The Transmission and Distribution System:

Plans, Forecasts, and Implications for Increased Electrification of Transportation and Heating in Vermont

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This report is the result of a ten-week research internship directed by Energy Action Network (EAN) Senior Fellow, Christine Donovan.

Section 1: Introduction & Purpose

The passage of the Global Warming Solutions (GWSA) Act in 2020 created and mandated targets for reducing greenhouse gas emissions in Vermont. The emissions reduction requirements necessitate the replacement of high emission sources of energy (such as greenhouse gas producing fossil fuels) with low emission sources (such as clean, renewable electricity). Since nearly all of the electricity used in Vermont is generated from hydropower, nuclear energy, solar energy, and wind power – all with minimal greenhouse gas emissions - the increased electrification of transportation and heating is one of the top priorities of the state's legally mandated 2025 Climate Action Plan. The anticipated increase of electrification in the transportation and building sectors has implications for the transmission and distribution of electricity in Vermont in the future.

This report presents findings from ten weeks of research on the transmission and distribution (T&D) system in Vermont, which is integrally connected to the larger regional grid serving all of New England. The primary focus of the research was on existing expectations and projections for the T&D system going forward, as well as on plans to adapt the system given anticipated increases in the use of electricity for transportation and buildings. Research was conducted on:

- Expected infrastructure needs;
- Cost pressures and rate projections; and
- Methods of load management.

The purpose of this report is to synthesize and present in an understandable way existing plans for the future of the T&D system in Vermont, and to consider how the adoption of certain technologies (such as electric vehicles for transportation and heat pumps for building heating and cooling) may affect the reliability of the T&D system, the price of electricity, and overall household energy costs. Key questions addressed are:

- Who regulates and operates the transmission and distribution grid in Vermont?
- What is the Forward Capacity Market that purchases power for the grid?
- What roles do energy efficiency, demand response, distributed generation from solar and wind, and battery storage have in the capacity market and for the grid, overall?
- Are increases in demand for electricity projected for the future and what are the implications for the T&D grid delivering that power?
- What opportunities exist for managing future load and ensuring system reliability for the T&D grid?
- Are electricity rates and/or household energy costs expected to change as a result of increased electrification of transportation and heating?

As Vermont seeks to increase electrification of transportation and heating, it is important that decisionmakers and interested parties in Vermont have a basic understanding of: what the T&D system is; who owns, operates, and maintains it; how system planning is carried out and by whom, and likely changes to the grid resulting from increased electrification. To help ease understanding of key transmission and distribution terms and concepts, presented in Table 1 is a brief explanation of key grid-related terminology used in this report.

Table 1: Common Transmission and Distribution Terminology

Term	Explanation
Load	The amount of power needed to supply the demand for electricity. Measured in MW (megawatts) or GW (gigawatts).
Transmission and Distribution (T&D)	High-voltage transmission lines that deliver electricity produced at a power plant to lower-voltage distribution lines that deliver power to customers' meters.
Pooled transmission facility (PTF)	Transmission facilities which are shared between states in a region.
Distributed generation (DG)	Electricity generated by small "decentralized" sources. Common examples in Vermont include customer-sited rooftop solar, ground-mounted solar installations, and ridgetop wind.
Energy efficiency (EE)	Measures and behavior changes that result in less energy being used to accomplish a task.
Non-transmission alternatives (NTAs)	Strategies for meeting energy needs while avoiding new T&D infrastructure projects.
Undergrounding	The process of burying power lines underground in order to increase line resilience.
Load management	The reduction of demand for electricity by turning off equipment or shifting the time of use of equipment during periods of high-demand.
Vegetation management	The clearing of vegetation, such as tree pruning and removal, to prevent outages and other impacts.
Peak/Peak hour	Specific times of the day when electricity demand is at its highest.

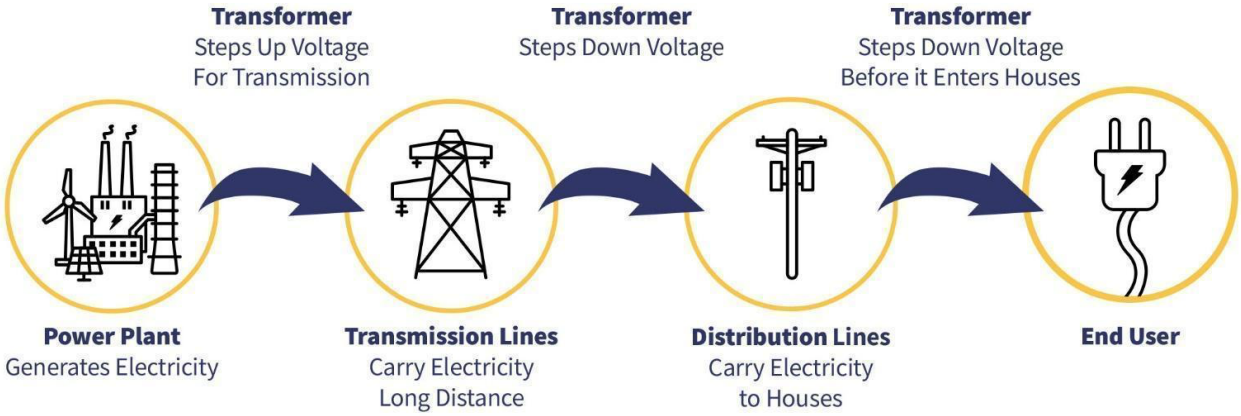
Capacity	The maximum amount of electricity a battery can store or a power plant, solar installation, or wind generator can produce.
Project Curtailment	The cancellation or stoppage of new or expanded infrastructure projects due to reliability or cost concerns.
N-1-1 Contingency	A reliability standard designed to ensure the T&D system can withstand the failure of a generator and a transmission line at any point in time without causing a larger system-wide power outage. Compliance with N-1-1 helps ensure continuous power supply during emergencies.
Congestion	Occurs in either of two ways: when demand for electricity exceeds the capacity of transmission lines; or when the supply of electricity from a distributed generation source (such as a solar farm or ridgetop wind) exceeds the capacity of transmission lines.
Loop Flows	Undesirable electricity flows which circulate on parallel paths, causing congestion and system inefficiencies.

Section 2: Key Elements of the Transmission and Distribution System

Presented in Figure 1 is a diagram illustrating the flow of electricity from a central power plant through transmission and distribution lines to the end use customer in a traditional power grid.[1] This is followed by a brief explanation of Vermont's grid (which now benefits from advanced metering and is currently operated as a 'smart grid'), and an overview of federal and state agencies and other entities charged with the regulatory oversight, operation, and maintenance of the T&D system in New England and Vermont.

[1] FERC. An Introductory Guide for Participation in ISO New England Processes | Federal Energy Regulatory Commission.

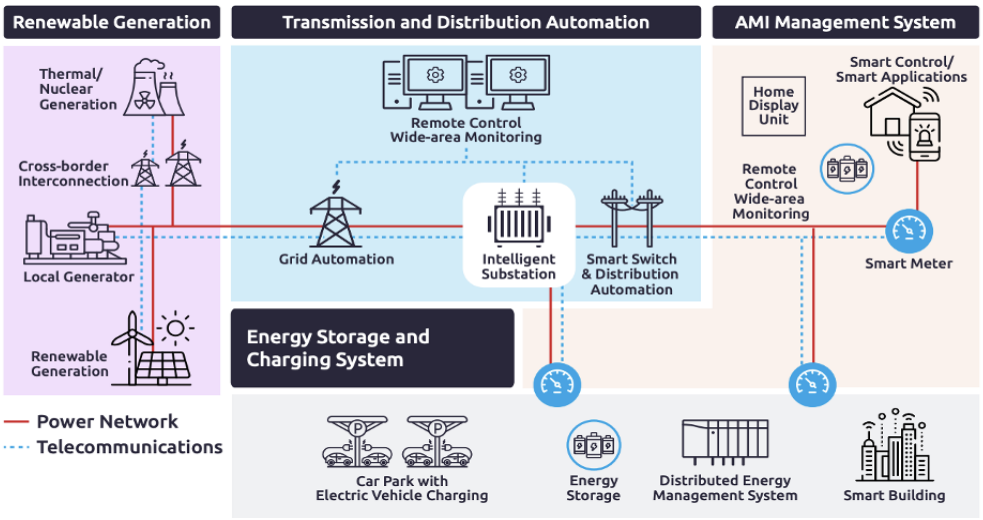
Figure 1: Overview of a Traditional Transmission and Distribution System[2]



Vermont's Smart Grid

Vermont is a "smart grid" state, made possible by $69 million of funds awarded to Vermont's utilities through the federal Smart Grid Investment Grant program.[3] The funds supported $138 million of infrastructure improvements, including investment in Advanced Metering Infrastructure (AMI).[4] Smart grids differ from traditional grids through their use of two-way communication devices (AMI) to improve efficiency and reliability. The use of AMI enhances the ability to integrate distributed generation and energy storage into the grid and to flexibly use energy efficiency, demand response, and other load management practices. Presented in Figure 2 is an illustration of a smart grid.

Figure 2: Overview of a Smart Grid Transmission and Distribution System[5]



[2] FERC. An Introductory Guide for Participation in ISO New England Processes | Federal Energy Regulatory Commission.
[3] PSD. Smart Grid | Department of Public Service.
[4] PSD. Smart Grid | Department of Public Service.
[5] Trend Micro. Energy Transformation via Cyber-Resilient Smart Grid | Trend Micro (US).

Regulatory and System Planning Oversight

Regulatory oversight of the transmission and distribution system in Vermont is carried out by a variety of federal and state government agencies (as in all states). In addition, numerous regional and state agencies as well as electric and gas utilities conduct (or help inform) the T&D system planning needed to ensure a smoothly-operating, economically-viable, and reliable electricity grid.

Federal Energy Regulatory Commission (FERC) - Formed in 1977, FERC sets national standards and regulations for the interstate transmission of energy. In 1996, FERC issued Order No. 888 promoting open access to transmission networks. The order laid the groundwork for the creation of Regional Transmission Organizations (also referred to as Independent System Operators) who operate and manage pools of power generated by multiple utilities and provide non-discriminatory access to transmission of the power to multiple utilities operating in a region.[6] Per FERC, Regional Transmission Organizations have no environmental (and therefore no climate) mandates. Rather, they seek to include consideration of state energy policies and goals in their planning and in systems operations.

ISO New England - ISO New England is the Regional Transmission Organization formed in 1997 to operate the bulk power system serving Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont (in compliance with FERC rules and regulations). Per FERC, ISO New England has no environmental mandates, but instead seeks to accommodate state energy regulations, laws, and goals. States and utilities in New England engage in and have input into ISO New England's decision-making, budget, and work plan through representation in the New England Power Pool (NEPOOL), through the New England States Committee on Electricity (NESCOE), and via other forums and committees. NEPOOL predates ISO-NE by several decades and was started as a power sharing arrangement among electric utilities facing power shortages. The current role of NEPOOL is to run a regional stakeholder process involving utilities in the region. NESCOE is a not-for-profit entity that represents the shared perspectives of New England Governors in regional electricity matters.

Vermont Public Utility Commission (PUC) – The PUC is a quasi-judicial agency that regulates the siting of energy infrastructure (both electric and natural gas) and provides state regulatory oversight of the electric, natural gas, and energy efficiency utilities serving Vermont customers. The PUC:

- Establishes rates for electric, gas, and water utilities to ensure fair pricing;
- Reviews and approves utility service applications and infrastructure projects;
- Ensures compliance with state and federal regulations for utility operations;

[6] FERC. RTOs and ISOs | Federal Energy Regulatory Commission.

- Mediates disputes between utility providers and consumers; and
- Conducts public hearings to gather input on utility matters.[7]

Vermont Department of Public Service (PSD) – PSD is an agency within the executive branch of state government. Its responsibility is to represent the public interest in matters regarding energy, telecommunications, water, and wastewater. The Department carries out this charge by:

- Representing the public interest in utility cases before the Public Utility Commission, federal regulatory agencies, and state and federal courts;
- Providing long range planning for the state's energy and telecommunications needs through the Vermont Electric Plan, the Comprehensive Energy Plan, and the Vermont Telecommunications Plan;
- Facilitating broadband expansion;
- Promoting energy efficiency;
- Administering federal energy programs;
- Resolving utility customer complaints;
- Informing the public about utility-related matters; and
- Making and administering contracts for the purchase of power on behalf of the state.[8]

Additionally, PSD convenes and leads the multi-stakeholder Vermont System Planning Committee (discussed below). As the public's advocate, the Department is a separate agency from the PUC, which serves as the decision-making authority in utility regulatory cases.

The Transmission and Distribution System

The term "T&D system" refers to the transmission and distribution of electricity generated by power plants. Transmission serves as the intermediary between generation and distribution, bringing electricity from the source of generation for distribution to end use customers.

Prior to the commercialization and use of what is now referred to as "distributed generation" from customer sited solar, solar farms, and ridgetop wind in Vermont, electricity was generated in central power plants or large and small hydroelectric facilities. As noted above, power from the grid previously flowed in one direction – from the power source to the customer. The advent of what is now referred to as the "smart grid" - in which advanced metering infrastructure can detect power flowing in two directions, either from a central power plant to the customer or from the customer to the grid – has revolutionized power system planning and operation. T&D planners and engineers are now engaged in overseeing a complex system of power transmission and distribution that seeks to optimize power both from centralized and distributed power

[7] PUC. https://puc.vermont.gov/about-us.
[8] PSD. https://publicservice.vermont.gov/publicservice/about-us.

sources as well as the load reducing capabilities of energy efficiency, demand reduction, battery storage, and a host of flexible load management strategies.

Grid Operation by ISO New England and VELCO: The transmission and distribution of power is achieved through a complex infrastructure of power lines and poles connected together over long distances that cross state (and sometimes national) borders. States in New England share a pooled transmission system administered by ISO New England. In addition, the Vermont Electric Power Company (VELCO) serves as Vermont's statewide transmission company. VELCO was formed in 1956 when Vermont utilities joined together to establish the nation's first statewide "transmission only" company responsible for developing and maintaining an interconnected power grid in the state. In addition to maintaining the 740 miles of transmission lines in Vermont, VELCO manages 13,000 acres of rights-of-way and constructs transmission upgrades when needed for system reliability or growth. VELCO is a public benefits corporation (with a for-profit status) that is owned by the electric utilities serving Vermont. VELCO funds which exceed project costs are delivered back to the utilities, thereby reducing revenue requirements for the utilities.[9]

Grid Planning by ISO New England and VELCO informed by the Vermont System Planning Committee: ISO NE and VELCO are ultimately responsible for conducting the T&D system planning needed to ensure a reliable supply of electricity to utility customers. Their periodic transmission and distribution plans are informed, in part, by interaction with and input from the Vermont System Planning Committee (VSPC). VSPC is a multi-stakeholder collaborative process established by law in 2007 to facilitate the full, fair, and timely consideration of cost-effective non-transmission alternatives to new transmission projects. The process involves increased coordination among Vermont's utilities, transparency to the public about planning activities, and structured mechanisms for public involvement. Members of the VSPC include representatives of each Vermont electric distribution and transmission utility, each energy efficiency utility that provides electric efficiency services, four public members, and two non-voting members (one representing the Standard-Offer Facilitator and the other representing the Department of Public Service). The VSPC meets at least quarterly and seeks to ensure:

- All options to solve grid reliability issues receive full, fair, and timely consideration; and

- That the most cost-effective solution is chosen - whether it is a poles-and-wires upgrade or non-transmission alternatives (NTAs) such as energy efficiency, demand response, distributed generation, energy storage, or a hybrid of multiple approaches.[10]

[9] VELCO. https://www.velco.com/who-we-are.
[10] PUC. https://puc.vermont.gov/electric/vermont-system-planning-committee-vspc.

Distribution Utilities - There are 17 distribution utilities (DUs) delivering power to customers in Vermont, the largest of which is Green Mountain Power. Some of the electricity is generated in-state by hydroelectric plants, customer-sited solar, solar farms, and wind turbines. However, most power used in Vermont is generated in, and transmitted from, Quebec and nearby states. Each distribution utility files a least cost integrated resource plan (IRP) with the Department of Public Service every three years. Each plan forecasts anticipated demand and supply of electricity for the utility and lays out the least cost approach for delivering power reliably and cost-effectively to the utility's customers. Typically, each IRP:

- Evaluates existing energy resources and infrastructure.
- Identifies potential energy efficiency and conservation measures;
- Explores renewable energy options and their integration;
- Analyzes costs and benefits of various energy supply alternatives; and
- Develops a long-term strategy for sustainable energy development.

The timing of the submission of each IRP varies among utilities, therefore some plans have more up-to-date information and data than others at any point in time. The 17 distribution utilities in Vermont and their retail sales in 2023 shown in Table 2.

Table 2: Electric Utilities Serving Vermont and 2023 Retail Sales[11]

Electric Utility	2023 Retail Sales (MWh)
Burlington Electric Department (BED)	318,589
Green Mountain Power (GMP)	4,033,028
Ludlow Electric Light Department	49,788
Swanton Village Electric Department	52,243
Vermont Electric Co-op (VEC)	462,308
Village of Barton	14,506
Village of Enosburg Falls	26,920
Village of Hardwick	35,170
Village of Hyde Park	13,288

[11] Vermont Public Service Department, "2025 Annual Energy Report", pg. 35. vt-psd-res-engagement-becc.

Village of Jacksonville	5,374
Village of Johnson	12,051
Village of Lyndon Electric Department	64,441
Village of Morrisville Water and Light Department	46,761
Village of Northfield	29,116
Village of Orleans	11,931
Village of Stowe Electric Department	79,920
Washington Electric Co-op (WEC)	73,651

Over a century ago, many Vermont communities decided to create electric departments as part of their municipal government. Such utilities are subject to both state and municipal regulations. Many municipal utilities (both large and small) are members of the Vermont Public Power Supply Authority (VPPSA), a joint action agency established by the legislature in 1979. VPPSA provides its members with a broad spectrum of joint action services such as: power aggregation, financial support, IT support, rate planning support, and legislative and regulatory representation.[12]

Section 3: The New England Forward Capacity Market

A key element of a well-designed and operated transmission and distribution grid is the reliable supply of power, available to all customers whenever it is needed. The term "capacity market" refers to a market mechanism created in the electric sector to ensure the reliable supply of power at all times. As the region's grid operator, ISO New England is responsible for balancing power supply with demand and ensuring the region has enough electricity capacity to meet both current and future demand.

ISO-New England Forward Capacity Auctions

Each year, ISO New England conducts a Forward Capacity Auction (FCA) to secure local and systemwide resources three years in advance of when they will be needed. As such, the Forward Capacity Market is designed to ensure that the New England power system will have sufficient resources to meet the future demand for electricity. Forward Capacity Auctions (FCAs) are held annually, three years in advance of the operating period. Electricity resources compete in the auctions as well as energy efficiency and demand response initiatives that reduce demand for

[12] VPPSA. https://vppsa.com/about-vppsa/.

power. During the auction, electrical power, energy efficiency, and demand response resources obtain a commitment to supply capacity in exchange for a market-priced capacity payment. These payments help support the development of new electrical power, energy efficiency, and demand response resources. Capacity payments also help retain existing resources. For example, they incentivize investment in technology or practices that help ensure strong performance. Capacity payments also serve as a stable revenue stream for resources that help meet peak demand but don't operate the rest of the year during periods of non-peak demand.

One of the unique features of the Forward Capacity Market is that it encourages energy efficiency, demand response, and distributed generation aggregated from small, decentralized sources to participate on an equal footing with electricity from traditional, centralized power plants. The price of electricity during the competitive auctions is largely driven by the availability of generation and demand-reducing resources. Market participants that "clear" (i.e. win) the auction are those with the lowest-priced offers. The payments received for the power (or energy efficiency and demand reduction commitments) encourage investments in new generation resources as well as in energy efficiency and demand response.

The 2024 Forward Capacity Auction

During the 2024 Forward Capacity Auction (the most recent auction), market participants made capacity supply obligations for the operating period that will run from June 1, 2027, through May 31, 2028.[13] Forward Capacity Auction 18, held on February 5, 2024, had more than 8% (2,614 MW) of all obligations come from demand response programs and aggregated distributed energy resources, including residential solar panels and batteries. The Auction also derived 6% (1,800 MW) of its cleared capacity from energy storage projects and an additional 4% (1,250 MW) from wind and solar resources. The amount of capacity provided by each of these three categories of resources was substantially higher in Auction 18 than any prior auctions.[14]

ISO New England is currently in the process of a capacity market overhaul with the intent of improving energy efficiency, reliability, and capacity procurement timeliness.[15] If accepted by FERC, reforms are set to go into effect beginning on June 1, 2028. Currently, the capacity market operates according to ISO New England's "Pay-for-Performance" (PFP) rules whereby generators are subject to capacity supply obligations.[16] Generators are compensated for supplying capacity in accordance with their obligations and penalized if they fail to do so.

[13] PCI Energy Solutions. https://www.pcienergysolutions.com/2024/07/24/new-england-capacity-market-explained-a-guide-to-the-iso-ne-forward-capacity-market/.
[14] FERC. https://www.publicpower.org/periodical/article/iso-ne-files-finalized-capacity-auction-results-with-ferc.
[15] ISO Newswire. Capacity market reforms take shape as stakeholder discussions continue - ISO Newswire.
[16] ISO New England. About FCM Pay-for-Performance (PFP) Rules.

Section 4: The Vermont Planning Process to Ensure Grid Capacity

As mentioned above, the system planning process used to ensure sufficient electricity capacity compared to demand involves close coordination and collaboration between ISO New England and VELCO, the statewide transmission company serving Vermont utilities. The decisions by ISO New England and VELCO about the operation and planning of the future grid are also informed, in part, by input from the Vermont System Planning Committee consisting of representatives of the distribution utilities in Vermont, Efficiency Vermont, and other stakeholders who serve on the VSPC. The portion of grid planning conducted in Vermont is discussed in this section. The areas of focus for VELCO, VSPC, and Vermont utilities during system planning and the processes used to conduct the planning are summarized in Table 3.

Table 3: T&D System Planners in Vermont and Their Roles during System Planning

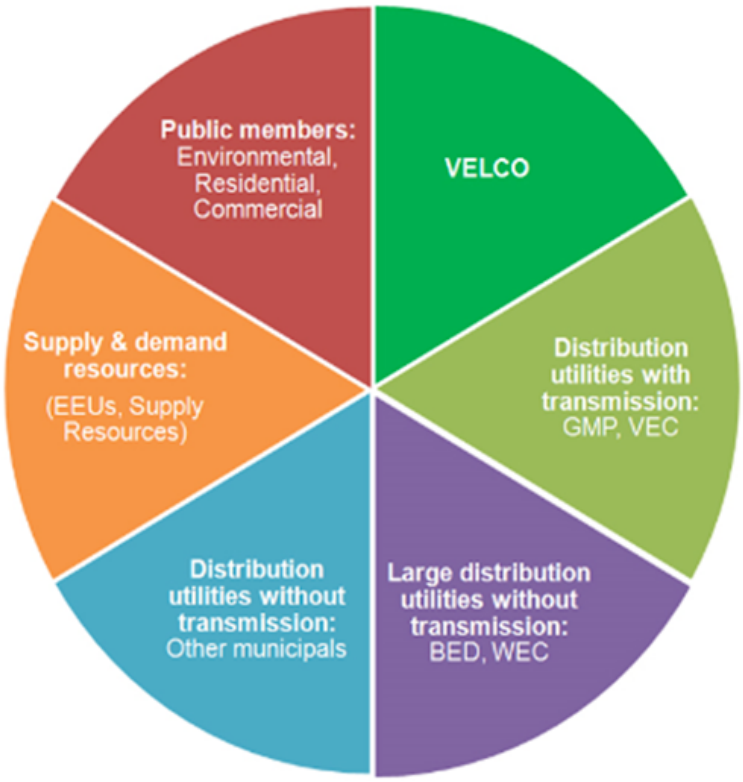
System Planner	Key Roles
VELCO	➢ Uses a 20-year planning horizon, as mandated by the Vermont PUC. ➢ Publishes a Long-Range Transmission Plan every three years, updating projections with more recent data.[17] ➢ Uses N-1-1 contingency planning. This builds in redundancies in order to avoid outages during extreme or unexpected conditions by planning for an outage event, followed by a system readjustment, and a second outage. ➢ Acquires certificates of public good for proposed projects.
VSPC	➢ Conducts least-cost analysis of projects to determine if transmission or non-transmission projects are necessary to meet reliability needs. ➢ Comprised of six voting sectors (shown in Figure 2). Public members are appointed by the PUC.
Distribution Utilities	➢ Submit Integrated Resource Plans that include a plan of action for meeting future energy needs.

[17] 2024 Vermont Long Range Transmission Plan (VSPC Draft). https://www.velco.com/sites/default/files/2024-04/2024%20VLRTP_publicreview_clean.pdf.

	➢ Provide input for VELCO's 20-year plans.
Efficiency Vermont	➢ Provides programs and services to distributed utility customers that reduce the use of electricity (and fossil fuels). ➢ All electric utility customers in Vermont are eligible to participate in Efficiency Vermont's programs except BED customers (because BED operates its own energy efficiency programs). ➢ Some energy efficiency measures (such as increased building insulation) reduce demand for energy in perpetuity. Others (such as turning off machinery during times of peak power demand) reduce demand for specific durations of time (referred to as "demand response"). ➢ Both energy efficiency (EE) and demand response (DR) are acknowledged during T&D system planning by ISO New England, VELCO, and the VSPC. ➢ Both EE and DR are monetized during ISO New England Forward Capacity Market auctions.

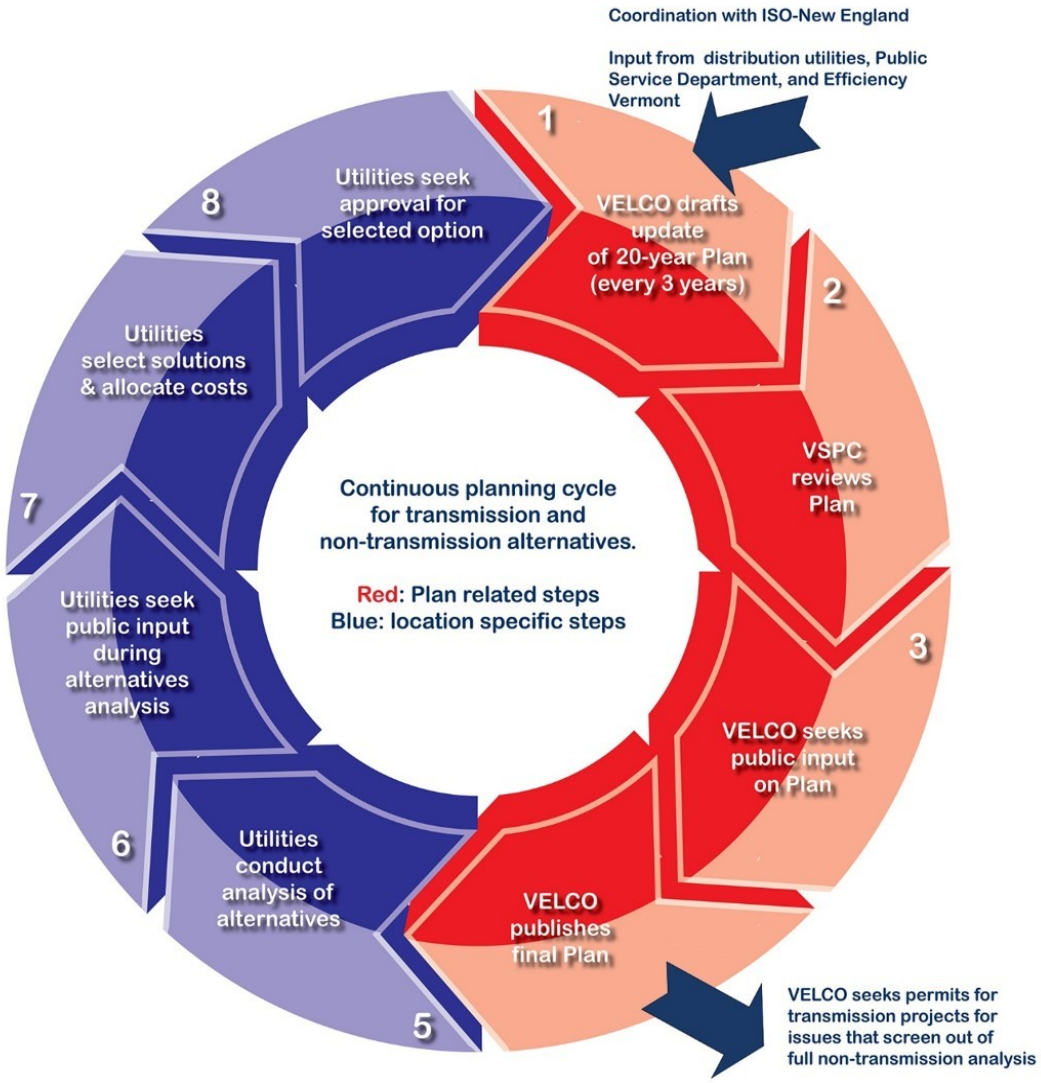
Presented in Figure 3 is detailed information about membership in the Vermont System Planning Committee. This is followed in Figure 4 with an explanation of the key steps used by T&D systems planners in Vermont, illustrating the wide range of interests considered during system planning. System planning in Vermont currently addresses the need for traditional infrastructure-driven T and D expansions as well as non-transmission alternatives such as energy efficiency, demand reduction, and storage. This has significant implications (discussed in Section 7) as Vermont seeks to increase electrification of transportation and heating.

Figure 3: Vermont System Planning Committee Membership[18]



[18] VSPC. Membership | Vermont System Planning Committee.

Figure 4: The Steps Involved During T&D System Planning in Vermont[19]



The system planning work completed by VELCO in collaboration with the VSPC leads to utility-specific plans for T&D expansions and improvements within a utility's service territory, for which each utility must then seek regulatory approval from the Vermont Public Utility Commission. Approved improvements are paid for by:

- Utility Companies: Primarily through their capital budgets.
- Ratepayers: Costs are often passed on to consumers through utility rates.
- State and Federal Grants: Financial assistance sometimes is available from government programs aimed at infrastructure upgrades.

[19] Vermont System Planning Committee. Grid Planning | Vermont System Planning Committee.

- Public-Private Partnerships: Collaborations between government and private entities can help share costs.
- Energy Efficiency Programs: Some improvements may be funded through initiatives designed to enhance energy efficiency.
- Bonds and Loans: Utilities may issue bonds or take out loans to finance large-scale projects.

Trends in Load Growth

ISO New England's 2025 projections of electricity demand in each New England state are presented in Table 4 for 2025 through 2034, with forecasts for transportation and heating shown separately. As can be seen in the table, electricity demand is projected to increase in all states for both transportation and heating over the forecast period. A factor which may contribute to this increase is the focus in many New England states on reducing greenhouse gas emissions from fossil fuels through increased electrification of transportation and heating.

Table 4: ISO New England Electrification Forecasts 2025-2034[20]

		Annual Energy (GWh)									
Category	**State**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Transpo-rtation	**CT**	51	151	265	404	576	786	1,038	1,333	1,668	2,044
	MA	102	302	526	793	1,118	1,511	1,976	2,516	3,128	3,808
	ME	19	57	101	156	226	312	416	538	679	837
	NH	21	61	109	168	244	338	452	588	743	917
	RI	14	42	73	113	162	223	296	382	481	591
	VT	17	50	85	126	174	229	294	367	448	538
	Total	224	663	1,160	1,761	2,499	3,398	4,472	5,724	7,148	8,735
Heating	**CT**	70	131	199	275	360	458	576	719	884	1,077
	MA	257	478	735	1,028	1,361	1,742	2,181	2,675	3,191	3,732
	ME	188	296	413	539	676	826	996	1,189	1,394	1,610
	NH	38	67	99	134	176	225	280	340	405	479
	RI	25	47	71	98	129	164	207	259	319	387
	VT	114	168	227	290	358	431	508	590	674	763
	Total	692	1,188	1,743	2,365	3,060	3,846	4,748	5,773	6,867	8,049

[20] ISO New England CELT Report, 1.7 Electrification Forecast. 2025_celt.xlsx.

Another forecast of the electrification of heating and transportation in Vermont is discussed in the VSPC's 2024 draft of the Vermont Long-Range Transmission Plan. In its "Vermont Roadmap" scenario, the VSPC forecasts that by 2040, 90% of non-fleet, light duty vehicles in Vermont will be EVs; it also considers that by 2043, 50% of households in Vermont will have heat pump heating and cooling systems installed.[21]

Vermont's system planning necessarily focuses on meeting environmental goals while still retaining long-term reliability. System planners must either:

- Identify new sources of electricity;
- Reduce demand for electricity (referred to in T&D system planning as 'reducing load'); and/or
- Find new and expanded opportunities for storing power during non-peak periods through the use of batteries and other forms of storage.

An example of the result of such system planning is a determination by the VSPC that a 75-megawatt reduction in load is needed in Northern Vermont by 2033 to avoid a costly transmission improvement that would otherwise be needed to meet projected load in the area.[22] Examples of non-transmission alternatives now being assessed to avoid such a transmission project include enhanced energy efficiency, increased distributed generation, and line disconnections.

The Vermont Long-Range Transmission Plan

The most recent Vermont Long-Range Transmission Plan submitted to the PUC by VELCO in 2024 is a comprehensive document describing VELCO's analysis of projected load growth and the resulting transmission needs over a 20-year period. Key findings from the plan related to the focus of this report include the following:

- There are serious concerns about the ability of the system of substation transformers and sub-transmission lines in Vermont to continue to operate reliably in the future.
    - Among these concerns are the age of the substations and load forecasts exceeding what the infrastructure was built to handle;
    - Upgrades will be costly to both customers and energy generators, but may (in part) be avoided through load management, grid-optimization at certain locations, and generation curtailments that reduce load in certain locations and during certain time periods.

[21] 2024 Vermont Long Range Transmission Plan (VSPC Draft), Pg. 30. https://www.velco.com/sites/default/files/2024-04/2024%20VLRTP_publicreview_clean.pdf.
[22] Shana Louselle (VELCO Communications & Public Relations Manager, VSPC Manager & Facilitator) Interview via Zoom, 7/25/2025.

- Northern Vermont is a major area of concern about potential overloads in certain transformers and transmission lines by 2033.
    - This is the result of loop flows along the sub-transmission system, causing congestion in and an overloading of the system.
        - This is because the infrastructure was not built to handle the load currently projected in the future. If not addressed in some way, increased outages are expected in the future.
    - Overall, throughout the T&D system key components such as power lines, poles, and substations will likely require upgrades, relocation, and increased maintenance in order to adapt to more extreme weather conditions. These include warmer winters which result in more frequent and severe ice storms, as well as increased flooding from more extreme rainfalls during the summers.

Table 5: Examples of T&D Infrastructure Solutions[23]

Transmission Solutions by Region	Cost	Screened In as Non-transmission Alternative	Lead and Affected DUs
Northern Vermont • Install new 115 kV line between Essex and Williston • Affected transformers: Queen City, Tafts Corner, Barre • Timing - 2032	$120 M $ 33 M	• 75 MW load reduction by 2033 • NTA grows over time	Lead: GMP Affected All VT
Northwest Vermont • Rebuild West Rutland to Middlebury 115 kV line • Affected transformer: Middlebury • Timing – 2029	$215 M $ 13 M	• 80 MW load reduction by 20233 • NTA grows over time	Lead: GMP Affected: All VT
Central Vermont • Rebuild Coolidge – Cold River - North Rutland 115 kV line • Affected transformers: N. Rutland, Cold River, Windsor • Timing – 2034	$185 M $ 13 M	• Keeps load below 2033 level • NTA grows over time	Lead: GMP Affected: All VT

[23] 2024 Vermont Long Range Transmission Plan (VSPC Draft), Pg. 6, Table 2. https://www.velco.com/sites/default/files/2024-04/2024%20VLRTP_publicreview_clean.pdf.

Southern Vermont • Rebuild NGRID Bellows Falls-Ascutney Tap 115 kV line • Affected transformer: GMP Vermont Road 115/64 kv • Timing – 2034	No Estimate	• Keeps load below 2033 level • NTA grows over time	Lead: GMP Affected: All VT, NGRID
Statewide • Install new 345 kV line between Vernon and Eversource Northfield, MA • Affected transformer: Bennington • Timing – 2034	$5 M for VELCO portion $13 M	• Keeps load below 2033 level • NTA grows over time	Lead: GMP Affected: All VT, Eversource

The Vermont Comprehensive Energy Plan

The Comprehensive Energy Plan (CEP), mandated by law and updated every 6 years by the Department of Public Service, is designed to achieve the following:

- Establish a framework for achieving the state's policy goal to rely on 90% renewable energy by 2050;
- Identify key strategies and actions for enhancing energy efficiency across all sectors of the economy including the residential, commercial, industrial, and agricultural sectors;
- Specify plans to further the development of renewable energy sources such as solar, wind, and biomass;
- Promote electric vehicle adoption and expanded charging infrastructure;
- Encourage community engagement and local energy solutions; and
- Identify opportunities for fostering economic growth through clean energy job creation and innovation.[24]

The plan includes analyses of energy demand and supply, trends in load growth, and methods for achieving energy goals. The CEP serves as a roadmap for how Vermont can achieve its energy goals. It is intended to complement, but not duplicate, greenhouse gas reducing strategies and actions prioritized in the state's Climate Action Plan.

[24] PSD. "2022 Comprehensive Energy Plan". https://publicservice.vermont.gov/sites/dps/files/documents/2022VermontComprehensiveEnergyPlan_0.pdf.

Section 5: T&D System Reliability and Load Management

Electricity is the lifeblood of the economy and ensuring a reliable supply of electricity to all customers is vital to ensuring public safety, public health, and economic activity. Given this, maintaining reliability of the power grid is a key concern among federal and state regulators, utilities, and customers in all jurisdictions throughout the nation. A key to maintaining reliability is managing the demand for electricity. The process of managing demand for electricity is commonly referred to as "load management." Important aspects of maintaining reliability and managing load are discussed below.

Reliability

Two key metrics are used for measuring electric system reliability including the:

- **System average interruption duration index (SAIDI)**, which calculates the average amount of time (measured in minutes) that customers spend without electricity over the course of a year; and the
- **System average interruption frequency index (SAIFI)**, which measures the average number of outages experienced by customers over the course of a year.

Both of the metrics are monitored and reported on by utilities and they are documented and made available by the federal Energy Information Administration. A review of the metrics can be used to assess how Vermont is doing compared to other states in the region.[25] As shown in Figure 5, Vermont's SAIDI and SAIFI scores (when summed over the ten-year period from 2013 to 2023) indicate that Vermont had the second highest duration and occurrence of power outages in New England (with Maine having the highest). Between the years of 2013 to 2023, Vermont had a cumulative SAIDI score of 5,703 and a cumulative SAIFI score of 24.865. Not surprisingly, given these results, grid-related practices and technologies which promote reliability and help manage load are consistently prioritized by T&D system planners and utilities in both Vermont and New England overall.

[25] FERC. How Affordable and Reliable is Your Power? | Federal Energy Regulatory Commission.

Figure 5: SAIDI & SAIFI Electricity Reliability Scores for New England, 2013 to 2023

Infrastructure Improvements that Increase Reliability

A variety of infrastructure-related activities can be undertaken to increase the reliability of electricity supply to customers. Generally, such infrastructure projects are grouped into two categories – reliability-based projects and asset condition projects (ACPs).

Reliability-based Projects: Examples of reliability-based projects include:

- The construction of new transmission lines;
- Battery storage installations;

- Installation of hendrix cables (which are power lines with a thick protective outer layer in order to prevent direct contact with tree limbs); and the
- Burying power lines underground (referred to as "undergrounding" in the utility industry).

Both the use of hendrix cables and undergrounding protect lines from damage caused by environmental factors, including contact with tree limbs, UV degradation, icing, and other extreme weather conditions. Undergrounding is particularly effective at preventing outages that would otherwise occur on overhead lines due to events such as lightning strikes, and is highly correlated with reduced outage durations.[26]

Asset Condition Projects: Examples of asset condition projects include:

- The replacement of aging substations; and
- The replacement of aging Pooled Transmission Facilities (PTFs), costs for which are shared between New England states, all of which benefit from these transmission facilities.

The need to implement ACPs is increasingly common in Vermont due to the age of the T&D infrastructure in the state. Much of the transmission and distribution system was originally built in the 1950s and is now rapidly approaching the end of its usability.[27] These aging assets are anticipated to negatively impact reliability if they are not upgraded or replaced during the next several years, making them a priority for utilities. Once it is determined which T&D infrastructure improvements are most urgently needed and where, it can be challenging to figure out how to pay for the improvements for a variety of reasons:

- Except for Green Mountain Power, most electric utilities in Vermont are small and have a relatively small customer base to spread infrastructure improvement costs across.
- Although Vermont Electric Cooperative and Washington Electric Cooperative have larger customer bases compared to the smallest of Vermont utilities, their service territories are spread out and the density of their customer base is low. Both co-ops have many poles and lines serving rural country roads, resulting in many miles of poles and wires serving few customers. This results in small customer bases to spread infrastructure improvement costs across.
- In addition, the state's mountainous terrain prone to winter storms and the river valley terrain prone to flooding increase the likelihood of storm damage to poles and wires and

[26] Department of Energy Grid Deployment Office *Undergrounding Transmission and Distribution Lines Resilience Investment Guide*, Pg 3. Undergrounding Transmission and Distribution Lines Resilience Investment Guide.
[27] Shana Louiselle (VELCO Communications & Public Relations Manager, VSPC Manager & Facilitator) Interview via Zoom, 7/25/2025.

result in the need for frequent infrastructure repairs resulting from winter and summer storms.

Any infrastructure project considered by utilities in Vermont is assessed using a cost-benefit analysis that seeks to ensure the net benefits to utility customers will be greater than the costs. Unfortunately, in some cases, known solutions for increasing reliability (such as the undergrounding of power lines) would be ideal for increasing resilience, but are unlikely to be financially feasible due to the topography and rural nature of the state.

With all of this in mind, the larger utilities (including GMP and Vermont Electric Cooperative) thus far have begun innovating with the use of batteries and other techniques to help increase reliability in their service territories. Several years ago, Green Mountain Power received regulatory approval for implementing a battery storage pilot program. The program was designed to improve reliability and to provide a new source of stored power that could be drawn upon to help offset peak power loads. Similarly, VEC recently launched a pilot battery storage program for its customers that is also intended to help offset peak power loads.

Other, smaller utilities in Vermont have not developed battery storage programs (thus far), largely due to concerns over how economically viable such programs would be, given their small customer bases.

Managing Load to Increase Reliability

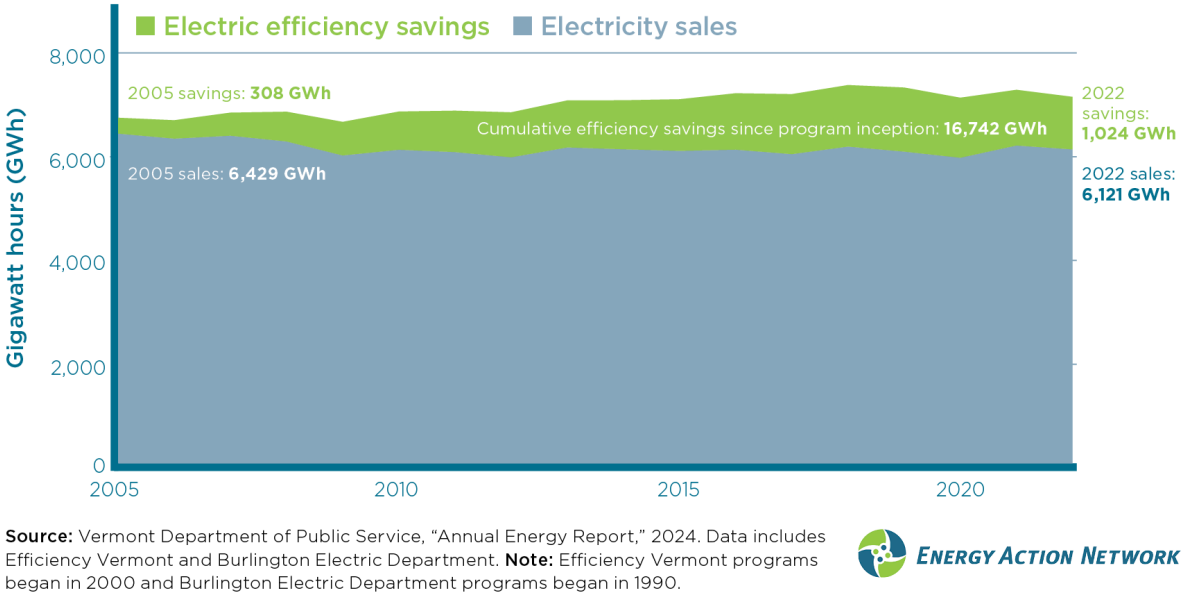
In June of 2025, during development of this report, New England experienced a heat wave which severely challenged the reliability of the T&D system serving the region. However, during the heat wave, the region benefitted directly from the significant energy efficiency, demand response, distribution generation, and battery storage capacity purchased during past ISO-New England auctions. During the three-day event, energy storage in conjunction with distributed generation from solar, enabled utilities to save ratepayers across New England an approximate $20 million.[28] This is a huge milestone for the region and demonstrates the value of Vermont, and the larger regional grid, continuing to adopt new technologies, measures, and load management practices that maintain and improve reliability while also avoiding costs associated with procuring expensive (and often greenhouse gas emitting) peak power sources.

Energy Efficiency & Distributed Generation - The nation-leading focus on delivering a cost-effective portfolio of energy efficiency programs across all sectors of the economy in Vermont for more than 25 years has resulted in significant reductions in electricity (and fossil fuel) demand in the state. The millions of dollars invested in energy efficiency initiatives over many years (and more recently in demand response and flexible load management practices) has

[28] Canary Media. A heat wave hit New England's grid. Clean energy saved… | Canary Media.

clearly alleviated pressure on the T&D system. This is illustrated in Figure 6. The successful implementation of customer-sited and distributed generation from rooftop solar, solar farms, and wind turbines has also provided alternatives to central power plant power generation and the subsequent transmission and distribution of the power over long distances.

Figure 6: Electricity Savings From Vermont Electric Efficiency Utilities (2005 - 2022)[29]



Source: Vermont Department of Public Service, "Annual Energy Report," 2024. Data includes Efficiency Vermont and Burlington Electric Department. **Note:** Efficiency Vermont programs began in 2000 and Burlington Electric Department programs began in 1990.

ENERGY ACTION NETWORK

That said, Vermont's transmission and sub-transmission systems are not currently projected to be able to accommodate expected growth in distributed generation in all locations without significant constraints. The location of distributed generation, storage, and a variety of load management strategies are key to alleviating transmission overloads that prevent new sources of distributed power from being delivered successfully and cost-effectively to customers. T&D system planners note in the VSPC's report on the Vermont Long-Range Transmission Plan that:

> "… 500 MW of solar PV has been installed as of December 2020. This is in addition to another 90 MW of distributed generation technologies. While certainly there are benefits to the generation, the proliferation of DG has started to stress parts of the system and has contributed to curtailment of larger renewable generators that are controllable by ISO-NE as the market administrator. Our analyses have found that transmission capacity will be exceeded if DG continues to be deployed in the same manner as today…"[30]

[29] Energy Action Network, "Annual Progress Report for Vermont 2024", Pg 34. EAN-APR-2024-updatedMay2025.pdf.
[30] 2024 Vermont Long-Range Transmission Plan (VSPC Draft), page 8.https://www.vermontspc.com/sites/default/files/2024-02/2024%20VLRTP_VSPC_draft_0.pdf.

The report goes on to state that greater attention should be paid in the future to transmission system impacts when reviewing, approving, and deploying new distributed generation in Vermont. It is anticipated that future T&D system planning in Vermont (and in New England overall) will increasingly focus on these important and relevant issues as we continue to electrify transportation and heating.

Energy Storage **-** A priority opportunity identified in the Vermont Long-Range Transmission Plan is the potential for advancing energy storage using batteries. Energy storage presents the opportunity for utilities to save excess energy during low load periods and deploy the stored energy to prevent outages during periods of peak demand without imposing additional costs on customers.

As mentioned above, both GMP and Vermont Electric Cooperative currently have energy storage programs in place. GMP's program provides customers the option (for a monthly fee of $55 or a one-time fee of $5,500) to install batteries to their homes for backup power, which GMP can use for demand response. Each installed system provides GMP with an additional 10 - 11.5 kw of capacity.[31] Additionally, the energy storage system includes electric school bus batteries, and a mobile utility-scale battery. Similarly to GMP, VEC has a residential energy storage program that provides the option of monthly bill credits or an upfront payment accompanied by monthly bill credits as an incentive to enroll in the program.[32] Incentive options are:

- Monthly bill credit of $6.40 per Kilowatt (KW); or an
- Upfront payment of $268 per KW and monthly bill credits of $3.20 per KW.

In addition, VEC has implemented two utility-scale battery storage projects and has signed a ten-year lease with Viridity Energy Solutions in 2018 for 400 kilowatt hours of storage.[33]

Battery storage capacity has been steadily growing in Vermont as the technology becomes increasingly popular and available. Statewide energy storage trends can be seen in Figure 7. However, as federal incentives for battery adoption are repealed and US Department of Energy (DOE) grants are slowed by recent government reorganization, it is likely that adoption will slow in coming years. At the same time, battery manufacturers will, without federal assistance, not be subject to Foreign Entity of Concern (FEOC) regulations, enabling them to purchase components from countries such as China in order to mitigate costs while continuing production.[34]

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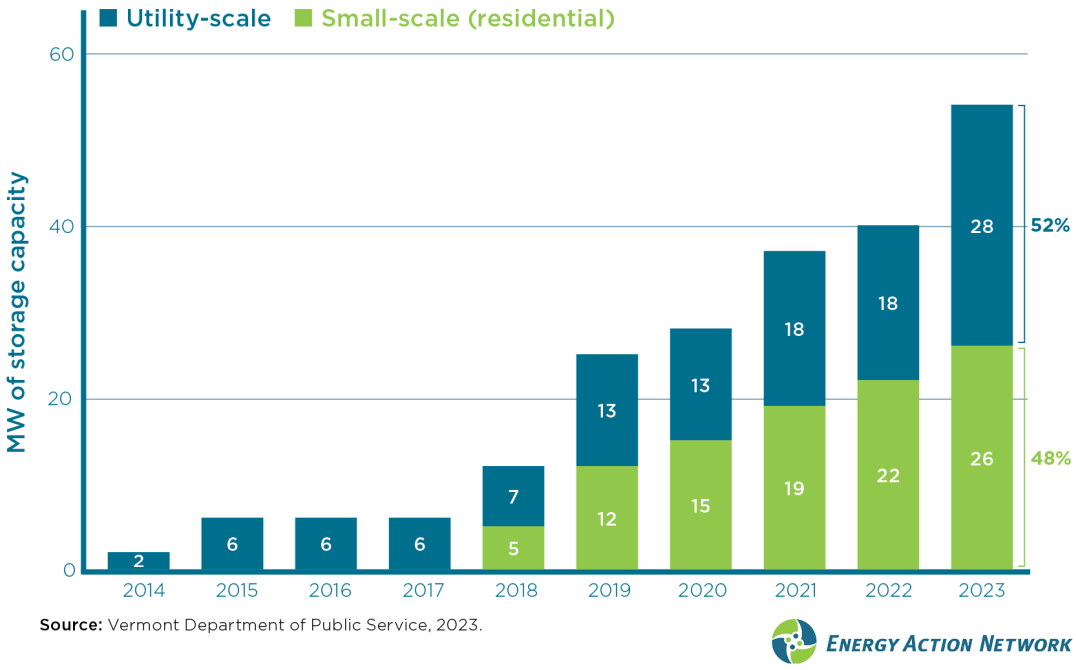
[31] Green Mountain Power *2024 Integrated Resource Plan*, Pg 31. 2024-12-10-GMP-218c-Integrated-Resource-Plan.pdf.
[32] Vermont Electric Cooperative. VEC Launches Residential Battery Storage Incentive Program - Move is further step in continuing VEC innovation — Vermont Electric Coop.
[33] NRECA. Vermont Co-op Sees Immediate Value of Energy Storage Project.
[34] Chad Farrel (Encore Co-CEO), Interview Via Zoom 7/14/2025.

Figure 7: Installed Battery Storage Capacity in Vermont. 2014-2023[35]



Utilities also have measures and techniques to manage load in addition to battery storage through a variety of demand reduction approaches, time-of-use rates, controllable thermostats, and voluntary initiatives that ask customers to change their behavior during periods of peak demand. BED's "Defeat the Peak" program, for example, is a voluntary initiative that asks customers to reduce electricity consumption during peak hours by turning off non-essential lights and waiting to charge electric vehicles EVs and use appliances until the peak ends. All of these measures and techniques are important and have demonstrated their ability to help reduce demand for power during peak periods in both New England overall and specifically in Vermont.

Section 6: Power Supply and Household Energy Cost Considerations

There are two major cost-related issues to assess when contemplating future electricity prices resulting from the transmission and distribution of electricity and the impact of electricity prices on household energy bills. One area is "system level" costs - which are costs related to the generation, transmission, and distribution of power. The other is "end use customer or household energy" costs - which are a function of the rates charged for electricity, the amount of electricity used by a customer, and any fossil fuel costs avoided resulting from electrifying household transportation and/or heating. Each of these are discussed below.

[35] Energy Action Network, "Annual Progress Report for Vermont 2024", Pg 35. EAN-APR-2024-updatedMay2025.pdf.

Electricity Costs and Projected Increases

The Department of Public Service projects that Vermont will experience 5% annual increases in electricity rates from 2025 to 2030. [36] This is a result of a variety of issues related to power supply (including generation, transmission, and distribution) in Vermont and New England overall. When power generators experience increased costs, those increases will likely result in increased electricity rates. There are six major cost pressures driving projected increases in power supply costs, ranging from transmission costs driven by regional costs and ISO NE tariff adjustments, to expanding rates reflected in net income increases to utilities, increasing operational costs, and costs associated with taxes. The majority of the projected increase in Vermont electric rates is due to anticipated increases in transmission and power supply costs.

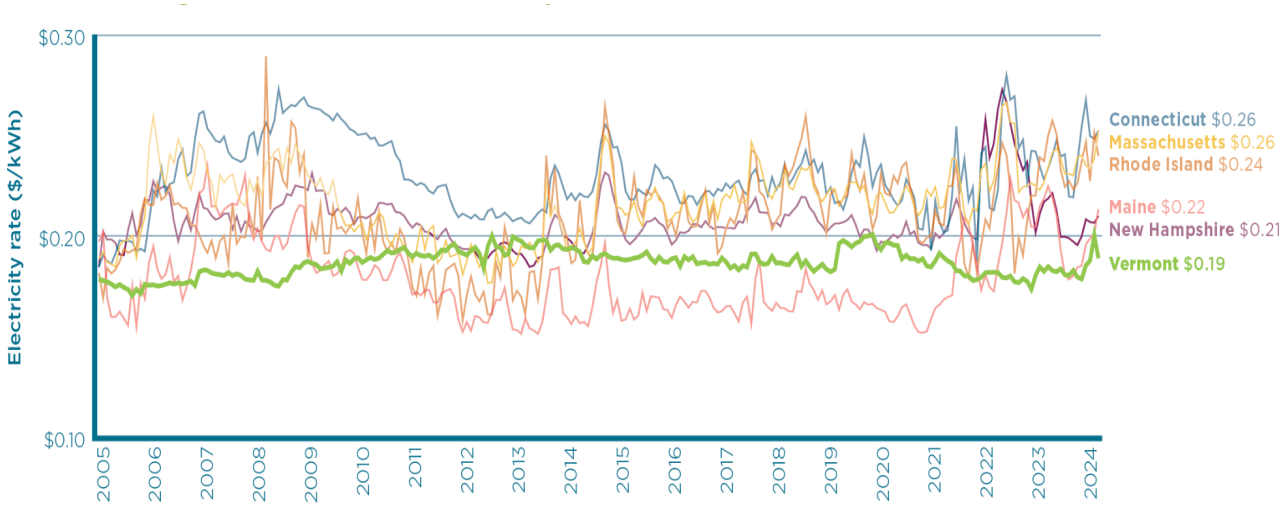
Table 6: Power Supply Costs and Projected Increases in Vermont[37]

	Projected Expense and Annual Increase in %
Transmission & Power Supply	**Power Supply** $435.3 to $505 million - **3.2% annually** **Transmission** $156.9 to $183.7 million - **3.4% annually**
Depreciation and Amortization	$113.1 to $136.9 million - **4.2% annually**
Administrative and General & Operations and Maintenance Costs	$368.7 to $441 million - **3.9% annually**
(Non-Income) Taxes	$60.3 million to $72.1 million - **3.9% annually**
Interest Expense and Income Taxes	**Interest Expenses** $61.6 to $93.1 million - **10.2% annually** **Income Taxes** $26.3 million to $47 million - **15.7% annually**
Utilities' Net Income	$91.6 to $149.9 million - **12.7% annually**

It is important to note that the expected increases in power supply costs noted in Table 6 are not unique to Vermont - the same is true across New England, as the whole region faces similar pressures on power supply costs. It is also important to note that although increases in electric rates are being projected by the Department of Public Service as a result of increasing power supply costs, Vermont has historically experienced relatively low and stable electricity rates when compared to other states in the region, a trend which is shown in Figure 8.

[36] Public Service Department, Memo to Commissioner Kerrick Johnson, May 12, 2025.
[37] Public Service Department, Memo to Commissioner Kerrick Johnson, May 12, 2025.

Figure 8: Average Monthly Retail Electricity Rates by New England State[38]

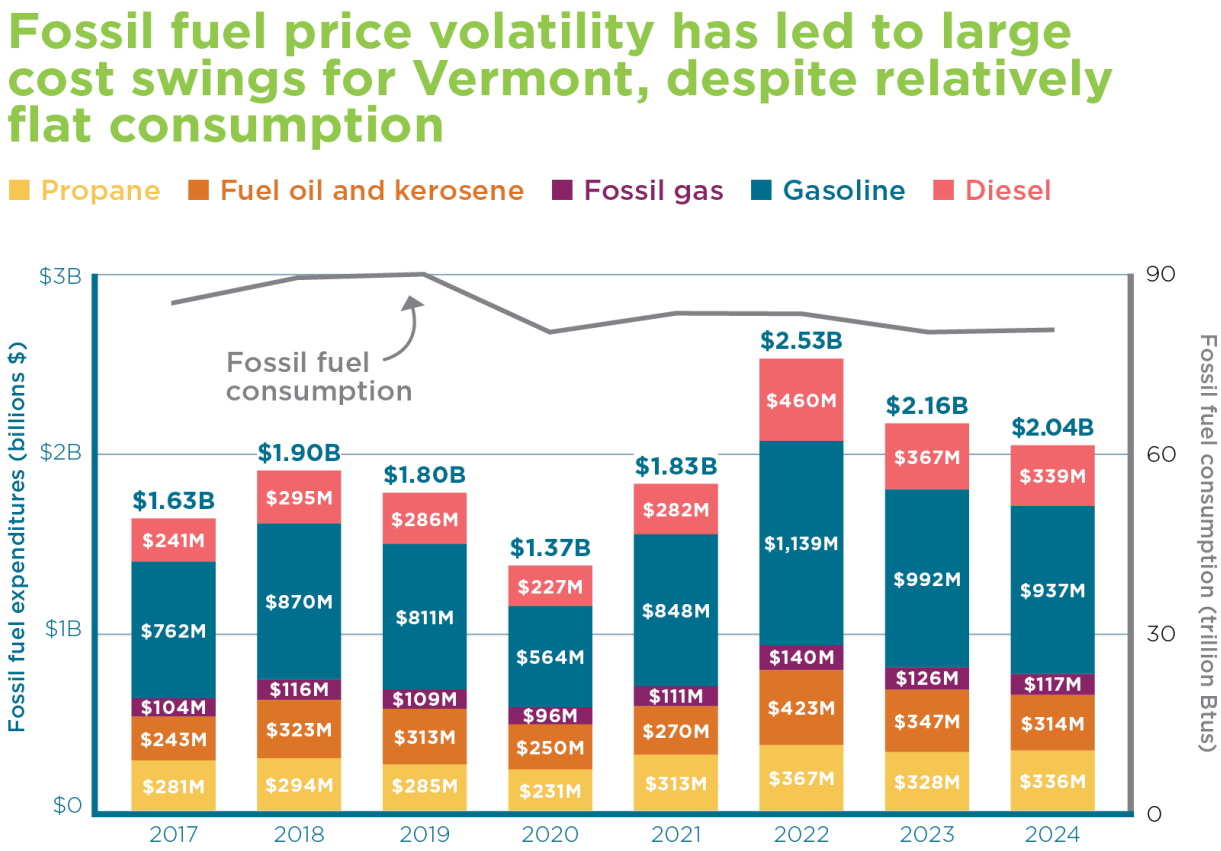


Source: U.S. Energy Information Administration, Average retail price of electricity, all sectors, 2025; U.S. Bureau of Labor Statistics, CPI for all urban consumers, 2025.

Cost-mitigating Factors **–** While it is important to note expected upward pressures on electricity rates in Vermont and to consider implications for increased electrification of transportation and heating, it is also important to note the historic volatility of fossil fuel costs despite relatively flat consumption. This is illustrated in Figure 9 and is observable in both the thermal and transportation sectors. Fossil fuels are subject to significant price fluctuations regardless of consumption, creating the possibility for significant and frequent unexpected swings in costs. This is in sharp contrast to electricity rates in Vermont which historically have been quite stable and low, relative to nearby states.

[38] Energy Action Network, forthcoming "Annual Progress Report for Vermont 2025." Internal Draft. Summer 2025.

Figure 9: The Volatility of Fossil Fuel Costs in Vermont [39]

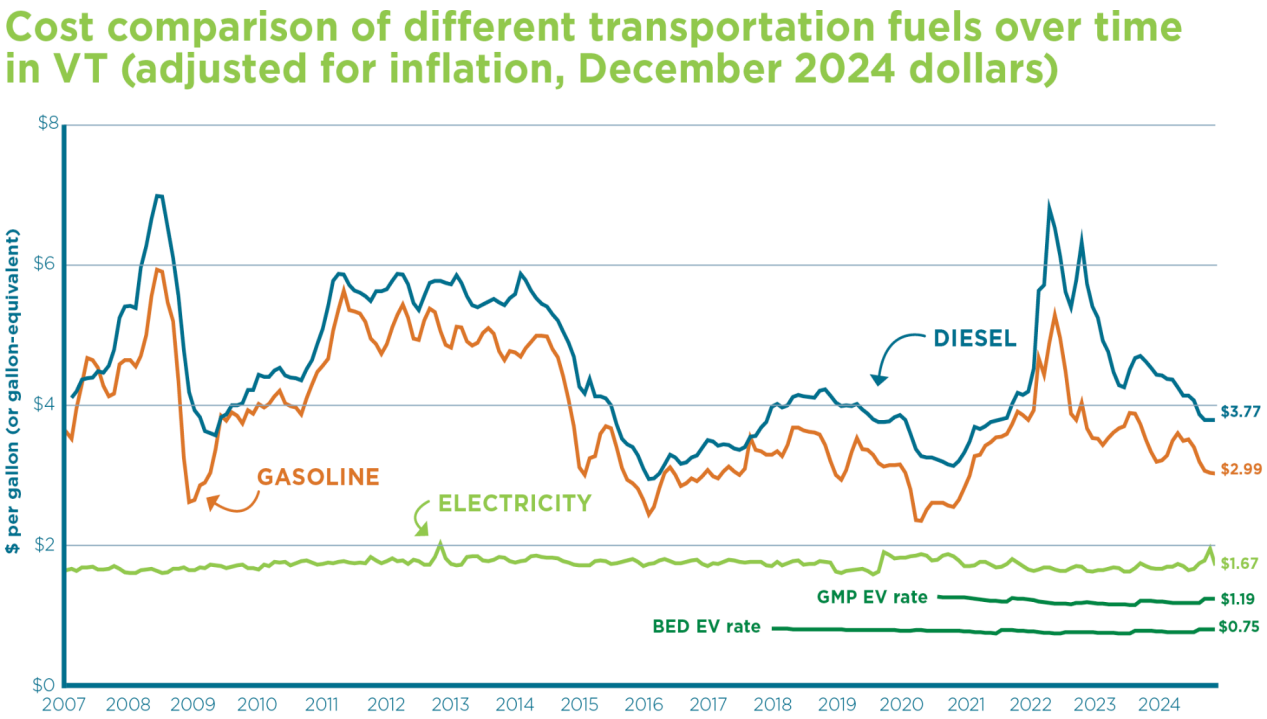


Sources: Gasoline and diesel sales volumes from Vermont Department of Taxes via the Joint Fiscal Office; fuel oil, kerosene, and propane sales volumes from Vermont Department of Taxes; fossil gas sales volumes and prices from VGS; other fuel prices from Vermont Department of Public Service and EIA. **Note:** This estimate only includes Vermont sales of gasoline, diesel, propane, fuel oil and kerosene, and fossil gas. It does not include sales of aviation gasoline or jet fuel from the transportation sector or of fossil fuel-based electricity generation (less than 10% of Vermont's electricity portfolio).

End Use Customer Costs and Affordability – In addition to reflecting on the volatility of fossil fuel compared to electricity costs when contemplating cost pressures related to power supply (including generation, transmission, and distribution), it is also important to consider cost pressures on end use customers resulting from increased electrification of transportation and heating. For customers who switch to electric vehicles, although their electricity bills may increase, transitioning from gasoline or diesel to electricity can result in net savings in transportation costs, as shown in Figure 10.

[39] Energy Action Network, forthcoming "Annual Progress Report for Vermont 2025." Internal Draft. Summer 2025.

Figure 10: Cost Comparison of Fossil Fuels and Electricity Used for Transportation[40]

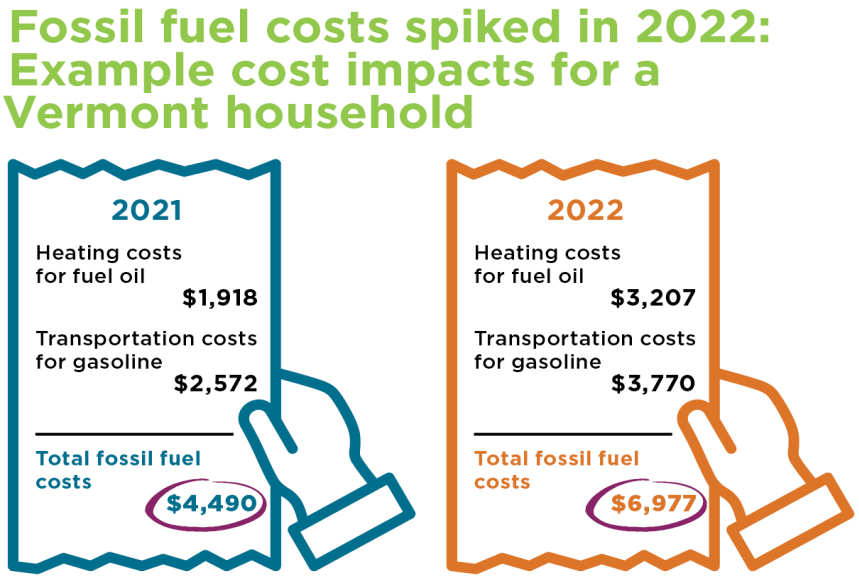


Sources: VT electricity, gasoline, and diesel prices: EIA, 2025; Off-peak EV rates: Green Mountain Power and Burlington Electric Department, 2025. **Notes:** Data through December 2024. Prices shown are in December 2024 dollars, using the U.S. Bureau of Labor Statistics Consumer Price Index. The electricity prices shown in light green are average statewide residential rates.

The instability of fossil fuel prices creates uncertainty for household budgets and can result in higher energy burdens and less affordable energy costs for households. Shown in Figure 11 are the impacts of a spike in heating and transportation fuel prices for a hypothetical Vermont household between 2021 and 2022. The cost spike shown would be avoidable for the hypothetical household if they had electrified their heating and transportation. This point is further emphasized in Figure 12 directly comparing overall costs between two households, one which makes use of electrified heating/cooling and transportation, and one which relies on fossil fuels.

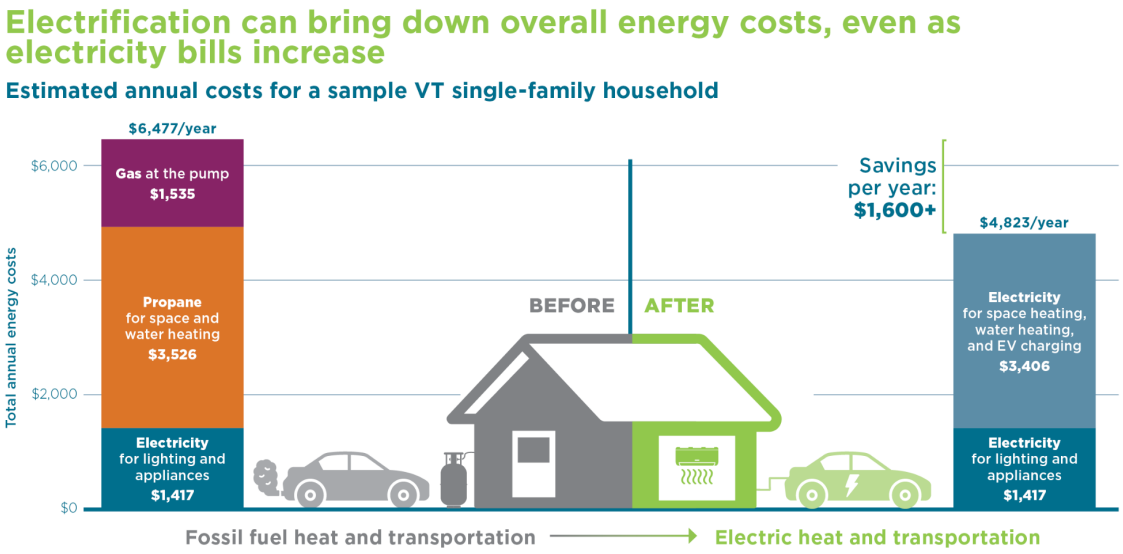
[40] Energy Action Network, forthcoming "Annual Progress Report for Vermont 2025." Internal Draft. Summer 2025.

Figure 11: Fossil Fuel Cost Spike, 2021 - 2022[41]



Sources: Transportation costs estimated for a household with 2 gasoline vehicles based on VT average annual VMT from the Federal Highway Administration, average MPG assumption from the 2021 Vermont Transportation Energy Profile, and average annual gasoline prices for New England from EIA. Heating costs for a fuel oil furnace estimated based on average Vermont heating load of 83 MMBtu (adjusted based on annual heating degree days), average fuel oil furnace efficiency from the Efficiency Vermont Technical Reference Manual (TRM), 2024, and average VT fuel oil prices from the Department of Public Service.

Figure 12: Effects of Electrification on Overall Energy Costs



Sources: Energy bill savings calculated based on the average monthly prices for propane, gasoline, and electricity in 2024, from the Vermont Department of Public Service and EIA. Electricity costs for lighting and appliances reflect statewide average annual household electricity expenditures (Efficiency Vermont, "Vermont Energy Burden Report," 2023). Annual transportation fuel costs calculated using average fuel efficency of 23.4 MPG for vehicles registered in VT from the 2021 Vermont Transportation Energy Profile and VT average annual vehicle miles traveled (VMT) of 11,084 miles/year from the Federal Highway Administration. **Note:** Actual energy cost savings will depend on a number of factors, including a household's electricity rate. Several Vermont utilities offer lower electric rates for managed EV charging, providing additional savings to households with access to those rates. Upfront equipment/vehicle costs vary based on model and incentive eligibility; because of this variance, upfront costs are not quantified here. Savings estimates are for a one car household. Estimated savings would be higher for households replacing multiple gas vehicles with electric vehicles.

[41] Energy Action Network, forthcoming "Annual Progress Report for Vermont 2025." Internal Draft. Summer 2025.

Section 7: Key Considerations When Planning the Future Grid

To achieve greenhouse gas emission requirements established in Vermont's Global Warming Solutions Act, the transmission and distribution grid serving Vermont would ideally rely only on the use of cost-effective, proven, and reliable carbon-free power generation, energy efficiency, demand response, and storage. However, the grid is developed and managed with many objectives in mind. Effective transmission and distribution planning and operation involves optimizing many disparate variables including (among others):

- Reliability;
- System cost;
- Customer cost; and
- Resilience.

Presented below is a discussion of key issues that will be central to future T&D planning and operation in Vermont resulting from increased electrification of transportation and heating.

Opportunities

Electrification provides a unique opportunity to reshape the future of Vermont's energy systems and pursue environmental goals. The compounding efforts of distribution utilities and system planners have consistently allowed Vermont to meet challenges to the T&D system with a unique ingenuity which makes the system unlike any other in the U.S., and continues to enable collaborative and creative solutions to timely issues. There are three key takeaways from research completed for this report:

1. Vermont's utilities and system planners recognize the increasing demand for electricity resulting from climate and clean energy targets, and have developed plans to account for it as well as to retain reliability during major events.
2. Electricity costs will likely increase, but at a steady, consistent rate and in a manner that keeps Vermont's electric rates below the rest of New England.
3. Vermont's T&D system planning process recognizes the value of both traditional central power plant T&D as well as distributed generation, energy storage, energy efficiency, demand reduction, and flexible load management. The planning process incorporates the input and effort of numerous stakeholders including T&D system planners, the utilities, government agencies, and public members.

Challenges

While utilities and system planners have, when possible, taken initiative to advance technologies and practices that move Vermont closer to its environmental goals while still supporting

reliability, there are mitigating factors which require attention. Among those are: the grid's continued ability to reliably supply electricity as electrification and distributed generation grow in Vermont, and concerns over in-state electricity generation.

The proliferation of DG resources including solar installations, while offering new opportunities for Vermont and serving as a critical element of Vermont's smart grid, does pose challenges to the grid. The VSPC's 2024 draft of the Vermont Long-Range Transmission Plan states that:

> "If solar PV deployment continues without regard to transmission system capacity, the anticipated growth … will stress the transmission system to the point of causing additional curtailment of ISO-NE-controlled generation plants, or necessitate significant locally funded transmission upgrades." [42]

A number of options exist to address this concern, including grid-optimized locations for distributed generation projects, continued and expanded implementation of battery storage, further development of micro-grids, and more. Concerns over the grid's ability to handle increased flow of electricity from both centralized and decentralized generation will likely remain a focus, as system planners and operators continue to optimize the transmission and distribution of both.

In addition, there are concerns over the future of Vermont's in-state electricity generation, a worry resulting from failures of in-state hydroelectric plants to attain re-registration, and a lack of new wind projects.[43] As Vermont is a net-importer of electricity, shortfalls caused by a lack of in-state generation would need to be made-up by purchasing more power from other jurisdictions, potentially raising the amount spent importing power.

Opportunities for Increased Grid Adaptability

Despite notable challenges, there have been major advancements in both available technology and common practices which have gone a long way toward ensuring the grid will continue to be reliable and sustainable into the future. The combined use of energy storage, demand response, distributed generation, and flexible load management have enabled Vermont to benefit from each of these advancements, such as during the June 2025 peak event. In addition, the legislature has taken action in recent years to support the trend toward Vermont's environmental and energy goals. The "Renewable Energy Standard" (updated in 2024) establishes a five-tiered set of requirements for Vermont's distribution utilities, mandating that they:[44]

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[42] 2024 Vermont Long Range Transmission Plan (VSPC Draft), Pg. 9. https://www.velco.com/sites/default/files/2024-04/2024%20VLRTP_publicreview_clean.pdf.
[43] Darren Springer (BED General Manager), Interview via zoom 7/21/2025.
[44] PUC. Renewable Energy Standard | Public Utility Commission.

1. Procure a defined percentage of annual load from renewable sources;
2. Source a certain percentage of renewable energy needed to satisfy Tier I from distributed generation;
3. Either procure additional new (renewable) distributed energy consistent with Tier II, or fossil fuel saving through energy transformation projects, which reduce fossil fuel consumption of a utility's customers;
4. Use a percentage of new regional renewable energy to satisfy Tier I; and
5. Meet certain load growth requirements.

The transmission and distribution system is critically important to Vermont, as the transportation of electricity from generator to end-user remains as important today as it ever was, if not more so. In a time and environment where Vermont's T&D system is central to accomplishing state energy and environmental goals as well as the regular and reliable supply of energy, it requires careful planning and substantial investment of time and money. The system planning process focused on collaborative effort and coordination of numerous stakeholders enables a dynamic and need-responsive process, capable of navigating emerging challenges and balancing various needs. Practices and technologies such as energy storage, distributed generation, and demand response will remain important tools for Vermont and will continue to evolve as time goes on.

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