New Hampshire 10-Year State Energy Strategy

New Hampshire Department of Energy
July 2022

Acronyms

Alternative Compliance Payment	ACP
Bureau of Ocean Energy Management	BOEM
Community Power Aggregation	CPA
Distributed Energy Resources	DER
Distributed Generation	DG
Demand Response	DR
Energy Efficiency	EE
Energy Efficiency Resource Standard	EERS
Energy Information Administration	EIA
Electric Vehicle	EV
Federal Energy Regulatory Commission	FERC
Forward Clean Energy Market	FCEM
Gigawatt Hour	GWh
Independent System Operator New England	ISO-NE
Infrastructure Investment and Jobs Act	IIJA
Kilowatt	kW
Kilowatt Hour	kWh
Levelized Cost of Electricity	LCOE
Megawatt	MW
Megawatt Hour	MWh
Miles Per Hour	MPH
Minimum Offer Price Rule	MOPR
New England Power Pool	NEPOOL
New England States Committee on Electricity	NESCOE
New Hampshire Department of Energy	NHDOE
Office of Energy and Planning	OEP
Office of Strategic Initiatives	OSI
Photovoltaic	PV
Power Purchase Agreement	PPA
Public Utilities Commission	PUC
Renewable Energy Credit	REC
Renewable Portfolio Standard	RPS
Renewable Natural Gas	RNG
Revised Statutes Annotated	RSA
Site Evaluation Committee	SEC

Preface

This document identifies strategic goals and recommends policy and program actions to support those goals. The State Energy Strategy is designed to focus on the most critical energy issues facing New Hampshire. In doing so, the intent is to establish a framework for engaging on these issues by identifying guiding principles that will steer the development and evolution of energy policies.

The broadest objective of this document is to provide a platform to improve energy policies and programs to best serve New Hampshire's needs. Better informed decisions regarding New Hampshire's energy future will result from the goals of the State Energy Strategy and the discussion of the issues in each section.

Previous versions of this Strategy reflected a step in the ongoing development of a New Hampshire energy policy; this update is another step in that ongoing development.

Outcomes of this Strategy will enable business and consumer cost savings, job creation, economic growth, industry competitiveness, environmental protection, and a reliable and resilient energy system.

As part of the biennial budget process, in 2021 the Governor and NH General Court created the New Hampshire Department of Energy (NHDOE) in House Bill 2[1]. The Budget maintained the adjudicative functions of utility regulation at the Public Utilities Commission (PUC), transferred the remaining functions to NHDOE as well as the energy-related functions of the Office of Strategic Initiatives (OSI), which was dissolved. The NHDOE was tasked with providing "…unified direction of policies, programs, and personnel in the field of energy and utilities, making possible increased efficiency and economies from integrated administration and operation of the various energy and utility related functions of the state government."[2]

To produce this update to the State Energy Strategy, the OSI solicited written commentary and reached out to numerous stakeholders. With the passage of HB 2 (2021) in July 2021, OSI's energy functions and staff were transferred to the newly created NHDOE. NHDOE continued the work begun by OSI to complete this updated Strategy. Due to the COVID-19 pandemic, OSI was unable to convene any public comment sessions, as had been done for prior updates, but did solicit written public comment, which is posted on the NHDOE's website.

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[1] New Hampshire General Court. "relative to state fees, funds, revenues, and expenditures." HB 2-FN-A-LOCAL, 2021.
[2] New Hampshire General Court. "Establishment; Purpose." RSA 12-P:2, II, 2021.

NHDOE expects that this Strategy will continue to be adapted as technology, energy markets, and policy goals evolve over the coming years.

Legislative Charge

RSA 4:E directed the Office of Energy and Planning (OEP), in consultation with a State Energy Advisory Council, to develop a 10-Year State Energy Strategy for the state.[3] The statute also called for updates to the Strategy every three years, beginning in 2017, with opportunity for public commentary and consultation with the House Science, Technology, and Energy Committee and the Senate Energy and Natural Resources Committee.[4] NHDOE assumed the responsibility to update the 10-Year State Energy Strategy under RSA 12-P:7-a.[5]

Stakeholders

Energy policy impacts everyone in New Hampshire. This Strategy should reflect the diversity of needs across the state and seeks to do so by appreciating the interests of distinct stakeholders.

Data and COVID-19:

This strategy relies on the most recently available data, however there are some instances when using more recent data would produce an inaccurate portrayal of the current situation and lead to incorrect conclusions. An example is the effects of the COVID-19 pandemic. In those cases, data from 2019 is used instead.

Disclaimer

The energy goals listed in this strategy are not numbered by policy preference or priority. The energy goals are intended to work in conjunction with each other. Numbering the goals is solely a means of labelling and <u>not</u> prioritization.

Executive Summary

New Hampshire's energy prices are among the highest in the nation.[6] In 2019, on average, each state resident spent $4,078 on energy.[7] Low-income households and minority communities in

[3] New Hampshire General Court. "State Energy Strategy." Revised Statutes Annotated 4-E, 2013.
[4] New Hampshire General Court. "Establishing a state energy strategy." SB 191-FN-A, 2013.
[5] New Hampshire General Court. "State Energy Strategy." Revised Statutes Annotated 12-P:7-a, 2021.
[6] U.S. Energy Information Administration. "New Hampshire State Profile and Energy Estimates." Profile Analysis, U.S. Energy Information Administration, 2021.
[7] U.S. Energy Information Administration. "State Energy Price and Expenditure Estimates, 1970 Through 2019." U.S. Energy Information Administration, June 2021. 19.

particular face disproportionally high energy burdens.[8] Commercial and industrial consumers in New Hampshire purchased more than half of all retail electricity sales in 2021, and the high cost can make competition harder against businesses located in lower-cost regions of the country.[9]

Addressing energy costs is a critical goal for New Hampshire. Expensive energy – or pursuing policies that raise the cost of energy – directly and negatively impacts New Hampshire families and businesses and the quality of life in our state. As such, the priority of this Strategy is to organize goals around cost-effective energy policies.

However, there are numerous goals that should be pursued to improve state energy policy to better meet consumer needs. These goals are:

1. Prioritize cost-effective energy policies.
2. Ensure a secure, reliable, and resilient energy system.
3. Adopt all-resource energy strategies and minimize government barriers to innovation.
4. Achieve cost-effective energy savings.
5. Achieve environmental protection that is cost-effective and enables economic growth.
6. Government intervention in energy markets should be limited, justifiable, and technology-neutral.
7. Support a robust, market-selection of cost-effective energy resources.
8. Generate in-state economic activity without reliance on permanent subsidization of energy.
9. Protect New Hampshire's interests in regional energy matters.
10. Ensure that appropriate energy infrastructure is able to be sited while incorporating input and guidance from stakeholders.

Outcomes of this strategy will enable business and consumer cost savings, job creation, economic growth, industry competitiveness, environmental protection, and a reliable and resilient energy system.

This strategy identifies goals and recommends policy and program actions to support said goals. It updates and expands upon the 2018 State Energy Strategy to reflect changes in the energy landscape and advancement of technologies over the past few years. This document, too, will need to be updated to reflect future developments.

This Strategy is not intended to be an exhaustive policy overview. It is designed to highlight policy goals that are to the point and effective in focusing discussion on the most critical energy

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[8] Drehobl, Ariel, and Roxana Ayala. "How High are Household Energy Burdens?" American Council for an Energy-Efficient Economy, 2020.
[9] U.S. Energy Information Administration. "Electric Power Monthly with Data for December 2021." U.S. Energy Information Administration, February 2022, 135.

issues facing New Hampshire. In doing so, the intent is to establish a framework for policymakers and stakeholders to engage on these issues by identifying guiding principles that will steer the development and evolution of energy policies.

Section Summaries

Energy Overview

New Hampshire faces increased energy costs for many reasons. Among these include the policy preferences of neighboring states seeking above-market-cost energy resources, lack of supply for low-cost resources, uncertainty in national and international markets, inadequate infrastructure, and geographic realities. These challenges contribute to an environment that has and continues to make low energy costs an elusive goal. Without a paradigm shift in public policy, New Hampshire is unlikely to see lower energy costs rates in the short or long term.

New Hampshire’s energy system does not exist in a vacuum. New Hampshire is connected to our neighboring New England States through a regional electric grid, run by ISO New England (ISO-NE). ISO-NE is a non-profit organization with a three-part mandate to operate the grid, administer the wholesale market, and plan for future electricity needs. As a part of this ISO-NE managed grid, New Hampshire participates and shares its policy views on regional electricity issues as part of the New England States Committee on Electricity (NESCOE). NESCOE represents the six New England states in electricity matters and New Hampshire shares decision-making authority with our regional neighbors through the New England Power Pool (NEPOOL) stakeholder process and at the Federal Energy Regulatory Commission (FERC). New Hampshire is also responsible for shared regional electricity costs. Regional policy reforms are necessary if New Hampshire is to avoid increasing electricity costs.

Every aspect of New England’s electricity rates is costly. The main components that make up the cost of electricity are generation, transmission, and distribution and each is more expensive in New England than the US average as seen in Figure E1.

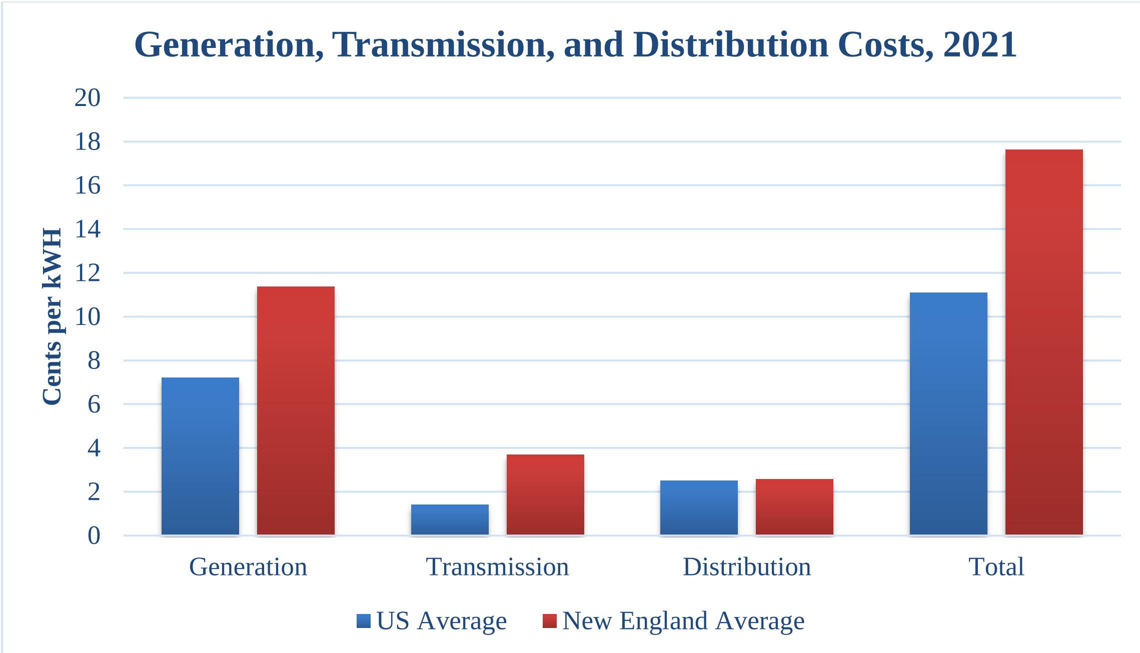

Figure E1

Source: [EIA Annual Energy Outlook 2022, reference case tables 54 and 54.7]

Fuel Diversity

New Hampshire will be best served by fostering technologies and solutions that are tailored to our state's needs. Having a diverse resource mix can help ensure a secure, reliable, and resilient energy system.

Investments and policies should prioritize the most cost-effective energy production and delivery. New Hampshire can foster a sustainable and dynamic energy economy by ensuring a favorable regulatory environment, not a regulatory and statutory environment based on favoritism. Resources should compete in the market, not compete for government policy preferences. Competitive markets should steer those investments, not government sponsorship. The end goal with energy infrastructure should be unaided market competition where the technology competes on its own specific attributes and costs, not one that depends on taxpayer or ratepayer support.

Renewables have a critical and growing role to play in our resource mix, but it is important to remember that the effectiveness of each renewable energy source depends on the environmental and economic conditions of the region in which it is deployed. New Hampshire energy policy should not seek to mimic neighboring state renewable energy policies. Instead, New Hampshire should seek the most appropriate investments and goals given our state's geographic location, environmental considerations, land use requirements, and need to deliver cost-effective energy.

Delivering cost-effective electricity to consumers means measuring the economic lifespan of an existing resource and its ability to deliver value to the market through competitive pricing rather than through government mandate. In fact, it is a well-established tenet of regulatory economics that regulation should emulate competitive market outcomes where possible.[10] Natural gas and renewables will likely make up an increasingly sizeable fraction of New Hampshire's fuel mix into the future. To achieve cost-effective energy delivered to consumers, state policy should encourage the siting and construction of new generating assets that have a low levelized cost of electricity (LCOE).[11]

Electricity Generation

Nuclear Power

It is essential that New Hampshire's energy strategy recognize the many attributes of nuclear power and its role in the New England grid so that its economic lifespan is not artificially shortened by state or regional policy decisions. In the near term, it is likely that New England's carbon emissions would increase significantly if the plant were to stop generating. Preserving Seabrook Station as a source of zero-carbon electricity generation is the most realistic and cost-effective means of managing emissions in New Hampshire at scale. Nuclear generation should be allowed to compete fairly and without unwarranted constraints in New England's wholesale markets thereby contributing to a market-driven, cost-effective resource important to New Hampshire's environmental goals and policy frameworks.

Natural Gas

State and regional electricity reliability is tightly connected to natural gas markets and availability. New Hampshire's energy policy must be realistic about the necessity of natural gas into the foreseeable future while ensuring that infrastructure projects or expansions protect our natural resources. United States carbon dioxide emissions have fallen to the levels of the early 1990s largely due to the market driven replacement of coal and oil by natural gas.[12] However, it

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[10] In his classic text on regulation, Alfred Kahn stated, "the single most widely accepted rule for the governance of he regulated industries is regulate them in such a way as to produce the same results as would be produced by effective competition, if it were feasible."

[11] The levelized cost of electricity (LCOE) represents "the per megawatt-hour cost (in discounted real dollars) of building and operating a generating plant over an assumed financial life and duty cycle." U.S. Energy Information Administration, March 2018. "Levelized Cost of Electricity and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook." New Hampshire stakeholders should seek to limit reciprocal harm. For example, if electricity demand were steadily increasing, it would make sense to encourage investments furthering long-term policy aims where no reciprocal harm would be inflicted on current investments. However, as demand is flat or potentially falling, introducing new resources into the mix (beyond the rate of retirement) by mandate means that existing resources will face increased competitive pressure. It contradicts the principle of conservation and full-resource-utilization for government to subsidize a more costly resource such that it is rendered economic where that competition then puts another, unsubsidized, less costly, resource out of business.

[12] U.S. Energy Information Administration. "U.S. Energy-Related Carbon Dioxide Emissions, 2020." U.S. Energy Information Administration, December 2021.

is essential that any infrastructure improvements or expansions fit with New Hampshire values and needs. New Hampshire must answer the questions of what resources and infrastructure will best serve its citizens, enhance its economy, and protect its natural resources.

Renewable Energy

Renewable energy will continue to grow as a percentage of total electricity generation in New England. In past years, federal and state energy and tax policies, not competitive markets, were the primary drivers of the construction of renewable resources in New England. Historically, the growth in renewable energy has been largely driven by preferable tax treatment, subsidies, and government mandated preferences. While those policies still have a major and often decisive impact, technological advancements have rapidly reduced the cost of some renewables to the point that they are cost competitive without additional government supports.

Lazard's national assessment shows that certain forms of solar and wind are cost competitive with conventional generation technologies in certain situations.[13] While there is currently greater potential for cost-effective wind generation in New Hampshire than for solar, a buildout of that technology sufficient to surpass the generation of other renewables would necessitate extensive land use and stakeholder input concerning the impact on our state's scenery and natural resources.

Offshore wind development, while still facing some of the same challenges as land-based wind development in terms of impacts to natural resources, shows potential for New Hampshire. The Gulf of Maine has some of the highest consistent offshore wind speeds in the nation, making it an ideal site for offshore wind development.

Battery Storage

Battery storage is a growing part of the energy infrastructure of the region. In 2021, for the first time, ISO-NE accepted two battery facilities in the forward capacity market, meaning those facilities can be relied upon in the future for electricity output on demand.[14] Large scale electricity storage offers promise for improving the integration and utility of intermittent resources, such as solar and wind, but will not of itself make those resources cost-effective from a market-based standpoint. Utility scale and distributed storage also has the potential to lower electricity costs by flattening or eliminating peaks in demand. Charging during periods of low demand and discharging during demand peaks could replace costly and carbon intensive peaking plants, a benefit to customers as well as to the environment.

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[13] Lazard. "Lazard's Levelized Cost of Energy Analysis – Version 15.0." Lazard, October 2021.

[14] Spector, Julian. "Plus Power Breaks Open Market for Massive Batteries in New England." Greentech Media, February 11, 2021.

Distributed energy resources (DERs)

DERs represent a growing segment of the energy generation and delivery business that can provide on a local level the same or similar electricity services historically provided by large scale, vertically integrated utilities. The Distributed Generation (DG) resources may be from fossil fuels, renewable resources such as solar, battery storage as well as energy efficiency and demand response, or a combination of them. They represent a shift from a utility-dominated and large centralized system to a diffuse, smaller-scale generation/distribution infrastructure design. The integration and control of numerous DERs presents challenges but also opportunities. The key to long-term DER success is a thorough planning environment with a robust, fair and transparent set of guidelines and standards that will enhance reliability, improve customer satisfaction and lower emissions while providing a stable investment policy to all stakeholders, and avoid cost-shifting among ratepayers.

Renewable Portfolio Standard (RPS)

The RPS framework depends on mandates that segment renewable technologies from each other and from the broader competitive electricity market. If reducing emissions is a primary objective, then in order to have conceptual consistency, the RPS should be redefined to include other zero-carbon or low-carbon resources. If the goal is to pursue the most cost-effective low-carbon options, then segmenting electricity generation technology types thwarts that outcome. Using an infinitely replenishable fuel is only one component of sustainable electricity production. A sound RPS should include competition among generation technology types and include other low carbon resources to pursue the most cost-effective options.

Heating

Heating represents a substantive portion of every household and business budget during winter months. More than 80% of New Hampshire homes are heated by either propane, oil, or natural gas. The remaining balance is made up of electricity, wood, heat pumps, solar, and coal.[15] Efforts to reduce carbon emissions will likely include an increased use in wood, renewable natural gas (RNG), and heat pumps as replacement sources. Replacement of heating systems is an enormous cost to homeowners and business owners. State and local policies should not force early, uneconomic replacement of these systems, or unreasonably interfere with a home or business owner’s choice in fuel source.

[15] United States Census Bureau. “2019 American Community Survey – Table B25040 (Home Heating Fuel)." U.S. Census Bureau.

Transportation

Transportation accounts for just under a third of the total end use of energy in New Hampshire,[16] with gasoline and diesel as the primary fuel source. Propane and natural gas-powered vehicles are growing in popularity as a less carbon intensive replacement for diesel, especially for fleet vehicles, such as delivery vehicles and school busses.

Since the 2018 State Energy Strategy update, there has been a significant increase in the widespread adoption of electric vehicles (EVs). With the urging of the Federal government, American car manufacturers have committed that by 2030, EVs will make up between 40% and 50% of new sales.[17] European and other foreign manufacturers have committed to similar targets. New Hampshire is set to receive roughly $17 million over the next five years for the build out of EV charging infrastructure. Rising gas and diesel prices have also spurred greater consumer interest in EVs. All of these factors will lead to an accelerating percentage of EVs in use across the region and the state.

Demand Side Resources

Energy Efficiency

Energy efficiency (EE) is often the cheapest and cleanest energy resource. New Hampshire should prioritize capturing cost-effective energy efficiency in all sectors, including buildings, manufacturing, and transportation, to achieve savings for the benefit of individuals, businesses, and institutions statewide.

With the passage of HB 549 (2022), the Governor and the General Court restored the state's EE programs This bill sets the rates to fund state-level EE efforts and restores certain elements of the Energy Efficiency Resource Standard (EERS) framework into the new State Energy Efficiency Planning Program. Additionally, the recent passage of the Infrastructure Investment and Jobs Act (IIJA) allocates additional funding to weatherization and other EE efforts.

Electric Generation and Transmission

Demand Response

Demand Response (DR) is a method of incentivizing electricity users to reduce power use during specific peak periods when electricity is most expensive. Demand response takes two forms: passive demand response and active demand response. Passive demand response is essentially

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[16] U.S. Energy Information Administration. "New Hampshire State Profile and Energy Estimates." Profile Overview, U.S. Energy Information Administration, August 2021.

[17] Krisher, Tom, and Aamer Madhani. "US automakers pledge huge increase in electric vehicles." Associated Press, August 5, 2021.

energy efficiency measures undertaken by end users, such as LED bulbs, weatherization, and updated heating and cooling systems. Active demand response involves a suite of services that encourage an immediate reduction in peak load through price incentives, either offered by ISO-NE or through the distribution utility.[18] The development of new rate structures and programs that economically integrate demand response resources represents a successful growth of competitive markets, and as opposed to state action, is the most cost-effective mechanism to incentivize demand response adoption.

Heating

Weatherization of buildings is a common sense and cost-effective way of reducing energy consumption in homes and businesses, improving comfort, saving money, and reducing carbon emissions. Programs such as NHSaves and the Department of Energy's Weatherization Assistance Program assist homeowners by defraying the costs of those upgrades.

Increasing zoning density would increase energy efficiency for both heating and transportation as well as reduce demand. Increased density also makes for neighborhoods where it is possible to live, work, and shop all within a small area, increasing the viability of public transit and encouraging self-propelled means of transportation such as walking and cycling.

Transportation

New Hampshire does not require a wholesale rethinking of transportation infrastructure to achieve energy efficiency gains**.** Reducing the energy intensity of transportation activities, without discouraging the activities themselves, is paramount. It is important to protect consumer-preferred forms of transportation while lowering the energy intensity of travel.

Energy use largely reflects infrastructure availability. These capital-intensive investments shape energy use patterns for decades. The most effective near-term energy management strategy for the state is to utilize existing infrastructure efficiently and fully. Maximizing infrastructure utilization improves efficiency while helping reduce environmental impacts.

It is unlikely that large public transit infrastructure projects will deliver energy efficient transportation for New Hampshire travelers due to low ridership. Cost-shifting to support legacy infrastructure does not adequately incentivize the utilization of that infrastructure.

Personal Vehicles

Personal vehicles are by far the dominant transportation mode in New Hampshire and nationally. While most of the ability to improve transportation efficiency lies with vehicle manufacturers,

[18] ISO-New England. "About Demand Resources." Holyoke, MA: ISO-New England, 2022.

there are a number of actions the state and municipalities can make to reduce idling times, reduce congestion, and ultimately reduce the amount of wasted energy, such as improving traffic signals, installing additional roundabouts, moving forward with all electronic tolling on the state turnpike system, and making sure that infrastructure exists for non-motorized transportation, such as biking and walking.

Mass Transit:
There are certain concentrated areas of New Hampshire that can benefit from mass transit, and many more areas where mass transit is not an economically advantageous method of providing transportation. Mere availability of mass transit is not beneficial to New Hampshire--utilization and cost-effectiveness should determine where and when mass transit modes are merited and necessary.

Freight Rail
Shipping by rail is one of the most energy efficient ways to move goods and raw materials. Only one gallon of diesel fuel is needed to move a ton of freight 480 miles at between 25% and 33% of the carbon emissions of trucking. Though handling 40% of all freight volume, rail only accounts for 1.9% of all transportation carbon emissions.[19] Further utilizing rail to transport freight in the state would reduce carbon emissions, reduce truck traffic on the roads, and reduce the energy expended on moving goods. However, there are significant capital costs involved to rehabilitate and restore existing rail corridors.

Siting

Electric Generation and Transmission

Siting electricity infrastructure is both challenging and necessary. Delivering appropriate electric infrastructure requires predictability, defined processes, good communication, and clear standards for achievement. Responding to these issues is difficult and requires balancing numerous interests but does not remove the necessity of siting appropriate electric infrastructure to meet New Hampshire's needs.

There is usually a tension between residents' understanding the justification for infrastructure development and the reality that it may be built in proximity to one's home, workplace, or community. Shifts in demand and the ability of technologies to deliver on market needs will continue to evolve, and there will be corresponding pressures on land use.

[19] Association of American Railroads. "Freight Railroads & Climate Change." Association of American Railroads, March 2021.

In addition, some renewable technologies, such as on-shore wind, tend to be highly dependent on location; however, the best sites may not be near existing load centers or transmission lines. As additional renewables are brought online, there will be the need to site additional transmission lines to bring electricity onto the grid or to site large scale backup power systems.

Much of the siting for electric generation and transmission resources falls to the state's Site Evaluation Committee (SEC). The SEC's goals to promptly and thoroughly review siting proposals remain critical, but the current SEC process has a burdensome structure and needs to be streamlined to ensure a more effective regulatory siting structure. Reforming the SEC process will provide a more efficient, timely, yet thorough siting review that protects New Hampshire's values, does not cause undue harm to the state's economy, and balances broader public benefits with individual or community burdens.

Home Heating

Unlike electric infrastructure siting, home heating siting is largely confined within one's home and not subject to state or local oversight beyond meeting basic safety requirements. However, with new technologies available as home heating sources, it is critical that the state and municipalities do not put unreasonable regulations in place that stymie the adoption of lower cost heating systems.

In addition, as new technologies come to market, there will be the associated infrastructure within communities needed to support these systems. Preventing these businesses from operating is the functional equivalent of a ban, so state and municipalities should not put unreasonable regulations around the siting and operations of the associated infrastructure for these systems.

Transportation

New Hampshire has long established rights-of-way for transportation and for the most part, new transportation infrastructure is the rebuilding or expansion within existing rights-of-way. The proposed 10-Year Highway Plan as currently drafted does not include any major 'green field' projects. However, with highway vehicle miles projected to climb over the next decade, it is not sustainable long-term to scale highways directly proportional to the number of vehicles traveling them. Commuter travel is significantly impacted by land use policies and the availability of housing to workplaces. The long-term impact of the COVID-19 pandemic on commuting patterns remains uncertain.

Rather than the siting for physical infrastructure for transportation, a potential challenge will be the siting of infrastructure to facilitate new energy sources for transportation, or the revitalization of infrequently used rights-of-way, such as rail lines, for greater use. In their filing with the

Surface Transportation Board for their acquisition of Pan Am Railways, CSX Transportation has stated they do not anticipate discontinuing or abandoning any lines and plan to invest substantial sums into the entire system, bringing mainline track speed up from 10 MPH to 25 MPH.[20] Increased rail traffic will result in additional noise and interactions at grade crossings. State and municipal regulations must strike the right balance between the quality-of-life issues raised by people living near railroad lines with increased use and allowing freight rail to grow in the state.

[20] LaRocca, Anthony, Peter Denton, and Sally Mordi for CSX Corportation and CSX Transportation, Inc. "Amended and Supplemented Application." 36, 48. In U.S. Surface Transportation Board Docket. No. FD 36472, *CSX Corporation and CSX Transportation, Inc. – Control and Merger – Pan Am Systems, Inc., Pan Am Railways, Inc., Boston and Maine Corporation, et al.*, dated July 1, 2021.

Section 1: Energy Policy Goals

This section identifies major energy policy goals to establish a framework for pursuing policy mechanisms. The purpose of this section is not to describe a singular statutory and regulatory outcome, but to describe critical goals such that they can be discussed and implemented.

Goals

1. Prioritize cost-effective energy policies.
2. Ensure a secure, reliable, and resilient energy system.
3. Adopt all-resource energy strategies and minimize government barriers to innovation.
4. Achieve cost-effective energy savings.
5. Achieve environmental protection that is cost-effective and enables economic growth.
6. Government intervention in energy markets should be limited, justifiable, and technology-neutral.
7. Support a robust, market-selection of cost-effective energy resources.
8. Generate in-state economic activity without reliance on permanent subsidization of energy.
9. Protect New Hampshire's interests in regional energy matters.
10. Ensure that appropriate energy infrastructure is able to be sited while incorporating input and guidance from stakeholders.

Goal 1: Prioritize cost-effective energy policies.

New Hampshire has the fifth-highest average electricity retail prices among the Lower 48 states.[21]

In 2019, New Hampshire spent $4,078 per resident on energy, nearly 9.5% higher than the national average.[22] The cost of energy has a disproportionate impact on lower wage-earners, who often spend more than a third of their income on purchasing energy.[23] Commercial and industrial consumers in New Hampshire purchased nearly two-thirds of all retail electricity sales, and the high cost can make competition more difficult for New Hampshire businesses that compete with companies located in lower-cost regions of the country.

Addressing energy costs is a critical goal for New Hampshire. Expensive energy--or pursuing policies that raise the cost of energy--directly and negatively impacts New Hampshire families and businesses and the quality of life in our state. As such, the primary goal of this Strategy is to

[21] U.S. Energy Information Administration. "New Hampshire State Profile and Energy Estimates." Profile Analysis.
[22] U.S. Energy Information Administration. "State Energy Price and Expenditure Estimates, 1970 Through 2019."
[23] Drehobl and Ayala, "How High are Household Energy Burdens?"

pursue cost-effective energy policies which is even more important in this time of record energy prices and high inflation.

Goal 2: Ensure a secure, reliable, and resilient energy system.

As important as a lower cost, cleaner energy future is to New Hampshire businesses and households, it is imperative New Hampshire and the region doesn't sacrifice security and reliability along the way to a more decentralized, customer-focused energy system. The more digitized, decentralized, and reliant upon renewable intermittent resources the grid becomes, the more challenging it will be to operationally meet resource adequacy criteria. Robust planning is more critical now than ever. Greater recognition and coordination of the interactions between the distribution and transmission/wholesale systems is needed going forward both from an operational and planning perspective.

Goal 3: Adopt all-resource energy strategies and minimize government barriers to innovation.

No single energy resource will solve New Hampshire's energy challenges. Some resources are plentiful but expensive, while others are cheap but pose logistical or technical challenges that limit applications or usefulness. What is certain is that the mix of energy resources upon which New Hampshire relies will continue to evolve over time.

Government policies should be technology-neutral to enable the cultivation of cost-competitive resources. Public policymakers and regulators should not discriminate on the basis of technology when pursuing cost-effective energy. Energy policy should not seek to artificially preserve incumbent technologies, nor should it artificially create a market share for new technologies. In addition, government policies, both state and local should not impose unreasonable regulation on the siting or installation of new technologies and the necessary support infrastructure to construct, service and maintain them.

While some states may attempt to drive innovation through mandates and subsidization, New Hampshire should not engage in a competition of subsidies with neighboring states. Instead, our state should enable creativity and entrepreneurial endeavors by refraining from picking winners and losers among energy technologies.

New Hampshire policymakers should pursue market-based mechanisms for achieving cost-effective energy, while avoiding preferential quotas and mandates.

Goal 4: Achieve cost-effective energy savings.

Energy efficiency (EE) is often the cheapest and cleanest energy resource. Investing in efficiency boosts the state's economy by reducing energy costs for consumers and businesses. New Hampshire should prioritize capturing more efficiency in all sectors, including buildings, manufacturing, and transportation.

New Hampshire has an evolving EE programming. 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. Efficiency benefits more than just those customers who participate in efficiency programs. For example, reducing our electricity use, especially during expensive peak times such as the hottest and coldest days of the year, saves money for everyone on our energy systems. For reliability purposes, energy infrastructure is built to meet the need during peak demand. Reducing that peak means spending less on expensive transmission, distribution, and generation infrastructure.

Regional EE efforts are projected to significantly impact both peak demand and gross energy usage. ISO-NE projects that EE measures will save an additional 6,544 GWh regionally by 2030, reducing peak summer demand by 1,617 megawatts (MW) and peak winter demand by 1,380 MW and result in regional energy usage being reduced from growth of 1% per year to a 1% decrease of gross consumption.[24] This is derived from anticipated investments across New England of $1.1 billion annually from 2021 through 2030.[25]

State Energy Efficiency Programs

New Hampshire's EE programming has undergone recent transformation. Following the issuance of PUC Order 26,553, the state legislature passed and Governor Sununu signed, House Bill 549, which returned New Hampshire utility EE programs from an energy efficiency resource standard to legislatively set EE budgets. HB 549 set clear guidelines on program requirements, metrics, and evaluation. [26] Going forward, HB 549 will provide significant stability to the utilities, businesses, households and other stakeholders involved in New Hampshire energy efficiency.

Successful reimplementation of the new State Energy Efficiency Planning program will provide stability to New Hampshire's cost-effective energy efficiency programming while also being mindful of the costs to ratepayers.

[24] ISO-New England. "2021 Regional System Plan." ISO-New England, November 2, 2021.
[25] ISO-New England. "Final 2021 Energy Efficiency Forecast." ISO-New England, May 1, 2021.
[26] New Hampshire General Court. "Relative to the system benefits charge and the energy efficiency and sustainable energy board." HB 549, 2022.

Goal 5: Achieve environmental protection that is cost-effective and enables economic growth.

Environmental and health concerns are increasingly a factor in discussions of our energy supply. Climate change related to greenhouse gases is a real, escalating issue with significant impacts. These consequences are overarching across society, with economic, environmental, and public health impacts. Energy systems can contribute to and exacerbate the effects of climate change.

We must protect and conserve New Hampshire's natural resources while at the same time balancing energy needs. Protecting public health and our natural resources can be accomplished while pursuing cost-effective energy solutions. New Hampshire should seek to eliminate burdens on innovation and open up competition to all energy solutions that can deliver value to ratepayers and New Hampshire citizens.

New Hampshire has been among the most successful of US states in fostering a lower-carbon intensive economy. According to 2020 EPA data, New Hampshire has the fifth-lowest output emission rate (calculated as total annual adjusted emissions divided by annual net generation) in the United States.[27] New Hampshire ranks 8th-lowest in per capita energy-related carbon dioxide emissions in the United States[28]

The most successful way of reducing emissions and protecting our natural resources from climate change is to achieve a market where low-emission resources are economically competitive without government mandates and subsidies. Achievement of this objective is more likely if government action focuses on actual, rather than symbolic, costs and benefits. This assessment may be easier for acute environmental problems such as air and water pollution but becomes more difficult when weighing long-term actions to respond to climate change. Regardless of the mechanism, action should be driven by the need for efficient investments—solutions should have a meaningful impact, rather than merely an aspirational one. Energy policy is an important component of this discussion and should be driven by the same need for cost-effective and meaningful outcomes.

While some energy technologies have promise in being able to deliver inexpensive energy with relatively minor environmental impacts, a single point solution does not exist. Many low-emission resources are expensive on a levelized basis, or negatively impact natural resources through a larger land use footprint. Other resources produce varying degrees of emissions at low cost and operate on an energy-dense footprint. The current move toward electrification –

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[27] U.S. Environmental Protection Agency. *eGrid Data Explorer.* April 26, 2022.
[28] U.S. Energy Information Administration. "Energy-Related CO2 Emission Data Tables." U.S. Energy Information Administration, April 13, 2022. Table 4.

replacing fossil fuels with electricity to power our economy – is gaining momentum in many aspects of our everyday lives from building comfort to transportation. It promises lower emissions of air pollutants, a more decentralized grid, greater customer choice and potential cost savings, but grid security and the pace of integration will affect how quickly and cost-effectively electrification is adopted.

While low-carbon renewable resources will undoubtedly increase as a percentage of our fuel mix, the transition to such resources should not inflict unnecessary economic harm on generators and ratepayers. Instead, **New Hampshire can continue to safeguard natural resources and achieve emissions improvements by pursuing innovative programming, removing government barriers, and rejecting government-mandated market distortions**.

Goal 6: Government intervention in energy markets should be limited, justifiable, and technology-neutral.

Energy policy is rife with subsidies and preferences. While many policy interventions may have been laudable when originally crafted, too often they outlast their usefulness, turning from target mechanisms into near-permanent supports for the chosen segment. These features distort market efficiencies and confound the prioritization of critical goals in that government intervention and subsidization often works at cross-purposes.

Significant numbers of impactful policy preferences are created at the federal level, but states maintain broad discretion to pursue and implement their own energy goals. The exercise of that discretion should be specific and calibrated to the minimum effective intervention. An unregulated energy market should not be an end goal, yet policy interventions should be limited in time and scope, justifiable economically, and without admiration of or animus toward any particular technology.

Many well-intentioned policies deliver concentrated benefits with diffuse costs. That is, a small pool of stakeholders significantly benefit while the costs of that policy are spread among many, whether ratepayers or taxpayers. A collection of incremental costs in aggregate can amount to a significant burden on ratepayers and taxpayers. Too many of these costs are hidden, or brushed off as only cents on the dollar, even when in total the cost of energy is inflated because of inefficient or rent-seeking mechanisms.

Policy, by its very nature, yields more benefit for some than others. For example, conventional fuels (categorized into coal, natural gas, petroleum, and nuclear) received a total of $854 million in 2016 in direct federal financial interventions and subsidies. This represents a significant decline over prior years due to a 2005 tax provision for the accelerating expensing of certain refinery equipment that has now turned revenue positive.[29] On the other hand, renewables received $6.68 billion in subsidies. That means renewables received 90% of all generation-related subsidies and support in 2016 yet accounted for 13% of total generation.[30] The risk with any policy preference is that it misidentifies the most efficient path to achieve policy goals. Policymakers are often poorly positioned to identify technological advancements, and technology-specific subsidization often bolsters inferior technologies at the expense of efficient marketplace development. It is highly likely that the most impactful new energy technology of the 21st century has not yet been brought to market. **New Hampshire should seek to foster an environment where new and emerging technologies can flourish by the value they may bring to the market**, rather than through political preferences.

Investment in renewables is expected to yield returns in future years commensurate with their high degree of current support. At the same time, the degree of support is not sustainable if it scales with the growth of renewables in the marketplace. As such, subsidies, if necessary, should be responsive to need by a nascent industry or policy goal, and adaptive to the evolution of that sector or goal. Policy preferences should not be static. Taxpayer or ratepayer subsidization should not be a permanent component of any technology's bottom line. **The exercise of government power to economically advantage one technology over another should be time-limited, narrow, and necessary to achieve a specific policy goal**.

This Strategy is not the appropriate platform for an exhaustive review of policy preferences and benefits. However, organizing and crafting policy through rigorous discussion of the most efficient means of government intervention in markets, if warranted, will appropriately limit action to core needs, while reducing the likelihood of a disproportionate benefit going to a single stakeholder group.

Additionally, the structure, mandate, and autonomy of government entities concerned with energy issues can impact the nature and degree of state intervention. Other states manage energy policy and regulation through a variety of governmental structures: some have consolidated departments of energy, while others include an energy mandate within an agency with a broader portfolio. As part of the biennial budget process, in 2021 the Governor and General Court created the Department of Energy. No single structural arrangement is appropriate for all states—fragmentation or centralization of energy regulation and policymaking may deliver effective energy policy outcomes. New Hampshire's management of energy issues should be periodically assessed to ensure it can deliver the outcomes New Hampshire citizens and consumers deserve.

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[29] U.S. Energy Information Administration. "Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2016." U.S. Energy Information Administration, April 2018.
[30] *Ibid.*

Goal 7: Encourage market-selection of cost-effective energy resources.

New England wholesale electricity prices are primarily determined by the price of natural gas. Natural gas made up 46 percent of ISO-NE's resource mix in 2021, and based on proposed new generation and retirements of other generation types, reliance will increase to 56 percent by 2025.[31] Natural gas remains the most significant fraction of New England's resource mix and will continue to set the marginal price for wholesale electricity for years.[32]

At the same time, pipeline capacity constraints result in price volatility, largely when weather-related demand, such as during cold snaps, stresses supply. Public policies that discourage the utilization of natural gas, or restrict adequate supply, will drive up electricity prices. Increasing RPS mandates coupled with natural gas supply restrictions will result in increased ratepayer costs.

All infrastructure expansions create a tension between the utilization of natural resources and delivery of market-demanded energy. Natural gas pipelines or high-capacity power lines must run from point to point in corridors. Wind turbines will shape our skylines. Solar panels require adequate acreage to generate at scale. Even if total energy demand is flat, there will still be the ongoing needs to maintain, replace, or upgrade infrastructure capacity. Ideally, market selection of cost-effective energy resources will result in lower ratepayer costs than government-selected generation resources. At the same time, the inability to build out infrastructure to accommodate market demand will raise costs.

Importantly, appropriate infrastructure development can be achieved while still pursuing decarbonization obligations. However, state selection of out-of-market contracts for provisions of significant amounts of renewable energy through purchase power agreements (PPAs) distorts the competitive wholesale electricity market. Notably, Massachusetts' procurement of renewable electricity generation and renewable energy credits (RECs) totaling 9,450,000 MWh annually, with an additional 14,000,000 MWh annually coming from offshore wind will shape the New England energy landscape.[33] Massachusetts policymakers determined environmental goals justified the imposition of additional costs on Massachusetts ratepayers, yet costs will ripple through New Hampshire and the entire New England market.

The segmentation of the electricity generation market will likely force generators to artificially reduce their prices or result in otherwise competitive resources to leave the market. At face value, this price reduction may initially benefit consumers through lower rates as producers

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[31] ISO-New England. "Resource Mix." ISO-New England, 2022.
[32] ISO-New England. "2021 Regional System Plan," 17.
[33] Massachusetts Clean Energy, https://macleanenergy.com/.

compete for a smaller share of the market. However, the unintended consequences of that artificial competition will not just include generating resources that were economically competitive prior to market segmentation, but also consumers will have to rely on expensive generating resources. These expensive generating resources must now cover the demand placed on the market by intermittent and variable resources.

Though different in structure, Renewable Portfolio Standards (RPS) also segment markets by mandating that utilities purchase certain fractions of generation from selected resource types. This fragmentation through mandate eliminates cost pressures between technology types within the RPS market, and further limits that percentage of total market demand that can be served by competitive wholesale markets. Many New England states' RPS mandates are increasing and with additional out-of-market contracts, it is plausible that the competitive wholesale market would only serve a minority of total demand. If market segmentation trends continue, the wholesale markets will become increasingly meaningless tools to deliver cost-effective electricity to consumers and the benefits of competitive wholesale markets will diminish.

Given that the other New England states have aggressive decarbonization goals and increased electricity demand is anticipated due to greater electrification in the transportation and building sectors, the decision of which alternative to develop is most significant. The New England states have collectively expressed support for Forward Clean Energy Market (FCEM) development, and New Hampshire believes that approach represents the best alternative for a number of reasons.

An FCEM design would permit states voluntarily to procure, on a three-years forward basis, clean energy attributes from non-carbon emitting electric generation resources located in the New England region. The FCEM approach would enable renewable energy generation resources to obtain additional revenue streams if they successfully participate in a competitive market process, while non-participating states or utilities would not be required to pay for such clean energy attributes. Unlike long-term PPAs, the FCEM design would involve a centralized competitive market mechanism intended to result in least-cost supply options.

New Hampshire energy policies should avoid market segmentation while supporting healthy and competitive wholesale markets to deliver cost-effective energy to meet consumer demand.

Goal 8: Generate in-state economic activity without reliance on permanent long term subsidization of energy.

The exercise of government power to economically favor one technology over another should be limited, and justifiable. Subsidies should be responsive to need, if necessary. This means that they should be temporary and targeted. Subsidized resources too often rely on the benefit of being a permanent component of the bottom line. This reliance is not sustainable.

As with Goal 6, economic development can be achieved without resorting to the delivery of narrow, concentrated benefits to small, specific individuals or groups while the many incur increased, but often diffuse costs. Subsidization to support economically inefficient entities merely for the preservation of their operation ignores reciprocal costs. That is, subsidization of any particular industry or technology type may preserve specific economic activity in the short run, but only by imposing the costs of inefficiencies on ratepayers and taxpayers.

Reliance on mandates or subsidization necessarily means that an energy-related activity is not economically viable absent government support. While short-term market disturbances may justify limited intervention to preserve long-term viability, continued reliance on ratepayer and taxpayer funds is neither sustainable nor justifiable.

Government support for energy industries or sectors should be based on quantifiable data demonstrating consumer benefit. Subsidization will nearly always help the entity being supported, but the immediate and long-term cost to ratepayers and taxpayers must be included in order to properly weight public policy decisions. If no net benefit is shown, then it is highly likely ratepayer or taxpayer dollars could be more efficiently spent elsewhere, and alternative actions should be considered.

New Hampshire stakeholders should seek policies that limit economic waste, maximize the useful competitive lifespan of energy infrastructure, and avoid policy preferences that select for technologies or resources without regard to cost.

Goal 9: Support New Hampshire's interests in regional energy matters.

Every state has the right to pursue its own energy policy agenda. And while the integration of renewables into competitive markets is necessary, such integration must address additional costs associated with resources competitive only with subsidization. Compared to other New England states, New Hampshire does not have as aggressive renewable mandates or subsidy programs. Neighboring state renewable mandates create upward pressures on electricity prices from higher-cost renewables by increasing their share of the regional fuel mix. As such, there is a significant risk that those increased costs will be passed to New Hampshire ratepayers even though New Hampshire policy is not driving those costs.

States should be free to impose above-market costs on their citizens for policy reasons. However, one state should not shift above-market costs onto a neighboring state's ratepayers by distorting the wholesale market. As such, **New Hampshire should seek regional policies that allocate costs according to each state's preference for higher-cost resources**. As outlined in the New England Governors' Commitment to Regional Cooperation on Energy Issues issued on March 15, 2019, "…to the extent a state's policies prioritize clean energy resources, those states commit to work together on a mechanism or mechanisms to value the important attributes of those resources, while ensuring consumers in any one state do not fund the public policy requirements mandated by another state's laws." Any support for other states energy policies with the potential to impact New Hampshire ratepayers should be expressly conditioned on those states agreeing to apply this principle. To the extent that transmission system expansion is also needed to integrate clean energy resources, state support should also be conditional on states reaching agreement on a fair and equitable method for allocating the costs of such transmission facilities in line with this principle.

In short, states should be able to pursue their own policies impacting fuel mix but should also bear the cost to the degree such policies increase electricity rates and regional transmission costs.

Goal 10: Ensure that energy infrastructure can be sited while incorporating input and guidance from stakeholders.

Siting energy infrastructure is both challenging and necessary. An affordable energy resource is rendered either expensive or irrelevant if the cost to utilize it is high or it cannot be sited. New Hampshire requires robust, cost-effective energy systems that meet current and future needs with minimally disruptive impact. **Delivering appropriate energy infrastructure requires predictability, defined processes, good communication, and clear standards for achievement**.

Section 2: Energy Overview

New Hampshire electric prices are the fifth-highest among the Lower 48 states.[34] In 2019, on average, each New Hampshire resident spent $4,078 on energy.[35] Yet the distribution of costs has shifted. Over the past decade electric generation costs have fallen while transmission costs have increased.[36] Generation still makes up the majority of total delivered cost, but policy choices that impact the fuel mix shown in Figures 2.1 and 2.2 below could be more significant cost drivers than fluctuations in fuel costs or transmission investments.

New Hampshire 2021 Generation		
Total (thousand MWh)	**17,572**	100.0%
Nuclear	9,856	56.1%
Natural gas	4,466	25.4%
Biomass	1,026	5.8%
Hydro	1,167	6.6%
Wind	504	2.9%
Coal	284	1.6%
Solar	197	1.1%
Petroleum liquids	72	.4%

Figure 2.1

New England 2021 Generation		
Total (thousand MWh)	**106,773**	100.0%
Nuclear	27,073	25.4%
Natural gas	53,930	50.5%
Biomass	5,834	5.5%
Hydro	6,358	6.0%
Wind	3,796	3.6%
Coal	595	0.6%
Solar	7,060	6.6%
Petroleum liquids	292	0.3%
Other Renewables	1,835	1.7%

Figure 2.2

Source: EIA Data Browser

Projected Consumption Demand

Impact of COVID-19:

The COVID-19 pandemic had an enormous impact on energy demand across all sectors. Based on an EIA data, 2020 saw a 7.3% decrease in energy consumption nationally, with transportation seeing nearly a 15% decline, industrial a 5.2% decline, commercial a 6.7% decline, and residential a .9% decline.[37]

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[34] U.S Energy Information Administration. "New Hampshire State Energy Profile." U.S. Energy Information Administration, August 19, 2021.
[35] U.S. Energy Information Administration. "State Energy Price and Expenditure Estimates, 1970 Through 2019."
[36] Avard, Kevin, Jay Kahn, Herbert Richardson, Michael Vose, and Robert Backus. "SB 125 Study Committee Report." New Hampshire General Court, November 1, 2017.
[37] U.S. Energy Information Administration. "Monthly Energy Review: February 2022." U.S. Energy Information Administration, February 24, 2022, 37.

Electric Generation Net Demand Forecast:

ISO New England has projected the net electricity use for New Hampshire to grow from 12,510,000 MWh in 2021 to 14,757,000 MWhs in 2030, a compound annual growth rate of 1.9%.[38].

Electric Generation Load Demand Forecasts, by type:

Heating

Electric demand for heating is projected to dramatically increase across the region. By 2030, the load from electric heating is projected to be 63 times greater than it is in 2021. New Hampshire comes in slightly lower than the regional average at only 50 times greater, increasing from 2 GWh in 2021 to 100 GWh in 2030. New Hampshire's peak winter demand will increase by 56 MW because of this shift.[39]

Transportation

Electric demand for transportation is projected to increase dramatically as well. By 2030, regional demand on the electrical grid for transportation needs due to EVs is projected to be 75.6 times greater than in 2021. This forecast is built on the assumption that 11% of all light duty vehicles will be EVs by 2030. In New Hampshire, this increase is expected to be lower than the regional average, coming in at 28.4 times greater, which is roughly the same as the increases projected for Connecticut and Rhode Island. By 2030, in New Hampshire, peak summer demand is expected to be 37 MW higher and peak winter demand 48 MW higher as a result.[40]

Electric Generation Load Reduction Forecasts, by type:

Energy Efficiency

Reduction in demand due to energy efficiency will continue to grow. New Hampshire is projected to realize a 45% increase in energy savings by 2030, with a 4.2% compounded annual growth rate over the next 9 years, tied for the greatest increase in the region. These measures will see peak summer demand reduced by 204 MW by 2030, and peak winter demand reduced by 172 MW.[41]

Behind the Meter Solar

Behind-the-meter Solar are the photovoltaic (PV) solar systems installed to partially or entirely meet the electric demand for an individual home or business. These systems have the added benefit of reducing consumption on the regional grid. These systems in New Hampshire are

[38] ISO-New England. "2021 Regional System Plan," 37.
[39] *Ibid.*
[40] *Ibid*, 39.
[41] *Ibid*, 39-40.

projected to reduce cumulative electricity consumption by 316 GWh by 2030, with an 8.7% compounded annual growth rate over the next 9 years, above the regional average. Peak summer demand will be reduced by 52 MW in 2030, up from 39 MW in 2021.[42]

Fossil Fuel Transportation Demand Forecast, by type:

Gasoline

National gasoline consumption is projected to continue to increase coming out of the COVID-19 pandemic, increasing from 8.80 million barrels per day in 2021, to 8.96 million barrels per day in 2023. This is still below the pre-pandemic high of 9.31 million barrels per day. Consumption peaked in 2018 at 9.33 million barrels per day.[43]

Diesel

National diesel consumption is projected to continue to increase coming out of the COVID-19 pandemic, increasing from 3.66 million barrels per day in 2021, to 3.85 million barrels per day in 2023, exceeding to the pracademic levels.[44]

Fossil Fuel Heating Demand Forecast, by type:

Propane

National propane consumption is projected to hold relatively steady coming out of the COVID-19 pandemic, increasing from 839,000 barrels per day in 2021, to 853,000 barrels per day in 2023, still short of the pre-pandemic high of 868,000 barrels per day.[45]

Natural Gas

Nationally, residential natural consumption is projected to hold relatively steady coming out of the COVID-19 pandemic, increasing from 12.75 billion cubic feet per day in 2021, to 13.21 billion cubic feet per day in 2023. This is still below the pre-pandemic high of 13.75 billion cubic feet per day, although as with propane, residential consumption of natural gas is heavily dependent on the weather.[46]

[42] ISO-New England. "2021 Regional System Plan," 41.
[43] U.S. Energy Information Administration. "Short-Term Energy Outlook Data Browser, April 2022." U.S. Energy Information Administration, 2022. Table 4a.
[44] *Ibid*.
[45] U.S. Energy Information Administration. "Short-Term Energy Outlook Data Browser, April 2022." U.S. Energy Information Administration, 2022. Table 4b.
[46] U.S. Energy Information Administration. "Short-Term Energy Outlook Data Browser, April 2022." U.S. Energy Information Administration, 2022. Table 5a.

Oil

Nationally, 255,000 barrels of fuel oil were consumed for heating in 2021, projected to decline to 231,000 barrels per day in 2023. Consumption of fuel oil for heating has been on a consistent downward trend since 2003.[47]

Electric Generation Infrastructure

In 2021, New Hampshire generated approximately 17.4 million MWhs of electricity. Nuclear power, specifically Seabrook Station, accounted for about 9.8 million MWhs of that generation, or just over 56%. Natural gas accounted for just under 26% of New Hampshire's generation, with renewables (solar, biomass, hydroelectric, and wind) representing about 17%. Coal and oil combined account for roughly 2% of New Hampshire's annual generation.[48]

New Hampshire customers receive electricity from three regulated investor-owned utilities (Eversource, Liberty, and Unitil), one electric cooperative (New Hampshire Electric Cooperative), and several municipally-owned electric companies (Ashland, Littleton, Woodsville, New Hampton, and Wolfeboro). New Hampshire's electric industry is restructured, meaning that the ownership of electric generating plants has been separated from the distribution and transmission of electricity.

Within the last decade, New England has seen a wave of retirements of fossil fuel fired generators, largely due to the availability of inexpensive natural gas. All oil and coal fired plants in New England have either ceased operation entirely, or only operate as peaking stations during times of high demand and extended cold snaps. Oil and coal accounted for just over 2% of total generation in New Hampshire as compared to 11% in 2011.

Over the past two decades, natural gas has assumed a majority role in New England's installed generating capacity. From 2000 to 2020, installed oil and coal generating capacity fell from 46% to 25%, nuclear fell from 18% to 11%, hydroelectric fell from 14% to 10%, and renewable resources remained flat at 5%. Natural gas skyrocketed from 18% in 2000 to 50% in 2020.[49]

ISO-NE's interconnection queue, which tracks proposals for new electricity generation resources, identified 30,600 MW of proposed new generation, with renewables accounting for roughly 74% of the new generation. Only 2.8%, or 876 MW, comes from natural gas, and 23%, or 7,000 MW, from battery storage. Of that proposed generation, roughly 830 MW are proposed for New Hampshire, including several with solar backed by batteries. It is important to note that

[47] U.S. Energy Information Administration. "Short-Term Energy Outlook Data Browser, April 2022." U.S. Energy Information Administration, 2022. Table 4a.
[48] U.S. Energy Information Administration. "Electricity Data Browser." U.S. Energy Information Administration, 2021.
[49] ISO-New England. "2021 Regional Electricity Outlook." ISO-New England, 2021.

these figures, both for New Hampshire and the region are just proposals, not approved projects. ISO-NE notes that roughly 70% of projects in the interconnection queue are ultimately withdrawn and never constructed.[50]

Given the additional generation that is expected to come online in the future, there will be a corresponding need for new transmission infrastructure as well. Renewable generation is typically highly dependent on location and those locations tend not to be where the demand exists. This will necessitate the construction of additional transmission lines to transport the electricity from where it is generated onto the grid. ISO-NE has noted that the current grid, as it exists today, has the capacity to interconnect roughly 6,000 MW of offshore wind, but that anything greater than that would require building additional transmission infrastructure.[51]

Protection, Reliability, and Modernization of Infrastructure

<u>Cybersecurity</u>

It is federal policy to protect critical infrastructure from both physical and electronic threats.[52]American energy infrastructure assets must be paid specific attention as they are repeated targets of cyber-attacks, including by state actors,[53]and generation assets are also among those least protected from cyber intrusions.[54]

Cybersecurity is growing in importance as critical infrastructure is increasingly interdependent, and as “Smart Grid” electric power network modernizations continue to incorporate information technology systems and capabilities. Cybersecurity threats are constantly evolving and mitigating those threats is a continual challenge for energy infrastructure operators. Cybersecurity is not just fortifying our technological infrastructure it also encompasses the physical plant that is used to house this technology and should raise equal concerns with regard to security in the utility industry. Critical infrastructure failures could have devastating consequences for New Hampshire citizens.[55]

While the regional and national nature of energy infrastructure results in an “unclear delineation of responsibility and leadership, divergent risk perceptions, lack of transparency, and liability

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[50] ISO-New England. “Interconnection Request Queue.” ISO-New England, 2022.

[51] ISO-New England. “2021 Regional Electricity Outlook.”

[52] Congressional Research Service. “Cybersecurity: Critical Infrastructure Authoritative Reports and Resources.” Congressional Research Service, 2017.

[53] Cybersecurity and Infrastructure Security Agency, Federal Bureau of Investigation, and National Security Agency. “Alert (AA22-011A) Understanding and Mitigating Russian State-Sponsored Cyber Threats to U.S. Critical Infrastructure.” January 11, 2022.

[54] Walton, Robert. “Utility cybersecurity insurance premiums are on the rise, more than doubling for some independent power producers.” Utility Dive, February 17, 2022.

[55] As an example of the potential disruptive and destructive power of cyber-attacks, see the May 2021 ransomware attack on the Colonial Pipeline.

concerns...", New Hampshire stakeholders have a role to play in improving cybersecurity.[56] Notably, the New Hampshire Department of Safety, Division of Homeland Security & Emergency Management is responsible for coordinating the State's response to major disasters. Additionally, the Enforcement Division of the New Hampshire Department of Energy maintains information on critical infrastructure and cybersecurity.[57]

New Hampshire stakeholders need to make cybersecurity a priority and should continue to pursue available synergies with regional and national partners to identify and respond to cyber threats in real time.

Grid Modernization:

Grid modernization refers to the utilization of new technologies, equipment, and controls to make electric utility distribution systems more resilient, efficient, and reliable. "Smart grid" and other similar improvements have the potential to reduce the frequency of power outages, minimize storm impacts, restore electricity service faster when outages occur, lower system-wide generation, transmission, and distribution costs, and enable customers to more efficiently manage their electricity usage and integrate and operate distributed energy resources.

The PUC's "Investigation into Grid Modernization" docket[58] involved years of stakeholder input, staff review and analysis, numerous filings by interested parties, and PUC orders that ultimately provided detailed guidance on utility distribution system planning, while also outlining a process for continued investigation.[59] Most recently, the PUC concluded its investigative docket and committed to applying its grid modernization guidance in electric distribution utility least-cost integrated resource planning dockets, while also announcing it would commence a new docket to further explore related issues.

Utilities and other stakeholders should continue the development of grid modernization planning and implementation processes in New Hampshire, in keeping with the PUC's guidance and consistent with the broader policy goals outlined in this State Energy Strategy.

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[56] Sklarew, Jennifer F. "Cyber Security of Energy Systems: Institutional Challenges." George Mason University, Center for Infrastructure Protection & Homeland Security, 2016.

[57] New Hampshire Department of Energy. "Physical and Cyber Security." New Hampshire Department of Energy.

[58] New Hampshire Public Utilities Commission. "IR 15-296 Electric Distribution Utilities Investigation into Grid Modernization," New Hampshire Public Utilities Commission.

[59] New Hampshire Public Utilities Commission. "Order No. 26,358." In *IR 15-296 Electric Distribution Utilities Investigation into Grid Modernization*. New Hampshire Public Utilities Commission, May 22, 2020; New Hampshire Public Utilities Commission. "Order No. 26, 575." In *IR 15-296 Electric Distribution Utilities Investigation into Grid Modernization*. New Hampshire Public Utilities Commission, February 3, 2022.

Resource Adequacy:

New England winters challenge the ability of the region's generation assets to meet demand. During the cold weather months, most of the available natural gas in the region goes to natural gas utilities for home heating. There is little additional capacity left on the pipeline for natural gas-fired generation, and what is available is extremely costly. Generators can find alternative ways to get fuel, but those options are limited. Demand for electricity does not go away in the winter months, and to fill in the shortfall left by now idled natural gas plants, expensive oil and coal fired resources are needed to provide reliability services. Oil generators provide an extremely small amount of electricity over the course of a year due to the high fuel cost but can reach over 25% of generation during extreme cold spells, leading to massive price spikes. It gets even more difficult during a long stretch of cold weather, such as the polar vortex in the winter of 2014 and 2018. In cases such as these, oil generators could be unable to refill their tanks despite the region's desperate need for their electric generation.

ISO-NE has tried to resolve this through a series of winter programs. They developed the Winter Reliability Program, which paid oil generators to fill their tanks before high-priced winters. They then entered a contract to support one of the region's largest generators and proposed the Inventoried Energy Program and Energy Security Improvements. But these measures are short-term fixes, not a long-term, permanent solution.

ISO-NE has made some improvements to reduce the risk of outages due to severe winter weather, but the region must still solve the winter resource adequacy problem and find a way to ensure reliable service at reasonable rates through the difficult winter months.

Workforce Issues:

Like many other industries, the energy sector broadly is grappling with workforce issues due to a rapidly aging workforce coupled with a shortage of younger trained workers to fill those vacancies. The average age for a utility worker nationally is more than 50.[60] New Hampshire has a chronic shortage of truck drivers, including for deliverable fuels such as oil, propane, diesel, and gasoline.[61] The pandemic has only exacerbated this issue.

With all areas of the energy sector in the midst of massive transformational change, the loss of institutional knowledge from these retiring workers will be even more acute.

This critical need for additional workers can be met through a variety of means, such as apprentice programs and programs through the Community College System of New Hampshire.

[60] Muto, Jeff. "Addressing a Skilled-Trades Gap in the Energy Sector – and How to Ease the Transition." POWER, October 14, 2021.
[61] Finerman, Grace. "New Hampshire officials hope to recruit commercial driving instructors, more truck drivers." WMUR, February 11, 2022.

Some of these programs already exist, such as the Electrical Technology Associates Degree program at Manchester Community College, which also offers an Electrical Lineworker Certificate program.[62] and Lakes Region Community College offers several non-credit course programs in residential energy efficiency.[63] However, it is not enough to just train new workers in these sectors. New Hampshire needs additional workers to fill these positions as well.

These types of programs will be critical to training the next generation of energy sector workers in areas such as engineering, installation, maintenance, and computer systems, including training geared towards those whose jobs have disappeared because of the transition from fossil fuels to renewables.

New Hampshire should continue to develop workforce training programs and ensure that state and local policies do not constrain the workforce from growing.

New Hampshire and Regional Electric Markets

New Hampshire utilities participate in the New England regional wholesale markets designed and administered by ISO-NE, subject to the regulatory jurisdiction of the FERC. Participation in those markets provides numerous benefits in the form of regional access to generation and transmission infrastructure, economies of scale, and effective sharing of certain resources on a regional basis.

For many years, New Hampshire has followed three fundamental principles with respect to regional market participation: supporting well-designed markets and the competitive outcomes they provide, maintaining system reliability at reasonable costs to regional customers, and considering how other states' policies will impact New Hampshire rates and working to prevent or minimize any such rate impact determined to represent unjust or unreasonable "cost-shifting."[64]

The third of those principles has proven to be more challenging as other New England states have actively promoted the so-called "clean energy transition." All other states in the region are pursuing aggressive decarbonization efforts, often through sponsoring long-term PPAs with generators using specific renewable energy technologies. Those PPAs often include pricing that is both out-of-market and above-market, which has the effect of distorting competitive market outcomes, potentially resulting in unintended consequences for regional system operations and planning and related cost allocation.

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[62] Manchester Community College. "Electrical Technology." Manchester Community College, 2022.
[63] Lakes Region Community College. "Residential Energy Efficiency Training." Lakes Region Community College, 2022.
[64] New Hampshire General Court. "Participation in Regional Activities." RSA 374-F:8, 2021.

As a result, New Hampshire ratepayers are increasingly at risk of incurring higher costs driven by other states' public policies to support renewable energy resource development, despite the fact that the wholesale competitive markets were designed to be fuel- and technology-neutral. New Hampshire therefore should promote regional policy reforms intended to preserve the benefits of competitive market designs and system reliability while limiting cost increases and ensuring that one state is not required to bear the costs of another state's public policy initiatives.

ISO-NE's traditional three-part mandate is to operate the regional bulk power system, design and administer the wholesale markets, and plan for future electric power requirements. All three of those objectives are complicated when states pursue policies to promote a "clean energy transition" by subsidizing certain preferred resource types. ISO-NE is only beginning to plan for and take other actions to facilitate that regional energy resource transition, which implicates both system reliability and market efficiency concerns.

For example, ISO-NE recently submitted to FERC a proposal to eliminate the minimum offer price rule (MOPR) after a two-year transition period and the FERC approved that proposal. The MOPR effectively removes out-of-market revenues from the offer bids of resources into the Forward Capacity Market (FCM), through which ISO-NE runs an annual auction to purchase capacity, i.e., the ability to produce electricity when needed, for three years in the future. The MOPR often has the effect of preventing state-sponsored renewable energy generation resources from clearing in the FCM, because their costs are relatively high but are subsidized through their PPAs. As a result, the sponsoring states argue that they are forced to "pay twice" for capacity – once under their PPAs and then again in the FCM because their PPA resources are unable to clear in the annual auctions. Environmental advocates have also expressed opposition to the MOPR, as have a majority of current FERC commissioners.

ISO-NE has identified system reliability concerns associated with MOPR elimination, in particular with respect to the "disorderly retirement" scenario in which older fossil-fueled electric generation resources still needed to support reliability are unable to obtain sufficient revenues as a result of lower FCM prices driven by the participation of state-sponsored renewable resources. If that scenario is realized, then FCM prices may rise due to the need for additional reliable capacity resources and/or ISO-NE may be required to implement out-of-market programs to provide revenue support to prevent retirement of existing reliable generation units.[65]

In order to address those reliability concerns, ISO-NE intends to develop certain market reform initiatives during the two-year transition period before MOPR elimination, including in particular a resource capacity accreditation (RCA) project, better known as effective load carrying

[65] New Hampshire shares those reliability and market efficiency concerns and therefore was the only state to express opposition to MOPR elimination in the regional stakeholder process overseen by ISO-NE and the New England Power Pool (NEPOOL).

capability (ELCC). The RCA/ELCC market reforms will seek to better align the capacity credit for which both renewable and non-renewable generation resources qualify in the FCM with their actual ability to produce electric power when most needed to meet market demand and support reliable system operation.

New Hampshire should support such market reform initiatives in order to ensure that regional customers receive the greatest reliability value possible at the lowest cost possible through efficient competitive market mechanisms. And New Hampshire should do so while heeding the statutory mandate to ensure that the state's customers are not required to pay higher costs because of the non-reliability-based policy preferences of other New England states.

In New England there is currently also great interest in developing an alternative to state-sponsored, long-terms PPAs as a better means of enabling the clean energy transition policies adopted by a majority of states in the region. That was the primary focus of ISO-NE's recently-completed *Pathways Study: Evaluation of Pathways to a Future Grid*. The *Pathways* study evaluated four alternative approaches for meeting New England states' decarbonization goals: (1) the status quo PPA approach; (2) an FCEM design; (3) carbon pricing that would affect regional energy market clearing prices; and (4) a hybrid approach in which new resources would participate in the FCEM while existing resources would be supported through carbon pricing.

Given that the other New England states have aggressive decarbonization goals (i.e., each has a mandatory emissions reduction goal of 80% by 2050), and increased electricity demand is anticipated due to greater electrification in the transportation and building sectors, the decision of which alternative to develop is most significant. The New England states have collectively expressed support for FCEM development, and New Hampshire believes that approach represents a more attractive alternative for a number of reasons.

An FCEM design would permit states voluntarily to procure, on a three-years forward basis, clean energy attributes from non-carbon emitting electric generation resources located in the New England region. The FCEM approach would enable renewable energy generation resources to obtain additional revenue streams if they successfully participate in a competitive market process, while non-participating states or utilities would not be required to pay for such clean energy attributes.

Unlike long-term PPAs, the FCEM design would involve a centralized competitive market mechanism intended to result in least-cost supply options. Unlike carbon pricing, the costs of clean energy procurement would not be incorporated into the regional energy market, thereby raising costs for customers both in participating states and in non-participating states such as New Hampshire. If properly designed, an FCEM also should permit greater control by the states with a lower potential risk of interference by ISO-NE and FERC.

New Hampshire should actively support development of an FCEM while opposing attempts by ISO-NE, generation interests, and other stakeholders to promote regional carbon pricing. The

FCEM alternative presents the greatest potential to harness competitive market forces to facilitate the inevitable regional clean energy transition, while upholding the statutory directive to ensure that New Hampshire customers are not forced to bear additional costs driven by other states' public policy preferences.

Section 3: Fuel Diversity

Electric Generation

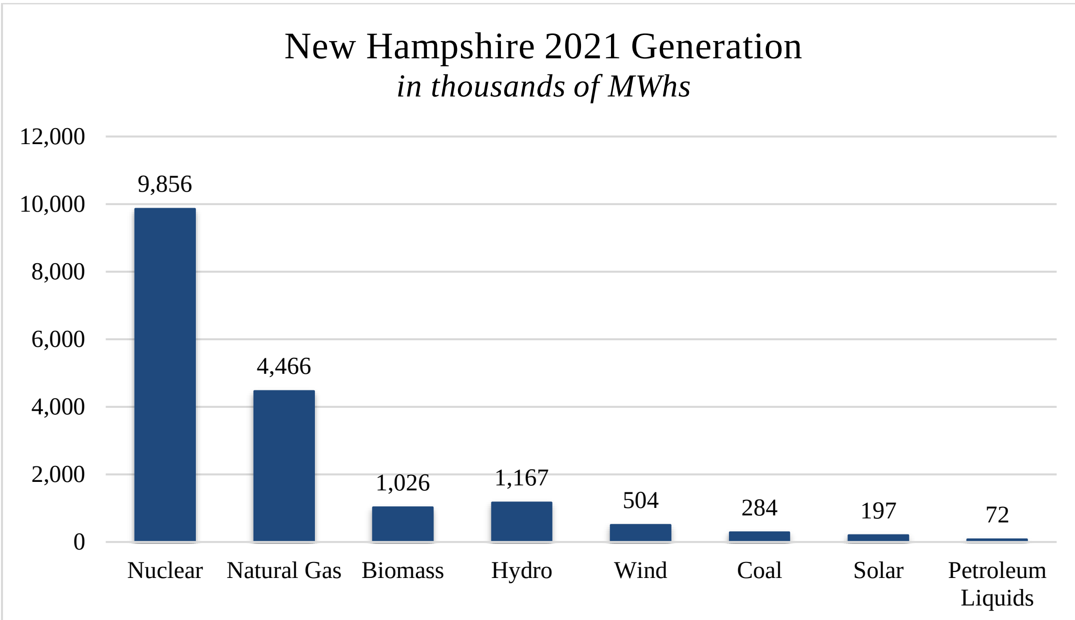

Figure 3.1 Note: percentages may not total 100% due to rounding

Source: EIA Data Browser

"Technology is neither good nor bad; nor is it neutral."[66] The impact of a technology depends on its geographic and economic context. To enable or protect cost-effective energy, stakeholders must figure out how to deliver the best products with the most impact, not merely new technology with limited impact. New Hampshire will be best served by fostering technologies and solutions that are tailored to our state's needs.

To deliver cost-effective energy to consumers, New Hampshire needs all-of-the-above energy policies. That means Energy Efficiency (EE), Demand Response (DR), Distributed Generation (DG), battery storage, renewable energy, and conventional resources. Diversity of available resources can limit cost spikes posed by fuel price swings or interruptions, better cover the generation gaps of intermittent resources, and help mitigate cyber threats. **Having a diverse resource mix can help ensure a secure, reliable, and resilient energy system.** Figure 3.1 shows output by generation resource in New Hampshire in 2021.

[66] Kranzberg, Melvin. "Technology and History: Kranzberg's Laws," *Technology and Culture 27*, no. 3 (July 1986): 544- 560.

Where taxpayer or ratepayer dollars are at stake, investments and policies should prioritize economic efficiency to achieve cost-effective energy production and delivery.

In well-functioning markets, technology-neutral policies will let the most competitive economically viable solutions succeed. Additionally, where overall electricity demand is flat, new resources added to the region should be selected by market performance, not based on mandates calling for a particular technology. Replacing competitive resources with subsidization-reliant resources is a recipe for increased ratepayer and taxpayer burdens.

While some states may attempt to drive innovation through mandates and subsidization, New Hampshire will never win a battle of subsidies. Instead, our state should enable creativity and entrepreneurial endeavors by refraining from picking winners and losers among energy technologies. New Hampshire can foster a sustainable and dynamic energy economy by ensuring a favorable regulatory environment for new technologies to flourish, not a regulatory and statutory environment based on favoritism.

New Hampshire should not seek to achieve renewable power market penetration merely to achieve parity with neighboring states or regions. Some states may choose to accept significant above-market costs to achieve a particular resource mix. With some of the highest energy costs in the nation, New Hampshire should be particularly sensitive to policy-imposed costs on ratepayers. Additionally, some regions possess environmental advantages that make intermittent renewable resources more efficient. There are increasingly large areas of the country where renewables are competitive. This should be recognized without jumping to the conclusion that all areas of the country can support similar levels of renewable infrastructure at similar costs. The degree of penetration of technologies should be determined by the competitive market. Otherwise, policy may create investments that may never be sustainable absent subsidization.

Renewables have an important role to play in our resource mix. As will be discussed in more detail later, in some regions of the country certain forms of solar and wind resources are becoming cost competitive with conventional generation technologies. However, many of these resources are currently unable to deliver at scale in New Hampshire without significant subsidization. While there should be pathways for all resources to achieve market penetration, such expansion should be accomplished by relying on the market value of power generation. Resources should compete in the market, not compete for government policy preferences.

Fossil fuels are currently the dominant fuel type in New Hampshire. While renewable resources will undoubtedly continue to grow, carbon-based fuels are likely to remain the most prominent overall fuel type of New Hampshire’s resource mix for decades. And regardless of what generation types are added to the resource mix, policies should let existing resources compete for market share. Delivering cost-effective electricity to consumers means measuring the economic lifespan of an existing resource by its ability to deliver value to customers in the market rather than through government mandate. Similarly, new resource entrants should compete on that same ability to provide customers with value. Basing resource entrants on a metric such as lowest levelized cost can be useful and informative, but ultimately, resource viability must be based on their ability to compete in the market.

Natural gas and renewables will likely make up an increasingly sizeable fraction of New Hampshire's fuel mix. Our state's electricity prices remain among the highest in the nation,[67] and those costs will remain high or increase if policies limit the utilization of natural gas or expand the subsidization of high-cost resources.

Nuclear power

Seabrook Station is the largest electricity generating asset in New Hampshire. With 1,250 MW of generating capacity, the nuclear plant produced more than 56% of all electricity generated in New Hampshire in 2021, and it is one of two nuclear plants in New England, which together supply 26% of the region's electricity.

It is essential that New Hampshire's energy strategy recognize the many attributes of nuclear power and its role in the regional grid. Seabrook Station produces the majority of our state's electricity and it has a significant impact on the local and state economy,[68] it delivers zero-carbon electricity into New England's grid, and the stability of production—it has what is known as a high capacity factor—is valuable for regional operations , especially during high peak periods in the summer and winter.[69] Given these realities, nuclear generation should be allowed to compete fairly and without unwarranted constraints in New England's wholesale markets thereby contributing to a market-driven, cost-effective resource important to New Hampshire's environmental goals and policy framework.

With regard to emissions, wholesale markets currently lack a mechanism to value nuclear power's carbon free attributes.[70] It is likely that New England's carbon emissions would increase significantly if Seabrook Station were to stop generating. For example, after several years of falling emissions, the closure of the Vermont Yankee nuclear plant was a driving cause in carbon dioxide emissions increasing 7% regionally in 2015.[71] Other states in the region with nuclear

[67] U.S Energy Information Administration. "New Hampshire State Profile and Energy Estimates."
[68] Nuclear Energy Institute. "Economic Impact of NextEra Energy's Seabrook Station." Washington, D.C.: Nuclear Energy Institute, November 2013.
[69] Nuara, Mary Louise. "ISO New England Update Consumer Liaison Group Meeting." Westborough, MA: ISO-New England, March 2, 2017, 7; ISO-New England. "Resource Mix."
[70] Van Welie, Gordon. "State of the Grid: 2017." ISO-New England, January 2017.
[71] Silva, Patricio. "Environmental Update." ISO-New England, February 2016.

plant closures have seen their carbon emissions increase in recent years.[72] It is worth noting that nuclear power also avoids the emission of nitrous oxides (NOx), sulfur oxides (SOx) and fine particulates, all of which are emitted from fossil fuel fired generation plants.

The Civil Nuclear Credit Program, created under the IIJA, will assist existing nuclear reactors that are at risk of closing or being replaced by higher-emitting power resources.[73] This program represents a federal recognition that nuclear power remains an important part in achieving carbon reduction goals.

There are no cost-effective or practical solutions to cover current nuclear power generation capacity with other zero-carbon assets, at this time, though special emission credits have been created elsewhere such as New York when, in 2016, the New York Public Service Commission created the ZEC (zero emissions credit), the first of its kind to recognize the emissions avoided by nuclear generation.

Seabrook Station has a capacity factor of 90%. This is an essential fact impacting grid management and planning. As such, there is value in factoring nuclear generation's zero-carbon emission product into state efforts to manage emissions and recognizing Seabrook Station as a source of zero-carbon electricity production is an important aspect of those efforts.

New reactor construction is often not economically viable in current conditions, although there may be opportunities in the future related to innovations with small modular reactors and the recognition in other states about the role nuclear generation can play in replacing retiring fossil fuel assets.[74] Currently however, there is significant value to New Hampshire and the regional electricity supply in maintaining Seabrook's generating capacity. Nuclear generation should be allowed to compete to deliver electricity into competitive wholesale markets and should also be recognized as a component in New Hampshire's environmental goals and policy frameworks. What is clear is that nuclear power still has a significant place in today's energy markets and that the future of nuclear power will depend on newer technologies and much needed research and development. New Hampshire should continue to review and study what innovative nuclear technologies develop over time.

Natural Gas

Natural gas constituted nearly 50% of New England's installed generating capacity in 2020, up from 18% in 2000.[75] Electricity markets continue to rely on natural gas as a versatile low-cost

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[72] Storrow, Benjamin. "3 states with shuttered nuclear plants see emissions rise." Politico, February 17, 2022.
[73] U.S. Congress. "H.R. 3684 – Infrastructure Investment and Jobs Act of 2021."
[74] Tomich, Jeffrey, and Kristi W. Swartz. "Big coal states eye small nuclear reactors for grid, economy." E&E News, February 17, 2022.
[75] ISO-New England. "2021 Regional Electricity Outlook," 12.

option for generation. While renewable resources are anticipated to grow, ISO-NE expects "natural gas resources to continue to set the marginal price for wholesale electricity in most hours through 2030."[76]

The second half of 2021 and first half of 2022 saw dramatic increases in the price of natural gas for a variety of reasons, including lower US domestic production because of the COVID-19 pandemic, national energy policy, increased European demand due to lower than average reserves due to a longer and colder 2020 winter, poor performance of renewable resources due to weather, the Russian invasion of Ukraine, and increased demand from China as it shifts away from its reliance on coal.[77]

Taken all together, these factors are placing enormous upward pressure on natural gas prices. The US spot market price in May 2022 increased by 208% over the pre-pandemic May 2019 spot price.[78] This will put significant upward pressure on the price paid by consumers for electricity and home heating.

In 2021, five natural gas pipeline projects were completed and brought into service in the New England region. These projects were incremental increases and upgrades to existing pipelines that, combined, increased natural gas capacity into New England by 339 million cubic feet per day, or a 6.5% increase in total import capacity. These projects represent the first increase in capacity into New England since 2008. The Iroquois Enhancement by Compression Project is currently seeking approval, which would boost capacity in the region as well as New York State.[79]

Natural gas has delivered benefits beyond cost-competitive electricity. The growth of natural gas production has contributed greatly to emissions reductions in the United States. U.S. carbon dioxide emissions have fallen to the levels of the early 1990's due to the market driven replacement of coal and oil by natural gas. For 2019, natural gas supplanting coal and oil were responsible for 60% of the reductions in CO2 emissions in the electricity generation sector, while renewables were responsible for the balance.[80] This has contributed to much of the progress that the U.S. has made towards emissions reduction goals.

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[76] ISO-New England. "2021 Regional System Plan," 17.
[77] U.S. Energy Information Administration. "Short-Term Energy Outlook." U.S. Energy Information Administration, March 8, 2022.
[78] U.S. Energy Information Administration. "Natural Gas Weekly Update for week ending June 1, 2022." U.S. Energy Information Administration, June 2, 2022.
[79] U.S. Energy Information Administration. "Natural Gas Weekly Update for week ending November 3, 2021." U.S. Energy Information Administration, November 4, 2021.
[80] U.S. Energy Information Administration. "U.S. Energy-Related Carbon Dioxide Emissions, 2019." U.S. Energy Information Administration, September 2020.

There is tension between the increasing demand for low-cost natural gas, the countervailing risk of dependence on the fuel, and production alternatives should natural gas supply infrastructure remain constrained. There are few, if any, resources currently available at scale in New Hampshire that offer natural gas' blend of cost-effectiveness and flexibility. Even though renewable projects are, on a percentage basis, the fastest growing segment of electricity generation, those resource types are not yet low cost and are constrained by environmental conditions—when the sun shines and the wind blows. ISO-NE projects the reliance on natural gas fired generation to increase due to the addition of those intermittent renewable resources.[81] New Hampshire energy policy must be realistic about the necessity of natural gas into the foreseeable future while ensuring that infrastructure projects or expansions are in keeping with natural resource and environmental protection.

Renewable Energy

In 2021 16% of electricity generated in New Hampshire was from renewable resources.[82] Hydroelectric generation was the largest renewable resource type at 6.6%, followed by biomass generation at 5.8%, wind at 2.9%, and solar at 1.1%.[83] Over the past five years, biomass generation has fallen due to plant closures and hydroelectric production has held steady as shown in Figure 3.2. Concerning hydroelectric generation in 2011, New Hampshire had a wetter than usual year[84]. New Hampshire was suffering from statewide droughts in both 2016[85] and 2020[86], impacting the level of hydroelectric generation. The average generation from NH hydroelectric dams in 2017, 2018, and 2019 was 1.4 million MWh.[87]

<u>Generation Outlook:</u>

Assuming no anomalous precipitation, hydroelectric output will remain steady, with two retirements planned in 2021 for a total loss of 2.1 MW[88] and one upgrade at an existing plant adding 4.6 MW in 2022.[89] It is possible that hydroelectric generation in the state may slightly increase due to retrofits and upgrades to existing facilities with the funding opportunities for these facilities under the IIJA.[90]

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[81] ISO-New England. "2021 Regional System Plan," 66.

[82] U.S. Energy Information Administration. "Electricity Data Browser;" U.S. Energy Information Administration, "New Hampshire State Profile and Energy Estimates."

[83] *Ibid.*

[84] NOAA National Centers for Environmental Information. "State of the Climate: National Climate Report for October 2011." NOAA National Centers for Environmental Information, November 2011.

[85] NOAA National Centers for Environmental Information. "State of the Climate: National Climate Report for October 2016." NOAA National Centers for Environmental Information, November 2016.

[86] NOAA National Centers for Environmental Information. "State of the Climate: National Climate Report for October 2020." NOAA National Centers for Environmental Information, November 2020.

[87] U.S. Energy Information Administration, "Electricity Data Browser."

[88] U.S. Energy Information Administration. "Electric Power Monthly with Data for December 2021," 173.

[89] *Ibid*, 184.

[90] The White House. "A Guidebook to the Bipartisan Infrastructure Law for State, Local, Tribal, and Territorial Governments, and Other Partners." The White House, January 31, 2022.

Wind and solar have expanded rapidly in New Hampshire. In 2011, there was negligible production, but increased to 2.6% in 2016 and 4.0% in 2021. This represents a nearly 54% increase over the course of five years. Growth in solar is poised to continue; per the Energy Information Administration (EIA), one utility scale solar projects are projected to be built in New Hampshire in the short-term with a nameplate capacity of 110 MW.[91]

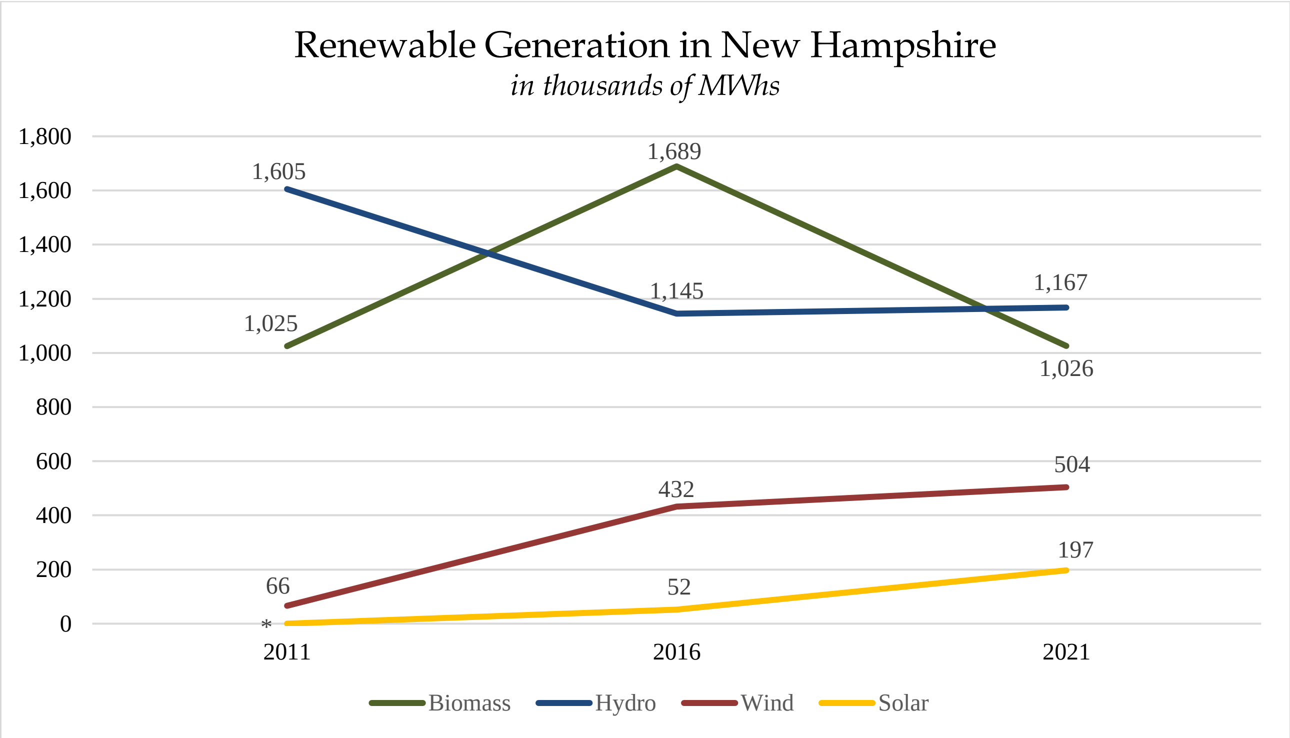

Figure 3.2

Source: EIA Data Browser; *Generation not sufficiently large to be captured by EIA.

Just as the scale and makeup of renewable energy production has changed significantly in the past few years, this trend will continue in the coming years. Renewable energy is highly likely to continue to grow as a percentage of total electricity generation in New Hampshire. That shift will also impact New Hampshire's economy, as jobs associated with renewable technologies will likely continue to make up a larger fraction of New Hampshire's workforce. The ISO-NE Interconnection Project Queue indicates nearly 830 MW of projects have been proposed for New Hampshire with in-service dates in the next several years. However, it is worth noting that, historically, 70% of these projects never come to fruition. Nonetheless, even at that ratio, 210 MW of additional utility scale solar capacity would be developed in New Hampshire.[92]

[91] U.S. Energy Information Administration. "Electric Power Monthly with Data for December 2021," 179, 181.
[92] ISO-New England. "Interconnection Request Queue." ISO-New England. 2022.

Analyzing the Cost-Effectiveness of Renewable Energy Technologies

Intermittent resources have different strengths and weaknesses as opposed to conventional generation sources. Importantly, renewables tend to have high capital costs (though economies of scale of driven them down significantly over time), low but improving capacity factors, and fuel costs that are near or at zero. In other words, the investment to build a renewable energy source is rather expensive per kW, and that capital cost is only producing electricity a low percentage of the time, but there are low or no fuel costs associated with operating the resource.

Market analyst company Lazard produces assessments of the LCOE, a measure that allows comparisons among generation resources absent subsidies. Lazard's national assessment shows that certain forms of solar and wind are cost competitive with conventional generation technologies in certain situations, especially for the construction of new generation.[93] However, it is important to parse this analysis more carefully as environmental and weather conditions can affect the output of a particular renewable resource. Performance can vary greatly by region and even within a region.

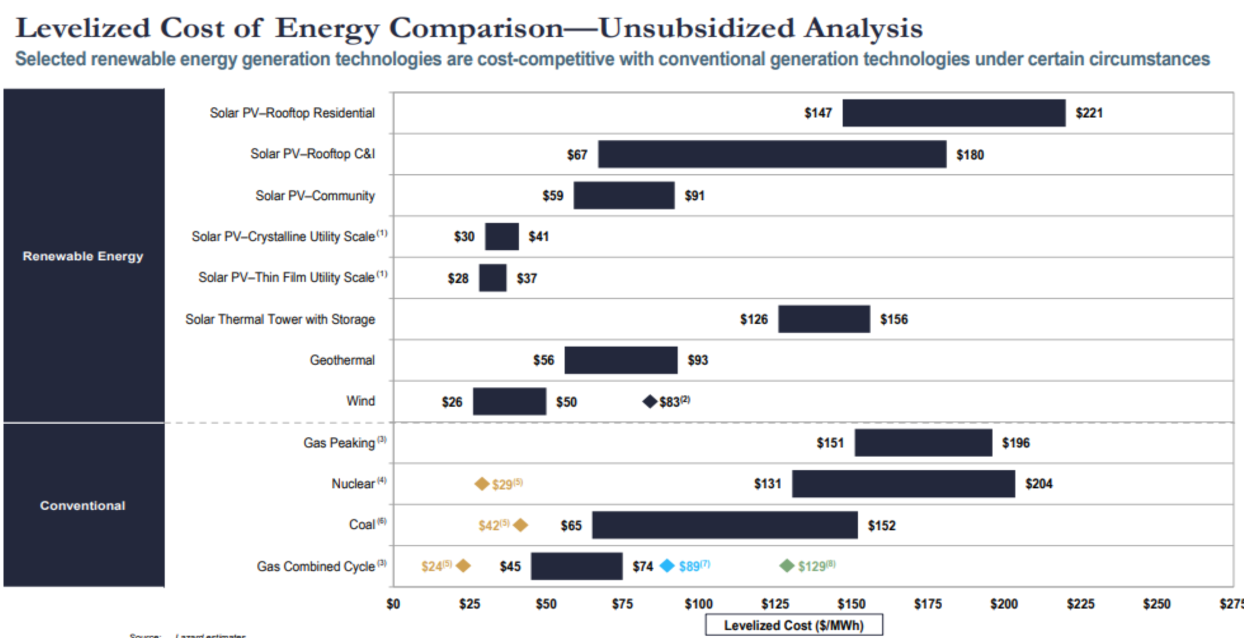

Figure 3.3

Source: Lazard's Levelized Cost of Energy Analysis – Version 15.0

For the purpose of comparing each generation type, the costs are compared to the cheapest conventional generator, gas combined cycle, i.e. natural gas. The cost for an existing natural gas

[93] Lazard, "Lazard's Levelized Cost of Energy Analysis – Version 15.0."

fired combined cycle plant ranges from $19 per MWh to $29 per MWh[94], with new generation costing between $45 and $74 per MWh.

<u>Rooftop Solar:</u>
Looking at the 'all in' costs of a new generation facility, residential rooftop solar is among the most expensive generation resources available measured nationally, with a cost in the range of $147 to $221 per MWh, roughly three times the cost of a new natural gas combined cycle plant.[95] Commercial and industrial rooftop solar is more cost competitive with new natural gas plants, coming it at $67 to $180 per MWh. While homeowners may express a desire to be energy independent, reduce their carbon footprint, or explore other factors that incentivize them to install rooftop solar arrays, from the standpoint of seeking cost-effective energy on a levelized basis, such systems are not generally advantageous, though for commercial and industrial customers, there are circumstances where rooftop solar are cost-effective on a levelized basis. Such installations may reduce transmission costs, although whether this is happening and to what extent, is currently being investigated by the department through the Value of Distributed Energy Resources Study (VDERS).

<u>Utility Scale Solar:</u>
The cost of new utility scale solar has fallen by 90% in the last 12 years, although the rate of reduction in cost has slowed in recent years. As of 2021, the 'all in' unsubsidized cost of utility scale solar ranged from $28 MWh to $41 MWh, less expensive than even the least expensive new natural gas combined cycle plant and within striking distance of being as inexpensive as an existing natural gas plant.[96] Once utility scale solar becomes cost competitive with existing natural gas generation, they will rapidly proliferate even in the absence of subsidies or mandates.

<u>Onshore Wind:</u>
Onshore wind has seen similar cost reductions as solar, although not as dramatic. The 'all in' unsubsidized costs of building and operating wind facility range from $26 per MWh to $50 per MWh.[97] When accounting for federal tax treatment, the lower end of the range drops to $9 per MWh.[98] This puts wind generation costs lower than an existing natural gas fired plant, and even when unsubsidized, puts it within striking distance of existing natural gas fired generation. However, siting is crucial to determine these costs, and New Hampshire does not have the same wind potential as other states like Texas, Kansas, or Nebraska. There are areas where the wind speeds make sense to site these turbines, but it is very limited given New Hampshire's topography. Other additional and legitimate concerns such as the wildlife impacts or scenic views may limit wind generation siting even further.

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[94] Lazard, "Lazard's Levelized Cost of Energy Analysis – Version 15.0," 19
[95] *Ibid,* 2.
[96] *Ibid*.
[97] *Ibid.*
[98] *Ibid*, 3.

Battery Storage:

Mass storage of electricity offers promise for improving the integration and utility of intermittent resources but will not of itself make those resources cost-effective. Storage infrastructure imposes additional costs on top of generation. Therefore, price parity can only be achieved when the unsubsidized levelized cost of energy plus storage reaches market rates. There are several applications, such as offsetting peaking generation in some scenarios, where battery storage is currently cost-competitive.[99]. In 2021, for the first time, battery storage facilities had winning bids in the regional forward capacity market auction, with more than 700MW worth of energy storage winning bids. Those facilities will come online in June 2025.[100] It is worth noting that large standalone batteries do not qualify for federal tax credits, and there are no state level mandates to purchase this kind of power.[101] As the price of battery storage continues to fall, more of these types of facilities will come online. These battery storage facilities are in a prime position to replace peaking stations, which are expensive to operate and have very high carbon emissions.

Other Renewable Resources

Biomass:

Biomass is the second largest renewable energy technology in New Hampshire, producing 5.8% of our state's electricity generation. The industry also touches many aspects of New Hampshire's economy. However, recent history has shown that the biomass industry cannot maintain competitiveness in regional electricity markets without state policy interventions to preserve their market share. Recent legislative attempts to do so have failed and several biomass facilities have closed or suspended their operations. Unsurprisingly, ISO-NE does not project expansion in biomass contribution to New England's resource mix, anticipating only 8 MW from biomass resources based on the ISO-NE Generator Interconnection Queue as of February 2021.[102] Although biomass plants drive economic activity in New Hampshire, protectionist policies always have reciprocal costs. Mandates to preserve biomass generation impose higher electricity costs on ratepayers and are not a sustainable mechanism to achieve cost-competitive and economically viable energy resources in New Hampshire.

Hydroelectric:

Hydroelectric generation is the largest renewable resource technology in New Hampshire, with roughly 6.6% of total state electricity generation. While New Hampshire's hydroelectric fleet is likely to remain operational, the plants are capital intensive, closely regulated, and depend on

[99] Lazard. "Lazard's Levelized Cost of Storage Analysis – Version 7.0." Lazard, October 2021.
[100] ISO-Newswire. "New England's Forward Capacity Auction closes with adequate power system resources for 2025-2026." ISO-Newswire, March 9, 2022.
[101] Spector, Julian. "Plus Power Breaks Open Market for Massive Batteries in New England."
[102] ISO-New England. "2021 Regional Electricity Outlook," 15.

price insulation from the Renewable Portfolio Standard mandate. Given relatively low wholesale market prices, high construction costs, siting difficulties and environmental impacts, it is unlikely that new hydroelectric plants will be constructed. However, given the substantial funding allocated to hydroelectric facilities under the IIJA, it is possible that hydroelectric generation in the state will increase due to retrofits and upgrades to existing facilities, enhancing existing generation assets, and bringing now dormant assets back into production.[103]

There is abundant excess hydroelectric capacity available outside the region, particularly in Canada. New England currently imports a significant amount of electricity from Quebec through high voltage DC lines that come through New Hampshire. Access to such resources could be an effective method of delivering zero-carbon electricity into New England at cost-competitive prices.

Offshore Wind:

In contrast to onshore wind, there is great potential in the waters off the coast of New Hampshire for offshore wind development. The Gulf of Maine has some of the highest average offshore wind speeds on the eastern seaboard making it prime for offshore wind development, although the deep waters of the Gulf pose technological challenges for deployment.

The viability of the deployment of offshore wind off New Hampshire has been in discussion for many years. As the industry has matured and technologies improved, New Hampshire has taken steps to begin a substantial review of the potential for offshore wind in the Gulf of Maine.

Governor Sununu, through Executive Order 2019-06[104], required various state agencies to collaborate on a report on Offshore wind. That report, *The NH Report on Greenhouse Gas Emissions and Infrastructure and Supply Chain Opportunities as it Relates to the Deployment of Offshore Wind in the Gulf of Maine*, prepared by the NH Department of Energy, the NH Department of Environmental Services, and the NH Department of Business and Economic Affairs, was released in February 2022.[105]

During the 2020 Session of the NH General Court, the State Legislature passed House Bill 1245, which established the Commission to Study Offshore Wind and Port Development (OSW Commission).[106] The membership of the OSW Commission, which meets monthly, includes state

[103] The White House. "A Guidebook to the Bipartisan Infrastructure Law for State, Local, Tribal, and Territorial Governments, and Other Partners." The White House, January 31, 2022.

[104] Sununu, Christopher. "Executive Order 2019-06." Office of the Governor of the State of New Hampshire, December 3, 2019.

[105] New Hampshire Departments of Energy, Environmental Services, and Business and Economic Affairs. "Report on Greenhouse Gas Emissions, and Infrastructure and Supply Chain Opportunities as it Relates to the Deployment of Offshore Wind in the Gulf of Maine." February 10, 2022.

[106] New Hampshire General Court. "Adopting omnibus legislation concerning state agencies." HB 1245, 2020.

legislators, representatives from various state agencies, the business community (including representatives from New Hampshire's commercial fishing industry), and labor unions.

The Department of Energy is currently conducting an assessment study on the potential impacts of the deployment of offshore wind in the Gulf of Maine. This assessment is an important step to move the public debate on this policy matter forward while providing unbiased data and analysis on the specific impacts to New Hampshire and New England of offshore wind deployment in the Gulf of Maine so all parties involved can make a more informed decision on whether supporting these efforts are in the best interest of New Hampshire's residents and businesses.

In January 2019, Governor Sununu requested of the U.S. Bureau of Ocean Energy Management (BOEM) the establishment of a task force for the Gulf of Maine that would include representation from New Hampshire, Massachusetts, Maine, and federally recognized Tribes in the area.[107] This request resulted in the chartering of BOEM's Gulf of Maine Intergovernmental Renewable Energy Task Force to facilitate coordination and consultation related to renewable energy planning activities on the Outer Continental Shelf in the Gulf of Maine. The task force first met in late 2019[108]. Work was paused due to the COVID-19 pandemic but resumed in early 2022. Moving forward, the Task Force will focus on BOEM's leasing and siting process, which will include significant input from state agencies from all three states along and from the residents & businesses in the Gulf of Maine who could be potentially impacted by the deployment of offshore wind.

There is great promise for offshore wind, however, costs are still quite high. Off the coast of southern New England, where the waters are much shallower, several PPAs are in place for offshore wind. They range in price from $58.47 per MWh to $99.50 MWh[109], in comparison to the average wholesale market price for electricity in New England which has ranged between $28.94 and $43.54 per MWh[110] though current wholesale prices have increased dramatically due to the increase in natural gas prices.

As technological improvements continue to reduce costs for offshore wind, New Hampshire should reduce unnecessary regulatory barriers that would hinder responsible wind development in the waters in the Gulf of Maine.

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[107] Bureau of Ocean Energy Management. "Gulf of Maine." Bureau of Ocean Energy Management.
[108] Bureau of Ocean Energy Management. "2019 Gulf of Maine Intergovernmental Renewable Energy Task Force Meeting." Bureau of Ocean Energy Management, December 12, 2019.
[109] United States Department of Energy. "Offshore Wind Market Report: 2021 Edition." United States Department of Energy, August 30, 2021, 23.
[110] ISO Newswire. "New England's wholesale energy market reaches historic low in 2019." ISO Newswire, March 18, 2020.

Renewable Natural Gas:

Renewable Natural Gas (RNG) is a new technology that utilizes the gases released from decaying matter, either from biomass or from landfills, and uses it as a replacement for traditional natural gas. RNG is an alternative to traditional natural gas for a number of reasons, primarily that it bypasses the transmission pipeline capacity issues and it can used within the existing distribution infrastructure and end users would not have to exchange or upgrade their existing appliances or machinery to use it. Using existing infrastructure not only means it can be deployed quickly but eliminates the need to build out brand new infrastructure to utilize it. In addition, it takes a byproduct that is either released into the atmosphere or flared off and makes it a marketable product. Finally, it helps to reduce methane emissions. Methane is roughly 25 times more effective as a greenhouse gas over a 100-year horizon than carbon dioxide.[111] However it remains to be seen if RNG is a cost-effective replacement for natural gas.

Hydrogen:

Hydrogen comes in a variety of hues, such as grey, blue, turquoise, pink, and green, depending on the source of energy used to produce it.[112] Turquoise, pink, and green hydrogen are all produced without carbon emissions.

Hydrogen, when used in a fuel cell, only produces water as a byproduct making it an emissions-free fuel. It can be used for several applications, such as transportation for hydrogen fuel cell vehicles, electricity generation, and as a cooking fuel. It also has promise for decarbonizing industries that are currently difficult to electrify. It can also be stored and moved via pipelines, however, there are significant technological hurdles that need to be overcome in production, storage, and transportation to make hydrogen commercially viable on a large scale.

Mandates and Incentives

Mandates will boost the presence of particular resources in the regional fuel mix. However, mandates are not necessary to achieve renewable market penetration.

The relative cost of solar and wind technologies has been falling per installed MW. Utility-scale solar has seen a 90% decline in levelized cost over the past twelve years, and wind's levelized cost has dropped by 72%.[113] It is likely that costs will continue to fall, even if not at the same rate. It is a natural outcome of development that the pace of improvement slows when constrained by the laws of physics. Solar and wind technologies are likely experiencing

[111] United States Environmental Protection Agency. "Overview of Greenhouse Gases." United States Environmental Protection Agency, November 19, 2021.

[112] It should be noted that while color coding of the source is common in the industry, it also has not been standardized.

[113] Lazard, "Lazard's Levelized Cost of Energy Analysis – Version 15.0," 8-9.

diminishing returns, and while improvements are undoubtedly forthcoming, the rate at which the technologies become cost-competitive on an unsubsidized levelized basis will vary.

Regionally, renewables will make up an increasing percentage of our fuel mix. At the same time, if cost-effective electricity is a critical goal, it is also important to ensure that generation markets maintain the ability to deliver transparent, efficient price signals to resources either currently participating in the market or to those that may enter the market. Currently, federal and state energy policies, not competitive markets, are the primary drivers of the construction of renewable resources in New England. Renewable portfolio standards reshape the market to guarantee an increasing fraction of generation to a designated set of technologies.

Nationally, the growth in renewable energy has been largely driven by preferable tax treatment. At scale in New Hampshire, renewable technologies are not at cost parity unless factoring in subsidization, credits, incentives, or mandates. This negatively impacts the operation of wholesale electricity markets and threatens the economic viability of otherwise-competitive conventional generators. Low wholesale prices or low bids into wholesale markets do not necessarily mean a low cost of production. In the case of many renewables, it means a high rate of subsidization, where negative bids reflect incentivization to produce electricity regardless of the actual cost of production, or at least the ability to submit negative bids to the extent commensurate with the level of subsidization.

Where federal and state energy policies lower the effective cost of renewable resources, electricity market prices will decrease. This may benefit ratepayers in terms of the price of electricity, but there is no free lunch—artificially low prices achieved through subsidization are paid for through other taxpayer or ratepayer mechanisms.

If intermittent resources displace other generation sources in the wholesale market, absent cheap storage capacity, on-call resources will still need to be maintained to run when the intermittent resource is not generating. This infrastructure reality imposes costs on consumers: first, in the form of taxes or rates to cover the incentivization of the construction of particular technologies; and second, in maintaining on-call generation infrastructure to be utilized when intermittent resources are not able to produce. It may also have negative environmental effects as fast start fossil-fired generating units need to come on line quickly to replace intermittent resources, per unit emissions may increase.

Policy makers should not enact any new mandates that place additional burdens on ratepayers or taxpayers.

Distributed energy resources

Distributed Generation (DG) represents a shift from a utility-dominated and large centralized system to a diffuse, smaller-scale generation infrastructure design. DG has been increasingly studied and implemented as benefits include greater flexibility in system designs as well as improved reliability and resilience. While there is the potential for duplication and vulnerability, DG brings opportunities and the possibility of designing an electric grid that meets New Hampshire's needs moving deeper into the 21st century. Advancements in technologies like battery storage have the potential to contribute to a grid that is decentralized and open for rapid innovation.

A critical issue with DG is how to value generation. It may be easy for a single producer to measure a DG investment against offset costs, but the value of grid-tied resources is not easily discerned. Dynamic pricing mechanisms appear to be essential to DG integration at scale to adequately value the power provided by DG assets based on real-time market conditions.

Net metering

Net metering is an arrangement between a customer and the utility which permits the customer to operate a small generation resource behind the customer's meter and receive compensation for the value of the electricity exported to the grid after the customer's own load is reduced by the customer's own on-site distributed generation output over the relevant period.

New Hampshire's net metering regime has evolved and continues to evolve to reflect new entrants, new information, and new management structures, as well as legislative amendments. In 2016 legislation was passed that authorized and directed the PUC to conduct a proceeding to adopt a new alternative net metering tariff, based on certain enumerated criteria. The PUC opened its net metering docket[114] and an order was issued on June 23, 2017 that adopted an alternative net metering tariff to apply from and after September 1, 2017.[115] In summary, the Commission accepted common elements of two settlement proposals, resolved several differences between those two settlements, and determined the mandatory provisions of an alternative net metering tariff to remain in effect while further study and data collection was conducted. In 2021, HB 315 was enacted, raising New Hampshire's net metering cap from 1 MW to 5 MW for net-metered projects developed by group net metering hosts for groups

[114] New Hampshire Public Utilities Commission. "DE 16-576 Electric Distribution Utilities Development of New Alternative Net Metering Tariffs and/or other Regulatory Mechanisms and Tariffs for Customer-Generators." New Hampshire Public Utilities Commission.

[115] New Hampshire Public Utilities Commission. "Order No. 26,029." In *DE 16-576 Electric Distribution Utilities Development of New Alternative Net Metering Tariffs and/or other Regulatory Mechanisms and Tariffs for Customer-Generators.* New Hampshire Public Utilities Commission, June 23, 2017.

including only political subdivisions as group members.[116] The lower 1 MW cap was retained for all other net-metered projects.

Over the past several years, the Department of Energy, in collaboration with stakeholders, have been collecting and analyzing data to better understand New Hampshire-specific net metering features. A locational value of distributed generation study was completed in 2020 and a value of distributed energy resources (VDER) study is nearing completion. There is a concern that the net-metering provisions as they currently exist may shift costs from those who net-meter to those who do not. Policy makers should be concerned with such potential cost-shifting not only from a ratepayer standpoint, but also from an equity standpoint, based on observed discrepancies in income levels of those who install solar panels and those who do not. To the extent that unreasonable cost-shifting does exist, it is likely that more affluent DG system owners may capture greater benefits than do middle- and lower-income customers. The VDER study is anticipated to address the level of potential cost-shifting between customers with net-metered DG resources and those without such systems, although not in a precise or definitive manner.

The VDER study should provide greater insight on whether unreasonable cross-subsidization and cost-shifting is occurring under the current net metering tariff structure, but the study will not provide a ready-made model or set of parameters for the next iteration of a net metering tariff design. All existing net-metered systems are grandfathered through 2040 at their current net metering tariff structures. The PUC will open a new proceeding in the future to revisit its prior determinations and to replace or modify the current alternative net metering tariff, as may be found to be warranted based on the. additional data and analysis available. Under RSA 362-A:9, XVI (a), as recently amended, the PUC must now consider balancing the interests of customer-generators with those of electric utility ratepayers "by maximizing any net benefits while minimizing any negative cost shifts from customer-generators to other customers and from other customers to customer-generators."

<u>In assessing the current net metering tariff structure and in the design of future net metering policies, it is important to determine whether cost-shifting among ratepayers is occurring, and if so, to develop better, more cost-reflective rate designs to avoid or at least minimize such cost-shifting among ratepayers.</u>

Renewable Portfolio Standard

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. The RPS requires electric service providers, including distribution utilities and competitive suppliers, to acquire a certain percentage of supply from renewable energy sources. In total, the 2021 RPS mandate calls for

[116] NH General Court. "Relative to the aggregation of electric customers and municipal host customer generators serving political subdivisions." HB 315, 2021.

21.6% of electricity sold to retail electric customers to be generated by renewable energy sources, with a goal of 25.2% by 2025. Under the New Hampshire RPS structure, applicable renewable energy sources are organized into four classes:

- Class I: New (after 2008): wind; hydrogen derived from biomass fuel, water 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 statute;
3. In certain situations, directly invest in eligible renewable projects (such as through RSA 374-G).

The RPS framework depends on mandates that segment renewable technologies from each other and from the broader wholesale electricity market. Achievement of the goals underpinning the establishment of the RPS therefore necessitates administrative selection of technology types that will be afforded varying degrees of protection from market pressures. This reality runs the risk of favoritism, inefficiency, and a constant tension among RPS-eligible resources for relative benefit.

In addition to fuel diversity, a prominent goal of the 2007 RPS statute is "employing low emission forms of such technologies [as] can reduce the amount of greenhouse gases, nitrogen oxides, and particulate matter emissions transported into New Hampshire and also generated in the state…."[117] If reducing carbon emissions is a primary objective, then in order to have conceptual consistency, the RPS must include other zero-carbon or low-carbon resources. Additionally, while in tension with the goal of fuel diversity, the pursuit of emissions reductions would justify breaking down artificial barriers between classes that restrict competition. If the goal is to pursue the most cost-effective low-carbon options, then "siloing" energy technology types thwarts that outcome.

[117] NH General Court. Electric Renewable Portfolio Standard. Revised Statutes Annotated 362-F:1. 2007.

In current statute, the RPS excludes nuclear power under the assumption that it is not a renewable fuel. This is correct under a mechanistic definition where "renewable" means an energy source/fuel type that can regenerate and can replenish itself indefinitely. However, it is somewhat artificial to draw a distinction between a fuel that can replenish itself indefinitely even where there may be significant resource and environmental impact to capture the energy in that fuel. Solar panels, wind turbines, biomass plants, methane gas, thermal infrastructure, and hydroelectric dams all require non-renewable material to capture the value of their associated fuel type. Many renewable technologies depend on acquiring scarce resources, and the interruption of supplies limits production. Additionally, production of the material for, and construction of the sites themselves for all these infrastructure types has natural resource and environmental impacts. An indefinitely replenishable fuel is only one component of sustainable electricity production. Achieving the more concrete RPS goal of emissions reductions would be better served by making eligible zero-carbon resources that are currently excluded.

In summary, **<u>segmentation of the RPS that limits competition among generation technology types should be eliminated over time. The RPS should be evaluated as to whether it should be expanded to include other zero-carbon resources and to pursue the most cost-effective low-carbon options.</u>**

Opportunities for New Hampshire

The risk with any policy is that it misidentifies the most efficient source of achieving the policy goal. New Hampshire energy policies have often promoted the value of renewable energy technologies without corresponding concern for cost. New Hampshire needs efficient and cost-effective electricity generation that preserves our state's natural resources. Competition from new entrant technologies should be encouraged without segmenting production types into price-insulated silos with mandates. Additionally, state policy should refrain from picking winners and losers by subsidizing certain technologies on the backs of ratepayers and at the expense of healthy market pricing pressures. Renewable technologies will continue to grow in importance and market impact, and market selection should steer those investments, especially as costs continue to fall, making them competitive with traditional generation.

It should be an objective to seek an outcome where production technologies are not subsidized by ratepayers or taxpayers. Rapid shifts in public policy are difficult, and care must be taken when altering policies and incentives that impact existing investments and resources. That said, a status quo that uses preferential policy to allow incumbents—of any technology type—to freeze out competition should be unacceptable.

The distinction must be made between subsidization-created infrastructure, and investments justified by market conditions. Uneconomic resources would not exist absent subsidization, yet those same resources may be wise investments in the near future when cost curves are more favorable. A crucial question therefore is whether New Hampshire taxpayer and ratepayer support is essential for a particular technology, at a particular time.

An undesirable outcome would be for developers to pursue uneconomic investments in generation that require ongoing subsidization in order to participate in electricity markets. Policy makers should be especially wary where the entirety of a resource's production life depends on subsidization to operate. The end goal with energy infrastructure should be healthy market competition where the technology competes on its merits and the risks are borne by those who invested their capital.

Other New England states are pursuing various policies to expand renewable energy footprints and market presence. While New Hampshire stakeholders can learn from the successes and failures of such policies, New Hampshire should seek the most appropriate investments and goals given our state's geographic location, environmental considerations, land use requirements, and need to deliver cost-effective electricity.

<u>Community Power Aggregation:</u>
Community power aggregation (CPA), authorized under New Hampshire RSA 53-E, permits cities, towns, and counties to adopt plans that provide for the aggregated supply of electric energy to customers within their boundaries, including residential customers and commercial and industrial customers.

CPAs may work with a competitive electric power supplier to procure their electric energy supply, or they may participate directly in the wholesale power markets and serve as the "load-serving entities" for their customers. CPAs may effectively serve as the default electricity suppliers within their municipalities or counties and are intended to self-fund through revenues received from participating customers rather than from local taxpayers. The local electric distribution utilities continue to own and operate the "poles and wires" and to deliver electricity to all customers in the CPA service area.

CPA plans are proposed and adopted through a democratic governance process at the local level, consistent with the RSA 53-E requirements. The plans must be filed with and reviewed and approved by the PUC. To date, several cities and towns have adopted CPA plans which will be reviewed and approved by the PUC once its final administrative rules have been adopted and are in effect.

CPAs may procure electric energy supply for their participating customers at favorable prices, due to purchasing power and economies of scale, and therefore potentially charge lower rates to their customers. CPA programs may also offer innovative services and rates for customers, potentially including 100% renewable energy premium products, time-varying rates, and net energy metering generation credits for customers with solar PV or other distributed generation systems.

Heating

New Hampshire remains reliant on oil as a source of home heating as shown in Figure 3.3. New Hampshire ranks second in the nation in oil heating per capita, with 42% of New Hampshire citizens using oil as their primary source of heat in 2019. Six percent of New Hampshire households also rely on wood as a primary source of home heating. Based on other data available, roughly 20% of those classified under 'Electric Heat' use heat pumps, roughly 2% of statewide total. Correspondingly, New Hampshire has a much lower share of households using natural gas and electricity for heating than the national average.[118]

Residential customers in 2019 in New Hampshire consumed 8 billion cubic feet of natural gas, 179 million gallons of oil, and 117.6 million gallons of propane.[119] The vast majority of this consumption was home heating related, although in the case of propane and natural gas there are other non-heating related household uses, such as hot water heaters and dryers. Total consumption of oil and propane has varied since 2000 ranging between 197 million gallons and 313 million gallons. This wide range in demand is largely driven by weather patterns, with years with colder winters seeing increased demand and warmer winters less.

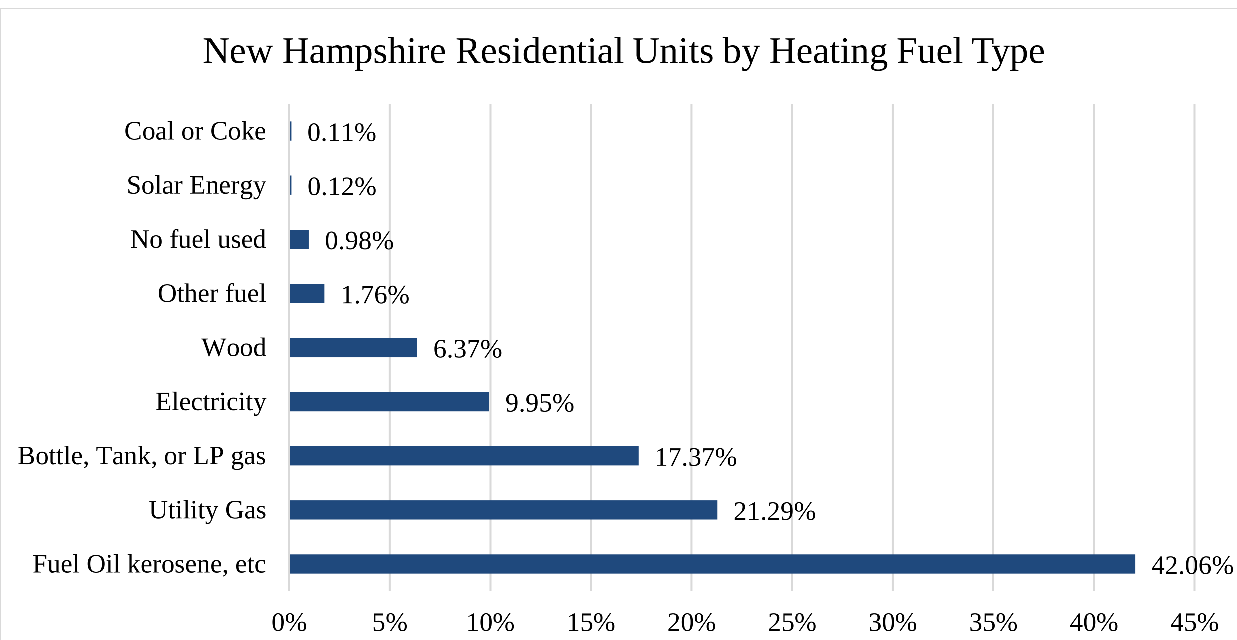

Figure 3.3

Source: 2019 American Community Survey

[118] United States Census Bureau. "2019 American Community Survey – Table B25040 (Home Heating Fuel)."
[119] U.S. Energy Information Administration. "State Energy Consumption Estimates, 1960 Through 2019." U.S. Energy Information Administration, June 2021, 331.

The dearth of new natural gas capacity drives prices for that fuel higher and high electricity costs limits its attractiveness for heating customers who could potentially transition to those sources from higher carbon emitting sources of heating fuel, primarily heating oil.

Wood pellet heating systems offer a potential replacement system. Increased use of wood would not only reduce carbon emissions but provide a new and large market for New Hampshire's low-grade wood. With so much of the debate around biomass plants centered on finding a market for the low-grade wood harvested from New Hampshire forests, enhanced use of wood pellet systems for home heating could provide some relief to that market without the need for subsidies or mandates on electric generation.

In some circumstances, heat pumps make sense as a replacement for high-cost carbon intensive systems. Put in the simplest terms, heat pumps function the same as an air conditioning unit works, except run in reverse. Heat pumps are very efficient and technological improvements have largely overcome the issues with keeping homes warm on the coldest days of the year.

Renewable natural gas is also a potential replacement fuel for home heating. Generated from the decomposition of organic matter, such as from landfills, agricultural and wastewater treatment byproducts, and biomass, this gas can be used within the existing distribution networks and with existing equipment. Using renewable natural gas has the added benefit of not only taking a waste product and finding a market for it, but it also significantly reduces the release of methane, a significant contributor to climate change.

State and local policies should not force the early replacement of heating systems, or unreasonably interfere with a home or business owner's choice in fuel source. State and municipal regulations, outside of basic safety codes, should wield a light regulatory touch on these or other types of replacement heating systems to minimize cost and ease adoption of new technologies.

Transportation

Transportation accounts for just under a third of the total end use of energy in New Hampshire.[120] Gasoline and diesel, which have been the dominant fuel source for decades for road vehicles, are on the precipice of being challenged by EVs.

[120] U.S. Energy Information Administration. "New Hampshire State Profile and Energy Estimates." Profile Overview.

Gasoline and Diesel:

Gasoline and diesel are the dominate fuel source for transportation in New Hampshire. The state consumes roughly 741 million gallons of gasoline per year, and 103 million gallons of diesel per year.

Demand Projections:

Gasoline consumption pre-pandemic had been growing between .7% and .8% per year, while diesel consumption peaked in 2018, and fell slightly in 2019.[121] As is the case with many other facets of life post-pandemic, it is unclear if demand will return to pre-pandemic levels, or not. Data, though incomplete for 2021, suggests that demand for both gasoline and diesel is above 2020 levels, but still short of 2019 levels.[122]

Electric Vehicles:

Since the 2018 Ten-Year State Energy Strategy, there has been growing momentum for electric vehicles driven by a number of factors, including federal government action, actions taken by vehicle manufacturers, attractive federal tax incentives, high gasoline and diesel prices, and consumer demand. Those tax incentives could grow even more attractive depending on ongoing policy discussions in Congress. All of these combined actions will dramatically increase market share for electric vehicles that likely would not have happened so rapidly in their absence. Continued improvements in technology have also reduced the cost difference between gasoline and diesel-powered vehicles.

Currently, electric utilities are encouraged to provide incentives for EV charging by aligning the time-varying costs on the electric distribution system with the price signals sent to EV charging via time-of-use rates. Realizing that EV owners cannot always choose the time of day to charge, an EV charging station owner on a time-of-use rate could choose whether to pass any potentially higher electric costs incurred by charging during peak periods on to the EV customer or absorb the costs. With the expansion of electric vehicle ownership, the electric utilities will see increased revenues associated with EV charging, which may allow costs to decrease for other customers since total distribution system costs will then be spread across more electric consumption. Further, any such increase in revenues could also allow the electric utility to offset, over time, any costs associated with make-ready infrastructure expenses or other EV incentives with the increased revenues from the electric vehicle charging.

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[121] United States Department of Transportation. "Monthly Motor Fuel Reported by States – December 2016." United States Department of Transportation, March 31, 2017; "Monthly Motor Fuel Reported by States – December 2017," April 16, 2018; "Monthly Motor Fuel Reported by States – December 2018," June 21, 2019; "Monthly Motor Fuel Reported by States – December 2019," June 10, 2020.

[122] United States Department of Transportation. "Monthly Motor Fuel Reported by States – November 2021." U.S. Department of Transportation, March 10, 2022.

Regulatory principles of cost-causation should be paramount in developing rates and infrastructure to minimize cost shifting. With the use of market price signals to discourage peak electric load growth through data and information, incentives, such as time-of-use rates, and other tools, such as smart meters or the embedded meters in the charging station, the development of a useful EV charging network can be done in a more cost conscious manner.

A portion of the VW settlement funds will be used to help defray electric vehicle charging stations costs for those which will be located in primary transportation corridors in the State. Additional federal funds through the IIJA should be targeted to rural areas unlikely to see private businesses or developers install them.

To assist in the placement of additional charging stations in the lowest cost areas of the electric distribution system, the utilities can facilitate charging station location by providing maps showing the gradation of development costs throughout the distribution system to encourage the placement of charging stations in lower cost areas.

The state should continue to take advantage of federal funds and other non-rate payer sources to build out electric vehicle charging infrastructure.

State policy should continue to pursue and adopt price reflects variation in cost over time for EV charging.

Demand Projections:
ISO-NE projects that regional demand for electricity for transportation purposes will increase to 3,554 GWh by 2030, up from only 47 GWh today. New Hampshire will see an increase to 199 GWh by 2030, up from 7 GWh today.[123] However, this only makes up roughly a quarter of the total demand increase anticipated.

Propane, Natural Gas, and RNG:
Propane and natural gas powered vehicles are growing in popularity as a replacement for diesel, especially for fleet vehicles, such as delivery vehicles and school buses. Propane and natural gas have the same flexibility that gasoline and diesel provide in terms of refueling times but provide additional benefits in reduced carbon emissions and especially in reduced fine particulate matter. Using renewable natural gas, derived from landfills, biomass, and other sources would further reduce carbon emissions.

[123] ISO-New England. “2021 Regional System Plan,” 39.

Section 4: Demand-Side Resources

Demand-side resources refer to products and services that modify consumer demand for energy while providing the same or better level of customer satisfaction. The definition includes anything that measurably reduces end-use demand for electricity from the power system. Demand resources include energy efficiency (EE), demand response (DR), and distributed generation (DG).

Energy Efficiency

Energy efficiency (EE) has been and continues to be a low cost and clean energy resource. Investing in efficiency boosts the state's economy and reduces energy costs for consumers and businesses. New Hampshire should continue capturing cost-effective energy efficiency in all sectors, including buildings, manufacturing, and transportation.

New Hampshire has modest but evolving EE programming. 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. Efficiency benefits more than just those customers who participate in efficiency programs. Reducing electricity consumption, especially during expensive peak times such as the hottest and coldest days of the year, saves money for everyone on the system. For reliability purposes, our energy infrastructure is built to meet the needs during peak demand. Reducing that peak means spending less on expensive transmission, distribution, and generation infrastructure. Peak demand generators are the costliest type of generation and tend to be very carbon intensive.

EE efforts are projected to significantly impact both peak demand and gross electricity usage. ISO-NE projects that EE measures in New Hampshire will reduce electricity consumption by 53,000 MWhs a year, on average, from 2021 through 2030.[124] This is derived from anticipated EE investments of $67,186,000 annually from 2021 through 2030.[125]

<u>State Energy Efficiency Programs</u>

The PUC furthered energy efficiency work initially through the Core programs, with savings goals largely based on funding availability. On August 2, 2016, the PUC issued Order No. 25,932, approving an Energy Efficiency Resource Standard (EERS) settlement agreement.[126]

The second triennial plan for 2021-2023 was submitted for consideration at the PUC in September 2020 and met with delays due to COVID-19 pandemic and turnover in PUC commissioners. In November 2021, the PUC issued Order 26,553 that reduced the funding

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124 ISO-New England. "Final 2021 Energy Efficiency Forecast," 28.

125 *Ibid* 30.

126 New Hampshire Public Utilities Commission. "Order No. 25,932."

available and made significant changes to how the programs would operate going forward and to performance incentives and metrics.

Following the issuance of PUC Order 26,553, the state legislature passed and Governor Sununu signed, House Bill 549, which returned New Hampshire utility Energy Efficiency programs from an energy efficiency resource standard to legislatively set Energy Efficiency budgets. The legislation also set clear guidelines on program requirements, metrics, and evaluation. Going forward, HB 549 will provide significant stability to the utilities, businesses, households and other stakeholders involved in New Hampshire energy efficiency.

Successful implementation of the new State Energy Efficiency Planning program will provide stability to an important segment of New Hampshire's energy economy, enhance cost-effective energy efficiency programming, and balance the benefits of the programs with the costs paid by New Hampshire's ratepayers.

Electric Generation:

Demand Response

Demand Response (DR) refers to a suite of services that focus on getting electricity users to reduce power use during specific peak periods when supply is short and electricity is most expensive. DR has grown 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. DR directly targets particular users, buying usage management with payment, which enables reductions in load that are requested at specific times by the utility or grid operator.

ISO-NE's DR programs began in 2001, and participation has grown from 63 MW to thousands of MW, largely through integration with the forward capacity market.[127] DR is eligible to participate in the forward capacity market alongside traditional generators and receives payment for reducing load when requested by ISO-NE. 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.

DR resources can be active or passive. Active resources are those that offer the real-time ability to reduce electricity use within 30 minutes of receiving ISO-NE dispatch instructions, while passive resources reduce electricity consumption during peak hours.[128] Peak load reductions (referred to as "peak shaving") results in savings across the entire regional grid for all customers

[127] ISO-New England. "About Demand Resources."
[128] *Ibid.*

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 infrastructure.

"In June 2018, active demand resources were fully integrated into the regional wholesale electricity marketplace through the ISO's Price Responsive Demand program. With the new framework now in effect, active demand resources are fully part of the market and reserve market systems and are dispatched economically based on their market offers, just like power plants and other supply resources."[129] These types of measures help reduce consumption, especially during peak times, and does so effectively and efficiently through pricing mechanisms that incentivize the reduction in electricity usage. The increasing maturity and flexibility of DR markets is likely to continue to allow stakeholders to respond to demand through the pricing signals of competitive markets.

While DR has largely focused on commercial and industrial customers, with the increasingly digital sophistication of homes there is the potential to facilitate widespread residential DR programs and services. Increasing DR utilization by New Hampshire's utilities and customers would enhance energy efficiency and grid management goals. The development of new structures and programs that economically integrate DR resources represents a successful growth of competitive markets, and, as opposed to state action, is likely to be the most cost-effective mechanism to incentivize DR adoption. Again, cost reflective time varying rate designs should be an integral aspect of any demand response programs.

Home Heating

Reducing heating costs is a goal of every renter, homeowner, or business owner. Heating costs constitute a significant portion of a family's or business's expenses during the colder months. Reducing heating costs not only means more disposable income for New Hampshire's residents, families, and businesses at the end of the month, but a reduction in carbon emissions.

<u>Weatherization:</u>
Newer construction in the state tends to be heavily insulated with additional measures such as double and triple paned windows becoming more commonplace. New Hampshire also has a significant portion of house stock that is older and more difficult, although not impossible, to insulate.

Conducting energy efficiency measures and home insulation upgrades can be difficult for low-moderate income Granite Staters to afford, even though these upgrades make financial sense in the long-term. The New Hampshire Department of Energy runs the Weatherization Assistance Program through the Community Action Agencies (CAA) to assist low income Granite Staters in

[129] *Ibid.*

insulating their homes. In addition, rebates and other services for home owners and businesses are available through the NHSaves Program, although programs are in currently the process of being restored and reopened after the passage of HB 549 (2021).

Zoning for Increased Density:

Increasing zoning density for both residential, commercial, and mixed used buildings would both increase energy efficiency for both heating and transportation as well as reduce demand.
For energy efficiency, the average single family detached home uses nearly three times more energy than an apartment in a building of five or more units.[130] People living in detached single-family units also consumed significantly more energy both per household and per person, than people living in any other type of structure.[131] This is for a variety of reasons, including smaller living spaces, and the benefit of reduced exposure to the outside environment, leading to dramatically reduced heating and cooling costs in particular.

Increased density also makes for neighborhoods where it is possible to live, work, and shop all within a small area, increasing the viability of public transit and encouraging other self-propelled means of transportation such as walking and cycling.

While increasing density is not viable for every municipality in New Hampshire, or even every neighborhood of a municipality, although those areas with existing water and sewer infrastructure are prime candidates for increased density.

New Hampshire is between 20,000 and 30,000 housing units short to meet the demand of the state's workforce, including the energy sector, and continued economic growth.[132] Encouraging higher density construction through changes to municipal zoning ordinances, would be a viable path to increase the number of housing units in the state while not sharply increasing energy demand as well.

Transportation

Simply lowering transportation energy usage is a blunt goal that ignores the importance of travel and transport to our lifestyle and economy. Instead, New Hampshire should seek to reduce the energy intensity of transportation activities, without discouraging the activities themselves.

New Hampshire does not require a wholesale rethinking of transportation infrastructure to achieve energy efficiency gains. Incremental improvements in traveler behaviors and purchasing

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130 U.S. Energy Information Administration. "Use of energy explained – Energy use in homes." U.S. Energy Information Administration, June 23, 2021.
131 La Jeunesse, Elizabeth. "U.S. Households Are Using Less Energy. Joint Center for Housing Studies of Harvard University, July 11, 2018.
132 New Hampshire Housing Finance Authority. "Housing Market Report: March 2020." New Hampshire Housing Finance Authority, March 2020, 2.

decisions can continue to improve the energy intensity of passenger-miles, even if determining how to best avoid cost-shifting poses a challenge to properly allocating transportation infrastructure costs. Policymakers should prioritize function over form. The goal should be efficient transportation reflecting consumer preferences, not centralized planning with the hope that building infrastructure will force individuals into new travel patterns. It is unlikely that large public transit infrastructure projects will deliver energy efficient transportation for New Hampshire travelers. Instead of new capital-intensive, publicly-funded infrastructure such as extensive commuter rail systems, enabling personal vehicle options combined with on-demand fleets can deliver high-utilization travel. Transportation energy efficiency is more likely to be achieved with full car seats, not mostly empty train cars.

Given this reality, policymakers should be especially careful with taxpayer investments. Distorting investment incentives through subsidization or mandates – picking winners and losers – obligates ratepayer or taxpayer dollars to particular technologies. Instead, allowing market demand to drive infrastructure investment decisions is more likely to deliver cost-effective energy to consumers over the long term.

Delivering traveler-preferred transportation options also means deriving infrastructure funding based on consumer decisions. Cost-shifting to support legacy infrastructure does not adequately incentivize the utilization of that infrastructure. For example, while highway networks are a public good, they are not uniformly utilized by all New Hampshire residents and visitors. If efficient utilization is the goal, where highway infrastructure experiences capacity limits, consumers should be price conscious. With highway vehicle miles projected to climb over the next decade, it is not sustainable long-term to scale highways directly proportional to the number of vehicles traveling them.[133]

New capital-intensive infrastructure, limiting transportation options, increasing movement friction, or artificially raising costs are not consumer-friendly policies that play to New Hampshire's strengths and values. Instead, optimizing infrastructure is a light-touch energy management strategy that can support consumer choosing more energy efficient transportation options. The most effective near-term energy management strategy for New Hampshire is to efficiently and fully utilize existing infrastructure.

Maximizing infrastructure utilization improves efficiency while helping reduce environmental impacts. Tourism travel is driven by the desire to experience New Hampshire's natural resources. Transportation development should further New Hampshire citizen and visitors'

[133] "Yet even as these emerging modes and solutions garner broad appeal, vehicle miles traveled nationwide are projected to increase in the foreseeable future, threatening to overwhelm our already overburdened road network while impeding reductions in total transportation energy use and emissions." American Council for an Energy-Efficient Economy. "Transportation System Efficiency."

interests in protecting the environmental integrity of our state. Doing so does not mean abandoning private vehicles in favor of public transportation.

It is important to protect consumer-preferred forms of transportation, even where lowering energy intensity of travel is an important goal. With an economy that is fueled by tourism and with few areas in our state having the population density to support extensive public transportation options, it is likely that passenger vehicles will remain the dominant transportation mode for the foreseeable future. However, the energy usage required for car passenger-miles is likely to continue to fall and increased adoption of electric vehicles offers opportunities to reduce energy intensity in the transportation sector without drastic disturbances in consumer behaviors and expectations.

<u>Personal Vehicles:</u>

Personal vehicles are by far the dominant transportation mode in New Hampshire and nationally. Most of the ability to improve efficiency in transportation is with vehicle manufacturers, such as increased miles per gallon and technologies that reduce idling by turning off the engine while the vehicle is in gear. There are a number of actions the state and municipalities can make to improve vehicle efficiency by make changes that reduce idling times, reduce congestion, and ultimately reduce the amount of wasted energy. This is by no means exhaustive, but potential options include:

Traffic signal timing: Traffic signals operate in two basic ways, either a fixed cycle where the same sequence is repeated without regard to traffic flow or activated cycle where the traffic signal is made aware of the presence of a vehicle whereby means of some detection system, usually an induction loop in the pavement. In this system, the traffic signal can “skip over” giving a green a direction or turning lane where there is no vehicle waiting, meaning that traffic moving in other directions or turning lanes do not have to stop for a non-existent vehicle. In doing so, these types of signals reduce unnecessary idling times.

Traffic signal coordination: A series of traffic signals may also be coordinated, allowing groups of traffic to move through without having to stop at every single traffic light in the series. This reduces the amount of idling and emissions by significantly reducing the numbers of accelerations and decelerations.

Roundabouts: In recent years, the state and local communities have built dozens of roundabouts across the state. Roundabouts efficiently process traffic, reducing idling and congestion. The state and municipalities should continue to build roundabouts in lieu of traffic signals in places where the traffic patterns make sense for roundabout installation.

All Electronic Tolling: New Hampshire's Turnpike System has seen tremendous benefits from the move to Open Road Tolling at the Hampton and Hooksett mainline tollbooths. Allowing EZ Pass holders to pay their tolls while maintaining highway speeds eliminates the need to slow down, or stop entirely to pay the toll, only to accelerate back to highway speeds. Open Road Tolling preserves the option for those without a transponder to stop and pay at the toll. However, moving to All Electronic Tolling for the New Hampshire's Turnpikes system would build on those successes. There are projects under consideration in the proposed 2023-2032 Ten Year Transportation Improvement Plan to replace mainline toll plazas in Rochester, Dover, and Bedford with All Electric Tolling.[134]

Bike Lanes, Rail Trails and Sidewalks: The least energy intensive (at least from a grid and fuel perspective) is walking, biking, and other forms of self propelled transportation. The state and municipalities should continue to make investments in these types of projects to encourage non-motorized transportation for short trips.

<u>Mass Transit:</u>

Mass transit can perform essential functions in certain circumstances, notably, where population density allows infrastructure to be highly utilized. There are certain concentrated areas of New Hampshire that can benefit from mass transit, and many more areas where mass transit is not an economically advantageous method of providing transportation. Mere availability of mass transit is not beneficial to New Hampshire--utilization and cost-effectiveness should determine where and when mass transit modes are merited and necessary. In addition, the long term impact of the COVID-19 pandemic on commuting patterns remains to be seen, especially with whether work from home arrangements will become permanent.

Commuter travel is significantly impacted by land use policies and the availability of housing to workplaces. Highly dispersed development and lower-density residential growth will proportionally increase vehicle miles. Policies making transportation more difficult or expensive can cut against consumer living preferences. At the same time, transportation costs should not be disassociated from housing preferences. Cost-shifting to support long commutes leads to inaccurate pricing of living decisions.

From an energy use perspective, low utilization of capacity results in poor energy intensity. So even while optimal use cases for mass transit have remained steady, the ridership trends, expectations, and energy efficiency gains have changed such that relative energy consumption

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[134] New Hampshire Department of Transportation. "The New Hampshire Department of Transportation's Recommendations for the Ten-Year Transportation Improvement Plan 2023-2032, Projects Only, Submitted by the Governor to the Legislature as a Draft for Consideration and Approval." New Hampshire Department of Transportation, January 12, 2022, 11, 48.

among transportation modes has shifted. Passenger rail's popular routes have the lowest per-passenger-mile consumption rates of major transportation modes, but transit buses are on average more energy intensive than passenger cars and light duty trucks.[135] Energy expended per passenger-mile has fallen by nearly 52% for passenger cars over the past forty-eight years, while that for transit buses has increased by roughly 46%.[136] However, calculation is based on an average passenger load factor of a transit bus being 7.7 persons. This highlights the fact that low utilization can result in poor energy intensity.

New Hampshire should seek low-cost, flexible, and consumer-focused solutions that recognize our state's population densities.

Bus Service: New Hampshire has seen tremendous success in intercity bus service through Boston Express, Dartmouth Express, Concord Coach, and C&J. With minimal state investment, these companies offered multiple departures a day from Boston South Station and Logan Airport to multiple destinations across New Hampshire, with multiple departures per hour during rush hour. These services proved to be incredibly popular for both commuters and leisure travelers. In the wake of the COVID-19 pandemic, service has slowly been restored as demand has risen.

One easy and low-cost solution to improve bus service is the use of dedicated lanes. Detractors of increased bus service often point to the fact that busses are at the mercy of traffic just as much as a personal vehicle. By designating a bus only lane on highways during peak congestion will allow busses to bypass traffic reducing travel times for passengers. For motorists stuck in traffic, seeing these busses go past them at highway speeds will make a better case to utilize transit than any ad campaign ever could.

Passenger Rail: Even while delivering energy efficient transportation in certain conditions, passenger rail infrastructure is expensive, immobile once built, and rarely provides users with a one seat ride. Rail passengers often utilize another mode of transportation at each end of a rail trip. System changes to respond to new or diminished demand are often difficult. Rail may offer a subset of travelers an energy efficient mode of transportation but is more likely to serve a niche population of persons who consciously choose it as transit means and those who have no other option. Passenger rail is most competitive at attracting riders when the travel times are less than driving a person vehicle.

<u>Freight Rail:</u>

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[135] Btu per passenger-mile: commuter rail (1,603); cars (2,840); light trucks (3,388); and transit buses (4,560). Davis, Stacy C., and Robert G. Boundy. "Transportation Energy Data Book," 39 ed. Oak Ridge National Laboratory, Managed by UT-Battelle for the US Department of Energy, February 2021, 2-19, 2-20.

[136] *Ibid*, 2-19.

Shipping freight by rail is one of the most energy efficient ways to move goods and raw materials, with only one gallon of diesel fuel needed to move a ton of freight 480 miles, at between 25% and 33% of the carbon emissions truck. Railroads account for roughly 40% of all U.S. freight volume, yet only accounts for 2.1% of all transportation-related carbon emissions.[137]

Railroad lines were once ubiquitous across the state, with every town of any size served by at least one railroad station. By the mid-20th century, passenger and freight traffic began shifting to automobiles, trucks, and airplanes, and rail service was drastically curtailed, and lines abandoned or turned over to the state.

There are a handful of Class III railroads in the state operating on either their own lines or on state owned rail lines, mostly serving specific industries. Pan Am Railways, the successor to the venerable Boston and Maine, put itself up for sale in 2020 and was purchased by CSX Transportation, a major Class I Railroad, with roughly 21,000 miles of track. The acquisition was recently approved by the federal Surface Transportation Board.

CSX has indicated that they are not planning on abandoning any lines in the state, but instead are planning on upgrading existing lines, allowing increased speeds. By improving speed, reliability, and on time performance through these investments, it will make shipping by rail more viable and attractive to businesses in the state.

As these rail lines are revitalized or used more frequently, community engagement on behalf of the railroad is critical for long term success. Residents who are used to neighboring rail lines that are rarely or never used need to have their concerns with increased or revived service listened to and addressed appropriately. At the same time, local and state authorities should not impose regulations designed to stifle or prevent renewed or increased use of rail lines.

[137] Association of American Railroads. "Freight Railroads & Climate Change."

Section 5: Siting

Siting energy infrastructure is both challenging and necessary. A cheap energy resource is rendered either expensive or irrelevant if the cost to utilize it is high or it cannot be sited. New Hampshire needs energy systems that meet current and future needs with minimally disruptive impact and at low cost. Delivering this appropriate energy infrastructure requires predictability, defined processes, good communication, and clear standards for achievement.

Energy system infrastructure requires continual investment, whether to maintain access to existing resources or for the integration of new resources. This reality necessitates ongoing consideration of siting--where and what assets can be built to deliver energy as needed. The questions of what and where often highlight tensions between individual or small community interests, and collective interests. For example, the cost of infrastructure that benefits a smaller group may be socialized across a larger population, or infrastructure necessary to deliver a collective benefit may impose unequal costs or burdens on a smaller group or community. Responding to these issues is difficult and requires balancing numerous interests but does not remove the necessity of siting appropriate energy infrastructure to meet New Hampshire needs.

Process considerations

Predictability in state policy and review processes allows stakeholders to more accurately gauge the likelihood of outcomes. Uncertainty in how a proposal, investment, or action will be received creates instability and inefficiency. Investments become riskier, products or projects may become less valuable or outdated, and stakeholders bear the burden of ambiguity. Siting processes should be efficient, timely, and as straightforward as possible.

Clear standards for achievement and defined processes reduce regulatory risk which, while not guaranteeing a successful outcome, reduces financial risk. Too often in public dialogue the merits of a project or proposal are debated outside the context of statutory or regulatory guidelines. This discussion can be healthy, but debate in the public square should not cloud the procedural duties of governmental reviewing authorities. While statutory structures may impose requirements on assessments, state authorities should endeavor to frame energy system siting reviews within the context of energy infrastructure needs. As complexity obscures thresholds for achievement, governmental bodies should seek simplicity in execution to enable streamlined processing.

Communication with all stakeholders is essential to appropriate outcomes, even if those outcomes are not agreeable to all participants in the process. Impacted individuals and groups should have opportunity to express their opinions, but governmental review must still be limited to the often-narrow questions imposed by law. Executive entities are bound by statute and rulemaking, so frustration with review structures should be directed at later legislative or administrative amendment rather than mid-process modifications. In-review shifts – moving the goalposts – are more likely to corrupt the defensibility of outcomes. Review processes should enable the pursuit of New Hampshire's needs and values, the definition of which for government action necessarily resides in law.

To facilitate infrastructure investments, clear, defined, and streamlined processes should be established to deter delays. A fair and transparent business and regulatory environment must exist for investment to take place in New Hampshire. To ensure that projects can be built, the state must prevent unnecessary delays and a climate of uncertainty. Additionally, New Hampshire's siting process should allow facility owners a streamlined process that allows regulated entities a timely means to conduct necessary repairs, maintenance, or replacement of vital facility components.

Infrastructure projects are often stymied by permitting and siting barriers or delays. It is essential that any infrastructure improvements or expansions fit with New Hampshire values and needs. At the same time, interventions that discourage the utilization of low-cost resources such as natural gas raise prices for ratepayers. Inflicting additional costs on New Hampshire residents and businesses has consequences, and those burdens must be weighed against the pursuit of other policy goals.

New Hampshire must answer the questions of what resources and infrastructure will best protect its citizens, economy, and natural resources. There are reciprocal costs associated with all infrastructure decisions, so interests and goals must be balanced to achieve equitable and pragmatic outcomes. Simplistic assertions in opposition of a fuel type's utilization in New Hampshire and New England will not resolve these hard questions but will make viable solutions more difficult to attain.

Transmission: factors driving the need to construct or rebuild capacity[138]

Replacement: Transmission infrastructure wears out. Investments are necessary to replace old, worn-out, and obsolete equipment, and the replacement may require a different footprint to deliver on new needs or to meet current standards.

Reliability: Through 2020, New England made a cumulative investment of $11 billion in its transmission infrastructure. Based on projections, another $1.5 billion in future investment is expected through 2023.[139] A significant portion of that cost growth has been driven by the need

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[138] Hadley, Stanton W. and Alan H. Sanstad. "Impacts of Demand-Side Resources on Electric Transmission Planning." Oak Ridge National Laboratory, managed by UT-Battelle for the US Department of Energy, 2015.

[139] ISO-New England. "Transmission." ISO-New England, 2022.

to meet reliability standards after decades of minimal investment.[140] However, ISO-NE reports that reliability improvements have lowered the risk of blackouts, reduced air pollution, lowered wholesale electricity costs, reduced congestion, and allowed for the interconnection of new resources.[141]

Interconnection of new load or generation: New England has 9,000 miles of high-voltage transmission lines and has added 834 transmission components to the grid since 2002.[142] Twenty percent of electricity consumed in New England is imported from outside the region. Connecting new resources to the grid requires new infrastructure, which raises transmission costs, but which can be offset for consumers if the resource is cost competitive.

Economics: Moving electricity, whether generated in-region or out, requires a capable transmission grid that is balanced to inflows and demand. This infrastructure provides access to the lowest-cost resources by allowing competition on price, not merely on proximity to demand. It also lowers congestion costs and reduces the burden of supply interruptions. Additionally, many of the most scalable renewable resources sites such as hydroelectric and wind are distant from population centers. If these resources can compete based on price, and not through mandate, then getting this potentially low-cost energy into the market will require new or expanded transmission infrastructure.

Resources: siting infrastructure to meet current and future capacity needs

Current demand will shift the utilization of generation resources based on market factors. In particular, variation in the price of fuels or subsidies increases or reduces infrastructure demand for delivered capacity.[143] There is no certainty in predicting the most cost-effective technology stretching decades into the future. For example, few accurately predicted the impact of natural gas on energy markets.

It is clear that New Hampshire and the Northeast region have not developed the infrastructure to support the most plentiful and historically cost-effective energy resource currently available – natural gas. Current pipeline infrastructure has not kept pace with gas-fired generation[144], though nationally natural gas production is expected to continue to increase.[145]

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[140] "Facilities required to meet standards such as those of the North American Electric Reliability Corporation (NERC) and regional reliability councils, but primarily the NERC Planning Standards (1997)." Stanton W. Hadley and Alan H. Sanstad.

[141] ISO-New England. "Transmission."

[142] *Ibid.*

[143] U.S. Energy Information Administration. "Short-Term Energy Outlook." U.S. Energy Information Administration, March 8, 2022.

[144] ISO-New England. "Natural Gas Infrastructure Constraints." ISO-New England, 2022.

[145] U.S. Energy Information Administration. "Annual Energy Outlook 2021 with projections to 2050." Washington, D.C.: U.S. Energy Information Administration, February 2021, 22.

Consumers are hit with higher energy prices when low-cost resources are unable to enter the market. Failure to develop market-demanded infrastructure will only make the Northeast less competitive for businesses and raise the cost of living for residents. The effective quality of life will decline if energy costs surge due to capacity constraints and backfilling by high-cost resources.

The dependability of the region's generation fleet hinges on adequate arrangements for and access to fuel. On cold days natural gas pipelines are running at or near maximum capacity solely to meet heating demand, with little if any capacity for natural gas generators. "During several recent winters, this situation has severely limited the delivery of fuel to much of the region's power plants, which, in turn, threatened the reliable supply of electricity and drove up wholesale electricity prices…."[146]

The most critical current infrastructure need is for natural gas capacity, and as cost curves become more favorable on a levelized basis, a prominent future infrastructure need is the integration of Distributed Generation and renewable resources at scale. The current need for natural gas infrastructure and future need for renewable and DG integration are complementary. The flexibility of natural gas fired plants to relatively quickly increase or decrease electricity generation pairs well with the increasing integration of intermittent resources such as wind and solar. Siting this needed infrastructure should be driven by market signals, not by governmental guesses at what resources should be preferred over the coming decades.

Resource Land Use

There is sufficient land in New Hampshire and New England to house numerous generation types. However, there are competing uses for that land, as well as the community and visual impact of different types of development. Importantly, there is usually a tension between residents' understanding the justification for infrastructure development and the reality that it may be built in proximity to one's home, workplace, or community. There is no easy answer to this tension.

Shifts in demand and the ability of technologies to deliver on market needs will continue to evolve, and there will be corresponding pressures on land use. There is no outcome where energy infrastructure burdens will be eliminated.

Site Evaluation Committee

The Site Evaluation Committee (SEC) reviews, approves, monitors, and enforces compliance in the planning, siting, construction, and operation of energy facilities. This function is essential in engaging local, state, and regional interests to consider energy needs, supply, the economy,

[146] ISO-New England. "Natural Gas Infrastructure Constraints."

environment, and public health and welfare. The SEC's goals to promptly and thoroughly review siting proposals remain critical, but the current SEC process has a burdensome structure and can be streamlined to ensure a more effective regulatory siting structure. A recognition of these shortfalls is needed to ensure New Hampshire's siting process fully protects New Hampshire's values, ensures an adequate supply of energy to meet electricity demand, does not cause undue harm to the state's economy, and balances broader public benefits with individual or community burdens.

There are some significant shortcomings in the current SEC process that limits its effectiveness. For example, the SEC has some ambiguous jurisdictional issues. In some cases, the SEC has the discretion to exercise jurisdiction over energy facility siting, but there is lack of clear and concise guidelines on when a project should be subject to SEC review. The SEC does not have public policy guidance on whether an extensive siting review is necessary for sizable changes or additions to an existing energy facility. In the past, developers could work informally with the SEC to review these issues. However, this informal process has receded to a formal and judicial process that is time-consuming for the SEC, cost-prohibitive for developers, and confusing for the public and other interested stakeholders.[147]

Consistent and knowledgeable membership is needed to ensure the SEC's process operates as intended. Currently, the SEC is made up of nine members, the majority of which are state department heads. It can often be difficult for these SEC members, who already balance full-time jobs in overseeing executive departments, to meet statutory quorum requirements and schedule SEC meetings in a timely fashion.[148] In some cases, department heads can assign designees to assume their SEC role. However, there are no formal qualifications for these designees, and they are often unfamiliar with the SEC process and energy facility siting. The SEC process is also difficult on public members appointed to the SEC who may travel long distances to SEC proceedings in Concord. A lack of consistent SEC membership limits the ability to review energy facility proposals efficiently and effectively.[149]

As a public committee, the SEC has limited permanent support staff to help review project applications, as well as the ongoing monitoring, investigation, and enforcement of siting criteria. The SEC lacks a clear funding structure for that type of work, nor does it have the technical, legal, or administrative support to monitor every energy facility across the state.[150] Other state agencies have their own enforcement processes inspect licensees or permitted facilities.

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[147] Ward, Ruth, Bob Giuda, Michael Vose, Michael Harrington, & Peter Leishman. "Final Report of the Committee to Study Necessary Revisions to the Site Evaluation Committee." NH General Court, November 1, 2021, 4.
[148] Getz, Tom, and Barry Needleman. "How to Fix a Broken Site Evaluation Committee." NH Business Review, March 11, 2022.
[149] Ward, Ruth, Bob Giuda, Michael Vose, Michael Harrington, and Peter Leishman. "Final Report of the Committee to Study Necessary Revisions to the Site Evaluation Committee," 5.
[150] *Ibid*, 4.

Permanent, professional regulatory staff should be sought in any siting process. Maintaining a support staff offers predictability to developers and reassurance of public safety and regulatory compliance to the public. Once a project proposal has been fully adjudicated and approved by the SEC, a professional staff could play a vital role to monitor, investigate, and enforce an energy facility's compliance with state siting criteria.

The legislature should consider reforming the state's siting process.

Home Heating

While siting is rarely an issue for heating systems, since they are completely contained within the structure, it is worth mentioning for two reasons, local ordinances and associated infrastructure. As new technologies are developed and refined, there will be heating methods that unviable today, may be the next breakthrough technology tomorrow. State and local regulation should lay a light regulatory touch on these new technologies, limiting regulation to life and safety issues. In addition, state and local regulation should not force the early replacement of existing heating systems, which cost in the tens of thousands of dollars to install by banning certain systems.

Likewise, the infrastructure to service and maintain these heating systems may look and operate differently than they do today. State and local regulation on the siting of this associated infrastructure should also be reasonable and similar to analogous industries. Preventing the siting or these businesses by local authorities functions the same as a ban on the technology itself.

Transportation

There is very little need in New Hampshire for green field rights of way for new transportation network construction. Nearly all of the state's major projects of the last 30 years have been the expansion of roads and highways within existing rights of way. There are an abundance of existing underutilized rail corridors, providing plenty of opportunity for revitalization without carving new rights of way.

Siting will be critical for the new infrastructure needed to facilitate the adoption of new technologies, such as EVs, hydrogen fuel cells, propane, natural gas, or RNG to name a few. State and local regulation again should focus on quality of life and life and safety issues associated with siting this associated infrastructure, rather than attempt to regulate these businesses out of existence in an attempt to ban it without actually banning it. Regulation for these new industries should be similar to analogous industries, without undue burdens or restrictions applied.

Conclusion

This Strategy is designed as a tool for legislators, state agency employees, and other policymakers and stakeholders. It is not a comprehensive listing of every conceivable scenario or policy question. Rather, it is a set of principles and goals from which energy policy can be created. There are any number of factors and circumstances that can arise, and this strategy strives to provide a guiding philosophy to address them.

New Hampshire's policies should be focused first and foremost on New Hampshire. Our policies and programs should provide New Hampshire with a modern approach to the dynamic changes occurring in the energy field while providing our citizens and businesses with a robust, reliable energy grid. New Hampshire's environment must be protected in an efficient and cost-effective manner. The state must remain open and flexible so that new technologies and sources of energy can be developed. And most importantly, policy makers must do the above while remaining ever-vigilant of the burden on New Hampshire's ratepayers. It should be our priority to ease those costs and bring them in line with the rest of the nation.

This is not an easy path to navigate. So much depends upon our neighbors, upon the development of new technologies, and upon the availability of resources. But New Hampshire can do its part. New Hampshire can lead the way to find responsible, transparent, market-based solutions and to apply them vigorously. If the goals outlined in this strategy are achieved, the next decade will see lower electricity rates, more secure energy infrastructure, a cleaner environment, and a marketplace that can allow future technologies to thrive.

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Appendix A

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Appendix B

Further Reading

2014 State Energy Strategy and Appendices

2018 State Energy Strategy and Appendices

ISO New England Final 2021 PV Forecast

ISO New England 2021 Regional Electricity Outlook

ISO New England 2021 Regional System Plan

New Hampshire Renewable Energy Fund 2021 Annual Report

Public Utilities Commission DE 16-576: Development of New Alternative Net Metering Tariffs and/or Other Regulatory Mechanisms and Tariffs for Customer-Generators

Public Utilities Commission IR 15-296: Investigation into Grid Modernization

Public Utilities Commission DE 20-092: 2021-2023 Triennial Energy Efficiency Plan

Final Report of the Committee to Study Transmission, Distribution, Generation, and Other Costs in the State's Electricity System (Senate Bill 125, Chapter 83:1, Laws of 2017)

Final Report of the Committee to Study Subsidies for Energy Projects Provided by the Renewable Portfolio Standard (Senate Bill 51, Chapter 81:1, Laws of 2017)