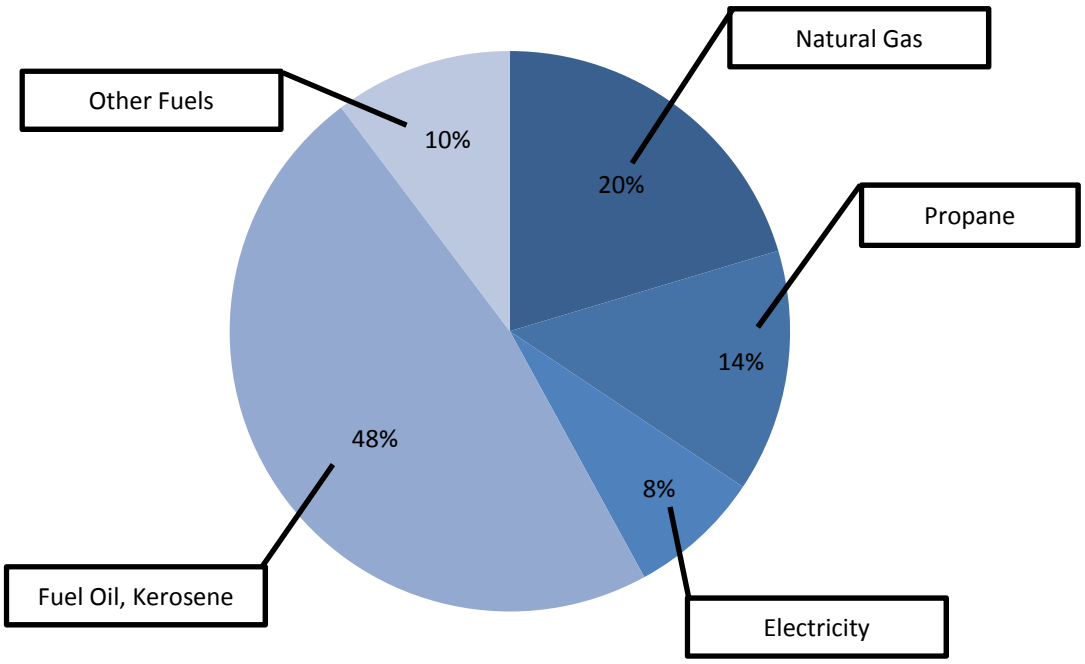
Although New Hampshire began restructuring in the mid-1990's and most electric utilities divested their interests in generation assets, the Legislature paused the process during the California electricity crisis, allowing PSNH to continue to own its fossil fuel and hydroelectric plants until they are no longer in ratepayers' interests.[28] As a result, New Hampshire is currently partially restructured, and a standing legislative committee is charged with continually reviewing the status of restructuring and providing an annual report.[29] In recent years, the issue has seen increased visibility among the public and legislature as PSNH's fossil plants age and their costs increase. In response, the PUC opened a docket in 2013 to "review market conditions affecting the default service rates of PSNH in the near term and how PSNH proposes to maintain safe and reliable service to its default service customers at just and reasonable rates" and to "explore the impact on the competitive electric market in New Hampshire of PSNH's continued ownership and operation of generation facilities."[30] In addition, HB1602 of 2014 requires that the PUC open a docket to determine if it is now in ratepayers' economic interests to require PSNH to divest ownership of its plants.[31] The legislation requires that the PUC open a docket by January 1, 2015, and to provide a progress report by March 31, 2015. This issue is anticipated to continue to play a large role in New Hampshire's energy discussions in the future. The recommendations of this Strategy remain valid regardless of the outcome of that process.

[28] http://www.gencourt.state.nh.us/legislation/2003/sb0170.html.
[29] http://www.gencourt.state.nh.us/rsa/html/XXXIV/374-F/374-F-5.htm.
[30] http://www.puc.state.nh.us/electric/IR%2013-020%20PSNH%20Report%20-%20Final.pdf.
[31] http://www.gencourt.state.nh.us/legislation/2014/HB1602.pdf.

2.4 DELIVERED FUELS

The terms "delivered fuels" or "deliverable fuels" typically refer to those energy sources used for heating that are not regulated and not delivered by transmission or distribution infrastructure. Delivered fuels include heating oil, propane, kerosene, wood and wood pellets. Motor fuels such as diesel and gasoline are also sometimes included in this category. Delivered fuels play a major role in New Hampshire, with more than 60% of homes using these fuels for heating, as shown below.[32]

2012 Estimates of Heating Fuel Type by Occupied NH Housing Units



While the PUC does not have regulatory authority over these fuels or the companies that deliver them, those companies must comply with consumer protection requirements such as laws related to offering pre-paid contracts ("pre-buys").[33] These businesses are also potential partners in providing other services to customers, such as assistance and weatherization.

[32] http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_1YR_B25040&prodType=table.
[33] RSA 339:79 http://www.gencourt.state.nh.us/rsa/html/XXXI/339/339-79.htm.

2.5 REGIONAL CONSIDERATIONS

Any discussion of a state's energy mix is complicated by the increasingly complex nature of energy markets, and this is particularly true for electricity. New Hampshire is part of a regional electric grid that is overseen by the Independent System Operator of New England (ISO), a private non-profit organization charged by the Federal Energy Regulatory Commission (FERC) with providing open and fair access to the regional transmission system; managing a non-discriminatory governance structure; facilitating market-based wholesale electric rates; and ensuring the reliable operation of the bulk power system.[34]

2.5.1 TRANSMISSION PLANNING

The planning of the regional transmission system is a continual process, the primary goal of which is to maintain reliability of the system. On an ongoing basis, ISO New England analyzes the transmission system in order to "identify electricity consumption patterns and growth; adequacy of resources to meet demand; and issues related to power plant fuel supplies, fuel diversity, environmental requirements, and integration of new technologies."[35] The results of this analysis are provided to the marketplace in the form of a Needs Assessment, which details the physical characteristics that a solution would need to have (i.e., capable of providing ***x*** kW of transmission capacity or ***y*** amount of voltage support). This information helps market participants decide how and where to invest in transmission system upgrades. These market responses can include demand-side measures, new generation, or transmission. In the event that market responses are not forthcoming or do not adequately meet the region's reliability needs, the ISO must conduct further transmission planning in order to develop 'backstop' solutions.

After the ISO has examined the market responses, it issues a formal Solutions Study. This report identifies the ISO's preferred solutions, which are those found to be the most cost effective means to fully meet the reliability need. The study then goes through stakeholder review, and its results are eventually incorporated in the Regional System Plan (RSP).[36] The RSP serves as a comprehensive guide to system status, needs, and solutions, and is published at least every three years.

At each step in this process, the ISO solicits feedback from stakeholders and market participants through the Planning Advisory Committee (PAC).[37] That committee includes a wide variety of stakeholders including utilities, generation companies, state officials, consumer advocates and environmental groups.

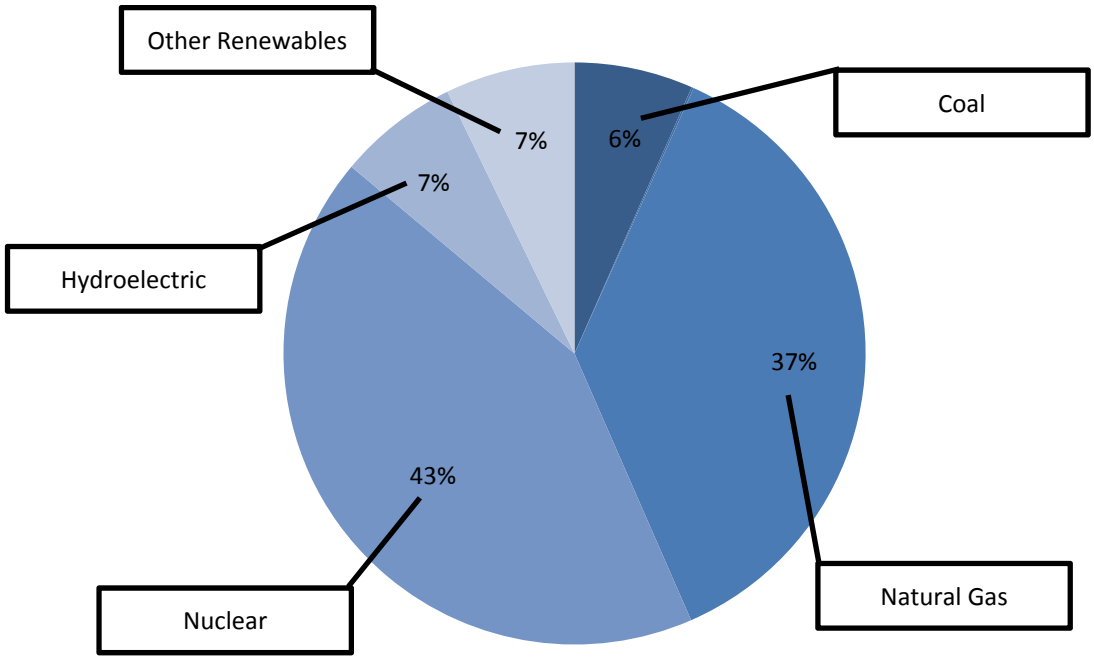
[34] http://www.iso-ne.com/aboutiso/.
[35] http://isonewswire.com/power-system-planning/.
[36] http://www.iso-ne.com/system-planning/system-plans-studies/rsp.
[37] http://www.iso-ne.com/committees/planning/planning-advisory.

2.5.2 WHOLESALE MARKETS

The second major function of the ISO is to administer the regional wholesale power markets. In New England, wholesale electricity can be bought and sold using either contracts between individual buyers and sellers or through auctions. In the auctions, power plants generate the electricity and offer to sell it through bids. "Load serving entities" or "suppliers" such as distribution utilities or competitive suppliers buy the electricity wholesale in the market and in turn sell it to retail consumers. In New Hampshire consumers may buy that electricity either from their local utility or from a competitive supplier.[38]

These complex regional interactions mean that the mix of electricity being used in the region, or in a particular state at any particular time varies depending on which generators have bid into the market for that hour.[39] As a result determining state by state *consumption* is difficult. However, the federal Energy Information Administration (EIA) provides estimates of the *generation* mix for each state. The EIA's estimate of New Hampshire's electricity generation in 2012 is shown below.[40]

2012 NH Electrical Generation by Source (thousand MWh)



[38] http://www.puc.nh.gov/consumer/energysuppliers.htm.
[39] ISO New England maintains a real-time dashboard that shows the changing conditions: http://isoexpress.iso-ne.com/guest-hub.
[40] http://www.eia.gov/electricity/data/browser/#/topic/0?agg=2.

2.5.3 ENGAGING IN REGIONAL EFFORTS

New Hampshire is well represented at the regional and national levels by the Public Utilities Commission, the Office of Consumer Advocate, the Office of Energy and Planning, the Department of Environmental Services, and the Governor's Office through participation in several groups and initiatives, including ISO New England committees, NASEO (National Association of State Energy Officials), NARUC (National Association of Regulated Utility Commissioners), NECPUC (New England Conference of Public Utility Commissioners), New England States Committee on Electricity (NESCOE), and CONEG (Coalition of Northeast Governors). The increasing importance of regional issues requires the continued attention of New Hampshire regulators and policymakers to ensure that New Hampshire's interests are protected in the many regional decision-making processes and forums.

Of particular note is the recent commitment by the six New England Governors "to work together, in coordination with ISO-New England and through the New England States Committee on Electricity (NESCOE), to advance a regional energy infrastructure initiative that diversifies our energy supply portfolio while ensuring that the benefits and costs of transmission and pipeline investments are shared appropriately among the New England States."[41] The New England region currently faces natural gas supply constraints exacerbated by increased demand in both the electric generation and heating sectors. (As noted in an earlier section, New England's generation mix is increasingly moving to natural gas as older coal and oil fired plants retire as they become less cost effective to operate.) This prompted ISO-NE to develop a special "winter reliability" program. The goal of this program is to ensure that natural gas and oil-fired electric generating facilities have sufficient fuel supplies to produce electricity during times of peak fuel usage during the winter. The program provides financial incentives, paid by regional ratepayers, for generators to have sufficient fuel to operate when needed. However, even with this program in place during the winter of 2013-2014, regional ratepayers paid nearly $3 billion more for electricity than they had during the prior winter.[42]

New Hampshire must continue to engage in these regional efforts to both protect our state's interests, and to ensure that there is a diverse and affordable supply of energy for our homes and businesses. In addition to engaging in regional efforts, the State must also continue to take steps on our own to address fuel diversity, cost and supply within our State. This Strategy focuses on those actions that the State can take to achieve our goals of cleaner, more diverse, and more affordable energy.

[41] http://nescoe.com/uploads/New_England_Governors_Statement-Energy_12-5-13_final.pdf.
[42] FERC held a technical conference and has a docket open to review issues related to winter 2013-2014 electric and natural gas supply constraints. See http://elibrary.ferc.gov/idmws/docket_sheet.asp.

3 GRID MODERNIZATION

Grid modernization refers to a wide range of actions aimed at ensuring that the electric grid is more resilient and flexible, better able to integrate variable energy sources and demand side management, and capable of providing real-time information to help customers manage their energy use and reduce energy costs. As consumers demand more from our electric grid – for smart homes and electric vehicles, and to produce their own power – states must prepare for the future. The potential benefits of grid modernization are wide-ranging and can include better outage response and increased reliability; enhanced customer engagement in reducing the high costs of meeting peak demand; easier integration of distributed generation, renewable resources and energy storage; improved efficiencies for distribution utilities; advanced integration of electric vehicles; and cost savings for all customers.

In order to achieve these benefits, significant investments in new technologies will be needed, along with grid planning policies and tools that encourage and allow that investment, and increased customer education on the benefits and opportunities of the technologies.

3.1 INFRASTRUCTURE IMPROVEMENTS

Much of the nation's electric grid is at or near the end of its useful life: it is estimated that the average age of the electric infrastructure is 40 years, and the American Society of Civil Engineers gave America's energy infrastructure a D+ in its 2013 annual scorecard.[43] As the number of extreme weather events increases and threats from physical and cyber-attacks grow, it is more important than ever to ensure that we have a modern and resilient grid.[44] Achieving this will not be easy, however; as noted in the 2011 EESE Board Report, "Updating decades-old infrastructure with high tech connected devices is a major change and opportunity, and presents new challenges."[45]

One of the most talked about aspects of grid modernization is the so-called "Smart Grid." Smart Grid devices and infrastructure allow for two-way, often real-time communication between utilities, sensors and controls along the transmission and distribution system, and customers. This gives the utility better information to manage its system, and can help avoid or delay costly replacements and upgrades. Smart Grid technologies can present an important opportunity to increase grid reliability in a flexible and cost effective manner, and can also provide important benefits for consumers such as increased access to timely information about their usage to allow them to make informed choices and save money. These technologies also support Time of Use rates that allow consumers to see the true price of delivering electricity to their home or business at different times of the day, or to recognize the real value of energy produced by customer-sited generation. This can allow and even incent consumers to shift usage patterns to reduce peak demand, reducing the need for costly transmission and distribution investments.

[43] http://www.infrastructurereportcard.org/energy/.
[44] http://www.nga.org/files/live/sites/NGA/files/pdf/2014/1403GovernorsGuideModernizingElectricPowerGrid.pdf.
[45] http://www.puc.nh.gov/Sustainable%20Energy/Reports/New%20Hampshire%20Independent%20Study%20of%20Energy%20Policy%20Issues%20Final%20Report_9-30-2011.pdf, page 8-1.

Several states are working on how best to prepare for a smarter grid. In October 2012, the Massachusetts Department of Public Utilities (DPU) opened an investigation to explore grid modernization goals. Following a stakeholder committee report, the DPU issued a straw proposal in December 2013 that identified four broad objectives for grid modernization: reducing the effects of outages; optimizing demand in order to reduce system and customer costs; integrating distributed resources; and improving workforce and asset management.[46] In June 2014, the DPU issued orders requiring companies to develop grid modernization plans that include the timing and nature of capital investments to be made to achieve those goals.[47]

In April 2014, New York announced a proceeding to *Reform the Energy Vision*.[48] One of the key elements is to "modernize [the state's] distribution system to create a flexible platform for new energy products and services, to improve overall system efficiency and to better serve customer needs" and to "create markets, tariffs, and operational systems to enable behind the meter resource providers to monetize products and services that will provide value to the utility system and thus to all customers."[49]

These efforts point to the emerging role that grid modernization will play in advancing the resilience and efficiency of electrical grids across the country. Efforts such as these are especially pertinent to New Hampshire, where storm outages and winter demand will continue to affect energy supply and pricing. Taking steps now to pursue modernizing our grid would help make New Hampshire a leader in this area.

While hardware upgrades offer exciting opportunities, to achieve the full benefits of grid modernization, technology upgrades must be paired with reformed regulatory and market structures, particularly those that engage and incent consumers and reflect the true costs of providing electricity and the true benefits of distributed energy generation sources.[50] Efforts to modernize our grid must include consideration of the infrastructure investments needed, as well as regulatory changes necessary to allow consumers to use and benefit from additional information to control their energy use and costs. In addition to state level action, New Hampshire should

Grid Resiliency

Grid modernization offers important opportunities to improve the resiliency of our energy systems. Advanced development of self-contained 'micro-grids' in combination with on-site generation can allow facilities to withstand major storms and other energy outages. For example, during Hurricane Sandy, the Princeton University campus was able to maintain heat and power despite the catastrophic damage sustained by the region's energy systems. In the wake of that event, micro-grids have gained national prominence, and one New York utility is now proposing to offer them on a voluntary 'subscription' basis.

While these types of advances are exciting and can offer important benefits to critical facilities, the underlying grid system must be sufficiently modernized to enable them. This makes it all the more critical that New Hampshire make progress on basic upgrades in the near term.

[46] http://www.mass.gov/eea/docs/dpu/electric/12-76-a-order.pdf.
[47] http://www.mass.gov/eea/docs/dpu/orders/dpu-12-76-b-order-6-12-2014.pdf.
[48] http://www3.dps.ny.gov/W/PSCWeb.nsf/ArticlesByTitle/26BE8A93967E604785257CC40066B91A?OpenDocument
[49] http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={5A9BDBBD-1EB7-43BE-B751-0C1DAB53F2AA}.
[50] http://www.cleanenergycouncil.org/files/NECEC_Leading_Next_Era_Electricity_Innovation.pdf.

advocate for complementary policies at the wholesale level as appropriate. Electricity markets must support state action to build a more resilient and flexible grid, and this is an area where New England can be at the forefront of wholesale electricity issues.

3.2 CONSUMER BEHAVIOR PROGRAMS

Consumer behavior programs or services save energy and shift energy use away from peak periods by engaging, educating, and incenting consumers. Examples of voluntary consumer behavior programs include energy saving competitions, usage comparisons against similar households, and innovative billing approaches. There are also programs that can be implemented at the regulatory level, such as Time of Use (TOU) pricing or peak-time rebates, which give consumers financial incentives to change their usage patterns. In addition to the benefits that individual consumers see from these programs and services as a result of reduced energy costs, the programs also provide important reductions in peak load that save money across the system.

Reducing peak load is important to maintaining the long-term affordability of the energy system. Peak load refers to the condition of maximum consumer demand on the grid, which typically occurs only a few times a year. To ensure reliability, the grid (including generation, transmission, and distribution capacity) must be sized to serve the maximum load (need), even though during the majority of the year the load is much lower. Building and maintaining this 'excess' capacity creates considerable costs for ratepayers, and with some of the highest electricity rates in the nation,[51] New England – and New Hampshire – must focus on reducing peak load. The Business As Usual forecast (see Appendix A) shows a projected 49% increase in wholesale electricity prices in the absence of policy changes. Fortunately, peak load reduction is one of the most promising applications for grid modernization, as demonstrated by programs around the country. A pilot program by Connecticut Light & Power that utilized peak time pricing in conjunction with Smart Grid technology demonstrated peak reductions of up to 28.5% in the residential sector and 9.4% in the commercial sector,[52] and a program by Oklahoma Gas & Electric (OGE) saw a 59% reduction in peak demand.[53] A national review conducted in 2009 saw an average reduction in peak of 13-20%.[54] Reducing peak load also has air quality benefits as all generators, including the dirtiest ones, must run to meet peak need.

In addition to reducing overall costs, reductions in peak load have been shown to translate into real savings for individual ratepayers. In Illinois, which has full TOU pricing, a program run by the state's largest utility since 2007 has saved participants more than 15% on electricity costs compared with what they would have paid under the standard flat rate.[55] Although there have been concerns expressed about the potential impact on low income customers, successful programs in other states have demonstrated that with the proper program design, low income customers can achieve similar benefits.[56]

[51] In 2014, New Hampshire's prices were 7th highest nationally: http://www.eia.gov/state/rankings/?sid=US#/series/31.
[52] http://nuwnotes1.nu.com/apps/clp/clpwebcontent.nsf/AR/recommendations/$File/recommendations.pdf.
[53] http://www.utilitydive.com/news/whats-the-secret-to-oges-dynamic-pricing-success/201414/.
[54] http://www.hks.harvard.edu/hepg/Papers/2009/The%20Power%20of%20Experimentation%20_01-11-09_.pdf.
[55] http://www.nga.org/files/live/sites/NGA/files/pdf/2014/1403GovernorsGuideModernizingElectricPowerGrid.pdf.
[56] http://ieee-isgt.org/files/2014/03/Day2_Panel1A_BrandiSchmitt.pdf.

New Hampshire utilities have recognized the value of customer engagement programs, and are testing how best to apply them. PSNH is conducting a pilot in collaboration with OPower in which 25,000 residential customers will receive personalized Home Energy Reports that provide tips for improving energy efficiency and reducing their bills.[57] NHEC is piloting TOU pricing and in-home displays to help customers manage their energy use.[58] A TOU pilot run by Unitil targeted residential consumers with central air conditioning systems and found highly favorable results, creating a reduction of peak and critical peak[59] usage by 34.0% for simple TOU rate customers, and up to 69.8% for customers with both a TOU rate and enhanced technology. The enhanced technology allowed the customers' air conditioners to automatically respond to peak pricing events, so that customers benefitted from the cost reduction without having to take action themselves.[60] Similar programs have been implemented for water heaters in the past. The success of these pilots, together with the success of time of use pricing in other states, shows that these programs and services can create real savings for consumers in New Hampshire. As customers see the benefits of lower bills, they can take action to contribute to the overall benefits to the entire energy system. The steps that the state should take to realize these benefits are discussed in the Recommendation section below.

3.3 DEMAND RESPONSE

Demand Response (DR) refers to a suite of services that focus on getting energy users to reduce power use during specific peak periods when energy is most expensive. DR has grown dramatically with the introduction of deregulated markets, the development of capacity markets, and the introduction of Smart Grid technology allowing for automated control of appliances and heating and cooling systems. Although similar to the consumer behavior activities described above, DR more directly targets particular users, and in exchange for payments to them, enables reductions in load that are requested at specific times by the utility or grid operator.

ISO New England manages DR as part of the forward capacity market.[61] DR is eligible to participate in the market alongside traditional generators, and receives payment for reducing load when requested by the ISO.[62] While very large customers can bid directly into the market, it is more common for aggregators to contract with groups of companies in the commercial and industrial sectors and bid into the market on their behalf. As noted earlier, these peak load reductions (referred to as "peak shaving") results in savings

[57] http://www.psnhnews.com/press-releases/psnh-launches-residential-home-energy-report-pilot-program.
[58] http://www.nhec.com/rates_pilot/.
[59] While daily peak demand occurs with predictable frequency and drives the dispatch of readily available peaking capacity, Critical Peak is a period of extraordinary demand that threatens the integrity of the grid. Critical peak demand is designated by the utility and typically occurs at the intersection of daily and seasonal peaks, or during extreme weather events when power generation, transmission, and distribution infrastructure is otherwise vulnerable.
[60] http://www.puc.nh.gov/Regulatory/CASEFILE/2009/09-137/LETTERS,%20MEMOS/09-137%202012-02-28%20UES%20EVALUATION%20REPORT%20FOR%20RESIDENTIAL%20TIME-OF%20USE%20PILOT%20PROGRAMS.PDF.
[61] The Forward Capacity Market (FCM) is used by the ISO to ensure that the power system has adequate resources to meet demand for electricity. By bidding into the market, generators and other resources indicate that they are available to provide capacity up to three years in the future, and they are compensated for guaranteeing that availability. http://iso-ne.com/support/faq/fwd_cap_mkt/gen/index.html.
[62] http://www.iso-ne.com/support/training/courses/isone_101/06_overview_fcm.pdf.

across the entire regional energy grid for all customers by reducing the need to run older, more expensive generation facilities during peak periods, and by deferring or avoiding the need to build new generation and transmission facilities. A 2012 analysis by the ISO estimated that energy efficiency investments had allowed the region to defer 10 major transmission upgrades at a savings of $260 million.[63]

Today, DR is focused on large commercial and industrial customers, as residential customer usage is often too small to make DR cost effective. However, recent innovations in home energy management systems and smart appliances may provide ways to facilitate widespread residential DR programs and services, and new technology makes it possible to allow customers of all sizes to benefit from the energy savings resulting from DR. In light of the immense benefits of demand response, it is more important than ever that the state take action to increase its utilization by New Hampshire's utilities and customers.

3.4 CONSUMER EDUCATION

The success of the strategies above will hinge on effective consumer education and engagement. Although modernized grid technology can empower consumers, we must be willing and able to use it. In some areas, consumers have had concerns about Smart Grid technology, such as issues regarding collection of usage information and health effects. New Hampshire must address these concerns while it continues to educate consumers about this technology. The State should work with stakeholders to find the most appropriate ways to give consumers information about their energy consumption while protecting their privacy and empowering them to respond to energy prices and market conditions.

RECOMMENDED GRID MODERNIZATION STRATEGIES

Recommendation 1 - GRID MODERNIZATION DOCKET

Summary and Rationale: The electric grid is aging, and changing consumer use patterns, along with a new generation mix and increased threats from severe weather events, have created the need for a more flexible, resilient grid. The New Hampshire PUC should open a docket to determine how to advance grid modernization in the state. Given the breadth of the topic, an investigation or information-gathering proceeding may be an appropriate first step. This less formal proceeding would give all stakeholders a chance to learn about grid modernization and would inform which specific areas should be pursued within future dockets. Some aspects of grid modernization may not be workable for New Hampshire, so the PUC and stakeholders should determine which approaches will benefit New Hampshire consumers, and when and how they should be implemented.

Design Considerations: While specific design considerations will have to be determined during the docket processes, the PUC should take advantage of the knowledge gained from similar dockets in New York, Massachusetts, Connecticut[64], and Maryland.[65] Additionally, the State should look to the initiatives being

[63] http://www.iso-ne.com/nwsiss/pr/2012/ee_forecast_final_12122012_post.pdf.
[64] http://www.ct.gov/deep/cwp/view.asp?a=4120&Q=508780.

undertaken by the US Department of Energy as they serve as good indicators of promising new technology and grid design innovations. The State should also ensure that our policies and regulatory mechanisms allow room for new and innovative technologies to be adopted as they come to market. In particular, electric storage technologies are an area that is expected to grow rapidly in the next decade, and they have the potential to provide substantial benefits to the system.

Recommendation 2 - EDUCATE CONSUMERS ABOUT A SMARTER GRID

Summary and Rationale: While the information gathering proceeding recommended above is underway, the utilities and the State should begin consumer education on the benefits of the Smart Grid. Successful programs from elsewhere in the country have demonstrated that proactive education and outreach are important to ensuring a smooth transition that benefits both utilities and consumers. Additionally, by engaging consumers in program design, utilities will be building demand and will have a consumer base that is ready to take advantage of the new programs or services. This will enable an accelerated ramp-up, which will allow the state to more quickly reap the benefits of a smarter grid.

Design Considerations: The need for comprehensive outreach and education is often reiterated in the efficiency and clean energy spheres in New Hampshire. Grid modernization efforts should build on and reinforce those efforts, and the utilities should collaborate with other stakeholders such as the EESE Board and low income advocates in their education efforts. These efforts should include the results from any applicable pilots, as it has been shown that providing data from existing programs can help consumers trust in the validity of a new approach.

[65] http://cleanenergytransmission.org/uploads/Utility%202-0%20Pilot%20Project-reduced.pdf.

4 ENERGY EFFICIENCY

Energy efficiency is widely understood to be the cheapest, cleanest, most plentiful energy resource. Investing in efficiency reduces the state's reliance on imported fuels, provides a boost to the state's economy by creating in-state jobs, and reduces energy costs for consumers and businesses. Action in this area is necessary to reduce the widening gap between New Hampshire and surrounding states, which have realized the cost savings and other benefits of efficiency, and are out-pacing New Hampshire in investing in this area. The 2013 EERS Study conducted for the Office of Energy & Planning found that if all buildings in the state were improved to the highest level of cost-effective energy efficiency, consumers would save $195 million each year and an additional $160 million would be added to New Hampshire's Gross Domestic Product (GDP) annually.[66] In addition to providing economic benefits, efficiency also reduces harmful emissions produced by burning fossil fuels.[67] Capturing more efficiency in all sectors, including all types of buildings, manufacturing processes, and transportation, should be priority actions for New Hampshire. This section focuses on actions in the near term to achieve our vision of being a more efficient state by 2025.

4.1 EFFICIENCY IN NEW HAMPSHIRE TODAY

New Hampshire has offered efficiency programs administered by our electric and natural gas utilities (CORE Programs) for over a decade, and has undertaken a wide range of policy, regulatory, and programmatic initiatives related to efficiency. New Hampshire also benefits from efficiency loan programs offered by utilities and other entities. Despite these efforts, New Hampshire is not taking full advantage of our full potential for savings from efficiency. A 2009 study conducted for the Public Utilities Commission (PUC) found that significant remaining cost-effective efficiency potential exists, even after nearly a decade of investments.[68] In 2011, the State commissioned an extensive report that detailed steps New Hampshire could take to capture more of that efficiency,[69] and in 2013, a third report reaffirmed that additional savings exist, and made recommendations for setting an efficiency goal to help achieve those savings.[70]

New Hampshire's utility efficiency programs must be "cost effective" as determined by the PUC, meaning that each dollar spent on the programs yields at least one dollar in savings – and they typically save even more. Today these programs deliver efficiency for about 3 cents/kWh. By contrast, a residential customer pays a total of 16 cents/kWh for electricity for their home. The math is simple: as we reduce usage through efficiency, we help customers save significantly on their energy bills.

Efficiency benefits more than just those customers who participate in efficiency programs. Reducing our energy use, especially during expensive peak times such as the hottest and coldest days of the year, saves

[66] "2013 EERS Report": http://www.nh.gov/oep/resource-library/energy/documents/nh_eers_study2013-11-13.pdf.
[67] The Regulatory Assistance Project has identified dozens of system, participant, and societal benefits of efficiency: http://www.raponline.org/document/download/id/7154.
[68] http://www.puc.state.nh.us/Electric/GDS%20Report/NH%20Additional%20EE%20Opportunities%20Study%202-19-09%20-%20Final.pdf.
[69] http://www.puc.nh.gov/Sustainable%20Energy/Reports/New%20Hampshire%20Independent%20Study%20of%20Energy%20Policy%20Issues%20Final%20Report_9-30-2011.pdf.
[70] 2013 EERS Report.

money for everyone on our energy systems. For reliability purposes, we build our energy infrastructure to meet our needs during peak demand. Reducing that peak means spending less on expensive transmission, distribution, and generation infrastructure.

Because efficiency is the cheapest, cleanest resource, and because it keeps more dollars in the local economy, many states are significantly expanding efficiency programs and spending. As discussed below, New Hampshire is falling behind, and missing out on the many benefits of increased efficiency.

To move New Hampshire forward, this Strategy focuses on taking action in four main areas:

1. Policy and Regulatory Structures
2. Program Design & Delivery
3. Consumer Access to Financing
4. State Leading by Example

4.2 POLICY & REGULATORY STRUCTURES

4.2.1 SETTING AN EFFICIENCY GOAL

Setting goals is a fundamental aspect of successful planning in any field, yet New Hampshire's efficiency programs have been operating in the absence of an over-arching statewide goal for over a decade. The 2011 EESE Board Report noted that the lack of a goal "hampers efforts to have a sustained, coordinated, adequately-funded approach that results in full market development and steadily increasing consumer benefits."[71]

Other states have used several methods for setting goals. One mechanism is an energy efficiency resource standard (EERS), which establishes specific targets for energy savings that utilities or non-utility program administrators must meet. An EERS can be adopted through either legislation or regulation. To date, 28 states have adopted an EERS or an efficiency goal through legislative or regulatory action that require utilities to develop and implement plans to capture all cost-effective efficiency.[72] New Hampshire is the only state in New England that hasn't adopted a formal goal. The goals in surrounding states are some of the most stringent in the nation, and contribute to their success in capturing greater efficiency, reducing energy bills, and realizing the associated economic, security, health, and quality of life benefits.[73]

Establishing a goal to capture all cost effective efficiency is critical to ensuring that New Hampshire does not continue falling behind regionally and missing the economic opportunities that other states are realizing. The 2013 EERS Report outlines an innovative approach to an EERS to address efficiency gains for both electricity and heating fuels. It focuses on metrics related to overall energy savings, market development, and energy intensity. By focusing on these metrics, an EERS can drive both savings and market transformation while remaining broadly applicable to gains in efficiency across all fuel types.

[71] 2011 Report at p. 14-4.
[72] http://www.dsireusa.org/documents/summarymaps/EERS_map.pdf.
[73] New Hampshire has dropped in a national ranking of energy efficiency as other states accelerate efficiency savings. See http://aceee.org/state-policy/scorecard.

Other models exist around the country, enabling states to adopt an approach that works for their specific needs, with appropriate short- and long-term goals and timelines.[74]

It is important that goals include savings for thermal fuels, as the costs of heating and cooling are significant for New Hampshire homes and businesses. The Gap Analysis prepared by Navigant for this Strategy (see Appendix C) shows that substantial additional thermal savings opportunities exist in both the residential and commercial[75] sectors. Capturing those savings will be a key component of reducing energy costs in New Hampshire.

Falling Behind

The American Council for an Energy Efficiency Economy (ACEEE) is a non-profit organization that works to advance energy efficiency policies, programs, technologies, investments, and behaviors. Each year, ACEEE releases a scorecard that ranks states on their efficiency programs and policies. New Hampshire currently ranks #21 nationally; having fallen from #17 in 2012, which places NH behind all other New England states as well as most other Northeast and Mid-Atlantic States.

The ACEEE scoring is intended to serve as a benchmark for states, and it can help inform the directions that New Hampshire's policies should take in order to achieve the benefits of increased efficiency.

The New Hampshire PUC is currently exploring how an EERS could be used to establish efficiency goals, and is expected to release its work in the early Fall of 2014 for consideration by stakeholders and the public. The PUC should follow this work by opening a docket and directing the utilities to work with interested stakeholders to develop short- and long-term efficiency goals, and to determine funding needs and the most appropriate way for the CORE programs to ramp up and be redesigned over time to meet new goals. New Hampshire law[76] already places efficiency high on the list of our energy priorities, and recent changes to the State's utility planning law now make clear that utilities must "maximize the use of cost effective energy efficiency and other demand side resources."[77] These tools can be used by the PUC to work with utilities to set goals to achieve all cost effective efficiency.

In addition to the PUC developing and implementing specific energy savings goals for the utility efficiency programs, the State should also establish an official overarching policy goal for efficiency. One approach would be to require that State agencies pursue all cost effective energy efficiency in their operations, programs and regulatory activities. HB1129 of 2014 requires several agencies to develop an implementation plan in 2015 to achieve greater efficiency, and that process can help inform future legislative efforts in this area.

[74] One free resource for states exploring efficiency goals is the Regulatory Assistance Project. RAP has examples of how they have helped states approach goal setting and implementation at http://www.raponline.org/featured-work/helping-states-reach-efficiency-targets-us.
[75] In this document, the term 'commercial' means commercial-scale buildings and includes schools, municipal and public safety buildings, non-profits, and hospitals.
[76] RSA 378:38.
[77] http://www.gencourt.state.nh.us/legislation/2014/HB1540.pdf.

4.2.2 IMPLEMENTING ALTERNATIVE RATE DESIGNS

In concert with setting goals, another requirement for successful efficiency programs is addressing the mixed directives to utilities to both sell energy and help customers save energy.[78] Traditional approaches to regulated rates reward utilities for each unit of energy sold; this is referred to as the "through-put" incentive. This gives utilities a strong motivation to sell more energy in order to maximize profits. This directly conflicts with their charge to administer efficiency programs that reduce demand, and with their growing understanding that customers increasingly expect their utility to help them reduce energy costs. As detailed in the 2013 EERS Report, states have addressed this conflict by developing new ways to design rates that make utilities champions of efficiency and strong partners in achieving a state's efficiency goals, often referred to as the "decoupling" of utility profits from sales.[79]

In recognition of the importance of appropriate rate design for facilitating more efficiency, the New Hampshire PUC issued an order in January 2009 allowing electric and natural gas utilities to propose rate design mechanisms to promote energy efficiency in future rate cases on a case-by-case basis.[80] One natural gas utility proposed a new rate design in 2010 but ultimately withdrew its request as part of a settlement agreement in the case.[81] As a result, all of New Hampshire's utilities are continuing to operate under rates that retain the through-put incentive and thus provide a *disincentive* for efficiency. A second proposal has recently been filed by Liberty Utilities in its 2014 gas rate case filing.[82] In order to move ahead in this area, the PUC should direct utilities to bring forward proposals for decoupling or other rate design mechanisms in future rate cases, rather than leaving it optional. This approach has been used with success by Massachusetts, Connecticut, and Rhode Island, and other states around the country. As new rate designs have become more prevalent nationally, lessons have been learned and best practices developed that can help to inform approaches in New Hampshire. It is also important to link goal setting, new rate mechanisms, and rigorous program evaluation to ensure that ratepayer funds are appropriately invested.

4.3 ENERGY EFFICIENCY PROGRAM DESIGN AND DELIVERY

4.3.1 IMPROVING PROGRAM COORDINATION

A major barrier to achieving greater efficiency in NH is the lack of coordination among programs. New Hampshire consumers have a variety of energy efficiency programs from which to choose, administered by various organizations, funded by a variety of sources, and offering different efficiency "products" (e.g., loans, audits, rebates, grants, interest rate buy-downs, etc.). While this diversity in offerings can be useful to help reach a variety of customers, it can also create consumer confusion and present a barrier to action, as consumers who are faced with too many choices may simply not take action.

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[78] ACEEE "Energy Efficiency Resource Standards: State and Utility Strategies for Higher Energy Savings" http://www.aceee.org/research-report/u113.
[79] 2013 EERS Report at page 40.
[80] NH PUC Docket DE 07-064, Order 24,934, January 16, 2009 http://www.puc.nh.gov/Regulatory/CASEFILE/2007/07-064/ORDERS/07-064%202009-01-16%20ORDER%20NO.%2024,934%20ORDER%20RESOLVING%20INVESTIGATION.PDF.
[81] National Grid proposed "decoupling" in its 2010 distribution rate case.
[82] NH PUC Docket DG 14-180 at http://www.puc.nh.gov/Regulatory/Docketbk/2014/14-180.html.

The absence of a single "go-to" source where New Hampshire consumers can find information about energy efficiency and the full suite of programs that are available is a related challenge. In 2011, a Communications Plan developed for the Office of Energy and Planning recommended creating a centralized web portal to house information about all efficiency and clean energy programs, noting that doing so would help establish and maintain a presence in the market.[83] The 2011 EESE Board report made a stronger recommendation that the State create a dedicated entity with responsibility for implementing and advocating for energy efficiency and sustainable energy policies and goals.[84] Some of the most successful programs in other states have used one of these approaches, including Efficiency Maine, Mass Saves, Efficiency Vermont, and the Connecticut Energy Efficiency Fund.[85] Having programs operated by a single administrator or utilizing a centralized structure and common website has facilitated educating customers so they know where to turn for efficiency information, advice, and action. This coordinated approach can also reduce administrative costs, allowing more funding to be used for programs.

In the absence of a centralized single-administrator program or centralized portal, it is important to, at a minimum, coordinate and unify programs so that the various program administrators agree to work together toward complementary program offerings. New Hampshire should take action to better coordinate the efficiency programs in the State and provide a single source of information to consumers. A good place to start is the utility efficiency program website, www.nhsaves.com. This site could serve as a portal to all efficiency programs in the State, and could also provide an important link to clean energy programs such as those supported by the Renewable Energy Fund, so that consumers can invest in efficiency along with renewable energy projects.

4.3.2 CORE PROGRAMS

The CORE programs are the foundation of New Hampshire's efficiency efforts and were first established in 2002.[86] The CORE programs grew out of the restructuring of the electric industry; legislation passed in 1996 recognized the value of efficiency and explicitly listed it as a goal of restructuring: "Restructuring should be designed to reduce market barriers to investments in energy efficiency and provide incentives for appropriate demand-side management and not reduce cost-effective customer conservation."[87] The legislation authorized utilities to undertake energy efficiency programs funded by a System Benefits Charge (SBC). The SBC remains the primary source of funding for the CORE programs, though it has been supplemented in recent years by Regional Greenhouse Gas Initiative (RGGI) funds.[88]

The CORE programs have grown and been refined over the last decade, and have won a number of national awards. However, despite the success of the programs, they are currently insufficient to help New Hampshire realize our full efficiency potential. The 2013 EERS Report found that New Hampshire's current levels of investment in energy efficiency amount to roughly one-third of those necessary to put

[83] http://www.nh.gov/oep/resource-library/energy/documents/burgess-plan.pdf.
[84] 2011 EESE Board Report at p. 14.
[85] See http://www.efficiencymaine.com/, http://www.masssave.com/, https://www.efficiencyvermont.com/, and www.energyizect.com.
[86] http://www.puc.state.nh.us/electric/coreenergyefficiencyprograms.htm.
[87] RSA 374-F http://www.gencourt.state.nh.us/rsa/html/XXXIV/374-F/374-F-mrg.htm.
[88] The electric utilities also re-invest any proceeds received from bidding the programs into the Forward Capacity Market that ISO-NE oversees, but that amount is comparatively small.

the state on track to achieve all cost effective gains in efficiency.[89] Additionally, the design of the programs should be more focused on market transformation and encouraging private investment in efficiency. Recent efforts such as a third-party financing pilot program by Liberty and Unitil, which partners with banks to provide financing for customers, are a step in the right direction because they encourage customers to invest in efficiency on their own and allow banks to get more comfortable with efficiency lending. Many changes to improve the design of the CORE programs are detailed in the 2011 EESE Board Report, and should be used as a source for continuous improvements to the existing programs through the PUC dockets for the programs. Finally, once the state sets a goal for achieving efficiency, it will provide important direction for improvements to the design and delivery of the programs.

4.4 ACCESS TO FINANCING FOR EFFICIENCY

One of the primary factors preventing consumers and businesses from investing in cost effective efficiency measures, even those with very short paybacks, is the up-front cost. Many consumers and businesses defer money-saving projects because they do not have the cash on hand to fund the projects, and can't find affordable financing options. While New Hampshire has a number of financing programs including revolving loan programs established through ARRA and RGGI, they suffer from a lack of sustainable, consistent funding sources. Most of the current revolving loan funds are committed, and loan repayments revolve relatively slowly, resulting in overall inadequacy of funds.[90] This lack of funding makes it difficult to maintain programs at a continuous level, and because vendors fear advertising a program that may not be available, this prevents programs from being well promoted. This also undermines efforts to educate customers and support an in-state market of efficiency providers.

Funding programs also tend to be poorly coordinated with each other and with other efficiency programs and services. As discussed previously, though diversity in programs can be beneficial, without strong coordination and collaboration it can actually harm efficiency efforts if consumers become confused and decide not to take action.

Several states are developing institutions to overcome some of these challenges to serve as finance and investment entities, sometimes referred to as "Green Banks."

PACE Financing

Property Assessed Clean Energy (PACE) financing is a unique mechanism that provides financing to property owners via a special assessment on property taxes or another locally-collected tax or bill, such as a water bill. In addition to helping remove the barrier of the upfront costs for a project, PACE financing ties the cost of improvements to the property so that the repayment obligation can transfer with ownership of the property if it still exists at the time of sale. This can help incent property owners to undertake efficiency measures, as any subsequent owner will have both the costs and benefits of the efficiency improvements, rather than the seller having to pay all of the costs up front.

Legislation passed in 2014 in New Hampshire clarified debt priorities in its PACE program, and partners in the state are now working to increase usage of PACE as a financing tool. One remaining challenge is that administration of this program can be difficult for municipalities, particularly smaller communities. Technical assistance to guide communities through PACE projects will be necessary to make it successful.

[89] http://www.nh.gov/oep/resource-library/energy/documents/nh_eers_study2013-11-13.pdf
[90] The 2011 EESE Board Report predicted this challenge, at p. 10-4.

These entities seek to overcome financing challenges, and provide a central location for both information and capital for projects. The Connecticut Clean Energy Finance and Investment Authority ("CEFIA") is one example that uses public funding to leverage private capital, encouraging a shift from one-time subsidies and grants to attracting market-based financial tools, and spurring private sector growth and competition in clean energy. The Green Bank Academy Report defines a Green Bank as "a state chartered and state capitalized lending institution designed to fill gaps in private market finance for clean energy generation and energy efficiency," and emphasizes the importance of State involvement so that public funds can help leverage private investment and increase investor confidence.[91]

New Hampshire should explore what structure works in our state to build upon existing financing mechanisms for energy efficiency and clean energy. A public-private partnership that brings together private lenders, public funds, and expertise on efficiency and clean energy could result in a model that works in New Hampshire. Attracting private capital for these investments will be important to help the state meet its efficiency potential. Additional benefits could include better coordination of existing programs and information being accessible in one place, making it easier for consumers and businesses to take action.

4.5 LOW INCOME CONSUMERS

One area of significant need for energy efficiency is in low income programs. Low income consumers spend a much larger portion of their income on energy costs,[92] and therefore see the greatest benefit from efficiency measures. However, these consumers rarely have the ability to pay for efficiency upgrades out-of-pocket, and even low-interest loans can be beyond their means, making finding additional sources of funding for low income efficiency programs a priority for the state.

New Hampshire has a strong tradition of providing low income programs. There are two existing funding sources for low income energy efficiency today: 1) the federal Weatherization Assistance Program (WAP), which is administered by OEP, and 2) the ratepayer funded low income programs administered by the utilities through the CORE programs. Both programs are delivered by the state's five Community Action Agencies (CAAs), and they successfully make the two funding sources work together to reach as many homes as possible. Despite this leveraging, great need remains, as an estimated 80,000 low income homes in the state are in need of weatherization[93] and fewer than 1,000 homes can be served each year with current funding.[94] This need has become especially pronounced in recent years as federal funding levels have dropped dramatically—the funding received by OEP for WAP in 2012 was enough to weatherize just 180 households, as compared to the 794 homes weatherized by WAP in 2008.[95]

While this issue is broader than simply an energy issue, and a long-term solution will require more comprehensive changes to improve the quality of housing available to our low income residents, the State should commit to increasing its energy-related efforts for this population as part of larger efforts to set goals and seek more sustainable sources of funding.

[91] http://www.coalitionforgreencapital.com/uploads/2/5/3/6/2536821/green_bank_academy_report.pdf.
[92] http://americaspower.org/sites/default/files/Energy_Cost_Impacts_2012_FINAL.pdf.
[93] See comments submitted by New Hampshire Legal Assistance, Appendix D.
[94] Based on 2014 numbers.
[95] http://www.nh.gov/oep/energy/programs/weatherization/highlights.htm.

4.6 STATE GOVERNMENT LEAD BY EXAMPLE

As noted by the EPA, "State governments are finding that . . . Lead by Example (LBE) programs produce substantial energy savings while offering a range of other benefits, including: demonstrating leadership and the economic competitiveness of clean energy; reducing emissions of greenhouse gases (GHGs) and air pollutants; increasing fuel diversity; improving energy system reliability; fostering markets for clean energy products, services, and technologies; and promoting sustainable alternatives to conventional practices."[96] New Hampshire has been Leading by Example for over a decade with great success: since 2005, the state has reduced energy usage per square foot by 19.4%.[97] However, despite this significant reduction in usage, prices for energy have risen so dramatically that they have out-paced efficiency efforts, and total costs over the same period actually increased by 4.1%. This points to the need to do more efficiency as quickly as possible in order to stay ahead of future price increases, and contain the State's energy costs.

Both the 2011 EESE Board report and 2013 EERS study made recommendations to do more to lead by example through state government. In 2012 and 2013, state agencies identified nearly $50 million in energy efficiency projects for consideration by the State Energy Manager. However, the major barrier at present is finding the up-front capital to undertake projects. Funding for projects is currently allocated to the State Energy Manager's office as part of the State's capital budget; in the current biennium, that office received $500,000 for projects. Although these projects will ultimately result in significant operational savings for the State over time, the entire cost of a project must be covered in a single biennial budget.

One way to avoid this challenge is by using Energy Savings Performance Contracts, a tool that can help the State overcome the up-front capital barrier. Under this structure, a third party Energy Services Company (ESCO) finances and manages the project, and guarantees the resulting energy savings. The State then repays the ESCO with the cost savings from the avoided energy usage. While the State has recently started to use this tool again, it is still under-utilized when compared to success in other states. New Hampshire should invest the resources required to increase its use here and examine some of the best practices from

Local Government Efforts

Local Lead by Example efforts also have a significant impact due to community involvement and high local visibility. Schools, public safety and municipal buildings tend to be some of the largest energy users in a community, and efforts to improve their efficiency saves taxpayers money. Efficiency measures can also improve the overall comfort and health for building occupants—something that is particularly important for schools.

Many New Hampshire towns have been pursuing benchmarking and efficiency initiatives in recent years, often thanks to the efforts of their Local Energy Committees/Commissions and the Local Energy Work Group (LEWG). The LEWG provides "collaborative guidance and technical support to Local Energy Committees/ Commissions, municipalities, schools, and other political subdivisions seeking to reduce energy use, minimize energy costs, and/or reduce fossil-fuel consumption."

[96] http://www.epa.gov/statelocalclimate/documents/pdf/epa_lbe_full.pdf; numbers do not include ARRA funding.
[97] http://admin.state.nh.us/EnergyManagement/Documents/AnnualEnergyReport2013.pdf.

other states, such as developing standardized contracts and having a process for pre-qualifying ESCOs. A small investment now will allow the State to reap huge savings in reduced energy costs over a long time horizon, with no up-front costs.

In addition to building efficiency, another area where the State can Lead by Example is in transportation. The State should examine whether it is adequately encouraging the use of modern technologies that help reduce Vehicle Miles Traveled (VMT), such as video conferencing and teleworking.[98] This would also reduce travel time and increase productivity.

HB1129 of 2014 requires state agencies to identify ways to improve efficiency across State buildings and submit a report to the legislature by July 1, 2015. Many of these issues will be examined during that process, and it will result in specific proposal for Executive and Legislative action.

4.7 BUILDING CODES AND LABELING

Energy codes are an important piece of the full suite of building codes, and they help to ensure that buildings are constructed in a safe and energy efficient manner. Buildings that are built to or above code are more comfortable, durable, and affordable to operate. The State Building Code Review Board, which is administratively attached to the Department of Safety, is charged with reviewing and proposing building code amendments to the Legislature.[99] The State Building Energy Code for residential and commercial buildings is based on the International Energy Conservation Code (IECC),[100] which is revised every three years. The 2009 IECC is currently in effect in New Hampshire, and the 2015 code is currently under review by the State Building Code Review Board. While some have expressed concern that continual updating can make it difficult for builders and inspectors to know what's current, there is good reason for the 3-year revision cycle. Building technologies can change rapidly, and each new version of the code seeks to recognize those changes, allowing builders to take advantage of better technologies. The codes are increasingly moving to performance-based, rather than prescriptive, standards that give builders more flexibility to maximize efficiency in the way that makes the most sense for each individual building. It is important that the State update the energy code on a regular basis to ensure that energy saving measures are incorporated in both new construction and in renovation projects. Every building that is constructed in an inefficient manner is a lost opportunity to keep more of our energy dollars in state, and retrofitting a building later costs more than building it efficiently from the start.

Beyond Code

The IECC should be considered a minimum level of efficiency, and builders should be encouraged to go beyond its requirements to maximize energy savings. For example, Rhode Island requires that every new residential building undergo performance testing, and Massachusetts has developed a "stretch" code to incentivize building to an even higher standard. These efforts require a strong focus at the state level and support for local communities, factors that are currently lacking in New Hampshire. The State should examine ways to leverage efforts underway in other states, and build upon the Collaborative.

[98] For more on the importance of reducing VMT, please refer to the Transportation Chapter.
[99] http://www.nh.gov/safety/boardsandcommissions/bldgcode/index.html.
[100] http://www.iccsafe.org/AboutICC/Pages/default.aspx.

While adopting codes is an important step, ensuring compliance with them is equally critical. Unfortunately, enforcement has historically been a challenge for New Hampshire, primarily due to insufficient municipal enforcement resources. Many municipalities lack the funding, staffing, and training to fully enforce energy codes. In addition to enhancing enforcement resources, a complementary approach is to drive market demand for efficient buildings by educating consumers, realtors, appraisers, lenders, and builders about their benefits. The Building Energy Code Compliance Collaborative is working to do just that. The Collaborative was established as part of the US DOE Energy Code Challenge funded by ARRA, and has been continued by dedicated volunteers who understand the important role that codes play in saving energy and money. While this group has made admirable progress, its efforts need the formalized and sustained support of the State.

Building labeling is one approach for increasing awareness of the benefits of efficient building. Much like the Miles Per Gallon (MPG) ratings for vehicles, building labeling helps quantify a building's energy performance and related operating costs. In the absence of such a label or rating, it can be extremely difficult for consumers to know how much it will cost to operate a home, and as a result, efficiency attributes are often not valued as the same way as other home upgrades. This has implications for lending, marketing, and sales of efficient buildings. Being able to value efficiency measures can facilitate accounting for those investments at the time of sale, which may encourage more building owners to make them. Determining how to develop and implement labeling will require careful thought and analysis, and there are a number of efforts underway nationally that the state should watch closely.[101]

The CORE programs are another important avenue for education. As the most visible efficiency programs in the state, the CORE programs can play an influential role in the building industry, and the code training workshops they have sponsored in the past have been extremely successful. The PUC should encourage the continuation and expansion of these programs.

[101] http://www.aceee.org/topics/building-rating-and-disclosure.

RECOMMENDED EFFICIENCY STRATEGIES

Recommendation 3 - ESTABLISH AN ENERGY EFFICIENCY GOAL

Summary and Rationale: In order to reduce energy costs by implementing more cost-effective efficiency programs, the State must set a formal efficiency goal. The Public Utilities Commission should open a proceeding that directs the utilities, in collaboration with other interested parties, to develop efficiency savings goals based on the efficiency potential of the State, aimed at achieving all cost effective efficiency over a reasonable time frame.

The Legislature should also adopt an overarching policy directive that all State actions be guided by the goal of capturing all cost effective energy efficiency in the State.

Design Considerations: The State should review work done in the other states that have established an EERS or efficiency goal, and determine the best approach for New Hampshire. Designing programs to meet the State's goal will be an important part of implementation, and monitoring and evaluation of programs must focus on validating program savings. In establishing savings criteria, the state should consider work done by the DOE Uniform Methods Project,[102] the Northeast Energy Efficiency Partnership, and other leaders in evaluation, monitoring, and verification (EM&V). Use of recognized standards can reduce cost and time for the State and ensure greater trust in the validity of results, particularly by the financial community, which may be important to the success of Recommendation 6 - Improve Consumer Access to Financing.

Recommendation 4 - ADDRESS UTILITY DISINCENTIVES

Summary and Rationale: Utilities are a key partner in efficiency work, and achieving New Hampshire's full efficiency potential will require removing barriers to utilities being leaders in helping customers to be more efficient. Current regulatory structures mean that utilities lack incentives to increase efficiency, as it reduces their sales. Realigning utility incentives to reward utilities for investing in efficiency is a necessary part of any effort to increase efficiency in New Hampshire.

Design Considerations: New Hampshire can benefit from the experiences of the many other states that have implemented rate design changes to remove barriers to increasing efficiency investments. Any consideration of rate redesign and revised performance incentives must occur within the broader context of modernizing the grid. The State should ensure that the docket recommended in the Grid Modernization chapter takes into consideration changes recommended here. However, rate redesign should occur in the short to medium term, whereas grid modernization will likely be a longer term endeavor.

[102] http://energy.gov/eere/about-us/initiatives-and-projects/uniform-methods-project-determining-energy-efficiency-program-savings .

Recommendation 5 - IMPROVE COORDINATION AND DESIGN OF EFFICIENCY PROGRAMS

Summary and Rationale: New Hampshire's current efficiency offerings are scattered and inconsistently offered, confusing consumers and businesses and preventing widespread market transformation. The programs must be better coordinated, and offer consumers a one-stop shop that provides trusted, accessible information about how to take action to be more efficient.

In addition, the current design of the CORE programs may not support scaling up and encouraging market transformation. The recommendations made in the 2011 EESE Board Report regarding program design changes should be considered and implemented as appropriate. The State should also undertake a comprehensive evaluation of the programs to see whether they are achieving their goals. Although recommended as long ago as the 2002 Energy Plan, such an overarching evaluation has never been conducted.

Design Considerations: Because the ultimate goal of efficiency efforts is to help consumers reduce energy costs by overcoming market barriers and spurring private market development, the State will need to be careful in its design of a 'one-stop shop.' It will be important to ensure that non-utility programs are presented to customers equally, and that public programs complement rather than compete with private offerings.

Recommendation 6 - IMPROVE CONSUMER ACCESS TO FINANCING

Summary and Rationale: One of the major barriers to efficiency investments is the up-front cost. Attracting private financing to work with public funds will expand the reach of limited public funds, and will also spur market transformation as more consumers implement efficiency projects and lenders see value in efficiency loans. Similar to a 'one stop shop' for efficiency program information, efficiency financing should also be grouped under a single entity. Organized this way, private financing offerings could be effectively organized, coordinated, and accessed by consumers.

Design Considerations: Regardless of the financing model chosen, an effective approach should seek to leverage public funds to attract additional private capital and build the market for such products. Financing programs (offerings) should be clearly defined and coordinated. Programs should attract projects with cost effective energy savings, and programs should include measurement and verification of energy savings. Additionally, financing programs should:

- Be technology and fuel neutral - let the market and consumers decide which technology and fuel works best.
- Enable the shift from subsidies to customers financing their own investments, providing greater long-term program sustainability and spurring market transformation.

The most effective finance programs in other states share several key characteristics:

- A solid link between financing, programs, and efficiency goals;
- Sustainable funding that is adequate to meet goals;
- Significant program participation;
- The ability to attract investment from outside financial institutions and private sources in a low-cost, leveraged vehicle; and
- A highly coordinated program approach with either a single centrally-administered program entity, or synergistic program design among all key players.

Recommendation 7 - BETTER SERVE THE LOW INCOME POPULATION

Summary and Rationale: New Hampshire's low income residents are the most vulnerable to high energy costs, as they spend a much higher proportion of their income on energy yet have the least access to the capital needed to make efficiency improvements in order to reduce those costs. Estimates show that there are over 80,000 low income homes in need of weatherization, but current funding sources are sufficient to weatherize fewer than 1,000 homes a year. The State should consider mechanisms to increase funding to better meet this need.

Design Considerations: Opportunities to leverage related funds, such as those designed to serve housing or health needs, should be considered in order to take a more holistic approach to reducing energy costs for low income consumers.

Recommendation 8 - INCREASE STATE LEAD BY EXAMPLE EFFORTS

Summary and Rationale: State buildings are one of the most important targets for energy efficiency efforts, because they save the taxpayers money and set an example for other building owners. While the State has been pursuing efficiency upgrades for nearly two decades, we must commit more resources to using creative funding tools. The State should provide additional support to the State Energy Manager's office to help develop and manage projects, and should investigate creative funding arrangements to allow agencies to pay for projects with the savings generated by the projects. The work required by HB1129 of 2014 will result in specific recommendations that will require quick Executive and Legislative action.

Design Considerations: In order to truly lead by example, the State needs to better publicize its existing successes, and make note of the factors that led to that success. For example, the State established a High Performance Building Standard many years ago that has led to significant savings, and publicizing that success could help private building owners take action, and could also build support for updating the state building code.

Recommendation 9 - CONTINUALLY ADOPT THE NEWEST BUILDING CODES

Summary and Rationale: Energy codes are important to ensuring that new buildings (and major retrofits) are constructed in a manner that is safe, durable, and affordable to operate. In the absence of strong codes, owners may find their buildings in need of major efficiency upgrades just a few years after being built—at much greater expense than if they had been properly constructed initially. New Hampshire should ensure that the most recent version of the IECC is continually adopted as the state's code, and should explore how to assist communities and the building industry with compliance.

Design Considerations: Educating consumers, lenders, appraisers, and builders is critical to ensuring that efficient buildings are valued and therefore pursued, and the State should continue its efforts in this area.

5 FUEL DIVERSITY

Like other states in the Northeast, New Hampshire has limited energy resources of its own, importing most fuels used in the state. As the sources and supply chains for these fuels become increasingly global, the state has seen volatility in both price and supply. The New England region is even more susceptible to these volatile conditions because it is at the end of fuel distribution networks. As demand for all fuels increases on a global scale, these challenges are not expected to ease, and prices are predicted to continue increasing. As a result, there is a need for focused efforts to reduce New Hampshire's vulnerability to price volatility and supply disruptions, and increase our flexibility and resiliency. Diversifying our fuel portfolio and increasing the use of in-state resources will be critical tools in achieving those goals, in combination with increased efficiency. Better utilizing New Hampshire's in-state resources will also provide an important economic boost, as more energy dollars are retained in state rather than spent on imported fuels, and the industries associated with building and installing systems that use these resources create local jobs.

This chapter makes recommendations for action to achieve New Hampshire's energy goals related to diversity, fuel choice, and increasing energy independence.

5.1 NEW HAMPSHIRE'S RPS PROGRAM

Given that all of New Hampshire's in-state energy resources are renewable, the most effective policy to increase deployment of those resources could be one that already exists—the Renewable Portfolio Standard (RPS). The RPS was established in 2007 as a tool to increase the use of renewable energy for producing electricity and to protect and enhance fuel diversity.[103] The RPS requires that electric service providers, including distribution utilities and competitive suppliers, must acquire a certain percentage of supply from renewable energy sources. In total, 25% of electricity sold to retail electric customers must be generated by renewable energy sources by 2025. Under the NH RPS structure, applicable renewable energy sources are organized into four classes:[104]

- Class I: New (after 2008): wind; hydrogen derived from biomass fuel or methane gas; ocean thermal, wave or tidal energy; methane gas; or biomass. Thermal energy from biomass, solar, and ground source heat pumps (geothermal) was recently added to this class.
- Class II: New solar electric (PV) generation.
- Class III: Existing biomass or methane facilities that meet air emission criteria.
- Class IV: Existing small hydroelectric facilities that meet fish passageway criteria.

Service providers have three options for satisfying RPS requirements:

1. Purchase Renewable Energy Credits (RECs) from eligible projects, 1 REC equals 1 MWh;
2. Make an Alternative Compliance Payment (ACP), the amounts of which are set by the State;
3. In certain situations, directly invest in eligible renewable projects (such as through RSA 374-G).[105]

[103] The RPS now includes thermal energy sources.
[104] https://www.puc.nh.gov/Sustainable%20Energy/Renewable_Portfolio_Standard_Program.htm.
[105] PSNH also uses RECs generated at its hydro and wood units to meet RPS requirements for default service customers.

Under ideal market conditions, service providers could purchase an adequate number of RECs to meet their RPS requirements. However, if construction of renewable generation in the region does not keep pace with RPS targets and services providers cannot purchase RECs, providers may make Alternative Compliance Payments (ACPs). ACPs function as a cost control mechanism—they effectively set a cap on prices, as suppliers will make ACPs rather than purchasing RECs if REC prices are higher.[106] Payments collected through ACPs fund the State's Renewable Energy Fund (REF), which is used to support future renewable energy investment. This feedback mechanism helps to balance and support the market by funding new projects that will produce additional RECs.

All states in New England other than Vermont[107] have an RPS, and have seen great success with their programs by setting clear goals and consistent ACP levels. For example, Massachusetts initially set a goal of 400MW for solar, realized success ahead of schedule,[108] and in April of 2014 raised their goal to 1,600 MW[109]. By creating a consistent policy environment, Massachusetts has achieved an economy of scale that has increased the cost effectiveness of renewables, and they still have some of the lowest electricity rates in New England.[110]

By contrast, in New Hampshire frequent changes to the RPS, including the decrease in ACPs in recent years, have disrupted the market's development. As a result, the Business As Usual forecast projects that New Hampshire will not meet its RPS goal of 25% by 2025 (see Appendix A). For New Hampshire to better position itself to meet its energy goals and ensure that renewable energy development provides maximum in-state benefits, the State will need to ensure that all mechanisms for increasing renewable generation and investment are considered, from market-level adjustments to consumer level incentives.

5.2 UTILITY SCALE RENEWABLE ENERGY

Utility scale projects will continue to provide the bulk of electricity generation in the state. These projects are owned by independent power producers[111] and generally have a size of 1 MW or larger. The utility scale renewables already contributing to New Hampshire's supply include terrestrial wind and biomass, and the Resource Potential in Appendix C shows that there is significant potential for future contributions from solar photovoltaic (PV) and offshore wind.

[106] RPS compliance costs are available at: http://www.puc.state.nh.us/Sustainable%20Energy/Renewable_Portfolio_Standard_Program.htm.
[107] Vermont has established goals to meet 20% of electricity needs with Sustainably Priced Energy for Economic Development (SPEED) program resources by 2017; 75% of electricity from renewable sources by 2032; and 90% of energy needs across all sectors from renewable resources by 2050. See: http://publicservice.vermont.gov/topics/renewable_energy.
[108] http://www.mass.gov/governor/pressoffice/pressreleases/2013/0501-solar-power-goal-reached.html.
[109] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=MA05R.
[110] http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a.
[111] New Hampshire does still have one utility, PSNH, which retains ownership of generation. Although the state began restructuring in the 1990s, it was not completed and remains under study by the legislature and PUC.

5.2.1 UTILITY SCALE SOLAR PV

Today there is no utility scale solar installed in New Hampshire, whereas utility scale projects are being installed in growing numbers in surrounding states: large solar projects in operation, under construction, or under development total 204 MW in Massachusetts, 31 MW in Connecticut, 18 MW in Vermont and 10 MW in Rhode Island.[112]

The current NH RPS requires that 0.3% of electricity sales come from new solar, and does not distinguish between residential/commercial and utility scale PV. That requirement is well below the modeled economic potential of 600MW (which would be equivalent to 13% of current electricity sales). New Hampshire's Alternative Compliance Payments (ACPs) for solar are also considerably lower than those in neighboring states. As a result, solar RECs from New Hampshire projects are often sold outside of the state, necessitating the payment of ACPs by our suppliers.

Despite these barriers, there is significant potential for solar PV generation in New Hampshire. Utility scale solar PV facilities have been very successful in neighboring states, and New Hampshire is missing the economic opportunities that come with the development of those facilities. The state needs ACP levels to be in line with regional prices in order to help achieve our solar potential, and should also consider raising the Class II requirement for new solar in the RPS to reflect our potential.

5.2.2 UTILITY SCALE WIND

At present there is 171MW of wind capacity operating in New Hampshire, most of which is utility scale (installations of over 1MW). The Resource Potential indicates that there are an additional 2,100MW of technical potential for terrestrial wind energy in the state (see Appendix C). The amount of economic potential will depend upon a number of factors, such as the price for RECs and costs associated with the siting process. In light of the uncertainty surrounding those issues,[113] this strategy focuses on mid-scale distributed terrestrial wind, as discussed in Section 5.3.2 .

Floating Wind

A prototype floating wind turbine design is currently being tested off the coast of Maine near Monhegan Island. The Maine PUC approved a PPA for a pilot project, pending the award of a $46 million DOE grant. If installed, the full scale installation could produce as much as 43,000 MWh annually.

The Resource Potential also indicates that there is significant technical potential for offshore wind resources, estimated at nearly 3,500MW. Historically, the high costs associated with construction and maintenance of offshore turbines have prevented implementation across the coastal United States, but recent advances in technology have made harnessing offshore wind increasingly feasible. Despite these advances, these projects still face siting hurdles; they require consideration of shipping lanes, marine sanctuaries, and migratory paths of various species. HB1312 of 2014 created a legislative study committee to consider the potential for both offshore wind and other ocean power technologies, and is tasked with issuing a report by November 1, 2014. While offshore wind

[112] Data current as of August 19, 2014. http://www.seia.org/research-resources/major-solar-projects-list.
[113] Recent legislation requires the state's Site Evaluation Committee (SEC) to develop comprehensive siting criteria covering all types of energy sources, including issues related to noise, aesthetics and cumulative impacts. http://www.nhsec.nh.gov/projects/2021.htm. For further discussion of siting considerations, see Appendix D.

energy is not likely to be a contributor in the short term to New Hampshire's energy mix, it is a technology that the State should watch for the long term.

5.2.3 BIOMASS FOR ELECTRIC GENERATION

As one of the most forested states in the nation, New Hampshire has the opportunity to capitalize on locally produced resources by using biomass for energy. Use of biomass helps keep money in state while promoting land conservation and sustainable forestry efforts.[114]

Biomass powered electric generation currently represents 267 MW of installed capacity in New Hampshire. Facilities qualify towards the Class I (New Renewable Energy) or Class III (Existing Biomass Systems < 25MW) resources in the RPS. Class I RPS targets grow from 5% present day to 15% by 2025, whereas Class III RPS targets grow from 3% today[115] to 8% by 2025.[116]

Two interrelated challenges face the expansion of wood biomass as a source of power generation in New Hampshire: maintaining a sustainable fuel source, and the increasing demand for this fuel in both the thermal and power generation sectors. The Resource Potential (see Appendix C) indicates that while an additional 443 MW of wood biomass capacity for electricity generation may be technically feasible, only another 54 MW may be economically viable based on the sustainable harvest rate from remaining resources. Additionally, the analysis of wood biomass electrical potential was conducted without regard for potential increases in demand for wood biomass as a thermal fuel. Since electric and thermal uses for wood compete for the same resource, neither electric nor thermal would be able to achieve its full technical or economic potential. Focusing future development of wood biomass on thermal or combined heat and power (CHP) applications, where the fuel is used to both generate electricity and provide heat, is the most efficient use of this resource and should be prioritized. The inclusion of thermal sources in the RPS is a good step in that direction.

Another way to address biomass fuel limitations is to ensure that the list of eligible fuels is broad, as wood is but one of many fuels used for biomass power generation. For example, Vermont's largest utility, Central Vermont Public Service, has been utilizing energy produced from biogas from dairy operations since 2002.[117] These systems make use of the methane gas produced as a byproduct of farm operations, turning an otherwise harmful greenhouse gas into useful power.[118] We should monitor development of innovative fuels and continue to ensure that they are eligible for incentives and RPS qualification.

5.3 DISTRIBUTED ENERGY GENERATION

Small and commercial scale energy generation will play an increasingly important role in meeting New Hampshire's energy goals, helping make us more independent and resilient to energy supply and price

[114] A property owner who can make a profit on their land by using it for sustainable timber harvesting is less likely to sell or develop it for other purposes, which helps maintain New Hampshire's forested lands as forest.
[115] A recent order by the PUC retroactively reduced the Class III requirement to 0.5% for 2013: http://www.puc.state.nh.us/regulatory/Orders/2014orders/25674e.pdf.
[116] http://www.puc.state.nh.us/sustainable%20Energy/Renewable_Portfolio_Standard_Program.htm.
[117] http://www.renewableenergyworld.com/rea/news/article/2012/04/biogas-technology-cow-power-catching-on-in-us.
[118] http://www.afdc.energy.gov/fuels/emerging_biogas.html.

volatility. Distributed Generation (DG) refers to producing electricity and/or thermal energy through dispersed, smaller scale generation facilities rather than relying on large, centralized power plants. This can include systems ranging from residential rooftop PV to campus-wide or municipal combined heat and power. These energy systems are more resilient, flexible, and efficient. In addition, small scale projects enhance New Hampshire's economy, as installation of these systems creates jobs that are difficult to outsource, and money spent on the projects circulates within the state's economy. Despite these benefits, DG remains under-developed in New Hampshire and the state needs to work to make it more affordable and attainable.

One challenge for increasing independence through the deployment of renewables, especially at the smaller scales, is up-front costs. One way to help customers overcome this is to provide stable and consistent markets for the 'products' produced by renewable energy. These products take two forms: payments for electricity generated, and Renewable Energy Certificates (RECs). RECs are the mechanism by which the utilities demonstrate compliance with the RPS. Participation in the REC market is difficult for small residential and commercial system owners, as the certification process requires an independent party to report production to market administrators. The cost of this process can be higher than the REC payments received, and has limited the number of systems participating in the REC market. Streamlining this process could increase access to the REC market for smaller residential and commercial systems. Massachusetts created a Solar REC (SREC) market that is easily accessed by small generation units. To participate, generators register with the state's centralized production tracking system (PTS), which can be done via email. Generators can upload their data automatically using a meter with that capability, or they can enter the data manually.[119] While this system lowers the barriers to participation, there is one additional barrier as generators must find a buyer for their RECs, which requires a market that creates sufficient demand for them. In Massachusetts this demand is created by the high targets set for solar in their RPS in combination with a special rate for SRECs. Therefore, while New Hampshire should consider a centralized REC participation mechanism, we should also implement other RPS recommendations such as making ACP prices consistent with those in the region.

In the interim, New Hampshire's net metering policy provides a good compensation mechanism for the electricity generated by PV systems (the first of the two 'products' mentioned above). Under net metering, when a system produces more electricity than the building is using the excess electricity flows back onto the grid. This effectively reverses the direction of the meter, 'netting out' that production so the customer-generator's overall bill is lower at the end of the month. If the usage in the month is negative, the customer gets a bill credit that can be applied to future months. New Hampshire recently expanded its policy to allow *group* net metering; under this structure, the owner of a PV system can share the output with other customers without the requirement that they share a meter. It also allows customers with multiple meters such as municipalities, schools, and businesses to share renewable production, and increases the amount of economically viable solar installations. New Hampshire should maintain and encourage the use of this policy. Additionally, in order to become 'best in class', the state should consider raising the cap on 'small' net metered systems beyond the current 100kW, which limits the growth of small renewable systems.

[119] http://www.masscec.com/pts. While the system is made available to users free of charge, administration of the system requires resources on the State side, which is something for New Hampshire to take into consideration.

5.3.1 RESIDENTIAL/COMMERCIAL SCALE SOLAR PHOTOVOLTAIC (PV)

Residential and commercial scale solar electric (PV) is one of the best technologies for individual households and businesses that wish to independently produce electricity. Recent cost reductions for PV technology have made it increasingly cost-competitive, and the relative ease of installation make it an attractive choice for those wishing to diversify. Additionally, because solar tends to produce power during periods that coincide with peak load, such as on the hottest summer days, it provides important peak reduction, which can result in major cost savings, as discussed in the Grid Modernization chapter. Reducing peak load can also reduce the need to run some of the oldest, least efficient power plants, avoiding high costs and emissions.

Although New Hampshire currently has just 8.6 MW of solar installed, the Resource Potential indicates that the state could install at least 600 MW of residential/commercial scale solar PV economically (see Appendix C). This large gap between what the market is providing and what is economically feasible indicates that we need to revise our policies and programs in order to provide appropriate market signals and enable investment.[120]

One of the barriers slowing market penetration of residential and commercial scale solar is the upfront cost. In the past five years alone, the cost of a typical residential system has dropped by more than 30%. Similar trends have been seen for commercial scale systems. However, even with this reduction in PV costs, access to financing is essential to helping homeowners and businesses overcome investment barriers. One means of addressing this would be to use a portion of the existing Renewable Energy Fund (REF) to leverage private financing. Currently, the REF offers only rebates, and those are fully subscribed every year. If a portion of the fund were used to provide credit enhancements by creating a loan loss reserve, or other mechanism to attract private lending for solar projects, it could provide consumers with a sustainable, accessible source of funding. This could also help demonstrate the market value of these systems, increasing investor confidence and opening up financing opportunities to additional consumers. This model has been used successfully in Iowa since 1996,[121] and is starting to be adopted by more states nationwide.[122]

Another funding mechanism that should be explored is better usage of RSA 374-G, the state's Distributed Energy Resources law.[123] This statute allows utilities to invest in smaller scale distributed generation, in partnership with customers. However, only two projects have been completed to date, due in large part to the approval process, which both the utilities and installers have noted was extremely burdensome for the one set of projects that has been approved. In 2013, changes were made to the statute to attempt to address these issues and encourage more projects.[124] The State should carefully track any additional projects proposed under this law, and ensure that the recent changes are effective.

[120] In surrounding states, policies have led to higher rates of development of PV; Massachusetts now has a total of 445MW installed, Connecticut 77MW, and Vermont 41.5MW: http://www.irecusa.org/wp-content/uploads/2014/07/Final-Solar-Report-7-3-14-W-2.pdf.
[121] http://www.iowaenergycenter.org/alternate-energy-revolving-loan-program-aerlp/
[122] http://www.jsonline.com/business/regulators-move-to-change-incentive-provisions-for-renewable-energy-b99308892z1-266691631.html
[123] http://www.gencourt.state.nh.us/rsa/html/XXXIV/374-G/374-G-mrg.htm
[124] http://www.gencourt.state.nh.us/legislation/2013/HB0374.pdf.

Two other factors affecting the expansion of residential PV systems are 'soft costs' and potential tax implications. 'Soft costs' refer to things like the time and fees associated with the local permitting and utility interconnection processes, which can sometimes significantly delay and increase the cost of projects. The Office of Energy & Planning is currently engaged in a project with other New England States to examine permitting processes for small scale projects, and to develop and share best practices for streamlining them.[125] The results of this effort should be implemented throughout the state to help reduce the costs of PV, as was recommended in the 2009 Climate Action Plan[126] and 2011 EESE Board Report. Additionally, towns should be encouraged to use Renewable Energy Property Tax Exemptions. Under existing statute (RSA 72:61 through :72), cities and towns may offer exemptions from local property taxes for certain renewable energy installations.[127] This policy removes a potential disincentive for system owners, and the state should work to encourage the adoption of the policy in all municipalities that are interested in participating.

Community Owned Solar

In Peterborough, New Hampshire a successful model for larger-scale, community owned solar is underway. The town, working with a private installer, will erect a 941 kW PV array at the site of a retired wastewater treatment plant. Lagoon areas present an ideal site of flat, unobstructed land that is not usable for other purposes (commonly referred to as a "brownfield"). The project used a third-party ownership structure, combined with a grant from the Public Utilities Commission, to install the array at zero upfront cost to the community. These types of creative land utilization and financing structures present a cost-effective way of pursuing large scale projects that benefit the citizens of New Hampshire while preserving the state's important environmental characteristics.

5.3.2 DISTRIBUTED WIND

The Resource Potential indicates that there is significant remaining economic potential (777GWH) for mid-scale distributed wind power in the state, more than for any other resource (see Appendix C). One successful model for deploying this type of wind is through community scale or community owned projects. In Montana, community scale renewable generation is encouraged by the state's RPS, which requires public utilities to annually source 50 MW of RECs and electrical output from community scale renewable projects, increasing to 75 MW in 2015.[128] Internationally, Germany is quickly becoming one of the most effective adopters of community wind projects, as German policies allow local government groups to act as limited partnership companies in community wind projects. Under this approach, residents can buy into their community's wind projects through shareholding, and have decision-making input to the project's siting and management.[129] New Hampshire could learn from these models to develop smaller scale wind projects that fit the state's landscape, benefit communities, and provide the other benefits of in-state energy sources discussed above.

[125] http://www.cleanegroup.org/blog/cesa-awarded-1-5-million-from-u-s-department-of-energy-to-reduce-solar-costs-across-five-new-england-states/#.U4toJvldU4U.
[126] http://des.nh.gov/organization/divisions/air/tsb/tps/climate/action_plan/nh_climate_action_plan.htm.
[127] Eligible technologies include solar systems (thermal and photovoltaic), wind turbines, and central wood-fired heating systems. Woodstoves and fireplaces are not included.
[128] http://www.northwesternenergy.com/news-center/news-releases/news-article/2014/06/13/NorthWestern-Energy-Issues-Request-for-Proposals-for-Community-Owned-Renewable-Generation-in-Montana
[129] http://www.seai.ie/Archive1/Files_Misc/File5.pdf.

5.4 THERMAL FUEL CHOICES AND TECHNOLOGIES

In addition to diversifying our electric generation, it's important for NH to diversify how we meet our thermal energy needs. This is particularly true from an individual consumer standpoint, as heating costs often make up a substantial portion of overall household expenditures. Enhancing consumer access to additional fuel choices and more efficient technologies, in combination with increasing building efficiency, can help reduce that burden.

5.4.1 BIOMASS FOR THERMAL USES

The Resource Potential identified biomass heat from wood as having significant untapped economic potential (see Appendix C). Wood offers a promising alternative to home heating oil and other petroleum products, providing a much needed option to extend fuel choice to rural areas of the state. Since New Hampshire is one of the most forested states in the nation, wood also presents an opportunity to capitalize on locally-produced resources, keeping money in state while promoting land conservation efforts.[130] The State already offers incentives for biomass through the Renewable Energy Fund. Bulk-fed, wood pellet central heating boilers and furnaces are eligible for rebates of 30% of the cost of the systems (capped at $6000 for residential and $50,000 for commercial).[131] These rebates should be continued and expanded if possible, to allow consumers and businesses to take advantage of the benefits of heating with biomass. However, consumers need to understand that the fuel is not regulated by the State, and that wood is subject to the same short- and long-term supply constraints faced by many fuel resources. Short-term constraints are driven largely by pellet production capacity, and were experienced during the unseasonably cold winter of 2013-2014, when consumers who rely on retail stores for pellets found them hard to find due to high demand and limited supply. While this situation is expected to resolve as wood pellet producers see that additional production capacity may be warranted, long term supply concerns remain. Widespread adoption of biomass heating systems could result in the state importing wood in the same way that it currently imports fossil fuels, with similar economic results. This is particularly true in light of the fact that the Northeast is increasingly exporting wood resources. To the extent possible, the State should work to ensure that conversions to biomass heating systems are occurring strategically, focused in places located near wood supply and in concert with comprehensive efficiency efforts.

As noted above, another way that New Hampshire can hedge against the possibility of becoming over-reliant on wood is to expand the list of fuels considered to be biomass. There are a number of innovative technologies coming to market that can provide significant thermal energy from unique sources. For example, the University of New Hampshire's Organic Dairy Research Farm recently installed a heat exchange compost system that uses fans to aerate compost, and then draws on the heated vapor to warm water. Utilizing thermal energy that would otherwise simply disperse, the energy exchange compost system can be used to supplement demands for hot water in heating or washing.[132] While not yet widely available, innovative applications such as this are important to our energy future, and the State should ensure that policies are flexible enough to allow and support these innovations.

[130] A property owner who can make a profit on their land by using it for sustainable timber harvesting is less likely to sell or develop it for other purposes, which helps maintain New Hampshire's forested lands as forest.
[131] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NH41F&re=0&ee=0.
[132] http://www.washingtontimes.com/news/2014/jun/21/unh-celebrates-unique-composting-system/

5.4.2 SOLAR THERMAL

Solar thermal technology has two main applications: heating water and heating air. The most common solar thermal application is heating water for domestic use. It is an effective alternative to traditional methods of water heating for residential purposes and for large hot water users such as hotels, hospitals, campgrounds, and college dorms. Solar thermal can also be used for space heating by heating either water or air.

Solar thermal is currently an eligible technology under the RPS as a Class I source, and qualifies for the state's existing rebate programs.[133] However, similar to solar PV, one of the main barriers slowing market penetration of residential solar thermal is the upfront cost. As described above in the Solar PV section, attracting private funds to allow customers to access financing would help increase the deployment of solar thermal technologies.

While advances are being made to solar thermal as a space heating technology, it is expected to remain limited in applicability given NH's existing building stock, and we should focus our efforts on encouraging additional solar thermal for heating water for domestic use in the short term. Those applications can have quick payback times and help reduce the need for fossil fuels, and are currently being underutilized in New Hampshire, particularly on the commercial side. The State should examine the incentives for solar thermal technology and ensure that it is eligible for any new financing programs that the State creates.

Solar Thermal Innovations

One new approach to solar thermal for heating uses black body radiation on south facing walls to passively heat air trapped behind a perforated clear polycarbonate superstructure. A building's air handling system pulls from this air source, reducing the temperature differential of inlet air and lowering thermal load on the HVAC system. This technology was recently installed on four buildings on the campus of Sanborn Regional High School in Kingston, NH. The school utilized a power purchase agreement (PPA) approach to financing the project, which eliminated the up-front cost to the school and allows them to save on their heating bills.[1] As with other solar applications, thermal systems must be designed and sized appropriately and a back-up heat source is often necessary.

5.4.3 AIR & GROUND SOURCE HEAT PUMPS

Ground source heat pumps utilize stable subterranean temperatures for both indoor heating and cooling. These systems consist of horizontal or vertically installed below ground networks of piping that circulate water or coolant. While temperatures above ground fluctuate with climatic conditions, a few feet below the ground temperatures remain fairly constant throughout the year. This consistency in temperature can be used for heating and cooling needs.[134] Air source heat pumps operate similarly, moving heat instead of generating it, and are composed of an indoor and outdoor set of connected copper coils with circulating refrigerant, extracting heat from outside air and releasing it inside a building. In the past, this technology has not been effective in temperatures below freezing and as such was not a good fit with New Hampshire's climate. However, recent innovations in inverter controlled heat pumps and dual-stage

[133] http://www.puc.state.nh.us/Sustainable%20Energy/RenewableEnergyRebates-CI.html
[134] http://energy.gov/energysaver/articles/geothermal-heat-pumps

compressors allow operation at temperatures as low as 5°F.[135] Both types of systems require electricity to drive the pumps.

Both of these technologies can contribute to lowering energy usage and costs in the state. However, as with all heating system conversions, up-front costs can be a barrier. While utility rebates for both technologies are currently available, the State should consider also making financing available to customers who wish to install these systems when combined with efficiency improvements. Alternatively, Green Mountain Energy in Vermont has developed an innovative approach that has seen success: under their Cold Climate Heat Pump Rental Program, customers rent equipment, with prices ranging from $43-$53 a month.[136] This helps consumers avoid the high up-front price while getting the technology out in the market.

Consumer knowledge may also be a barrier, as these technologies are somewhat new and complex. The State should provide information to help consumers understand the benefits and costs of these technologies. One area that can be particularly challenging for consumers is conducting a cost-benefit analysis, as heat pumps effectively heat with electricity and can therefore be difficult to compare to the costs of an existing fossil fuel system. One action that could be helpful for consumers would be for the State to provide data on installations already existing in state, such as New York's State Energy Research and Development Authority (NYSERDA) has done with solar installations.[137]

5.4.4 NATURAL GAS

Natural gas will continue to play a role in meeting New Hampshire's electrical and thermal energy needs. As indicated in the Business As Usual forecast, natural gas currently provides 16% of residential heating needs, 44% of commercial thermal needs and 54% of industrial thermal needs.[138] In total, only 51 New Hampshire cities and towns have access to natural gas, and the state's two gas utilities, Unitil and Liberty, only serve approximately 117,000 customers. Based on recent data from the EIA, at current prices consumers who switch to gas from heating oil or propane could expect to cut their annual fuel costs in half.[139] However, even with the lower cost of natural gas today, New Hampshire is still prone to supply and cost fluctuations. In the winter of 2013 -2014, the region did not have enough supply for both heating and electrical generation needs. This resulted in higher prices and volatility, especially on the coldest days.[140] While New Hampshire has limited influence over natural gas transmission and pipeline expansion, the State is engaged in regional efforts to explore ways to encourage additional pipeline capacity in the region. The State should continue such coordination efforts, ensuring that New Hampshire's interests are represented in larger decision-making forums, and exploring other opportunities such as reducing usage through efficiency and conservation.

On the local distribution side, although the New Hampshire PUC has regulatory authority over Liberty and Unitil, the technical and economic barriers to additional gas expansion remain difficult to overcome. The

[135] http://energy.gov/energysaver/articles/air-source-heat-pumps
[136] http://www.greenmountainpower.com/customers/heat-pump-rental/cold-climate-heat-pump-rental-program-/
[137] http://www.nyserda.ny.gov/About/Newsroom/2014-Announcements/2014-07-31-NYSERDA-Announces-Availability-of-Information-About-Nearly-10000-Solar-Projects.aspx
[138] http://www.eia.gov/state/seds/
[139] http://www.eia.gov/todayinenergy/detail.cfm?id=13311
[140] http://www.eia.gov/forecasts/steo/special/pdf/2013_sp_01.pdf

high cost per mile of pipeline expansion can prohibit expansion to areas that are not densely developed. This barrier is compounded by limits on allowable payback periods for expansions. In recognition of the importance of access to natural gas across New Hampshire, the PUC recently changed the acceptable payback period limit for Liberty Utilities. The new line extension policy provides for a 20 year payback on residential and a 10 year payback on commercial and industrial line extensions. This will help Liberty bring natural gas to more customers in communities that are already served by the local gas distribution network.

The State should closely monitor any distribution expansion that occurs as well as remaining active in regional discussions of transmission expansion. The State should also continue supporting policies that increase the utilization of existing infrastructure in order to provide access to natural gas to more customers already on existing networks, while minimizing environmental disruption and making existing systems more cost effective.

RECOMMENDED FUEL DIVERSITY STRATEGIES

In order to foster sustainable, diverse energy development, we need consistent policies that support this approach.[141] By continuing to build a regulatory framework that supports diverse energy sources while respecting communities and natural resources, the State will help consumers, businesses, utilities, and investors gain confidence in investing in these areas.

Recommendation 10 - EVALUATE RPS TARGETS AND ACP PRICES

Summary and Rationale: New Hampshire's ACP prices are lower than other states in the region, and this presents a challenge for in-state development of renewables to meet the state's RPS goals, particularly for solar. In order to realize the full economic and security benefits of renewable energy, the State needs to adjust ACPs to be more in line with others in the region. The State may also wish to examine the class requirements, as the Resource Potential revealed solar PV to be the technology with the largest untapped potential in New Hampshire, yet the RPS has a relatively low requirement for solar (0.3%). This indicates that the RPS targets may not be aligned with each source's potential, a possibility that is reinforced by the PUC's recent proceedings to adjust targets in other classes.[142] Rather than continue to make adjustments on a somewhat 'emergency' basis, the State should examine the RPS targets holistically and compare them to the economic and technical potential for each source.

Design Considerations: While regular evaluation of the targets against remaining potential will be important to ensure that the RPS is working, the state must be careful to also maintain certainty for the market. Market participants have been quite vocal about the fact that changes should be done at prescribed intervals and announced well in advance, noting that investor confidence requires stability and long term policies. The recent, frequent changes have eroded that confidence and delayed New Hampshire's progress toward fuel diversity and energy resiliency. As noted by the National Renewable

[141] http://www.puc.nh.gov/Sustainable%20Energy/Reports/New%20Hampshire%20Independent%20Study%20of%20Energy%20Policy%20Issues%20Final%20Report_9-30-2011.pdf, p. 7-3.
[142] http://www.puc.state.nh.us/Regulatory/Docketbk/2014/14-104.html.

Energy Laboratory, "RPS targets should be stable, ramp up steadily over time and not be subject to sudden or uncertain shifts."[143]

Recommendation 11 - CONSIDER RATE DESIGN CHANGES TO PROPERLY VALUE DG

Summary and Rationale: Dynamic pricing such as time-of-use (TOU) or real-time-pricing (RTP), discussed in the Grid Modernization section as important demand-side tools, are also tools for consumers to manage peak demand. These mechanisms can also be used on the supply side to reward distributed generation (DG) for the value it provides to the grid. In contrast to feed-in-tariffs, which set a cost-based fixed price for renewable energy supplied to the grid, or net metering with flat rates that ignore the time value component of power production, net metering with dynamic pricing mechanisms pays a premium for DG power that is produced during times of peak demand. With advanced metering infrastructure, these pricing mechanisms can be developed to properly value the power provided by DG assets.

Design Considerations: This recommendation needs to be considered in context with several others, such as any grid modernization efforts and recommendation Sub-Recommendation 12.B: (Continue to Expand Net Metering Opportunities).

Recommendation 12 - ENCOURAGE SMALL SCALE DEVELOPMENT

In the current energy landscape, the major inhibitors to small scale energy generation are the availability of investment funds, existence of incentives, and stakeholder knowledge. Taken together, the recommendations below can inform specific actions for bringing small scale and distributed clean energy to its full potential in New Hampshire.

Sub-Recommendation 12.A: INCREASE LEVERAGING OF PRIVATE FINANCING

Summary and Rationale: One barrier to greater renewable energy development is lack of access to capital. Traditional loan products are poorly suited for many installations, and commercial lenders have not yet fully embraced the potential of renewable energy loans. The State should explore using a portion of the Renewable Energy Fund to provide a credit enhancement that could attract private financing and connect consumers to lenders more easily.

The State should also work with utilities to increase the usage of the Distributed Energy Statute, RSA 374-G, which allows utilities to partner with customers to install small scale clean energy generation.

Design Considerations: As New Hampshire's renewable market develops, the need for coordinated administration of various programs will increase. Coordination of programs and financing can reduce overhead costs, enable comprehensive data collection, and increase efficiency in marketing, planning, and delivery. New programs funded by the REF, such as financing, should be developed in collaboration with existing institutions and efficiency programs to ensure full coordination. Additionally, the State should ensure that any loan products offered are clearly defined and consistent to reduce market confusion.

[143] http://www.nrel.gov/tech_deployment/state_local_governments/basics_portfolio_standards.html.

Sub-Recommendation 12.B: CONTINUE TO EXPAND NET METERING OPPORTUNITIES

Summary and Rationale: In 2013, NH expanded the State's net metering policy to allow group net metering.[144] This allows multiple customers within the same utility territory to enter into an agreement for shared use of renewable energy generated by one of the customers.[145] By spreading the costs and benefits across a group of customers, group net metering provides an important tool for funding small scale distributed renewables. While the adoption of group net metering was an important advancement, the State should consider further incentivizing independent generation by increasing the size of "small customer-generator" beyond the current 100kW cap in PUC 900 rules.

Design Considerations: Raising the net metering cap will require consideration of integration issues, particularly grid reliability. Utilities and other stakeholders should be involved in an informal process led by the PUC to determine the best level for New Hampshire.

Sub-Recommendation 12.C: EXPAND LOCAL RENEWABLE PROPERTY TAX EXEMPTIONS

Summary and Rationale: Towns should be encouraged to adopt Renewable Energy Property Tax Exemptions, as allowed under current statute (RSA 72:61 through 72). While this policy may not have a large impact on the overall installations of renewable energy in the state in the short term, it may help some individuals make the choice to invest in these systems. It is also relatively simple to implement, and low cost.

The state should also consider expanding the range of technologies eligible for the property tax exemption. In order to achieve maximum fuel diversity, the statute should be flexible enough to allow property owners to take advantage of all beneficial new technologies. It may be simpler for RSA 72 to simply reference the RPS statute (RSA 362:F), which already defines all types of renewable energy that qualify under that law.

Design Considerations: Consistency is important so that installers and consumers all have a common understanding of the policy. The Office of Energy and Planning, together with the Department of Revenue Administration and other interested stakeholders, should work to develop best practices and model processes and to assist towns in implementing the property tax exemptions.

Sub-Recommendation 12.D: STREAMLINE LOCAL PERMITTING FOR SMALL SCALE SOLAR PV

Summary and Rationale: To continue to decrease the cost of residential solar PV for New Hampshire's consumers, the State should continue to support efforts to reduce the 'soft' costs associated with solar electric installations. 'Soft' costs typically include all the permitting, interconnection, and inspection requirements, along with the time industry spends dealing with the inconsistencies among these requirements at the local level. Other states have streamlined and standardized local permitting processes, reducing overall costs for residential solar installations. New Hampshire should explore implementing best practices to make permitting, installing, and inspecting solar electric less time consuming. The Office of Energy & Planning is currently engaged with other New England States to

[144] SB98 http://www.gencourt.state.nh.us/legislation/2013/SB0098.pdf .
[145] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NH01R .

examine 'soft-costs' and interconnection processes specifically for residential solar PV, and to develop and share best practices for streamlining processes where possible. The results of this effort should be implemented throughout the State.

Design Considerations: While current work is focused specifically on residential solar electric, the state may wish to examine permitting for additional types of small scale distributed generation to ensure that it is not an undue burden.

Recommendation 13 - INCREASE CONSUMER FUEL CHOICE AND REDUCE NEAR TERM COSTS

While transitioning to renewables and increasing resiliency through distributed generation are important goals, the state is also facing big challenges when it comes to consumer costs associated with its dependency on expensive and volatile heating fuels. Increasing the fuel options available to consumers will be important to helping them manage their risks and costs.

Sub-Recommendation 13.A: CONVERT CUSTOMERS WITH EXISTING ACCESS TO NATURAL GAS

Rationale and summary: Natural gas currently offers considerable cost savings as compared to other fuels, and also burns more cleanly than fuel oil, providing local and global air quality benefits. Focusing on distribution-side efforts, the State should work to fully utilize the capacity of existing gas pipelines. This can reduce heating costs for customers and keep more dollars in state in the short term – dollars that can then be invested in efficiency and renewable energy for long-term sustainability. One tool that may be particularly effective in driving conversions for on-main customers is to provide financing for efficient gas furnaces. While the State currently offers rebates for high-efficiency furnaces, they cover only a small portion of the cost of a new system, and consumers may have difficulty obtaining capital for the remaining cost. Offering financing programs could help more customers benefit from heating system upgrades.

Design Considerations: As with any fuel, it is critical to ensure that it is being used as efficiently as possible, and any gas conversion programs should be carefully paired with efficiency programs.

Sub-Recommendation 13.B: MONITOR DEVELOPMENT OF TRUCKED CNG

Rationale and summary: Some areas are simply too remote to justify investments in natural gas distribution network extensions. However, the market has recognized a demand for natural gas even in these locations, and a number of companies are now making investments to offer trucked CNG service to larger customers, or to campus settings with a large anchor customer. The State should monitor these developments and work to clarify and simplify the permitting processes for such installations.

Design Considerations: The state should encourage targeted, strategic installations for trucked CNG in areas where the impact will be maximized. While many of these companies are not subject to the jurisdiction of the PUC, the state could encourage knowledge sharing and general coordination among these firms, and encourage customers to undertake efficiency improvements when they take advantage of CNG opportunities.

6 TRANSPORTATION

The State's transportation system is more than just roads and bridges. A comprehensive, multi-modal system will be necessary to meet the needs of NH's citizens and provide for movement of goods and people through and within the state. The transportation sector accounts for 35% of New Hampshire's energy consumption[146] and, as noted in the Business As Usual forecast (see Appendix A), comprises 46% of total energy expenditures throughout the forecast period. Motor vehicles are also responsible for a range of harmful emissions, including local air toxics: vehicles are the main contributor to ground-level ozone, which is the primary component of smog and can cause significant health issues, particularly in the young and elderly. Therefore, actions to reduce the impact from this sector are a vital component of an overall state energy strategy.

A strategic plan to reduce transportation energy use is also an important component of the State's economic development activities as the majority of transportation energy dollars immediately leave the State's economy to pay for imported fossil fuels. Actions that reduce imported fuel use, such as increasing vehicle energy efficiency, decreasing vehicle miles traveled (VMT), or improving the flow of traffic, can generate enormous energy and cost savings. Additionally, as car-free lifestyles become increasingly common nationally and internationally, alternative transit options will be crucial to ensuring that tourists will be able to visit the state. Finally, the increasing electrification of the transportation sector will have impacts on our electric grid. This poses both challenges and opportunities, and requires that we consider transportation energy use in future overall energy planning.

6.1 VEHICLE MILES TRAVELED

The Resource Potential identified reduction of vehicle miles traveled (VMT) as one of the biggest opportunities to cost effectively contain transportation energy demand and expenditures in New Hampshire (see Appendix C). The tools that help reduce VMT— improved transit options and supportive land use/development decisions— can also provide important quality of life benefits such as making travel easier for those without cars and easing traffic congestion.

6.1.1 BUS MASS TRANSIT

In addition to supporting the State's energy goals, mass transit options are needed to provide mobility for New Hampshire's residents. Access to transportation option for the state's aging population[147] will be increasingly important in the coming years, and will also be important for attracting and retaining younger people, whose preferences are shifting toward use of transit options.[148,149] Evidence of this demand for mass transit can be seen in the ridership numbers for the Boston Express Bus service, which have nearly doubled since service began six years ago, now serving approximately 46,000 riders a month. Transit ridership across the entire New England/Eastern Canada region rose four percent from 2011 to 2012, and

[146] http://www.eia.gov/state/?sid=NH.
[147] http://www.carseyinstitute.unh.edu/publications/Report-Johnson-Demographic-Trends-NH-21st-Century.pdf.
[148] http://business.time.com/2013/08/09/the-great-debate-do-millennials-really-want-cars-or-not/.
[149] http://www.bloomberg.com/news/2014-07-10/protected-bike-lanes-double-in-u-s-cities-bid-to-attract-youth.html.

rural transit services provide over 5.2 million rides annually in New England alone.[150] Fully realizing the potential of mass transit will require expanding and coordinating routes, increasing frequency, and making transit easier to use.

One barrier to increased use of mass transit is the lack of concentrated centers of demand in New Hampshire. The state's rural character can make it difficult to establish successful transit service. However, the Advance Transit service in the Upper Valley region of New Hampshire, which has experienced significant growth over the last two decades,[151] provides a model for rural transit. Advanced Transit has successfully coordinated with regional planners and employers to offer a service that meets local needs and provides significant economic benefits to the region. Advance Transit currently offers 7 free bus routes linking New Hampshire's Lebanon and Hanover areas with the Vermont towns of Norwich and Hartford Village, connecting the Upper Valley communities of both New Hampshire and Vermont.[152] Several communities in the area have also encouraged mixed use villages that support the use of this system.[153] This holistic approach to land use and transportation planning is important to enabling successful transit service across the state, and across borders as well.

A second barrier to sustainable mass transit is lack of coordination of routes and schedules between providers in the state, and lack of information available to the general public about services. At present, there are twelve local transportation organizations and nine long distance bus services operating in New Hampshire, but no easy way for users to plan a trip from start to finish exists. One tool for improving the coordination and ease of connection between operators is use of the General Transit Feed Specification (GTFS), a common software platform that allows services such as Google Maps to reflect transit routes and schedules and also allows transit providers to interface with each other.[154] The New Hampshire Department of Transportation's (NH DOT) I-93 Task Force has been working to enhance the coordination of transit providers in the I-93 corridor,[155] and the State could benefit from an extension of that effort to the areas outside the current scope of that Task Force.

6.1.2 PASSENGER AND FREIGHT RAIL

Passenger train service in New Hampshire also attracts significant ridership. Amtrak's Downeaster Service from Brunswick, ME to Boston carries over 550,000 passengers annually (31% from New Hampshire) and ridership has grown by 123% since 2005.[156] Additional passenger rail service in the state is also available on the Vermonter Amtrak line, which includes a stop in Claremont. In total, almost 400,000 riders per year originate or end rail trips in New Hampshire.[157]

[150] Report to the 38th Conference of the New England Governors and Eastern Canadian Premiers, Transportation and Air Quality Committee Report, July 14, 2014.
[151] http://www.advancetransit.com/AT2012%20Final.pdf.
[152] http://www.advancetransit.com/at_arra.htm.
[153] http://lesconference.nhenergy.org/uploads/1/6/7/3/16738072/t2s1_mixed_use_combined.pdf.
[154] For example, Google Maps currently indicates that there is no way to get from the Concord Park & Ride to Logan Airport via transit, even though Concord Coach provides that service.
[155] http://www.rebuildingi93.com/content/initiatives/.
[156] https://www.amtrakdowneaster.com/sites/default/files/NNEPRA2013AnnualReport_web.pdf.
[157] NH State Rail Plan, 2012, available at: http://www.nh.gov/dot/org/aerorailtransit/railandtransit/documents/FinalStateRailPlan.pdf.

The 2012 State Rail Plan makes evident that there is much more potential for passenger train service in the state:

> Ridership on both services [Downeaster and Vermonter] has shown significant growth in recent years. Establishing goals for future ridership will provide a measure of the progress this service is making in increasing the personal mobility of people in New Hampshire… There are several projects on each of the Amtrak corridors, as well as plans for other services in the state, that may increase rail ridership dramatically, including the New Hampshire Capitol Corridor service and MBTA Commuter Rail extension to Plaistow. The NHDOT goal for rail ridership in 2016 is for over 1 million trips, which would include implementation of these two services.[158]

The Capitol Corridor Rail and Transit Study, which DOT is currently undertaking, will include a study of potential rail and bus transit investments in the NH Capitol Corridor, which connects major population centers in New Hampshire to metropolitan Boston. This study will be taking a systems approach in the development of the alternatives that will be considered.[159] Results of the study will highlight specific projects that New Hampshire can pursue to address urban transit needs that both exist today, and those that that are expected to emerge in the coming years.

Freight rail also plays a vital role in the movement of goods within and through New Hampshire. According to the NH State Rail Plan (2012), an estimated 4.7 million tons of freight are moved by rail annually, about 7.3% of all freight moved in the state. Moving this same amount of freight by truck would require adding 188,000 trucks to our roadways. National forecasts project demand for rail freight to increase in New Hampshire in the next 30 years, and it is important that the state maintain existing infrastructure and invest strategically in the coming years to support this growing demand.[160]

6.1.3 COMMUNITY PLANNING AND DEVELOPMENT

Strategic community planning for development is an important complement to expanded mass transit and can further reduce the need to drive within a community. Making streets more bike and pedestrian friendly (with wider, protected sidewalks and dedicated bike lanes) can allow residents to complete short trips without using a vehicle, and can help overcome the 'last mile' hurdle that mass transit often faces, which refers to getting people to their ultimate destination, which can often be a mile or more away from a transit stop.[161] Mixed-use development within a community, which creates areas that combine housing and services such as grocery stores, can also reduce the need to drive. Transit-oriented development, which promotes the location of goods and services near transit centers to make the use of transit more convenient and attractive, is another way that community planning can help reduce VMT. These efforts help advance the goals of reducing costs, attracting and retaining younger people, providing choices to allow the elderly to age in place, and improving quality of life.

Adoption of a statewide "complete streets" policy may be one strategy to support biking and walking options. While true transformation will require sustained, long-term commitment to different development patterns, there are also low-cost efforts that can be undertaken in the short term that

[158] http://www.nh.gov/dot/org/aerorailtransit/railandtransit/documents/nhstaterailplan.pdf.
[159] http://www.nh.gov/dot/org/aerorailtransit/railandtransit/.
[160] NH State Rail Plan, 2012.
[161] http://usa.streetsblog.org/2011/10/18/the-last-mile-how-bike-ped-improvements-can-connect-people-to-transit/.

simply encourage citizens to re-think how they are getting around their communities. For example, in early 2014 the City of Nashua engaged in a public initiative called "Walk Nashua." Part of a national campaign, Walk Nashua fosters a non-vehicle travel urban environment by installing signs specifically targeted at walkers and bikers. The signs direct travelers to nearby groceries, fresh pizza, or park areas using arrows and estimated walking times. While the signs are temporary, organizers hope to spur a change in perception of Nashua's streets, which are already developed in a pedestrian-friendly manner.[162] Initiatives such as this will be important to catalyzing the cultural shift needed to reduce VMT, and should be encouraged across the State.

New Hampshire DOT supports active transportation through their Bicycle and Pedestrian Transportation Advisory Committee, which promotes active transportation options around the state and advises the Department in the development of transportation plans.[163] The efforts of that group could be expanded through better coordination with local efforts such as those led by Local Energy Committees/Commissions.[164] LECs have been extremely successful at increasing efficiency and renewable energy in their communities,[165] and are increasingly turning their eye to transportation considerations. The State should ensure that all groups working on transportation initiatives are coordinating.

6.2 ALTERNATIVE FUEL AND ADVANCED TECHNOLOGY VEHICLES

Since New Hampshire has no in-state sources of fossil fuels, electric vehicles (EV) represent the best near-term option for increasing the State's energy independence as power generation shifts to locally produced clean energy. EVs help keep transportation energy dollars in state, reduce consumer costs overall, and benefit from low infrastructure costs relative to other alternative fuels, as they can use the existing electrical distribution system. Most EV charging is anticipated to be at the residences of EV owners, using overnight charging. However, in order to support use of these vehicles across the state and the region, fast-charging public sites will need to be established at reasonable intervals around the state. A program used by the Illinois Department of Commerce and Economic Opportunity to expand charging infrastructure offers rebates of up to 50% of the cost of installation of charging equipment at businesses.[166] New Hampshire should consider creating a similar incentive through a business tax credit. This could make it economically viable for businesses to install the charging stations and perhaps attract additional customers. At the same time, EV owners would have more options for charging their vehicles, reducing 'range anxiety' and helping increase adoption of EVs.

Charging EVs in NH

Expanding networks of charging locations will be vital to enabling further adoption of electric vehicles in New Hampshire and the region. Currently, 61 publicly available charging locations exist across the state. EV users can easily locate these stations using online tools such as the "Alternative Fueling Station Locator" provided by the U.S. Department of Energy, found at: http://www.afdc.energy.gov/locator/stations/

[162] http://www.nashuatelegraph.com/news/1039013-469/nashua-aims-to-give-more-power-to.html.
[163] http://www.nh.gov/dot/programs/bikeped/advisory-committee/index.htm.
[164] http://www.gencourt.state.nh.us/rsa/html/iii/38-d/38-d-mrg.htm.
[165] http://www.nhenergy.org/purpose--outcomes.html.
[166] http://pluginchicagometro.org/2013/08/il-provides-incentives-for-ev-chargers/.

Even with a robust infrastructure, the cost of purchasing EVs and in-home charging equipment can still present a barrier to ownership, and in many other states consumers are offered incentives to help overcome this. In Massachusetts, buyers can receive a rebate of $2,500 per vehicle, funded by RGGI.[167] Georgia offers 20% of the vehicle cost (up to $5,000) and 10% of the cost of charging infrastructure installation as a tax credit (up to $2,500).[168] While a tax credit would be difficult to implement in NH as the state does not have a personal income tax or sales tax on vehicles, New Hampshire could investigate using RGGI funds to provide rebates, and could ensure that charging infrastructure is exempt from the vehicle excise tax.

New Hampshire should also focus on expanding EVs in the State-owned fleet. Including EVs in the state fleet and investing in charging infrastructure would be a particularly effective area of leadership, as it is one of the most visible fleets in the state. Installation of charging infrastructure at State office complexes would promote use of EVs by State employees, the state's largest workforce. State fueling stations are also used by municipalities, so investing in this area would also encourage and enable cities and towns to move to EVs.

Gathering Momentum for Alternative Vehicle Fuels

Across New England, a number of public and private fleets have been incorporating fuels such as compressed natural gas (CNG), propane, and biodiesel into fleet vehicle fuel use. At the June 2014 "Green Your Fleet" Conference hosted by the Granite State Clean Cities Coalition (GSCCC), fleet managers reported significant cost savings through these changes. The largest obstacle is the need for initial infrastructural changes to fueling and maintenance docks and regional refueling locations. Planned increases in natural gas fueling infrastructure, including the recent opening of Clean Energy Fuels' public access CNG station in Pembroke, and a second station in Bow planned by another company, will increasingly support those fleets. Several national companies are also converting to CNG. For example, Waste Management is converting its fleet to natural gas and has opened 50 refueling stations, 22 of which are open to the public. These types of efforts should be monitored by the State and supported where appropriate. In particular, use of biodiesel produced with in-state resources should be encouraged.

A final step that can encourage EVs is for the state to ensure that New Hampshire consumers have access to alternative fuel vehicles. One strategy that has now been adopted by fourteen states, including all other states in New England, is adoption of the California Low and Zero Emission Vehicle standards (CA LEV and ZEV). California has led the nation in reducing tailpipe emissions from light duty vehicles, and their program can be adapted for implementation in other states. The Zero Emission Vehicle (ZEV) program requires manufacturers to earn a certain number of 'credits' through the sale of battery electric or fuel cell vehicles.[169] Adoption of the standard in New Hampshire would provide an incentive for automobile manufacturers to actively market higher efficiency vehicles here, as those vehicles would earn credits for manufacturers. In the absence of those incentives, manufacturers have been focusing their sales in other states, and it is difficult for New Hampshire consumers to test drive or find an EV to purchase without going out of state.

[167] http://cleantechnica.com/2014/03/31/massachusetts-plugs-into-electric-vehicle-incentives/.
[168] http://www.pluginamerica.org/incentives.
[169] http://www.c2es.org/us-states-regions/policy-maps/zev-program.

Recently, eight states nationwide signed a Memorandum of Understanding that establishes a target of 3.3 million ZEVs on the road in the eight states by 2025,[170] and a multi-state ZEV Action Plan to accomplish this was released in May 2014.[171] Joining in these multi-state efforts can help New Hampshire give our consumers greater choice, reduce transportation-related energy costs, and increase the health of our citizens by reducing local air toxics.

6.3 OPERATIONAL EFFICIENCY

While mass transit and electric vehicles will be important long term strategies, traditional fuel cars will continue to play a role in New Hampshire's transportation use for some time to come. Therefore, ensuring that the operation of those vehicles is as efficient as possible will be important. Reducing unnecessary idling is one simple, cost effective step to reduce fuel use. In addition to saving energy, reducing idling increases the life of a vehicle's engine, reduces maintenance costs, and provides important public health benefits by reducing exposure to harmful pollutants in vehicle exhaust.[172]

Idling Reduction Technology

Idling is particularly problematic for construction and safety vehicles. These vehicles must often leave their lights on for extended periods of time, and to avoid the risk of battery drain, operators leave the vehicles running. This results in significant waste, and governments around the country have begun looking for ways to reduce these costs. Promising technology has emerged that senses the vehicle's battery charge level and automatically turns the engine on and off as needed. In 2010, the City of Concord installed such devices on 10 of its vehicles. The City estimates that the devices will offset 3,000 gallons of fuel usage per year, saving over $10,000.

The State should install this technology in its vehicles where appropriate, and encourage municipalities to do the same.

The Department of Environmental Services (DES) has an existing Administrative Rule (Env-A 1100) that restricts the length of time that a vehicle may idle.[173] However, authority to enforce this rule lies only with DES and since limited resources often prevent DES from responding immediately, violations of the rule are rarely cited. While DES has undertaken an outreach campaign aimed at encouraging voluntary idling reduction,[174] idling restrictions would be far more effective if additional state and local entities had the authority to enforce them. The State should pass legislation to officially adopt anti-idling restrictions into statute and give enforcement authority to local law enforcement and other state agencies such as the Department of Safety or Fish and Game.

Idling can also be reduced through better traffic control management. During low traffic periods from late evening to early morning, vehicles often sit at red lights for a minute or more even though no one is coming from the other direction. Use of smart traffic controls and sensors can reduce this unnecessary idling. Reconfiguration of intersections, such as installing roundabouts for high volume, low speed intersections, can also reduce idle time. These strategies have already been implemented in some parts of the state, and should be pursued consistently.

[170] http://www.arb.ca.gov/newsrel/2013/8s_zev_mou.pdf.
[171] http://www.arb.ca.gov/newsrel/newsrelease.php?id=620.
[172] http://www.epa.gov/cleanschoolbus/antiidling.htm.
[173] http://des.nh.gov/organization/divisions/air/tsb/tps/msp/irc/categories/overview.htm.
[174] http://des.nh.gov/organization/divisions/air/tsb/tps/msp/irc/index.htm.

RECOMMENDED TRANSPORTATION STRATEGIES

Reducing energy usage in the transportation sector will help consumers save significantly on energy costs, as the costs for transportation fuels are forecast to rise the fastest in the coming decade (see Appendix A). The actions recommended here will help New Hampshire reduce reliance on imported fuels and improve our economy by retaining more energy dollars in state. These strategies also offer other important non-energy benefits, and should be considered through a number of lenses. For example, reducing VMT will reduce wear and tear on roads, helping the Department of Transportation meet its maintenance goals. Expanded mass transit and park & ride lots can also reduce costs for individuals and improve the flow of traffic.

Recommendation 14 - ENABLE AND ENCOURAGE ADOPTION OF PLUG-IN ELECTRIC VEHICLES

Electric vehicles are an important part of New Hampshire's strategy to reduce reliance on imported fuels as the electric mix shifts to local, renewable sources. They can provide cost savings to consumers as compared to traditional fuel vehicles, and with zero emissions they provide local air quality and health benefits.

Sub-Recommendation 14.A: CREATE A PLAN FOR CHARGING INFRASTRUCTURE DEVELOPMENT

Summary and Rationale: One of the largest barriers to widespread EV adoption is the lack of a charging infrastructure, as consumers are unwilling to purchase vehicles that can't travel where they need to go. In order to ensure widespread infrastructure, the State needs to develop a strategic plan to highlight key corridors for development in the short term, with the eventual goal of 100% coverage in the state. DES, OEP, and DOT should continue to work with the Transportation Climate Initiative and the New England Governors/Eastern Canadian Premiers to develop plans for EV charging infrastructure that will enable travel by EVs throughout the mid-Atlantic/Northeast/Eastern Canada region.

Design Considerations: While the plan's focus should be ensuring adequate *public* charging locations, the State should also be considering the impacts of *residential-level* installations. The increasing popularity of Level 3 fast-charging stations (which draw considerable power) could pose a problem for the electric grid; if even a few houses in a small neighborhood installed them, it could require distribution system upgrades. However, if the electric utilities were able to communicate with the vehicles and indicate preferential charging times, EVs could help provide important load smoothing functionality for the grid. The PUC and OEP should work with utilities to find ways to better communicate with EV owners and offer creative rate structures to enable this type of advanced functionality.

Sub-Recommendation 14.B: SUPPORT DEVELOPMENT OF EV CHARGING INFRASTRUCTURE

Summary and Rationale: Once priority locations are identified, the State will need to find ways to incent development in those locations. One way to do this is to create a program that offers tax credits for businesses that install public charging stations, with a bonus incentive for businesses located in priority areas. This approach has been used in other states and seen success, but other mechanisms could be examined as well.

Design Considerations: Business owners who choose to install charging infrastructure will need to decide whether and how to charge customers for use. The State (particularly the PUC and Department of Revenue Administration) will need to be a partner in this effort to ensure that charges are done in a manner that benefits both the businesses and customers.

Sub-Recommendation 14.C: INCREASE CONSUMER ACCESS TO LEVS AND ZEVS

Summary and Rationale: All other New England states, and a total of fourteen states across the country, have adopted the California Low Emission Vehicle (LEV) standards and Zero Emission Vehicle (ZEV) standards. These standards create an incentive for auto manufacturers to sell low and zero emission vehicles in participating states. The state should considering participating in these programs to ensure that New Hampshire consumers have access to alternative fuel vehicles, and can benefit from lower transportation costs and fewer transportation emissions.

Design Considerations: While providing additional vehicle choice to consumers will be an important step, real market transformation will also require building consumer confidence. The State needs to work with dealers to share information about the benefits of EVs. Consumers and dealers will need to be able to quickly find out where public charging locations exist,[175] any available rebates (such as the $7500 federal tax credit) should be well-publicized, and any special at-home electric rates that the utilities/PUC decide to offer should be clearly explained. Lessons can be taken from the surrounding states, which are ahead of New Hampshire on EV adoption.

Sub-Recommendation 14.D: STATE LEAD BY EXAMPLE IN TRANSPORTATION

Summary and Rationale: As the largest fleet in New Hampshire, State-owned vehicles represent a prime target for EV adoption, providing important leadership to other fleet owners as well as to consumers. State investment in charging stations can also make a significant contribution toward creating a widespread publicly available charging infrastructure. The State should create a target for plug-in electric vehicles in the fleet and install charging infrastructure at large State office complexes and appropriate park & ride lots, in partnership with private employers or institutions where possible.

Design Considerations: One challenge with buying EVs is that, although they can provide long-term cost savings, they have a higher up-front cost than a standard fuel vehicle. In order to ensure that the State sees maximum savings from EVs, the highest-usage vehicles should be targeted for replacement first. The State should also reexamine agency vehicle ownership policies, and look at creating a centralized fleet to reduce the overall number of vehicles and increase vehicle utilization rates. Such an effort has the potential to reduce costs while enabling the State to benefit from the newest, most efficient vehicles on a regular basis.

As with installation at businesses, the State will need to consider appropriate fees for use of State-owned charging stations by the public and employees in personal cars.

[175] The US Department of Energy already collects and publicizes charging station locations, and the state can simply make people aware of that resource: http://www.afdc.energy.gov/locator/stations/.

Recommendation 15 - IDENTIFY SUSTAINABLE TRANSPORTATION FUNDING MECHANISMS

Summary and Rationale: The state's current funding mechanisms for transportation do not support a modern transportation system that allows the state to benefit from new, more efficient technologies. For the last decade, short-term fixes have been used to keep the Department of Transportation operating.[176] Significant increases in the cost of materials—the cost of asphalt cement has increased by 460% over the past two decades – and national trends of long-term falling gas tax revenue have left the Department under-funded.[177] This challenge is being experienced by states around the country, and creative solutions such as per-mile usage policies[178] and Public-Private partnerships[179] are emerging. However, even with significant leveraging of private dollars, some level of public funds is needed to support a modern transportation system, and NH DOT's budget constraints are limiting the ability of the state to pursue grant opportunities (which require matching funds) and other creative funding partnerships, such as supporting local efforts to enhance transportation options. The end result is a slowing of New Hampshire's transition to a more modern, accessible, and affordable transportation system. The ability to implement many of this Strategy's transportation recommendations hinges upon the availability of sustainable funding, which makes addressing New Hampshire's funding challenges a key priority.

Design Considerations: One issue of particular importance, as vehicles become more efficient and the fleet shifts to EVs, is the adequacy of the gas tax as a source of revenue.[180] There are a number of alternative ways to provide funding for transportation,[181] and the State should review how other states have addressed funding issues and determine whether any of those approaches could work for New Hampshire.

Recommendation 16 - EXPAND AND COORDINATE MASS TRANSIT

Summary and Rationale: Expanding mass transit options, including local, inter-city, and regional bus lines, is a critical step in reducing VMT. It also helps to enable the life style choices preferred by young workers and students, and provides mobility to the state's older residents. More robust mass transit can also allow visitors to move around the state without relying on a car, which could appeal to tourists, especially international visitors.

In the short term, mass transit options will continue to be advanced by private companies, which can present a coordination challenge for riders. The State can help build awareness of and demand for transit by requiring all operators that benefit from state or pass-through federal funds to adopt the General Transit Feed Specification. This open-access software tool enables potential riders to see transit options on services such as Google Maps and enhances the ability of private operators to coordinate routes and schedules between their services.

[176] http://www.nh.gov/dot/media/documents/newsletter-spring2014.pdf.
[177] http://www.nh.gov/dot/org/commissioner/documents/roads-to-nh-future.pdf.
[178] http://www.fhwa.dot.gov/ipd/revenue/road_pricing/defined/vmt.aspx.
[179] http://www.fhwa.dot.gov/ipd/p3/defined/.
[180] http://itep.org/itep_reports/2013/09/a-federal-gas-tax-for-the-future.php.
[181] http://www.transportationinvestment.org/wp-content/uploads/2014/01/State-Transportation-Funding-Mechanisms.pdf.

Design Considerations: Although mass transit in the state is expected to be largely privately operated, public funding is often necessary for start-up. As described above, in the absence of that public funding, the state misses the opportunity to leverage available private funds, delaying our ability to realize the benefits of reducing congestion and pollution and helping residents and businesses save time and money.

Recommendation 17 - SUPPORT EFFORTS TO MAINTAIN & EXPAND RAIL USE

Summary and Rationale: Rail is one of the most efficient methods of transportation, using significantly less fuel per mile than alternatives such as long-haul trucking and individual passenger vehicles. Additionally, rail can significantly improve quality of life for commuters and boost local economic activity. Recent studies have shown that the NH Capitol Corridor is the only rail corridor in the country with a population of at least 500,000 that does not have a commuter rail. The State should continue supporting efforts to bring additional rail to New Hampshire's commuters. In addition, the State should continue to acquire and hold abandoned rail lines for use as either future rail or to support active transportation options.

Design Considerations: Rail has historically been a challenge for the state, as the up-front costs are considerable. However, rail needs to be considered as part of an overall transportation system; many local communities have already recognized this and efforts are underway.

Recommendation 18 - EXPAND RIDE-SHARE PROGRAMS AND PARK & RIDE OPTIONS

Summary and Rationale: With New Hampshire's rural character, mass transit will not be able to serve every community. However, residents can travel to nearby park & ride lots to engage in carpooling. Expanded park & ride options in New Hampshire have the potential to reduce a significant amount of single occupant vehicle trips. The state should re-institute the Department of Transportation's Ride Share Coordinator position and develop a plan for creating additional park & ride locations.

Design Considerations: The state should investigate ways to coordinate New Hampshire's ride-share program with those in neighboring states. Today each of the New England states use different, incompatible software for their ride share programs. Pooling resources to purchase a single software platform could save each state money and make it easier for commuters to connect.

In establishing new park & ride lots, the state should look for ways to leverage private funding, such as the Public-Private partnership models that have been successful in other states.[182] Nearby businesses can often benefit from the establishment of a park & ride and may be willing to share in the investment.

[182] http://www.fhwa.dot.gov/ipd/project_profiles/.

Recommendation 19 - ENABLE ACTIVE TRANSPORTATION THROUGH COMMUNITY PLANNING

Summary and Rationale: Designing communities in a way that encourages biking and walking (Complete Streets policy) and enables transit will be important for meeting energy goals and retaining young people who increasingly express a preference for walkable communities, short commutes, and public transportation options. It will also help communities meet the needs of an aging population who may find themselves house-bound in the absence of such options, and can increase health overall for the state's population.[183] The State can support communities in these efforts by sharing model zoning ordinances with planning staff and incorporating Complete Streets design in state transportation projects. Local Energy Committees should also be encouraged to consider transportation issues.

Design Considerations: The change needed to create these types of mixed-use communities will, in many cases, be significant and occur over time. These efforts will require sustained support along with a clearly defined long-term plan. Modification of the state's existing Smart Growth statute (RSA 9-B) to include the use of a Complete Streets approach could be one way to institutionalize support for such efforts. Regional Planning Commissions (RPCs) and state agencies are also key partners in this effort and should help ensure that various groups working on transportation are coordinating.

Recommendation 20 - REDUCE UNNECESSARY IDLING

Fuel used on vehicle idling does not contribute to the movement of people or goods. Reducing this waste is a simple and immediate way to reduce NH's dependence on imported fuel, and to decrease costs for consumers, businesses, and state and local government. Reducing idling also has important air quality and health benefits, particularly around institutions where vulnerable populations reside such as schools, hospitals, and nursing homes.

Sub-Recommendation 20.A: INCREASE EDUCATION, OUTREACH, & ENFORCEMENT

Summary and Rationale: The State should adopt legislation that would establish state vehicle idling limits that could be enforced by state and local law enforcement officers, who are the most likely to encounter it.

Design Considerations: Targeting highly-visible areas such as school drop off zones, public building parking areas, shopping areas, and health care facilities can be a way to increase awareness while limiting the time required for enforcement. The State should also publicize technologies that exist for use by vehicles that have a need to idle, such as refrigerated trucks, and police, fire, and rescue vehicles. Some of these technologies have been tested in New Hampshire and lessons learned should be shared.

Additionally, legislation should give consideration to the need for exemptions for safety reasons, such as during extremely cold or hot weather, and for vulnerable populations (such as the young and elderly).

[183] http://switchboard.nrdc.org/blogs/kbenfield/data_summaries_show_walkable_c.html.

Sub-Recommendation 20.B: ENCOURAGE USE OF SMART TRAFFIC CONTROLS

Summary and Rationale: Traffic signal synchronization and the use of software that allows blinking or quick cycle lights during low traffic hours can reduce wait times and limit vehicle idling. Other intersection controls, such as roundabouts, can allow traffic to flow more smoothly, reducing fuel use as compared to stop-and-go driving. This can also result in quality of life benefits due to reduction of traffic congestion, wait times, and pollution.

Design Considerations: Each intersection is different and a "one size fits all" approach is not appropriate. DOT and OEP should provide technical assistance to Regional Planning Commissions and municipalities to ensure that they are using these tools appropriately.

7 CONCLUSION

While this Energy Strategy is organized into four chapters, the increasingly interrelated nature of our energy systems requires comprehensive planning across sectors. For example, modernizing our electric grid directly affects our ability to expand distributed generation, increase electrification of vehicles, and benefit more from energy efficiency savings. Our regulatory models will need to adapt to this energy future.

Additionally, we note that many of the recommendations in this Strategy are not new; some have been made more than once over the last decade, but we have not yet taken the steps to implement them. For New Hampshire to become more efficient, increase economic activity, and maintain our high quality of life, we must move from recommendations to action. It is our hope that when we update this Strategy in three years we are well on our way to implementing these recommendations. Action on these building blocks is necessary in order for us to be able to consider other, more innovative approaches as they emerge.

For Appendices, please visit the OEP website:
http://www.nh.gov/oep/energy/programs/SB191.htm

Appendices A-C: Baseline Forecast, Energy Vision & Resource Potential

Appendix D: Energy Facility Siting in NH

Appendix E: Public Comments