Vermont Department of Public Service

2019 Annual Energy Report

January 15, 2019

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I. Purpose of the Annual Energy Report

Vermont's energy policy, as articulated in statute, is:

> To assure, to the greatest extent practicable, that Vermont can meet its energy service needs in a manner that is adequate, reliable, secure, and sustainable; that assures affordability and encourages the State's economic vitality, the efficient use of energy resources, and cost-effective demand-side management; and that is environmentally sound.[1]

The three goals – reliability, affordability, and sustainability – can at times be in competition. Any policy actions should acknowledge this and should also be informed by objective data as to Vermont's existing energy usage and policies. This Annual Energy Report is designed to provide that objective data and also provide transparency regarding how this data informs the policies pursued by the Public Service Department (PSD or the Department).

In addition, the statutory comprehensive energy planning requirements set forth in 30 V.S.A. § 202b require an annual report on the progress toward meeting the goals set forth in the Comprehensive Energy Plan (CEP). Sections 3-5 provide data regarding the Electricity, Thermal, and Transportation sectors, as well as the Department's recommendations regarding policies to further the energy policy goals set forth in 30 V.S.A. § 202a.

II. Introduction

Vermont's Comprehensive Energy Plan, which is published every six years by the Department of Public Service, is designed to "implement the State energy policy set forth in section 202a" and be consistent with the relevant land use planning goals contained in 24 V.S.A. § 4302. The 2016 CEP contains an overarching goal of meeting 90% of the state's energy needs with renewable energy across the electric, thermal, and transportation sectors by 2050. In addition to the 90% by 2050 goal, the CEP contains many sector specific goals. These goals are summarized in the table below.

Table 1: 2016 Comprehensive Energy Plan Goals

Sector	Goal
Total Energy	90% by 2050
	40% by 2035
	25% by 2025
	Reduce consumption per capita by 15% by 2025 and by more than 33% by 2050
Electricity	67% Renewable by 2025
Thermal	30% Renewably by 2025
Transportation	10% Renewable by 2025
Greenhouse Gases	40% below 1990 levels by 2030
	80-95% below 1990 levels by 2050

[1] 30 V.S.A. § 202a.

The 2016 CEP also contains illustrative pathways that could be taken in order to reach the goals outlined above. For example, one such pathway is the installation of 35,000 cold-climate heat pumps by 2025. These pathways, while helpful to understand the rate and scope of change needed to reach our goals, should not be interpreted as the only possible pathways to reach those goals. Planning documents must recognize that technological changes, markets, and other forces will impact how we proceed into the future and which path we take to reach our goals. Dictating specific technologies now can limit more cost-effective options in the future. Conversely, waiting for the best possible technological shift or market change can result in the goals never being met. Good planning requires an eye towards what the future may bring while simultaneously striving to meet goals within the present context. Planning goals should inform and drive policy choices and not simply be a slogan that is used to spur or hinder progress.

Generally speaking, the CEP goals are being surpassed in the electric sector, there is moderate progress in the heating sector, and nascent movement in the transportation sector. The Renewable Energy Standard in the electric sector has led to approximately 62% renewability. The heating and transportation sectors are approximately 24% and 5.5% renewable, respectively.

With respect to the greenhouse gas (GHG) goals contained in the CEP, the most recent data, from 2015, indicates that Vermont is losing ground. Estimated GHG emissions for 2015 were 9.9 million metric tons CO_2 equivalent ($MMTCO_2e$), 16% above the 1990 baseline of 8.59 $MMTCO_2e$.[2] These figures do not reflect recent regulatory changes in the electric sector. As a result of the Renewable Energy Standard going into effect in 2017, 63% of the state's electric power supply was met through renewable energy in that year, with an additional 13% through nuclear. Accordingly, 76% of Vermont's electric supply is considered to be carbon free; an increase of 29% since 2016. Given the requirements of 75% renewable by 2032, the RES puts the electric sector on a steady path for future GHG reductions.

III. Electric Sector

A. Overview

Electricity is bought and sold in New England just like any other commodity. These purchases and sales can happen either through a bilateral contract – directly between the buyer and the seller – or in a regional, whole-sale marketplace. The regional marketplace is managed by the Independent System Operator – New England (ISO-NE). ISO-NE operates the energy markets, a capacity market, and an ancillary services market to ensure that cost-effective electricity is available for the entire region.

Electricity is sold on the retail level in Vermont by Distribution Utilities (DUs). These utilities have an obligation to serve all the households within their established service territory. Currently there are 14 municipally-owned utilities, e.g. City of Burlington Electric Department, two cooperatively-owned

[2] Vermont Agency of Natural Resources, Department of Environmental Conservation, Air Quality and Climate Division, *Vermont Greenhouse Gas Emissions Inventory Update: Brief 1990-2015,* June 2018. Available at: https://dec.vermont.gov/sites/dec/files/aqc/climate-change/documents/_Vermont_Greenhouse_Gas_Emissions_Inventory_Update_1990-2015.pdf.

utilities, e.g. Washington Electric Cooperative, Inc., Vermont Electric Cooperative, and one investor-owned utility, Green Mountain Power Corporation.

Vermont is part of the New England electric grid and continues to rely heavily on resources in neighboring states to supply sufficient energy. However, the Vermont system has changed considerably in recent years. Fifteen years ago, there were a few dozen generation resources in the state, now there are thousands of small-scale generation resources (primarily solar) distributed across the state.

In 2015, Vermont passed a Renewable Energy Standard (RES), years after all other New England states had implemented similar programs, and 2017 was the first year of implementation. The RES requires electric utilities to increase the portion of renewable energy they sell to Vermont customers to 55% in 2017, rising over time to 75% in 2032. This is the RES's Tier 1 requirement. Tier 2 requires that an increasing portion (1% in 2017, climbing to 10% in 2032) of electric energy comes from small-scale, i.e. less than 5 MW, electric generators that are connected to Vermont's distribution and sub-transmission grid. The Tier 2 requirements are a carve-out of the Tier 1 requirement; in other words, the total Tier 1 and Tier 2 requirement in 2032 is 75% of retail sales.

Tiers 1 and 2 of the RES requires utilities to hold Renewable Energy Certificates (RECs) to satisfy their requirements, as do all five other New England states. RECs, which are each equivalent to one MWh generated from a renewable resource, are created when a renewable unit generates electricity. RECs can be sold separately from the electricity generated by the unit. For example, a solar facility could sell electricity to a utility and RECs to another utility or to a private party. RECs, are registered by regional generators in the NEPOOL Generator Information System (NEPOOL GIS). The NEPOOL GIS tracks the characteristics of each generator in order to determine which "classes" of which states' renewable standards would be met by production associated with the REC. Utilities and generators buy and sell RECs on an open market in the region.

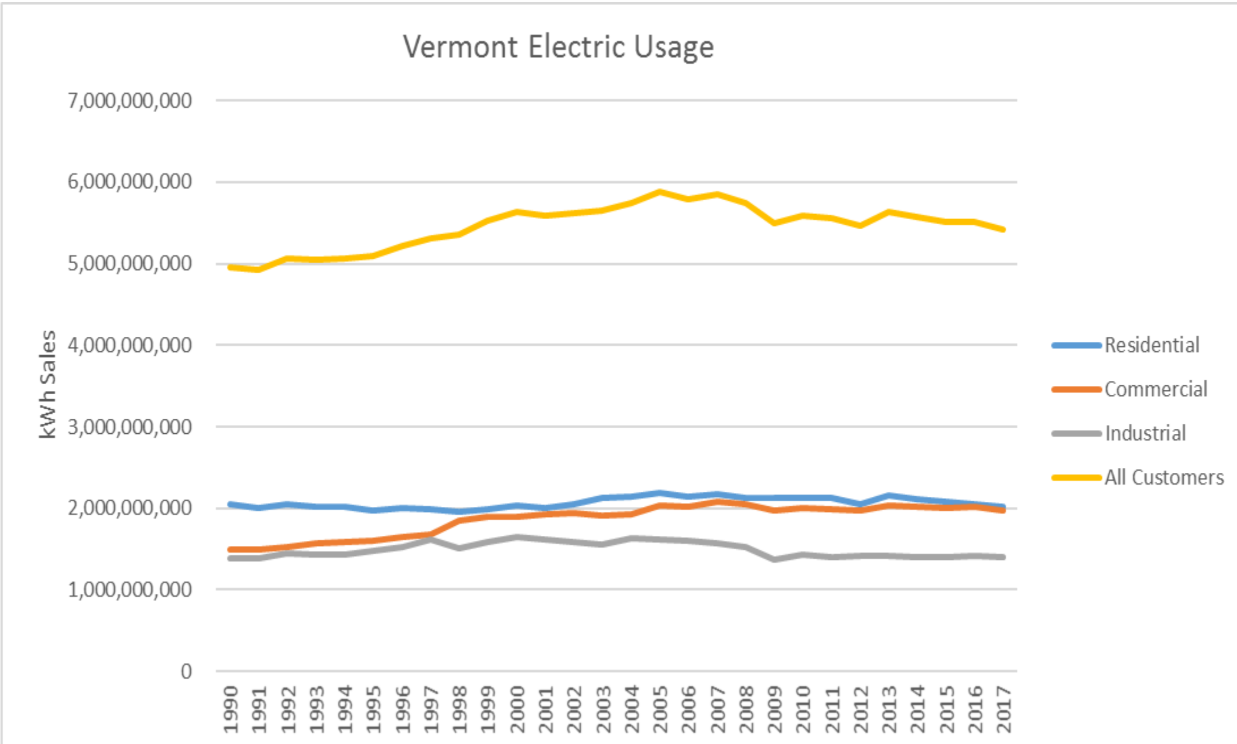
Act 56 also created a separate, Tier 3 energy transformation obligation that rises from 2% in 2017 to 12% in 2032. A utility may meet this requirement through additional distributed renewable generation, or through energy transformation projects that result in net reduction of fossil fuel consumption by the utility's customers. Examples of these projects could include building weatherization; air source or geothermal heat pumps and high-efficiency heating systems; increased use of biofuels; biomass heating systems; and electric vehicles or related infrastructure. The Tier 3 requirements are additional to the Tier 1 requirements.

B. Total Electric Energy Consumed

Table 2: Electric Sector Energy (MMBtu)

Total	Renewable	Percent Renewable
18,478,434	11,619,344	62%

Figure 1: Vermont kWh Sales 1990-2017

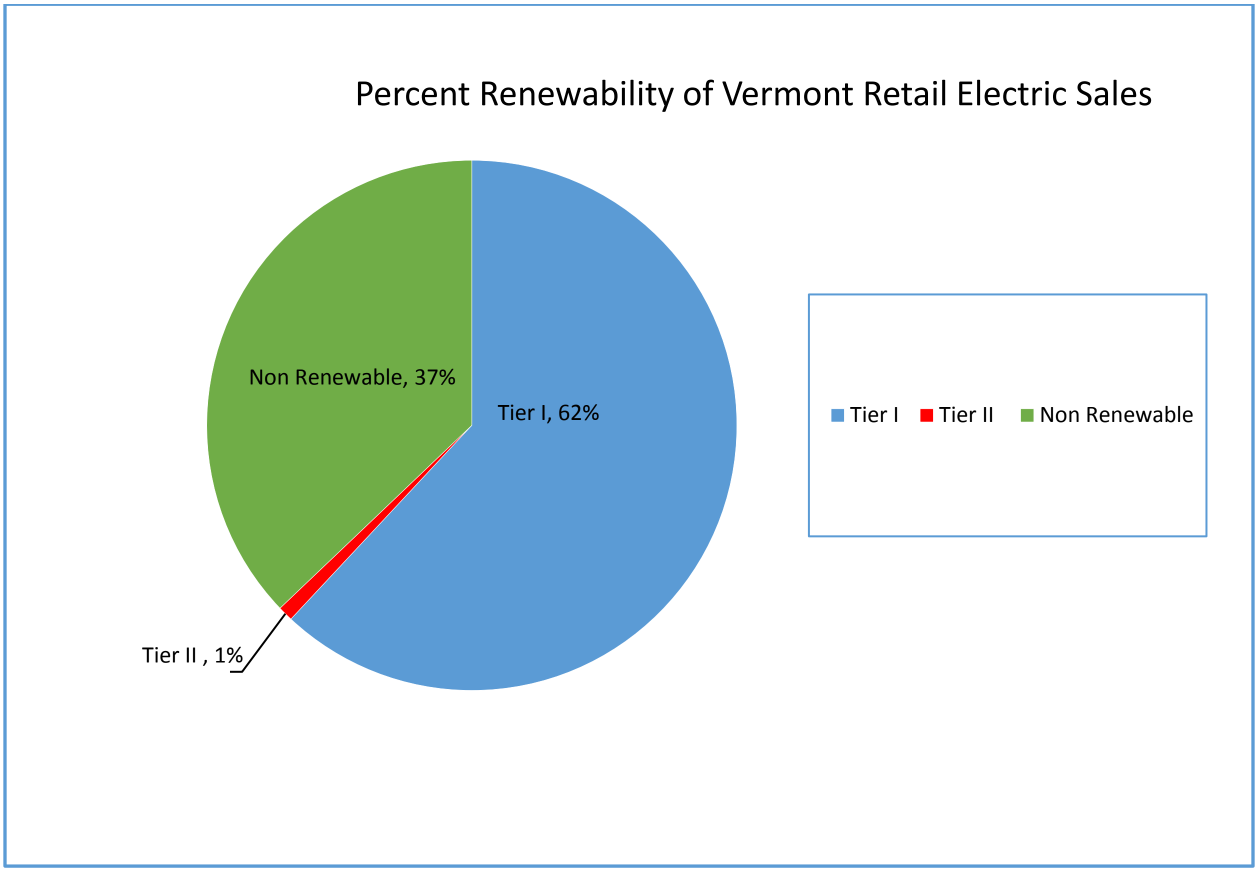


The chart above shows the total kWh sales by utilities to customers from 1990 through 2017. In 2017, that number was 5,415,719,322, which equals 18,478,434 MMBtus.

C. Renewable Energy Consumed

Of the 5,415,719 MWhs that were sold in Vermont during 2017, approximately 62%, or 3,405,435 MWhs, are considered to be renewable as demonstrated by the associated retired RECS produced by renewable generation facilities. An additional 13% of the MWhs sold were supplied by nuclear units; which are not renewable but are considered to be non-carbon emitting resources that help meet Vermont's GHG reduction goals.

Figure 2: Renewability of Vermont Retail Electric Sales (2017)



D. Vermont and New England Hour and Day of Summer and Winter Peaks

Peak demand measures the maximum amount of energy needed for the set time period – either for the day, month, or year; in turn, the electrical system is designed to meet annual peak demand. The Vermont System Planning Committee[3] is responsible for developing forecasts of Vermont peak loads. ISO-NE also develops a Capacity, Energy, Load, and Transmission (CELT) forecast every year. These estimates are used to predict future transmission needs. Peak loads are forecasted to be relatively flat or declining over the next decade. See Appendix C. The Vermont system is currently planned to 1100 MW, and the forecasted growth in electric vehicles and heat pumps does not push peak load over this amount over the next ten years, or even over the 20-year forecast horizon.

As can be seen on the charts below, Vermont remains a winter-peaking system, while the New England System continues to peak in the summer. It is also important to note that the amount of in-state solar generation has pushed Vermont's summer peak into the evening hours.

[3] The VSPC is comprised of stakeholders from electric distribution utilities, environmental groups, businesses, regional planning associations, energy efficiency utilities, and is organized by Vermont Electric Power Company, Inc. (VELCO). *See,* https://www.vermontspc.com/.

Table 3: Vermont System Peaks 2014-2017 (MW)[4]

2014			
MONTH	**DATE**	**HOUR**	**VELCO PEAK (MW)**
JAN	1/2/2014	18	1,004
FEB	2/11/2014	19	905
MAR	3/3/2014	19	874
APR	4/9/2014	21	763
MAY	5/15/2014	21	735
JUN	6/30/2014	19	871
JUL	7/2/2014	14	945
AUG	8/11/2014	19	845
SEPT	9/2/2014	20	897
OCT	10/16/2014	19	808
NOV	11/18/2014	18	884
DEC	12/8/2014	18	947

2015			
MONTH	**DATE**	**HOUR**	**VELCO PEAK (MW)**
JAN	1/8/2015	18	956
FEB	2/15/2015	19	937
MAR	3/5/2015	19	877
APR	4/9/2015	21	776
MAY	5/27/2015	16	822
JUN	6/23/2015	19	793
JUL	7/29/2015	18	905
AUG	8/19/2015	21	904
SEPT	9/8/2015	20	913
OCT	10/19/2015	19	775
NOV	11/30/2015	18	856
DEC	12/28/2015	18	930

2016			
MONTH	**DATE**	**HOUR**	**VELCO PEAK (MW)**
JAN	1/4/2016	18	961
FEB	2/14/2016	19	935
MAR	3/2/2016	19	836
APR	4/4/2016	21	772
MAY	5/28/2016	21	774
JUN	6/20/2016	21	825
JUL	7/13/2016	19	874
AUG	8/11/2016	21	918
SEPT	9/8/2016	20	862
OCT	10/26/2016	19	774
NOV	11/21/2016	18	863
DEC	12/19/2016	19	945

2017			
MONTH	**DATE**	**HOUR**	**VELCO PEAK (MW)**
JAN	1/9/2017	18	901
FEB	2/9/2017	19	873
MAR	3/4/2017	19	856
APR	4/6/2017	20	736
MAY	5/18/2017	20	737
JUN	6/19/2017	15	817
JUL	7/19/2017	21	804
AUG	8/22/2017	18	855
SEPT	9/26/2017	20	871
OCT	10/9/2017	19	750
NOV	11/10/2017	18	841
DEC	12/29/2017	18	973

[4] Source: VELCO. Note that blue shaded areas represent winter peaks and the orange shaded areas represent summer peaks.

Table 4: ISO-NE Seasonal Peaks, 2013-2017[5]

Summer					Winter				
Year	**Month**	**Day**	**Hour**	**Peak (MW)**	**Year**	**Month**	**Day**	**Hour**	**Peak (MW)**
2013	JUL	19	17	27,379	13/14	DEC	17	18	21,453
2014	JUL	2	15	24,443	14/15	JAN	8	18	20,583
2015	JUL	20	17	24,437	15/16	FEB	15	18	19,561
2016	AUG	12	15	25,596	16/17	DEC	15	18	19,647
2017	JUN	13	17	23,968	17/18	JAN	5	18	20,662

[5] Source: ISO-NE, Actual Peaks, https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/net-ener-peak-load

E. Projections in Energy Reductions & Shift to Renewable Energy

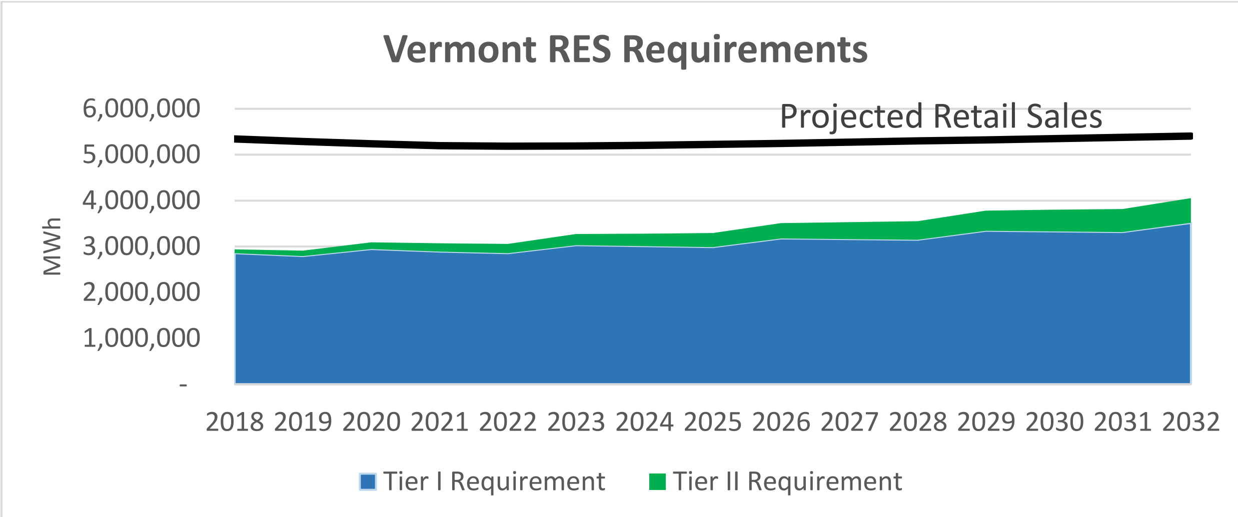
Vermont's Energy Efficiency Utilities (EEU) will continue to invest in energy efficiency into the foreseeable future. The Department conducts a study every three years that examines the potential amount of electric energy efficiency available. The table below, from the 2018 study, presents 1-, 2-, 3-, 10-, and 20-yr statewide sector-level cumulative annual realistic achievable potential (RAP) for energy, summer peak demand, and winter peak demand. The RAP approaches 300,000 MWh in 2020 and rises to more than 900,000 MWh by 2037. Summer and winter demand savings each exceed 100 MW after 10 years. The savings are cumulative, that is, a measure installed in 2020 will continue to provide savings for 11 years.

Table 5: Statewide Sector Level Cumulative Annual Realistic Achievable Potential

	2018 Potential	2019 Potential	2020 Potential	2027 Potential	2037 Potential
Annual Energy (MWh)					
RAP	106,494	206,269	295,100	752,686	925,166
Summer Peak Demand (MW)					
RAP	14.5	28.2	40.8	114.9	134.9
Winter Peak Demand (MW)					
RAP	16.1	31.5	41.9	97.5	118.9

Vermont's RES will dictate the pace of new renewable energy in the electric sector. Vermont's utilities are required to meet Tiers I and II of the RES, which require that a certain percentage of their overall load be renewable. See the chart below for projected retail sales numbers and the associated Tier I and II requirements. However, the RES does not preclude a utility from procuring additional renewable energy or RECs to go beyond the requirements of the RES. Certain utilities already do so, for example Burlington Electric Department, Swanton Electric Department, and Washington Electric Cooperative are 100% renewable.

Figure 3: Projected Vermont Renewable Energy Standard Requirements



F. Comparison of Electricity Prices

The average 2017 wholesale energy price was $33.94/MWh ($0.03394/kWh), the second-lowest average price since the introduction of the wholesale markets in 2003.[6] New England wholesale energy prices have been trending down as the price of natural gas has fallen. Natural-gas-fired units are typically the marginal units in the region and therefore set the price – natural gas prices and wholesale energy prices correlate extremely well; given constraints on the gas pipelines in the winter (due to natural gas being primarily used for heating in the winter) this means that annual average energy prices have become primarily dependent on winter temperatures.

Due to the fact that the Vermont electric utilities are significantly hedged against wholesale market prices (either through long-term contracts or utility-owned generation resources),[7] the benefits of these low wholesale prices are muted for Vermont ratepayers. Conversely, Vermont ratepayers are not bearing the significant price increases that occur when cold weather drives up wholesale prices. Wholesale prices also have an important role in the Department and PUC's review of additions to an electric utility's power supply portfolio as well. The cost of any new resource is compared against wholesale market prices – to the extent that there are significantly lower wholesale prices, it becomes more difficult for a utility to demonstrate that a particular resource provides an economic benefit to Vermonters. A similar approach is also applied to energy efficiency – low wholesale energy costs means that there are likely to be less energy efficiency measures that are economically justifiable. However, energy prices are only one component of the wholesale price paid by customers – as described below, costs associated with capacity and transmission have increased.

[6] Independent System Operator – New England, *New England's Wholesale Electricity Prices in 2017 Were the Second-Lowest Since 2003,* March 2018. Available at: https://www.iso-ne.com/static-assets/documents/2018/03/20180306_pr_2017prices.pdf

[7] Vermont's renewable energy policy encourages Vermont utilities "to enter into affordable, long-term, stably priced renewable energy contracts that mitigate market price fluctuations for Vermonters." 30 V.S.A. § 8001(a)(3).

1. Capacity Costs

ISO-NE operates the regional Forward Capacity Market (FCM). This market ensures that there are sufficient generation resources available to meet the future peak demand for electricity. ISO-NE holds an annual auction three years before the period of time to which the resources are committing to be available. Resources bid into the auction to obtain a commitment to supply generation capacity (termed a "capacity supply obligation"). Successful resources will be paid the market-based capacity price for performance. A utility's capacity costs are a function of its share of the total system-wide load in New England during the peak hour of energy usage during the year.

Capacity prices have been particularly difficult to predict as the FCM rules have been constantly changing since the introduction of the market. In addition, because entry and exit (retirement) in the market is "lumpy," even an FCM with stable rules will continue to have somewhat volatile prices. For example, the price in Forward Capacity Auction (FCA) 8 was largely driven by the retirement of one 2,000 MW resource.

As can be seen below, in the capacity period of June 1, 2018 to May 31, 2019, utilities will be paying the highest price for capacity since the introduction of the FCM. However, prices will decline over the next three years.

Table 6: ISO-NE Forward Capacity Auction Results[8]

FCA	1	2	3	4	5	6	7	8	9	10	11	12
Capacity delivery	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022
Capacity purchased	34,077	37,283	36,996	37,501	36,918	36,309	36,220	33,712	34,695	35,567	35,835	34,828
capacity price ($/kw-month)	$4.50 (floor price)	$3.60 (floor price)	$2.95 (floor price)	$2.95 (floor price)	$3.21 (floor price)	$3.43 (floor price)	$3.15 (floor price)	$15.00 (new)/ $7.025 (existing)*	$9.55	$7.03	$5.30	$4.63

*The blended price that was paid to settle load was $7.60/kW-Month

2. Transmission Costs

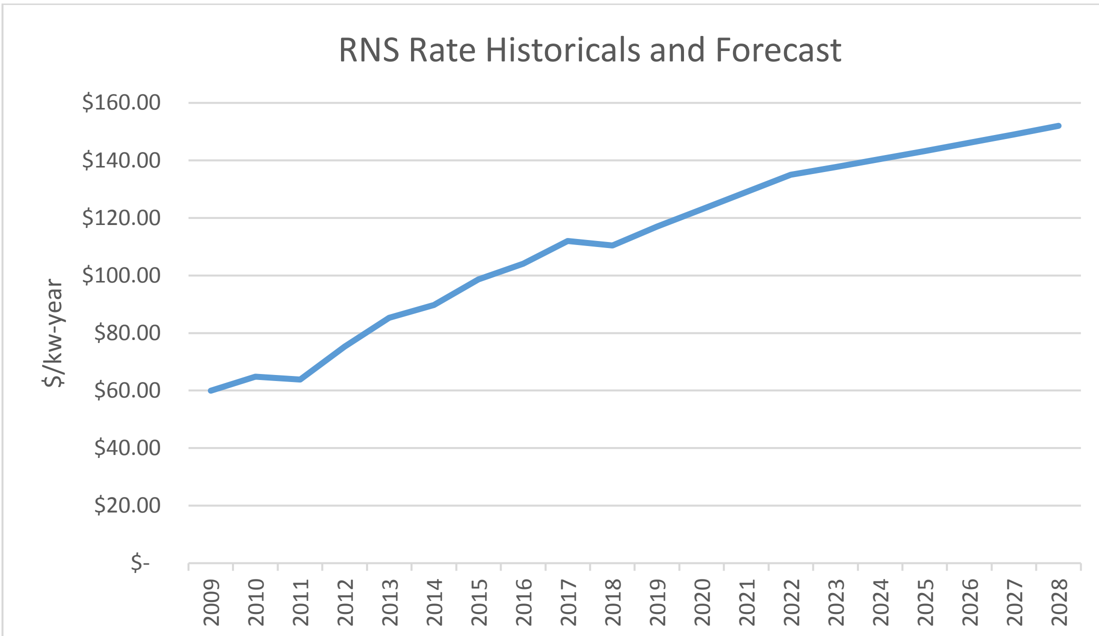
Regional Network Service (RNS) charges can be thought of as the local utility's share of the overall cost to maintain and upgrade the bulk transmission facilities relied on by all wholesale market participants in the region. From 2002 to 2015, New England transmission owners collectively put into service $7.2 billion of transmission infrastructure and ISO-NE projects that there will be an additional $4.8 billion spent on transmission infrastructure for reliability purposes from 2015 to 2025. The costs of reliability projects are socialized across the region, with each state paying based on its proportion of peak demand. Vermont accounts for about 4% of regional peak demand.

Utilities pay for the use of the regional transmission grid. Those bills are determined by each utility's demand during regional monthly peak loads (the electric use at the peak hour of energy use each

[8] Source: https://www.iso-ne.com/about/key-stats/markets#fcaresults

month). Because there is a fixed cost associated with maintaining the transmission system, by reducing monthly coincident peaks, utilities can reduce their own transmission charges, but will essentially be shifting those charges to other utilities and ratepayers in New England.

Figure 4: Regional Network Service Rates



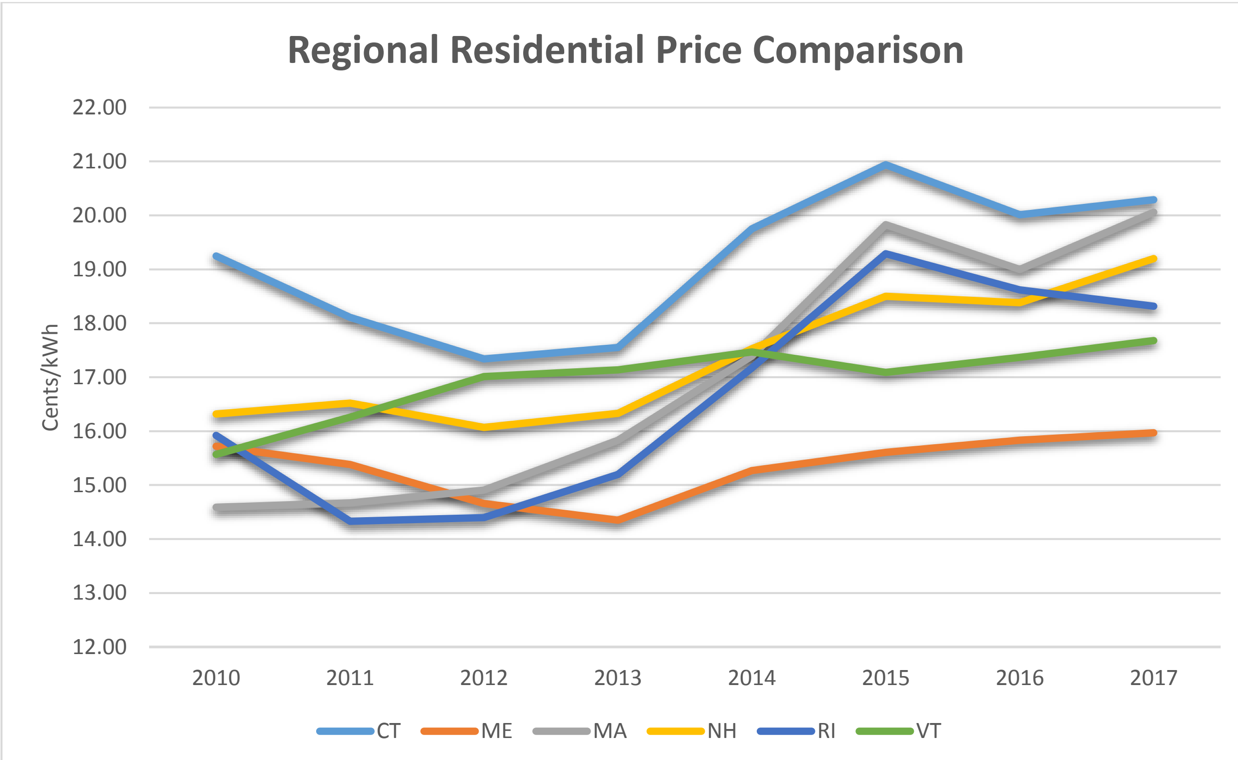
In addition to the regional transmission costs, there are also local transmission costs as well. These are costs associated with transmission infrastructure needed to maintain Vermont, as opposed to New England-wide, reliability. For 2017, local transmission costs totaled approximately $25 million.[9]

3. Retail Rates

Retail rates are what are paid by end-use customers. These rates reflect not just the power supply portfolio but also other regional costs (e.g. ISO-NE capacity and transmission), the costs of maintaining the distribution system (e.g. tree trimming, upgrading lines and transformers, etc.), and administrative costs (e.g. billing, customer service, etc.).

[9] A few Vermont utilities have Open Access Transmission Tariffs as well. An OATT is a regulatory mechanism that ensures consistent pricing for all resources that utilize the transmission network by establishing transparent terms and conditions that apply to all resources.

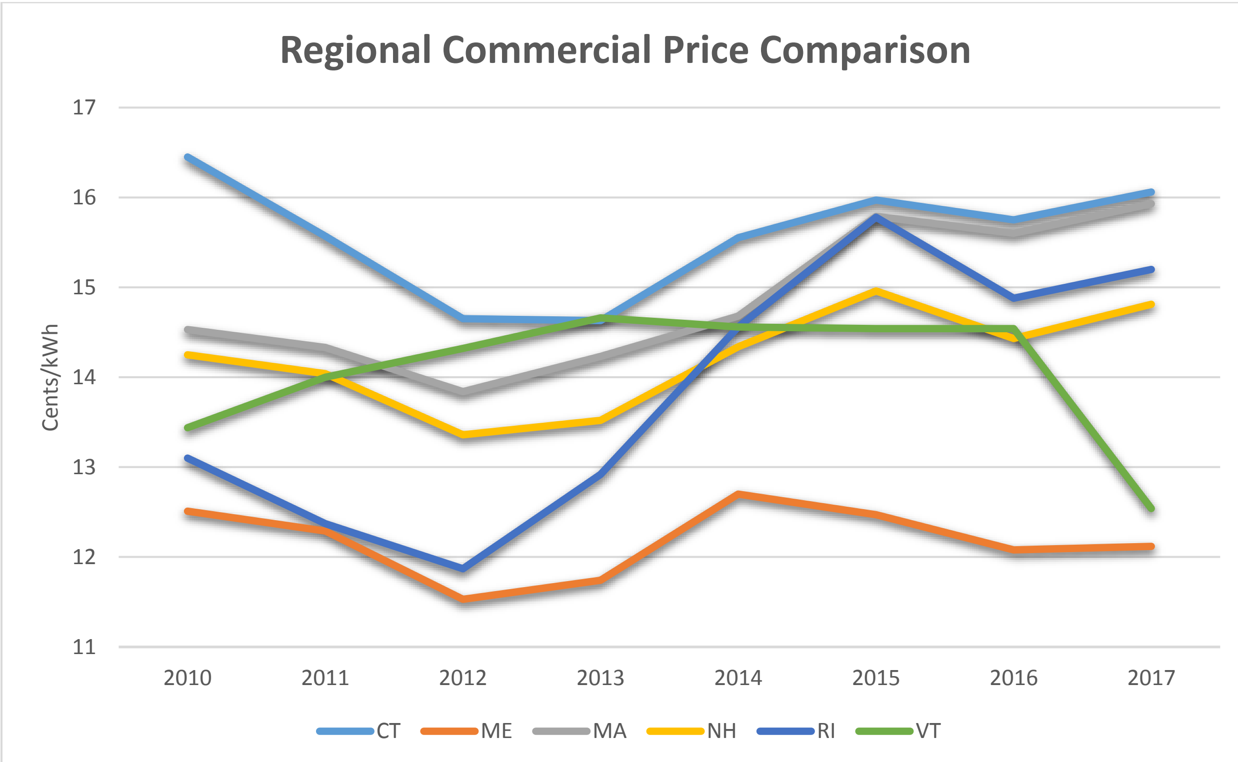
Figure 5: Residential Electric Price Comparison[10]



Vermont's average residential retail rate is the second lowest in the New England region. Additionally, as can be seen in the chart above, it has been more stable than the other New England states.

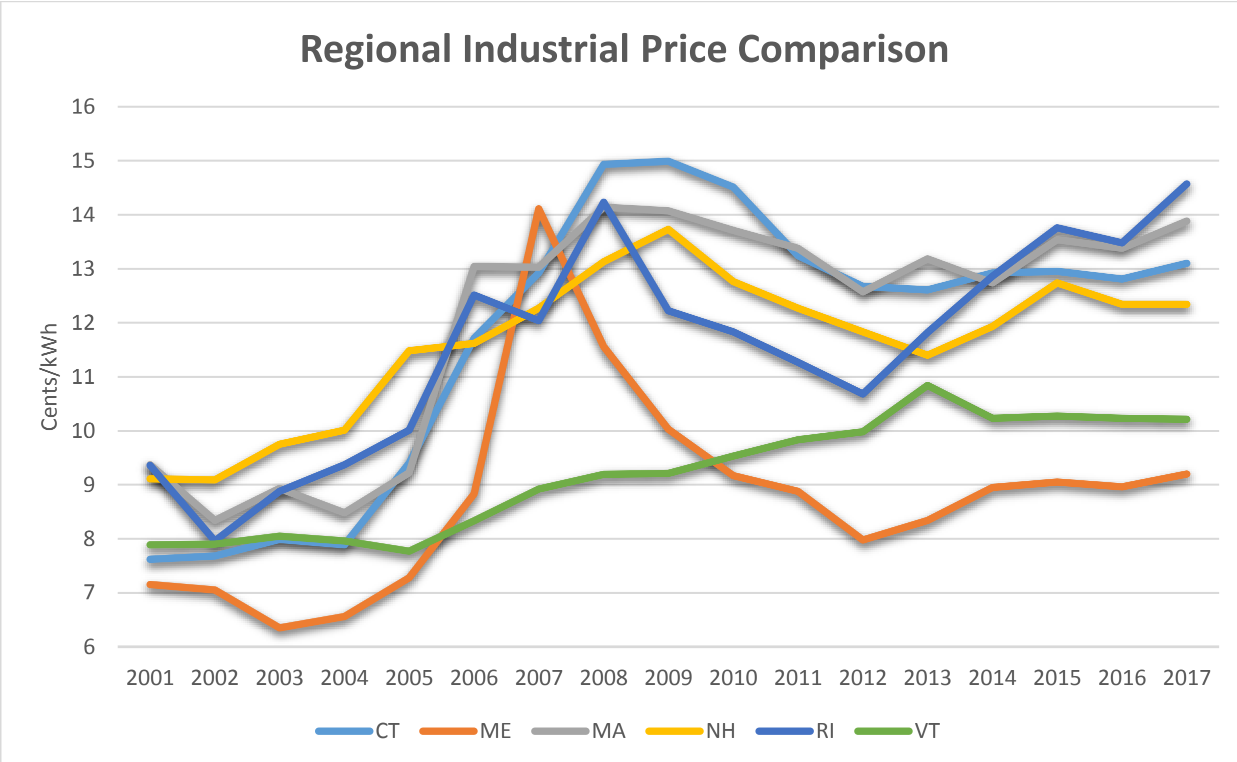
[10] Source: Energy Information Agency.

Figure 6: Commercial Electric Price Comparison[11]



[11] Source: Energy Information Agency.

Figure 7: Industrial Electric Price Comparison[12]



G. Major Vermont and Federal Incentives Available

1. Federal Incentives

The Business Investment Tax Credit (ITC) is available for commercial entities that invest in renewable energy. The table below summarizes the technologies that are eligible as well as the credit percentage available based upon investment dates.

Table 7: Business Investment Tax Credit Eligibility and Percentage

Technology	12/31/16	12/31/17	12/31/18	12/31/19	12/31/20	12/31/21	12/31/22	Future Years
PV, Solar Water Heating, Solar Space Heating/Cooling, Solar Process Heat	30%	30%	30%	30%	26%	22%	10%	10%
Hybrid Solar Lighting, Fuel Cells, Small Wind	30%	N/A	N/A	N/A	N/A	N/A	N/A	N/A

[12] Source: Energy Information Agency

Geothermal Heat Pumps, Microturbines, Combine Heat and Power Systems	10%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Geothermal Electric	10%	10%	10%	10%	10%	10%	10%	10%
Large Wind	30%	24%	18%	12%	N/A	N/A	N/A	N/A

The Renewable Electricity Production Tax Credit is an inflation-adjusted, per-kilowatt-hour (kWh) tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year. The duration of the credit is 10 years after the date the facility is placed in service for all facilities placed in service after August 8, 2005. The tax credit amount is $0.015 per kWh in 1993 dollars for some technologies and half of that amount for others. The Internal Revenue Service (IRS) publishes the inflation adjustment factor no later than April 1 each year in the Federal Registrar.

Renewable energy equipment can qualify for accelerated rates of depreciation under the Modified Accelerated Cost-Recovery System. Equipment placed in service before January 1, 2018 can qualify for 50% bonus depreciation. Equipment placed in service during 2018 can qualify for 40% bonus depreciation and equipment placed in service during 2019 can qualify for 30% bonus depreciation.

The Residential Renewable Tax Credit was initially available to other forms of renewable energy. However, since 2016 it has only been available to solar thermal and photovoltaic installations. The percent available is listed below and decreases in the out years.

- 30% for systems placed in service by 12/31/2019
- 26% for systems placed in service after 12/31/2019 and before 01/01/2021
- 22% for systems placed in service after 12/31/2020 and before 01/01/2022

2. State Incentives

The State sets the rate at which net-metering facilities are compensated for the power they produce. The PUC and the PSD review these rates on a biennial basis and the rates have been decreasing over the past several years and are expected to continue to decrease. Net metering is compensated at a rate of up to 18.9 cents/kWh whereas utility projects, Standard Offer projects or bilateral contracts all come in around 10-13 cents/kWh. These above market reimbursement rates represent an incentive for net metering facilities.

The State has also set up the Standard Offer program which offers a certain amount of capacity to renewable projects on an annual basis. The allocations are conducted via an auction, which is designed to leverage competition to bring prices to near or at market values. However, resources that are successful in the auction are offered long-term contracts, which provides a certain amount of stability and predictability that functions like an incentive.

H. Major changes in relevant markets, technologies, and costs

In New England, natural gas has become the dominant fuel source for electric generation. This has led to the lowest energy prices since the introduction of the wholesale electricity markets in 2003; however, during cold periods there is insufficient natural gas capacity available to fully supply both heating and generation in the region. As a result, ISO-NE is now relying on aging oil-fired units to ensure sufficient generation during cold periods and electricity prices are now more dependent on winter weather than summer. Going forward, the likely construction of off-shore wind projects in New England has the potential to mitigate some of the cold-weather fuel security concerns as the output from off-shore wind appears to correlate relatively well with cold periods.[13]

The amount of solar generation in Vermont has moved the peak hour until after sunset at all hours of the year and has ensured that Vermont's peak load will be during winter months for the foreseeable future. In some distribution circuits, there is insufficient capacity to add new distributed generation. This is not inherently negative and reflects the success of programs such as net-metering. It is important to recognize that this changes the relative value of solar as a generating source – it no longer provides meaningful contributions to system peak reductions and is unlikely to be generating during cold periods when wholesale electricity prices are highest.

Energy consumed changes minute by minute, but generally, a prediction can be made of what the load will be in any given hour of a day, depending largely on temperature, and increasingly, the amount of net metered generation being produced. Minimum load has historically been in early morning hours – around 3 a.m. However, as the amount of net-metered solar increases, the daily minimum is likely to be during peak solar production. This type of load curve has been seen in other states with high penetrations of solar and has been termed the "duck" curve. In April 2017 and 2018, Vermont minimum load was at 3 p.m., creating the "Champ" curve. The figure below provides a comparison of the load curves for the same April day in 2012 and 2018.

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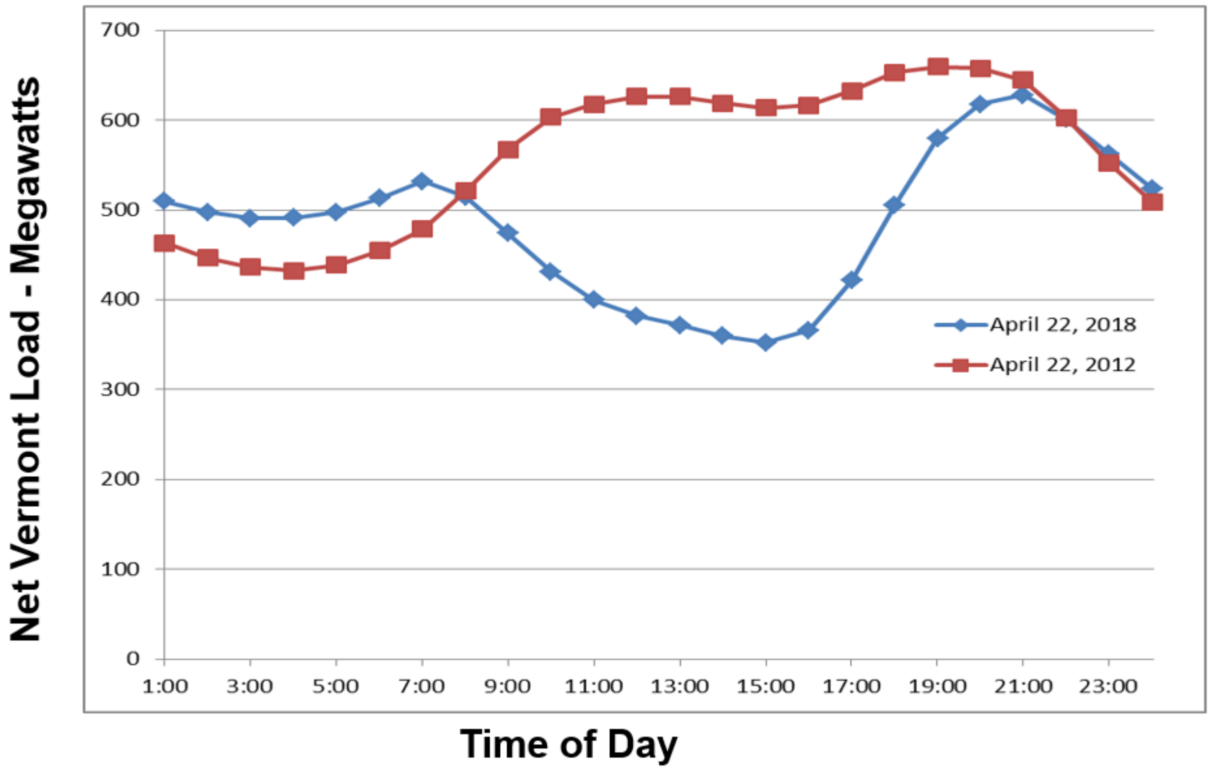
[13] Independent System Operator – New England, *High-Level Assessment of Potential Impacts of Offshore Wind Additions to the New England Power System During the 2017-2018 Cold Spell*, 2018. Available at: https://www.iso-ne.com/static-assets/documents/2018/12/2018_iso-ne_offshore_wind_assessment_mass_cec_production_estimates_12_17_2018_public.pdf

Figure 8: The Champ Curve[14]



The timing of minimum load does not present reliability challenges, but it does require a change in thinking about peak loads. This is especially true with respect to managing loads. For example, three years ago there would have been an expectation that minimum load would occur in the middle of the night during all hours of the year, which would have been the optimal time to charge electric vehicles. Going forward, the timing of daily peak load is likely to change significantly depending on season – in the spring, when solar is producing the most and the system load is generally lower, minimum load, and therefore optimal charging time, will likely be in the middle of the day, while the rest of the year (and especially during winter) minimum load will likely continue to be in the early morning hours.

1. Electrification

Recent technological advancements – primarily lower-cost lithium batteries and improvements in air-source heat pump technologies – have made electrification of the transportation and heating sectors more of a reality. Given the efficiencies of electric vehicles and heat pumps compared to internal combustion engines and conventional heating sources, electrification can reduce overall energy use significantly. Projected adoption of cold-climate heat pumps and electric vehicles is not expected to add

[14] Source: VELCO.

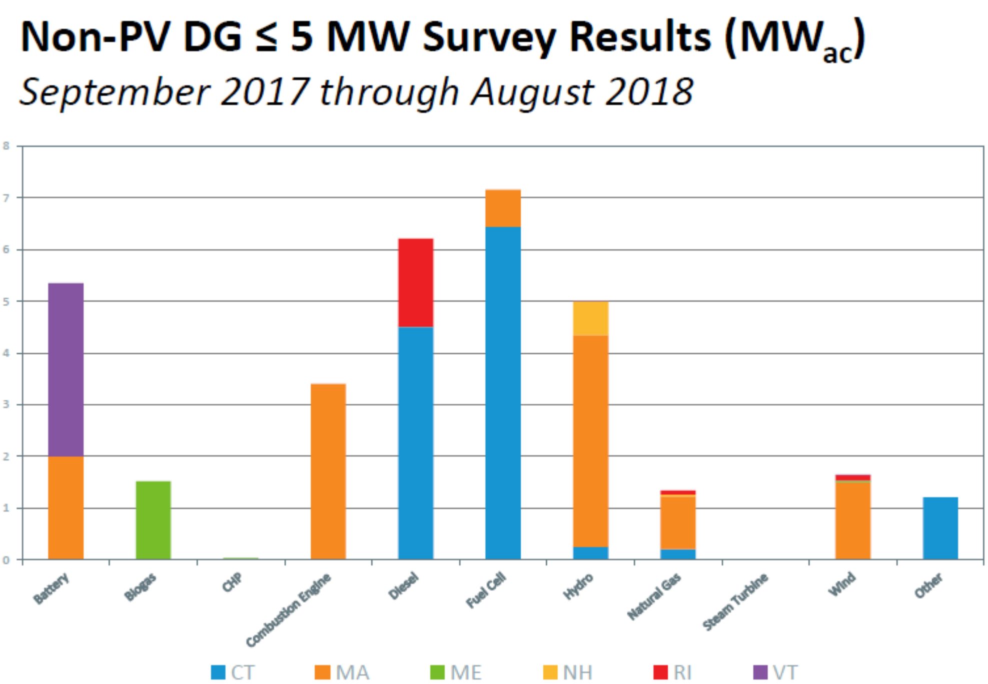
significant amounts of load in the next 5-10 years.[15] Regardless, it is important that electrification be done in a manner that minimizes infrastructure costs. Absent price signals or direct control, the deployment of numerous electric vehicles and heat pumps would have the effect of increasing peak demand with corresponding increases in infrastructure costs.

Additionally, it is important that there is clarity regarding the entities responsible for providing incentives for strategic electrification. Given the need to control loads, and the fact that the cost-effectiveness is dependent on electric rates, the electric utilities are best positioned to ensure that heat pumps and electric vehicles are deployed in a reasonable manner that minimizes costs for all ratepayers. While the efficiency utilities can have some role in education, the primary entities responsible for electrification efforts will need to be the electric utilities going forward.

2. Energy Storage

Continuing decreases in battery costs, clarification of market rules, and federal- and state-level policy drivers continue to grow the storage market across the nation; Vermont is no exception. At the end of 2018, nearly 5 megawatts (MW) of utility-scale storage and an additional 5 MW of residential-scale storage projects had been installed in Vermont. Another 13 MW of utility-scale projects are in some phase of development and could become operational in 2019. The chart below shows the relative growth in storage (and other non-solar distributed generation) in Vermont compared with other New England states from September 2017 to August 2018:

Figure 9: Regional Non-Solar Distributed Generation[16]



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[15] Vermont Electric Power Company, *Vermont Long-Range Transmission Plan,* 2018. Available at: https://www.velco.com/our-work/planning/long-range-plan

[16] Source: ISO-NE Distributed Generation Forecast Working Group

At present, the primary economic drivers for storage projects are reductions in wholesale transmission and capacity charges associated with monthly state and annual regional peak electricity use. Utilities (themselves or in partnership with third parties) can "stack" on additional monetizable benefits to make projects cost-effective, such as revenues from participating in the regional market for frequency regulation. Depending on how "booked" the battery is performing other duties, other non-monetizable benefits can be pursued, including integrating renewables and providing resilience. Utilities deploying storage in Vermont are in the process of exploring ways to optimizing ratepayer and societal costs and benefits of storage deployment. In the case of Green Mountain Power's Tesla Powerwall pilot, for instance, the utility and customers share the costs and benefits: the utility can call upon the "fleet" of residential batteries to reduce peaks, and customers can use their individual batteries to provide backup power during outages.

Storage technologies, applications and costs continue to rapidly evolve. Of particular benefit to Vermont will be long-duration storage (days or weeks) to transform renewables into dispatchable energy resources and to extend their benefit (particularly of solar) into winter months. At present, pumped hydropower is the only cost-effective way of storing energy at scale in the region, but extensive research is underway on breakthrough long-duration storage materials and methods (e.g., flow batteries, compressed air storage, etc.).

For additional information regarding battery storage, please see the Public Service Department's Battery Storage Report from 2017.[17]

3. Net-Metering

The rate of net-metering has been particularly high in recent years, due in part to both the compensation rate and the falling cost of solar installations. Net-metering is compensated at a rate of up to 18.9 cents/kWh whereas utility projects, Standard Offer projects or bilateral contracts all come in around 10-13 cents/kWh. If net-metering had continued at the pace seen in 2016 and 2017 (during 2017 the PUC received over 2,500 applications for net metering facilities), it would exceed the requirements of Tier 2. Tier 2 of the RES establishes a clear-cut mechanism for distributed generation to become part of Vermont's supply mix. Given these considerations, the PUC lowered the compensation rate in May 2017 for net-metering during the recent biennial review of net-metering rates.[18]

I. Projections of Energy Reductions and Shift to Renewable Energy Under Existing Policies, Technologies, and Markets

Vermont's RES mandates the pace of the shift to renewable energy in the electric sector. The RES requires that a utility's overall power portfolio be 55% renewable in 2017 rising to 75% by 2032. There is a specific carveout for smaller-scale distributed generation (Tier 2 of the RES) which requires that utilities procure power from in-state resources smaller than 5MW in nameplate capacity. The Tier 2 requirement rises from 1% in 2017 to 10% in 2032. The RES also contains a third Tier that requires

[17] Vermont Public Service Department, *Energy Storage Report,* 2017. Available at: https://publicservice.vermont.gov/sites/dps/files/documents/Pubs_Plans_Reports/Energy_Storage_Report/Storage_Report_Final.pdf.

[18] See PUC Order in Case No. 18-0086-INV.

utilities to procure fossil fuel savings equivalent to a certain percentage of their load. This percentage starts at 2% in 2017 and rises to 12% in 2032.

In the past few years there have been areas of the grid where the amount of generation exceeds the capacity of the grid. As described in the Department's report *Identifying and Addressing Electric Generation Constraints in Vermont*,[19] these constraints are not currently impairing the ability of Vermont's utilities to meet the RES requirements. However, going forward, there will need to be increased attention to planning mechanisms that can identify cost-effective mechanisms for minimizing constraints.

J. Recommended Policies

The introduction of the Renewable Energy Standard (RES) in 2017 was the single most significant action taken to date in the electric sector to move toward the 90% by 2050 contained in the Comprehensive Energy Plan. As explained in the Department's report prepared under 30 V.S.A. § 8005b(b), the requirement that utilities retire RECs to demonstrate compliance with Tiers 1 and 2 will increase cost to ratepayers. However, Tier 3 has the potential to decrease the overall rate impact by spreading the costs of providing service over an increased number of kWh.[20]

The RES puts the electric sector on track to meeting Vermont's CEP goals; the CEP does not supplant the RES or otherwise require more renewable generation: "[p]ower supply questions now revolve around the most cost-effective way to meet the RES requirements, not around how much renewable energy to acquire."[21] The Department does not recommend any legislative changes with respect to the electric sector.

Instead, the most significant improvements that can be made to the electric sector involve improving the economics of technologies such as electric vehicles and heat pumps; actions that can best be accomplished through developing new rate designs that remove barriers to beneficial electrification efforts such as those contemplated under Tier 3 of the RES. The Department has had ongoing discussions with stakeholders regarding the development of such rate designs and intends to continue working with those stakeholders to promote the development of such rates. In particular, the Department and GMP will report on progress made toward crafting innovative rate-design to the PUC during 2019.[22]

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[19] Available at: https://publicservice.vermont.gov/content/legislative-reports.

[20] See, Department of Public Service's 2019 Annual Report on the Renewable Energy Standard, Page 9. Available at: https://publicservice.vermont.gov/content/legislative-reports.

[21] 2016 Comprehensive Energy Plan at 277. See also the statement of the PUC on this issue, in Case No. 18-0086-INV, Order of 5/1/18 at 29: "With respect to electric supply, the CEP recognizes that the consideration of future supply should be done in the context of the RES."

[22] See PUC Order in Case No. 18-2850-TF

K. Recommendations Related to Tracking Data

The Department has several recommendations related to reporting and tracking data in the electricity sector. The Department believes that several reports are no longer necessary and that the attendant reporting requirements could be streamlined. Reports that are no longer necessary include:

- The Act 165 Small-and -Micro Hydroelectric report;
- The Village Green Report; and
- The Fuel Efficiency Fund Report.[23]

Additionally, the Department recommends:

- Streamlining the RES reports under 30 V.S.A. 8005b(b) and 8005b(c); and
- Altering the timing of the 30 V.S.A. 8010(d) net-metering report.

See Appendix B for further details as well as specific recommended statutory language related to each change discussed below.

[23] If any funds are allocated to the Fuel Efficiency Fund, progress could be reported within the context of the Department's Annual Energy Report.

IV. Heating Sector

A. Overview

Of Vermont's total energy consumption, 30% is thermal energy use in buildings. By 2025, the 2016 CEP calls for 30% of the energy used to heat Vermont's buildings and 25% of the energy used for heat in industries to be renewable. Meeting the 2016 CEP goal for heat energy will require efforts to both increase the adoption of renewable energy (including wood biomass), and to increase energy efficiency.

It is important to note that there can be significant variability in thermal usage on a year-by-year basis, depending on weather. The amount of thermal energy required to heat homes during a mild winter will be noticeably less than during a particularly cold winter. Accordingly, looking at the total thermal energy used each year might not provide a meaningful illustration of the effects of weatherization and installation of renewable heating systems.

The 2016 CEP provides several pathways to help meet the renewable thermal energy goals outlined above. Importantly, reaching the 2016 CEP goals will require efforts to reach the State's building efficiency goals, set forth in 10 V.S.A. § 581. Under Section 581, the goals of the State include weatherization of 80,000 homes by 2020 and the reduction of annual fuel needs and bills by an average of 25%.[24] In addition to weatherization, the 2016 CEP calls for "significantly increasing the use of both bioenergy and heat pumps."[25]

Unlike electricity, there are no RECs associated with thermal energy that can be used to calculate the renewability of heating fuels. Advanced wood heating systems (AWH) are considered by the Department to be renewable and some portion of the heating provided by cold climate heat pumps is also considered to be renewable. However, that electricity is already being reported as renewable in the electric sector and thus cannot be counted under the thermal sector. The renewability of heat pumps depends on the renewability of a utility's portfolio. The majority of DUs in Vermont are not 100% renewable, and thus the energy provided by heat pumps cannot be 100% renewable for those utilities. For example, on a statewide basis, the utilities' power supply portfolio is 62% renewable, and therefore heat pumps can generally be considered to provide 62% renewable heat.[26]

B. Total Thermal Energy Consumed:

Table 8: Thermal Energy (MMBtu)

Total (MMBtu)	Amount Renewable	Percent Renewable
38,610,000	9,266,400	24%

In 2016, approximately 38.61 trillion BTUs (38,610,000 MMBTUs) were used for thermal energy.[27]

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[24] 10 V.S.A. § 581

[25] Vermont Public Service Department, *Comprehensive Energy Plan,* at page 8, 2016.

[26] In the utilities' reporting of Tier 3 savings associated with heat pumps, at least some of the utilities have reported the fossil fuel reductions associated with heat pumps in a manner that includes the nuclear component of their power supply mix. Consequently, the fossil fuel reductions that are reported for heat pumps used to comply with RES Tier 3 cannot be directly equated to the renewable component of heat pumps.

[27] Vermont Public Service Department, *Comprehensive Energy Plan,* at page 88, 2016.

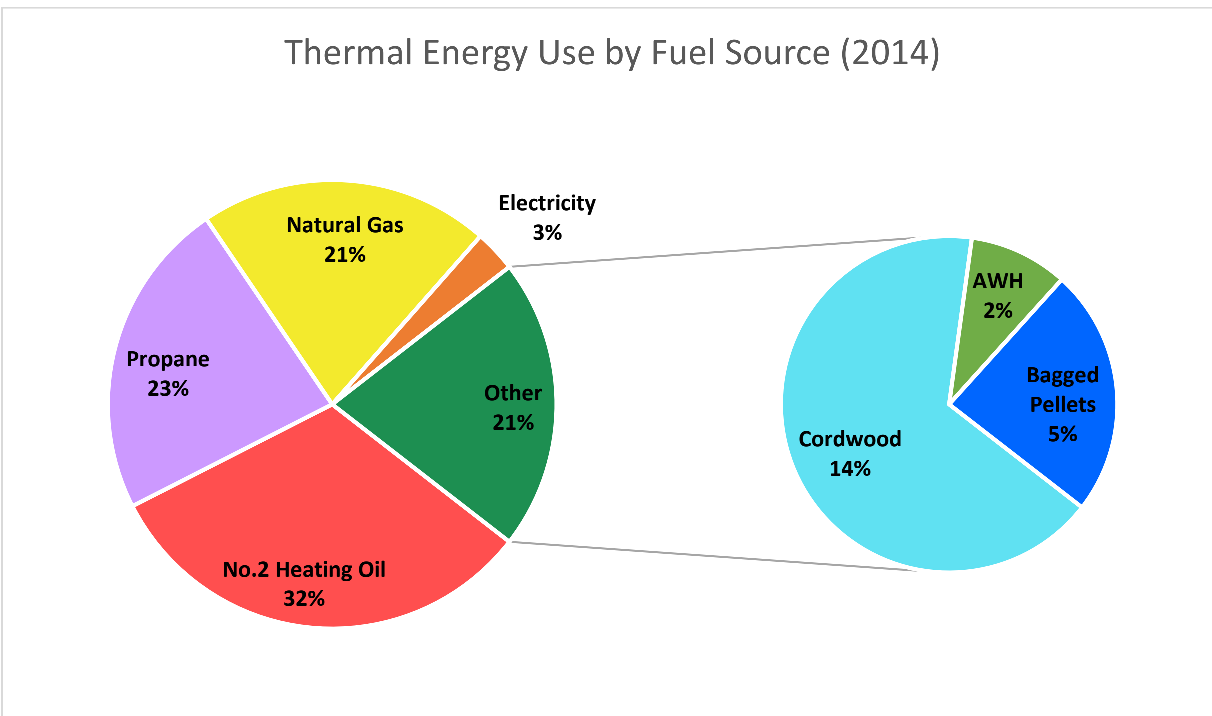
C. Renewable Energy Consumed

Using data from the Energy Information Administration (EIA) and the Residential Fuel Assessment, the Biomass Energy Resource Center calculated the percentage of fuel sources used for thermal space heating and hot water needs for Vermont in 2014. The table below depicts those calculations and includes an estimate of MMBTUs for each fuel source annually, calculated as a percentage of the total 38,610,000 MMBTUs used for thermal energy. Of the 38,610,000 MMBTUs, approximately 9,266,400 MMBTUs were renewable.

Table 9: Thermal Energy by Fuel Type (MMBtu)

Fuel Source	No.2 Heat Oil	Propane	Natural Gas	Wood	Electricity
Percentage	32%	23%	21%	21%	3%
MMBTUs	12,355,200	8,880,300	8,108,100	8,108,100	1,158,300

Figure 10: Percentages of Thermal Energy Use by Source



Approximately 24% of thermal energy use in Vermont in 2014 was renewable.

D. Major changes in relevant markets, technologies, and costs

1. Advanced Wood Heat Systems

Wood heat is a promising strategy to reduce fossil fuel usage in the thermal energy sector, support the local economy and Vermont's forest products industry, and help keep the landscape forested. When wood is used for heat or in combined heat and power systems, the thermal energy averages 75-80 percent efficiency (compared to an average efficiency of 20-25 percent when used for electricity generation.)[28] Wood heat can be a cost-effective and efficient pathway to reach the 2016 CEP's thermal renewable energy goals.

Although the percentage of households using wood heat has decreased as compared to the 1980s, it has increased by nearly 4% since 1998.[29] According to U.S. Census Data from the 2012-2016 American Community Survey, 43,863 households (nearly one in six) in Vermont utilize wood as their primary house heating fuel.[30] A study completed for the Clean Energy Development Fund (CEDF) in 2017 suggests that the number is closer to 65,000 households.[31]

The 2016 Vermont Wood Heat Baseline Study completed for the CEDF found that wood heat (both traditional and advanced wood heat) accounted for 21% of total heating in Vermont, with 38% of households (96,951 individual households) using wood for at least part of their heat. Of these households, 31,051 (12% of households), heated in part with wood pellets.[32]

Although wood heat accounts for a sizable portion of heating in Vermont, AWH accounts for just 2% of total heating in Vermont.[33] AWH is distinguished from other wood heating systems as AWH systems can be relied on as a primary source of central indoor heating and have the ability to continuously operate without manual loading of pellets or other servicing for at least a week.

As defined in 32 V.S.A. § 9701, an "advanced wood boiler" is a boiler or furnace that meets the following conditions:

- Installed as a primary central heating system;
- Rated as high-efficiency, meaning a higher heating value or gross calorific value of 85% or more;
- Containing at least one week of fuel-storage, automated startup and shutdown, and fuel feed; and
- meeting other efficiency and air emissions standards established by the DEC. [34]

Additionally, bulk woodchip systems will play a large role in helping to reach 2016 CEP goals. Bulk woodchip systems are installed on the commercial and institutional level, with a few systems having a large impact on fossil fuel reduction. One consideration with bulk woodchip systems, as compared to wood pellet boilers, is the need for additional maintenance.

The Baseline Assessment for 2016 for Wood Heating in Vermont estimates that there are 477 AWH pellet boiler installations in Vermont. Of these installed systems, 377 pellet systems were installed in residential settings, and 100 pellet systems were in commercial and institutional settings. From 2014-

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[28] Biomass Energy Resource Center, *Biomass Energy: Efficiency, Scale, and Sustainability*, 2009.
[29] Vermont Department of Forests, Parks and Recreation, *Vermont Residential Fuel Assessment for the 2014-2015 Heating Season,* 2016.
[30] U.S. Census Bureau, *House Heating Fuel: 2012-2016 American Community Survey 5-Year Estimates*, Available at: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk
[31] Biomass Energy Resource Center and VEIC, *Wood Heating in Vermont: A Baseline Assessment for 2016*, 2017. Available at: http://publicservice.vermont.gov/sites/dps/files/documents/Renewable_Energy/CEDF/Reports/AWH%20Baseline%20Report%20FINAL.pdf.
[32] Ibid
[33] Ibid
[34] 32 V.S.A. § 9701

2016, an estimated additional 64 residential pellet systems and 9 commercial and institutional pellet systems were installed each year in Vermont.[35] Additionally, the report estimates that there are 62 woodchip systems installed in Vermont, all in the commercial and institutional setting.[36]

Table 10: Advanced Wood Heat Installations in Vermont (2016)

Installed pellet boilers (residential)	377
Installed pellet boilers (commercial and institutional)	100
Total number of installed pellet boilers	477
Installed woodchip systems (commercial and institutional)	62
Total number of installed AWH systems (pellet boilers and woodchip systems)	539

The table below is re-made from the Baseline Assessment for 2016 on Wood Heat in Vermont and displays the estimated annual wood consumption for heating in Vermont. AWH includes only bulk pellets (not bagged pellets) and woodchips.

Table 11: Estimated Annual Wood Consumption in Vermont (2016)

Sector	Traditional Fuel: Cordwood (green tons)	Traditional Fuel: Bagged Pellet (tons)	AWH Fuel: Bulk Pellet (tons)	AWH Fuel: Woodchips (green tons)
Residential	700,000	126,000	2,000	-
Commercial and Institutional	940	-	7,000	86,000
Total tons of wood consumed (annually)	701,000	126,000	9,000	86,000
Total MMBTUs	5,800,000	2,100,000	100,000	800,000

2. Heat pumps

Heat pump technology includes both air-source heat pumps and ground-source heat pumps. Given the high capital cost of most ground-source heat pump installations, the CEP focuses on the installation of air-source heat pumps as a cost-effective measure to reduce fossil fuel usage and generate energy savings. Cold-climate air-source heat pumps (CCHPs) are energy efficient heating measures. Heat pumps can be used to heat living space or hot water. In this report, the term "heat pump" refers to units that heat living space, as opposed to hot-water heat pumps (HWHP).

Table 12: Number of CCHPs Installed through Prescriptive Programs Offered by the EEUs

2016	4,118
2017	4,161

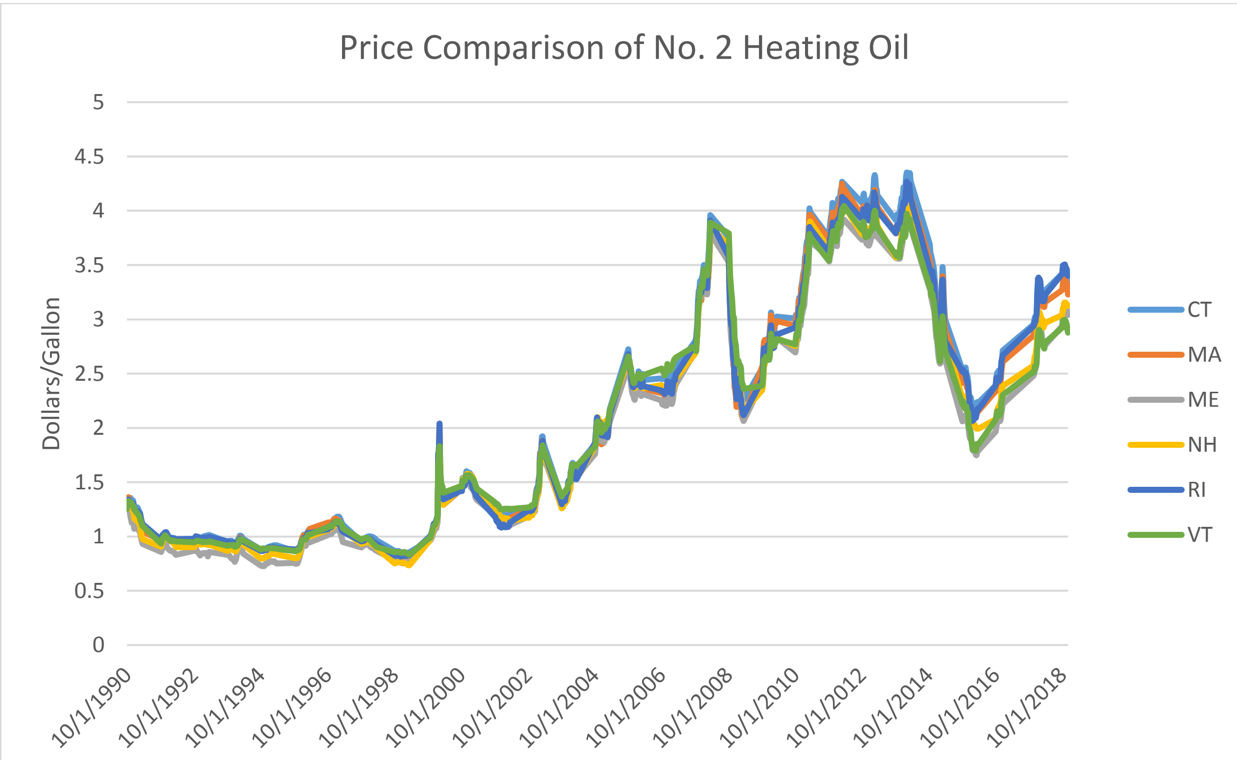
[35] "Wood Heating in Vermont: A Baseline Assessment for 2016"
[36] "Wood Heating in Vermont: A Baseline Assessment for 2016"

2018	2,786

E. Comparison of Vermont Prices

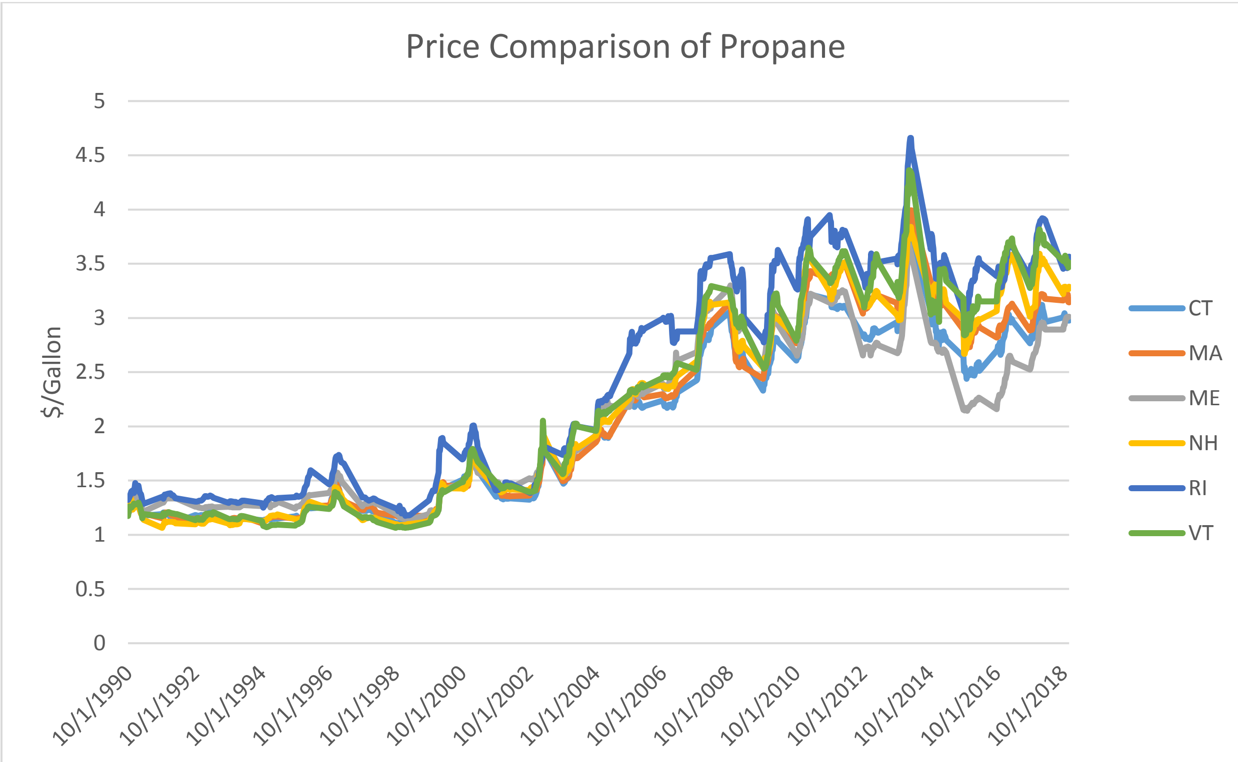
The three graphs below compare the prices of propane, heating oil, and natural gas among the New England states. As can be seen, these prices are quite volatile and there is not significant variability among the New England States.

Figure 10: No. 2 Heating Oil Price Comparison[37]



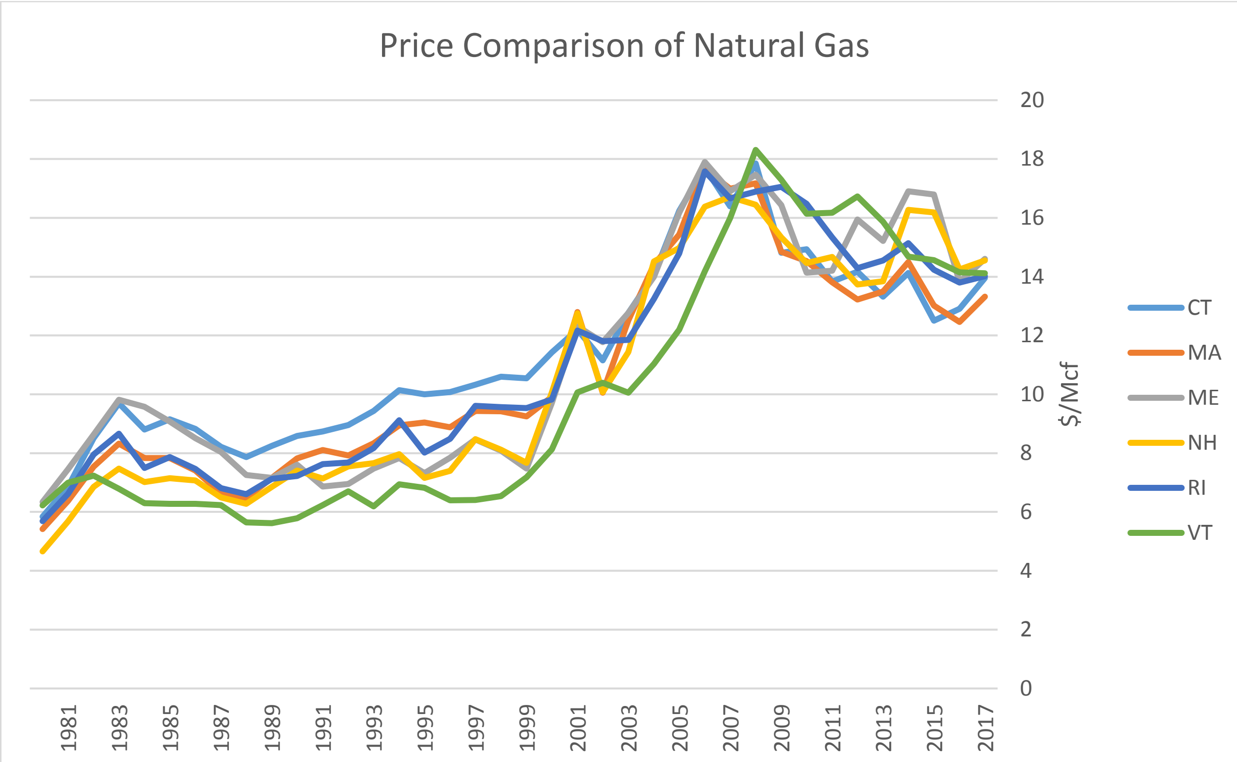
[37] EIA, https://www.eia.gov/dnav/pet/pet_pri_wfr_a_EPD2F_PRS_dpgal_w.htm

Figure 11: Propane Price Comparison[38]



[38] EIA, https://www.eia.gov/dnav/pet/pet_pri_wfr_a_EPLLPA_PRS_dpgal_w.htm

Figure 12: Natural Gas Price Comparison[39]



F. Major Vermont and Federal Incentives Available

The table below includes details regarding state and federal incentives that are available in the heating sector.

Table 13: Vermont and Federal Incentives Available in the Heating Sector[40]

Source	Incentive	Eligible Entities
Efficiency Vermont	$3,000 for automated wood pellet boilers or furnaces	Residential, Commercial, Institutional, Municipal
Efficiency Vermont	$1.25/sq. ft. for commercial buildings over 5,000 sq. ft. up to $50,000	Commercial
CEDF	$3,000 rebate for automated wood pellet boilers or furnaces	Residential, Commercial, Institutional, Municipal
Washington Electric Coop	$1,000 rebate for automated wood pellet boilers or furnaces for Coop members	Residential, Commercial, Institutional, Municipal
Windham Wood Heat Initiative	Up to $100,000 towards technical and installation costs for an automated wood heat system	Windham County public schools, municipal

[39] Source: EIA
[40] Source: https://fpr.vermont.gov/sites/fpr/files/Incentives%20Handout.pdf

		buildings, and public serving institutions
Vermont Electric Cooperative	$150 bill credit to members for the purchase of a pellet stove	Residential
Clean Energy Development Fund	Wood Stove Changeout Program: $1,000 towards purchase of pellet stove or $800 towards wood stove when you turn in a non-EPA certified wood stove	Residential
Clean Energy Development Fund	Up to $20,000 for a wood pellet or chip fired evaporator	Maple Producers
USDA Rural Development	Rural Energy for America Program: Grants from $2,500 to $500,000 for biomass energy and efficiency projects. Loans are also available.	Farms and small business in rural areas
USDA Rural Development	Community Facilities Direct Loan & Grant Program: Grants and loans for biomass energy projects	Cities, villages, and towns with populations less than 20,000

Starting July 1, 2018, advanced wood heat boilers will qualify for a retail sales-and-use tax exemption. The exemption is on qualifying equipment and directly associated equipment must meet the following requirements: (A) installed as a primary central heating system; (B) rated as high-efficiency, meaning a higher heating value or gross calorific value of 85 percent or more; (C) containing at least one week fuel-storage, automated startup and shutdown, and fuel feed; and (D) meeting other efficiency and air emissions standards established by the Department of Environmental Conservation. The tax exemption is estimated to provide an average of $900 in savings per boiler.[41]

G. Projections of Energy Reductions and Shift to Renewable Energy Under Existing Policies, Technologies, and Markets

Recent developments in the heating sector have put this sector on a path towards renewability. AWH has seen significant growth, from essentially zero to over five hundred deployments in the last several years. Incentives for AWH are available from both the CEDF as well as Efficiency Vermont (EVT). These incentives will continue to promote the conversion to AWH. Additionally, CCHPs have become more

[41] Vermont Department of Forest, Parks, and Recreation, *Modern Wood Heat in Vermont: Incentives and Rebates*, 2018. Available at: https://fpr.vermont.gov/sites/fpr/files/Incentives%20Handout.pdf.

affordable and viable heating options. Tier 3 of the RES, under which many of the DUs are providing incentives for cold-climate and hot-water heat pumps, will further the adoption of heat pumps. It is important to note; however, that we are still in the early stages of the RES and the DUs' offerings under Tier 3. As such, the incentives for heat pumps varies between utilities. These market directions are promising for the heating sector and will likely continue to increase the percent of renewability in this sector through conversions to the above technologies. The current, low-price environment for fossil fuels presents a challenge as conversions are less economically enticing.

A. Weatherization

Weatherization is the path for improving a building's shell and reducing the amount of energy required to heat the building. The up-front costs associated with weatherization can be considerable, and although the investments are long-lived, the payback for investments can also be of longer duration than is typical for consideration of electric efficiency investments.

One issue that has been difficult for increasing the amount of weatherization in the state is funding. There are four major funding sources: (1) Federal weatherization assistance funds, managed by the Vermont Office of Economic Opportunity; (2) funds received from the participation of Vermont's energy efficiency peak reductions in ISO-NE's Forward Capacity Market; (3) funds received from Vermont's participation in the Regional Greenhouse Gas Initiative; and (4) the energy efficiency charge paid by customers of Vermont Gas Systems.

Table 14: 2017 Weatherization Accomplishments Summary

	Comprehensive retrofit projects	**Notes**
Total Projects (# units served)	**2,012**	The total number of housing units counted toward the annual goal[42] include all comprehensive projects completed through the five participating organizations (EVT, VGS, BED, OEO and 3E Thermal).
Average % fuel usage reduction	**23%**	The average fuel usage reduction for projects completed. Does not include projects that span multiple years. Fuel use reductions are measured using actual fuel usage data when available and reasonable estimates when fuel usage data is unavailable.
Carbon emissions reductions	**5,988,367 lbs.** **(2,994 tons)**	Carbon reductions use a uniform calculation method based on Federal standards published on the EIA website for fossil fuels, and Vermont Agency of Natural Resources values for electricity savings.
Incentive costs	**$11,083,404**	Direct financial incentives to the homeowner or building owner
Participant costs	**$8,666,786**	Participant contributions to the cost of building improvements
Total project costs	**$19,750,190**	

[42] The PUC has established a goal of conducting comprehensive retrofits projects on 80,000 units by 2020.

On an annual basis, the Department provides a report to the PUC regarding building energy efficiency goals established in 10 V.S.A. § 581. The Department's December, 2018 report concluded the following:

> The progress toward the building energy efficiency goals for the State as defined in 10 V.S.A. § 581(1) has been steady since 2008, but well below the rate necessary to achieve the 2020 goal of 80,000 homes. The average savings per home has also tracked slightly below the goal of 25% reduction in energy usage. At the end of 2017, only 42% of the 2017 interim goal for completions of comprehensive energy retrofit projects was achieved. Only an immediate and unprecedented ramp up of the efforts and expenditures by the participating organizations would make it possible to achieve the goal of improving the energy fitness of 80,000 homes by the end of 2020.
>
> The benefits to Vermont residents from the efforts to reach the goals of Section 581 have been substantial, measurable and will continue to pay dividends for decades to come. These benefits include reduced energy bills, increased employment in the energy efficiency sector and reduced greenhouse gas emissions, as well as the non-energy benefits of improved health, safety and comfort for the residents of participating homes.[43]

Table 15 below provides data for the past ten years regarding progress toward building efficiency goals.

Table 15: Number of Housing Units with Comprehensive Thermal Retrofit, 2008-2017

	Number housing units completing a comprehensive thermal retrofit											2017 Average % Fuel Use Reduction	2017 Average % Fuel Use Reduction Statewide
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**		
EVT	298	480	644	952	1,132	1,162	1,081	821	834	653	8,057	17%	
BED		3	2	8	7	2	13	5	19	4	63	49%	
VGS	178	393	465	235	332	360	388	356	331	344	3,382	17%	23%
OEO/WAP	1,427	1,570	1,785	1,162	1,479	927	1,102	802	646*	674*	11,574	28%	
3E Thermal	0	0	63	813	381	215	190	129	205	337	2,333	37%	
Total (annual)	1,903	2,446	2,959	3,170	3,331	2,666	2,774	2,113	2,035	2,012			
Total (cumulative)	**1,903**	**4,349**	**7,308**	**10,478**	**13,809**	**16,475**	**19,249**	**21,362**	**23,397**	**25,409**			

[43] Annual Report of the Department of Public Service on Vermont's Progress Toward Building Energy Goals Pursuant to 10 V.S.A. § 581.

H. Recommended Policies

The heating sector is the second largest with respect to carbon emissions. It is also the sector that is most important with respect to addressing vulnerable populations.

The state is significantly behind its weatherization goals, with the major concern being the lack of funding. An area of potential promise entails expanding the State Weatherization Assistance Program (WAP) through new finance and funding options. Current resources for meeting the state's low-income weatherization goals are insufficient. A proposal of the Climate Action Commission suggests accelerating the rate of implementation using a bonding strategy or expanding the amount of funding for the WAP. This approach could prove beneficial where there are long term returns that yield health impacts and energy savings along with improved affordability and improvements to quality of life for Vermont's most vulnerable families.

Additionally, the Department recommends that the Energy Efficiency Charge associated with the kWh used by heat pumps be specifically ear-marked for weatherization efforts. This would provide consistency between the fee being assessed and the programs funded by the fee as heat pumps are a significant heating source. The Department also recommends the development of informational language regarding the correct operation of a heat pump that maximizes savings.

The Department is currently pursuing a ruling from the PUC that makes clear the responsibility for electrification. Until the summer of 2018, EVT was utilizing limited thermal efficiency funds to provide incentives for heat pumps, thus reducing the funding that was available for weatherization efforts. Although EVT has chosen to discontinue this practice for now, there is no regulatory mechanism currently in place that would prevent EVT from making this decision in the future. In order to ensure appropriate accountability, the Department is recommending that utilities be responsible for funding and directing electrification efforts and EVT fund weatherization and AWH efforts.

I. Recommendations Related to Tracking Data

Currently, tracking progress towards thermal energy use goals is challenging given the lack of standardized data. One potential method of tracking progress is to have wood-stove shops report the number and type of stoves sold, cordwood dealers report the number of cords sold, and pellet dealers report sales in bags and bulk. This data could only be released in the aggregate, to protect privacy concerns.

V. Transportation

A. Overview

There has been little progress in meeting the State's transportation related energy and climate goals. The 2016 CEP contained three broad transportation goals for 2025:

- Reduce Energy Use by 20%;
- Increase the share of renewable energy to 10%; and
- Reduce GHG emissions by 30% from 1990 levels.

Progress towards these goals has been minimal or non-existent. The percent of renewable energy in the transportation sector is currently at approximately 5.5% and GHG emissions are above 1990 levels.[44]

The 2016 CEP discusses progress towards our transportation energy goals and states "…this CEP calls for a significant increase in focus on transportation energy usage – but we will not successfully reach our transportation energy goals unless electric vehicles and biofuels truly take hold nationwide, conventional fuel standards are significantly improved, and transportation infrastructure funding is decoupled from petroleum usage. Nevertheless, we can and should set a direction for Vermont that moves toward a more sustainable future, while simultaneously advocating for policy alignment with the private sector and the national government."

B. Total Energy Consumed

Transportation represents the largest portion of Vermont's total energy consumption. In 2016, Vermont's Total Transportation Energy Consumption equaled 49 Trillion Btu.[45]

Table 16: Transportation Sector Energy (MMBtu)

Total	Amount Renewable	Percent Renewable
49,000,000 (MMBtu)	2,695,000	5.5%

C. Renewable Energy Consumed:

According to the Vermont Agency of Transportation's (AOT) 2017 Transportation Energy Profile,[46] approximately 5.5%, or 2.695 trillion Btu, of the energy consumed in the transportation sector was renewable.

D. Major changes in relevant markets, technologies, and costs

Electric vehicles, including electric buses, have recently become viable transportation option as the range of such vehicles increases and the upfront costs decline. It is expected that costs will continue to

[44] Vermont Agency of Transportation, *Transportation Energy Profile,* 2017.

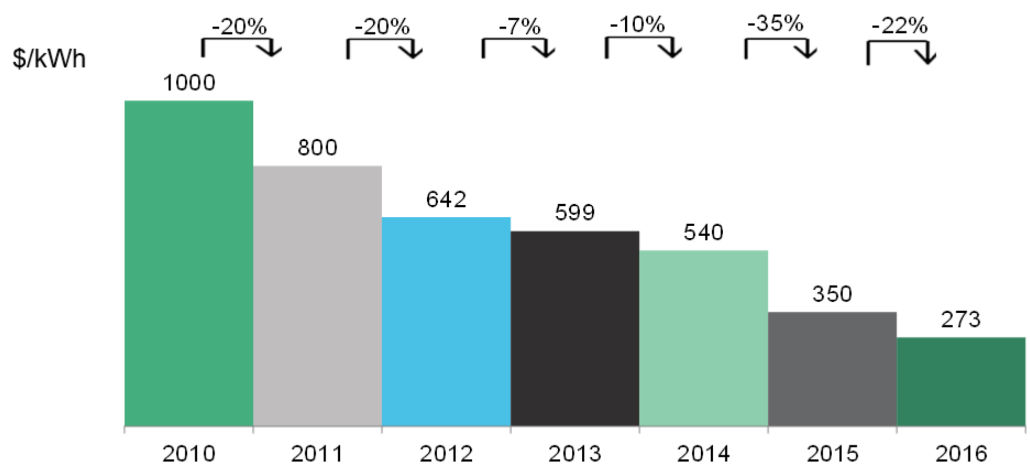
[45] US EIA, *Vermont State Profile and Energy Estimates,* Last Updated November 16, 2017. Available at: https://www.eia.gov/state/data.php?sid=VT, Accessed December 08, 2017.

[46]https://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/The%20Vermont%20Tranportation%20Energy%20Profile_2017.pdf

decline and that EV adoption will continue to rise. The graphic below shows the declines in the cost of lithium-ion batteries, one of the major cost drivers for electric vehicles, over the past several years. In addition to declining costs, the availability of a variety of models (for personal automobiles) that meet differing customer needs is anticipated to drastically increase. Several auto manufacturers have announced plans to produce more EV models and some have even announced goals to discontinue internal-combustion engine vehicles.[47]

There are several electric bus purchases planned within Vermont. With the assistance of federal grants administered by AOT, Green Mountain Transit is in the process of acquiring three full-size electric busses, which will operate in Chittenden County. Through a separate funding process, two cutaway electric shuttle buses can be expected to begin operating in Washington County within the next year.

Figure 13: Lithium-Ion Battery Cost Trends[48]

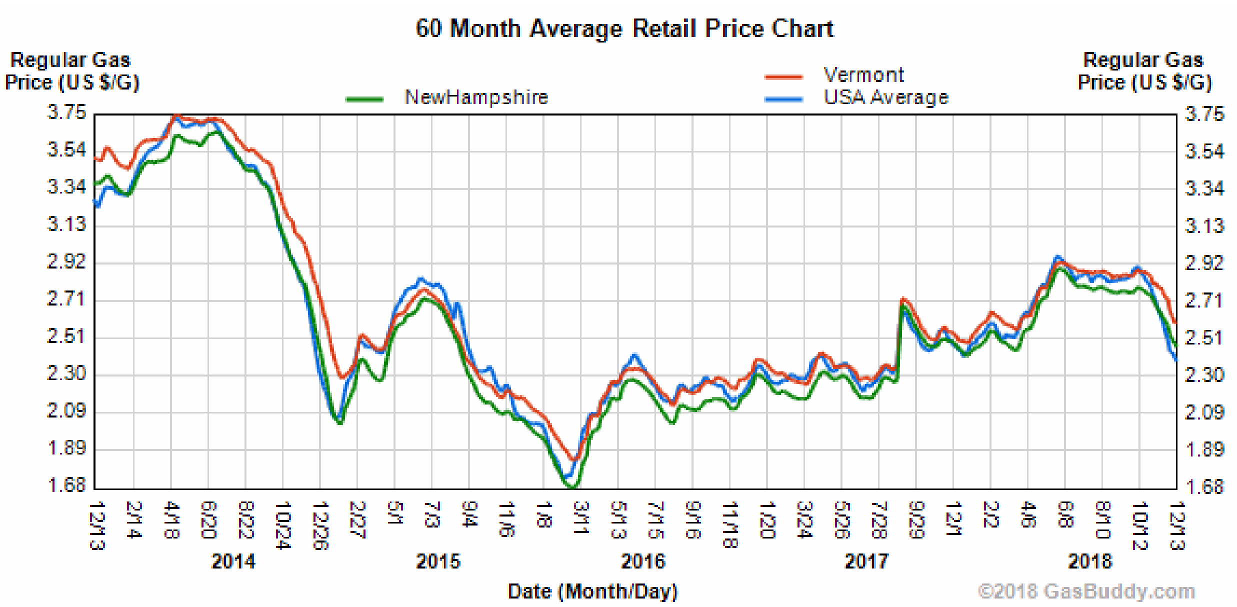


[47] See Ford's announcement here: https://www.reuters.com/article/us-autoshow-detroit-ford-motor/ford-plans-11-billion-investment-40-electrified-vehicles-by-2022-idUSKBN1F30YZ and GM's announcement here: https://www.nbcnews.com/business/autos/gm-going-all-electric-will-ditch-gas-diesel-powered-cars-n806806.

[48] Bloomberg New Energy Finance, *Lithium-Ion Battery Price Survey*, 2010-2016.

E. Comparison of Vermont Prices

Figure 14: Gasoline Price Comparison 2014-2018[49]



F. Major Vermont and Federal Incentives Available

Although there are no state-level incentives for electric vehicles in Vermont, several electric utilities have adopted programs to encourage electric vehicle purchases in order to meet Tier 3 obligations under the Renewable Energy Standard. Drive Electric Vermont maintains an updated list of all the electric vehicle related incentives offered in Vermont.[50]

In addition to the incentives provided by utilities, a federal tax credit is also available. The federal tax credit ranges from $2,500 to $7,500 depending on battery capacity and phases out when the manufacturer sells 200,000 qualified vehicles.[51] This credit is also passed down to those who lease EVs, as the leasing company will require a lower down payment or decreased monthly payments.

G. Projections of Energy Reductions and Shift to Renewable Energy Under Existing Policies, Technologies, and Markets

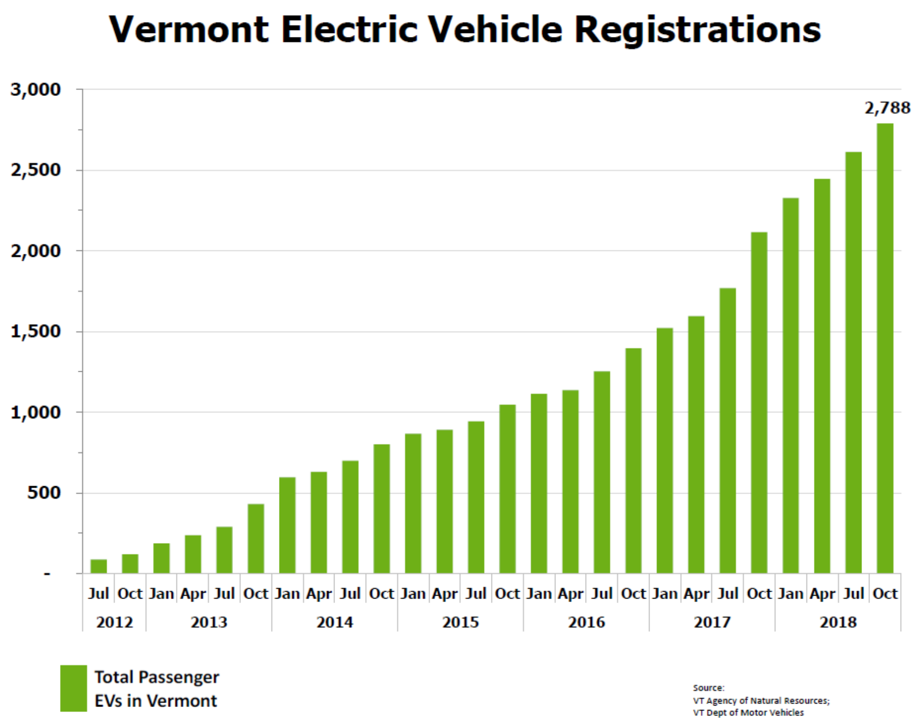
[49] Gas Buddy, Available at: https://www.gasbuddy.com/Charts?_ga=2.132332301.283721332.1547499799-1117221985.1547499799.

[50] Available at: https://www.driveelectricvt.com/buying-guide/purchase-incentives.

[51] Internal Revenue Service, *Plug-in Electric Drive Vehicle Credit at a Glance*, 2018. Available at: https://www.irs.gov/credits-deductions/individuals/plug-in-electric-drive-vehicle-credit-section-30d

1. EV Registrations

Figure 15: EVs Registered in Vermont, 2012-2018



Electric vehicle registrations in Vermont continue to grow. As EVs can be powered renewable, the percent of the transportation sector that is renewable is expected to grow alongside growth in EVs. The figure above demonstrates the growth in registrations over the past several years. It is important to note that it is difficult for VT to move the EV market by itself. Changes are more likely to come from nationwide shifts in EV prices, range, and availability of a variety of models, including pickups and all-wheel drive. However, this doesn't mean that VT should not take action. Rather, it means that Vermont must be strategic in the areas in which the state choose to act and further incentivize EV adoption. One such example is rate design. Vermont DUs should offer rates that ensure charging costs are reasonable and contain either adequate price signals or direct control by the DUs to minimize the potentially negative impacts of charging on the grid. Additionally, such innovative control mechanisms can also facilitate increased grid choreography between flexible loads and intermittent generation.

2. Fleet Composition

The composition of Vermont's vehicle fleet can have a significant impact on both the energy consumed in the transportation sector and the GHG emissions associated with the energy consumed. Vehicles powered by alternative fuels, e.g. electricity or compressed natural gas (CNG), are often more efficient and have significantly less GHG emissions. This statement is especially true for electric vehicles where they are powered by renewable resources. The table below shows the composition of Vermont's vehicle fleet. Recent trends include an increase in plug-in electric vehicles (PEV), which includes both all-electric (AEV) and plug-in hybrid electric vehicles (PHEV) as well as hybrid electric vehicles (HEV). Table 12 below shows the quarterly increases in PEV increases since 2012.

Table 17: Composition of Vermont Vehicle Fleet, 2008-2017[52]

Year	PEV		Propane/CNG	Diesel	Gasoline	
	AEV	PHEV			ICEV	HEV
2008	N/A	N/A	75	32,140	578,881	4,656
2009	N/A	N/A	69	30,724	528,930	5,473
2010	N/A	N/A	59	25,932	524,810	5,877
2011	N/A	N/A	51	28,513	550,711	7,056
2012	48	140	48	38,684	541,872	7,693
2013	130	466	43	28,209	516,339	7,945
2014	197	670	43	29,879	525,199	9,242
2015	248	865	44	31,239	533,118	9,895
2016	330	1,192	43	31,213	533,021	10,676
2017	381	1,387	47	30,205	532,370	10,901

3. Fleet Fuel Economy

Another important metric regarding the Vermont vehicle fleet is average fuel economy. The federal Corporate Average Fuel Economy (CAFÉ) standards have been driving increases in the average MPG as older, less efficient vehicles are cycled out of the fleet. The table below shows this increasing Miles per Gallon (MPG) trend over the last several years. Additionally, the EPA established the Miles per Gallon Equivalent (MPGe) standard for vehicles that do not use liquid fuels. The MPGe rating for a vehicle represents the number of miles the vehicle can travel using the same amount of energy that is contained in a gallon of gasoline.[53] The table below does not incorporate the MPGe rating of vehicles that do not use liquid fuels.

Table 12: Fuel Economy Vehicles Registered in Vermont, 2011-2017[54]

Year	Registered Vehicles	Average City MPG	Average Highway MPG	Combined MPG
2011	586,422	18.1	24.2	20.3
2012	578,415	18.4	24.5	20.7
2013	552,665	18.7	24.8	20.9
2014	564,591	19.1	25.3	21.4
2015	589,608	19.5	25.6	21.8

52 Vermont Agency of Transportation, *The 2017 Vermont Transportation Energy Profile,* 2017. Available at: https://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/The%20Vermont%20Tranportation%20Energy%20Profile_2017.pdf

53 US Environmental Protection Agency, *Electric Vehicles – Learn More About the New Label*, Available at: https://www.epa.gov/fueleconomy/electric-vehicles-learn-more-about-new-label.

54 Vermont Agency of Transportation, *The 2017 Vermont Transportation Energy Profile,* 2017. Available at: https://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/The%20Vermont%20Tranportation%20Energy%20Profile_2017.pdf

2016	591,864	19.8	25.9	22.1
2017	596,783	20	26.1	22.2

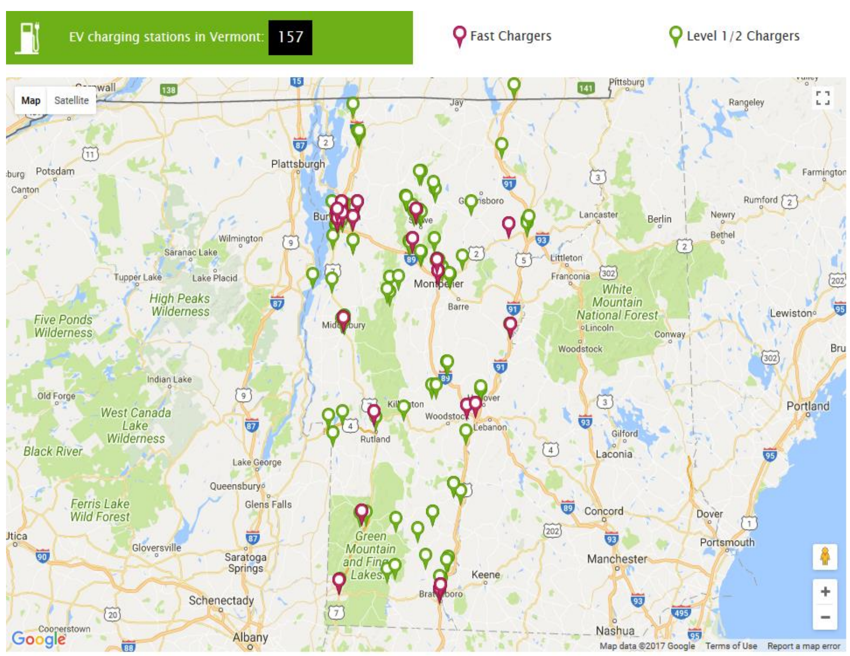
4. Electric Vehicle Charging Stations in Vermont

As of December 8, 2017, there are approximately 160 publicly available charging stations in Vermont:

- 11 locations with Level 1 charging, which charges at approximately 1.4 kW power and provides 5 miles of range per hour of charging;
- 132 locations with Level 2 charging, which charges at approximately 3-7 kW and provides roughly 10 to 20 miles of range per hour of charging; and
- 23 DC Fast Chargers, which charge at 25-120 kW and generally takes 30 minutes to provide an 80% charge.

The Drive Electric Vermont program (supported by AOT, ANR, and PSD) keeps track of the publicly available charging stations in Vermont and maps them statewide (see the image below).

Figure 16: Map of Publicly Available Electric Vehicle Charging Stations



While electrification for Vermont's light-duty fleet is a viable option, and some heavy-duty freight transportation needs can be met by shifting freight to rail, there are many heavy- and medium-duty applications for which no electric or rail options are available. In those applications, alternative fuels — including biodiesel, ethanol, and compressed or liquefied natural gas — offer a lower-carbon alternative to gasoline and diesel, with significant GHG savings and fewer emissions. While biodiesel is preferred to natural gas for heavy- and medium-duty applications, both biodiesel and natural gas are preferred over petroleum products.[55]

Because biodiesel can be blended with diesel and used in existing medium and heavy vehicles, biodiesel in particular offers a unique opportunity to reduce the GHG emissions of Vermont's vehicle fleet without any new investments in specialized vehicles, equipment, or infrastructure. Environmental concerns, including poor energy return on energy invested and questions about the climate change impact associated with ethanol make it a less attractive option for the state. Compressed and liquefied natural gas also offer GHG savings above gasoline and diesel, but are currently a non-renewable resource. However, the use of renewable natural gas in transportation will count toward meeting Vermont's sectoral goal of deriving 10% of its energy use in transportation from renewable sources by 2025 and 80% by 2050. [56]

Public transit can be less energy-intensive that single-occupancy vehicles and can offer potential cost savings for consumers. The Agency of Transportation periodically develops a public transit policy plan[57] and expends a significant portion of its transportation budget on the capital and operating needs of the state's nine public transit providers.[58]

The following chart outlines the 2016 CEP Transportation Goals and the most recent current status update. It also outlines the average annual change that must occur to be on track to reach the CEP goals. For example, to reach the 2016 CEP goal of tripling the number of state park-and-ride spaces, at minimum, 146 spaces must be added each year between 2018 and 2030. This represents a simple way to calculate whether the state is on track to reach the transportation goals outlined.

Table 18: 2016 CEP Transportation Objectives and Current Status

Goal	Goal (Numerical)	Year	Current Status	Source	Requirement to Reach CEP Goals
Triple the number of state park-and-ride spaces	3,426	2030	1,525 (2017)[59]	CEP Transportation Goals (2016)	Add 1901 spaces, adding at least 146 spaces each year.
Increase public transit ridership by 110%	8.7 million annual trips	2030	4.71 million annual trips (2016)	CEP Transportation Goals (2016)	Increase ridership by 4.01 million annual trips, adding 308,462 trips each year.

[55] Vermont Department of Public Service, *2016 Comprehensive Energy Plan*, at page 174.
[56] Ibid.
[57] Available at: https://vtrans.vermont.gov/planning/PTPP.
[58] Vermont Department of Public Service, *2016 Comprehensive Energy Plan,* at page 148.
[59] Vermont Agency of Transportation, *2018 Fact Book and Annual Report*, Available at: http://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/VTrans-2018-FactBook-web.pdf

			4.69 million annual trips (2017)[60]		
Quadruple Vermont-based passenger rail trips	400,000 annual trips	2030	92,422 annual trips (2016) 145,746 annual trips (2017)**?[61]	CEP Transportation Goals (2016)	Increase rail trips by 254,254, adding 19,558 passenger rail trips each year.
Double the rail freight tonnage in the state	13.2 (based on 2011 figure) million tons	2030	7.3 million tons (2014) 6.7 million tons (2017)[62]	CEP Transportation Goals (2016)	Add 6.5 million tons of rail freight, adding 500,000 tons each year.
Increase the percentage of the vehicle fleet that are EVs	10% of the vehicle fleet	2025	0.3% (2016) 0.3% (2017)	CEP Transportation Goals (2016)	By 2025, an additional 9.7% of vehicles should be EVs, increasing the percentage of EVs in the fleet by 1.21% each year.
Increase the number of medium and heavy-duty vehicles powered by renewable energy	10% of vehicles	2025	None*** A 2009 study estimated Vermont's transportation biodiesel use at approximately 76,000 gallons, or 0.02% of the total transportation fuel portfolio in 2008 (White, 2009).	CEP Transportation Goals (2016)	By 2025, an additional 9.98% of medium and heavy-duty vehicles should be powered renewably, increasing from our current percentage at a rate of 1.25% a year.

H. Recommended Policies

Progress towards our renewable energy goals can occur in either a linear or exponential fashion. The linear approach suggests more state level intervention up front whereas an exponential approach relies more heavily upon technological or market developments to drive change. There are positive and negative aspects of both approaches. For example, a linear approach may cost more state resources up front than would otherwise be needed to reach a goal and an exponential approach leaves much of the progress outside of the control of state government but may end up costing less. Neither of these approaches is likely to be the right choice. Most likely an appropriate balance between the two is the best path forward. Of the three sectors, Vermont has made the least progress towards our

60 Ibid.
61 Ibid.
62 Ibid.

transportation related goals. The Department includes several recommendations below that strive to achieve the correct balance between the approaches described above.

In addition, the PUC is presently conducting a proceeding to address the three items below, among other considerations.

1. Set the regulatory stage early to ensure that barriers to growth in the EV market do not exist when significant growth is realized. This includes not just clarifying the jurisdictional scope of state agencies – that is whether the ownership or operation of an EV charging station results in regulation as a utility or if some other regulatory structure is appropriate – but also implementing rate designs that address cost effectiveness of EVs.
2. One of the concerns that has been raised with respect to EVs is that there is currently no mechanism to ensure that EVs pay for their share of transportation infrastructure. Gasoline and diesel vehicles pay a fuel tax. An increased registration fee could help address this; however, it is possible to impose a volumetric charge on charging.   Given that there is not a useful role for Efficiency Vermont in the electric vehicle space, it would be useful to divert the Energy Efficiency Charge customers would otherwise pay for the electricity associated with vehicle charging toward a replacement for the fuel tax.
3. Vermont is the only state in New England without statewide EV incentives. With a limited timeframe to reap the Federal tax credit incentive and the slow progress that Vermont is making towards the transportation CEP goals, a statewide EV incentive may help to bridge the gap between the high upfront costs of EVs, until there is cost parity between EVs and ICEs. One possible source of funding for such an incentive is the $3.6 million Vermont received from the State Volkswagen settlement.

Another important policy development worth mentioning is the recent agreement by most states within the Northeast and Mi-Atlantic Region, including Vermont, to develop a regional transportation-fuels cap-and-invest policy proposal through the Transportation and Climate Initiative. Participating states have committed to developing the policy over the next year at which point each state will decide whether and how to adopt and implement the policy in its own jurisdiction.

I. Recommendations Related to Tracking Data

Currently, the Vermont Agency of Transportation reports on energy use in the transportation sector through its biennial Transportation Energy Profile. This document presents a lot of very useful data in a user-friendly manner. However, there currently is no mechanism to track progress towards heavy duty vehicles powered with biodiesel (see the table above from the 2017 Transportation Energy Profile). The Department recommends that some method of tracking biodiesel sales be implemented in order to track progress towards this goal.

VI. Appendices

Appendix A - Statutory Language Requiring Report

(e) The Commissioner of Public Service (Commissioner) shall file an annual report on progress in meeting the goals of the Plan. The report shall address each of the following sectors of energy consumption in the State: electricity, nonelectric fuels for thermal purposes, and transportation. In preparing the report, the Commissioner shall consult with the Secretaries of Administration, of Agriculture, Food and Markets, of Natural Resources, and of Transportation and the Commissioner of Buildings and General Services.

(1) The Commissioner shall file the report on or before January 15 of each year, commencing in 2019. The provisions of 2 V.S.A. § 20(d) shall not apply to this report.

(2) The Commissioner shall file the report with the House Committees on Energy and Technology and on Natural Resources, Fish, and Wildlife and with the Senate Committees on Finance and on Natural Resources and Energy.

(3) For each sector, the report shall provide:

(A) In millions of British thermal units (MMBTUs) for the most recent calendar year for which data are available, the total amount of energy consumed, the amount of renewable energy consumed, and the percentage of renewable energy consumed. For the electricity sector, the report shall also state the amounts in megawatt hours (MWH) and the Vermont and New England summer and winter peak electric demand, including the hour and day of peak demand.

(B) Projections of the energy reductions and shift to renewable energy expected to occur under existing policies, technologies, and markets. The most recent available data shall be used to inform these projections and shall be provided as a supplement to the data described in subdivision (A) of this subdivision (3).

(C) Recommendations of policies to further the renewable energy goals set forth in statute and the Plan, along with an evaluation of the relative cost-effectiveness of different policy approaches.

(4) The report shall include a supplemental analysis setting forth how progress toward the goals of the Plan is supported by complementary work in avoiding or reducing energy consumption through efficiency and demand reduction. In this subdivision (4), "demand reduction" includes dispatchable measures, such as controlling appliances that consume energy, and non-dispatchable measures, such as weatherization.

(5) The report shall include recommendations on methods to enhance the process for planning, tracking, and reporting progress toward meeting statutory energy goals and the goals of the Plan. Such recommendations may include the consolidation of one or more periodic reports filed by the Department or other State agencies relating to renewable energy, with proposals for amending the statutes relevant to those reports.

(6) The report shall include a summary of the following information for each sector:

(A) major changes in relevant markets, technologies, and costs;

(B) average Vermont prices compared to the other New England states, based on the most recent available data; and

(C) significant Vermont and federal incentive programs that are relevant to one or more of the sectors.

Appendix B - Proposed Statutory Language Regarding Reporting Modifications

1. Reports that are no longer necessary:

a. Act 165 Report

The purpose of this report is to inform the General Assembly of progress to date in carrying out Act 165, "An act relating to expediting development of small and micro hydroelectric projects." In 2012, the Vermont legislature passed Act 165, which directed the Commissioner of the Public Service Department (PSD), in consultation with the Secretary of the Agency of Natural Resources (ANR), to "seek to enter into a memorandum of understanding [MOU] with the Federal Energy Regulatory Commission (FERC) for a program to expedite the procedures for FERC's granting approval for projects in Vermont that constitute small conduit hydroelectric facilities and small hydroelectric power projects."1 Act 165 requires the Commissioner to report to the General Assembly biennially, in perpetuity, on the "progress of the MOU program, including an identification of each hydroelectric project participating in the program."

As discussed in the 2014 and 2016 reports, after consulting with FERC and many stakeholders, the agencies concluded that it was not feasible to enter into such an MOU, and that the next best way to expedite the development of small hydropower projects in Vermont was to provide greater assistance to developers early on in a project; to better coordinate communications to developers and to FERC; and to identify projects that could gain support from the state resource agencies, then communicate such support to FERC to expedite the permitting process.

An interagency MOU, which was fully executed by the PSD, ANR, and the Agency of Commerce & Community Development (ACCD) in July 2013, provides for such enhanced coordination, including identification of and assistance to developers of low-impact projects of high public value (such as those owned by public entities and those utilizing existing infrastructure), as resources allow. The House Fish, Wildlife & Water Resources Committee encouraged the agencies to proceed with implementation of the interagency MOU in 2014; the three agencies have since developed the Vermont Small Hydropower Assistance Program (VSHAP).

Section 4. 2012 Acts and Resolves No. 165, Section 2 is amended to read:

Section 2. MEMORANDUM OF UNDERSTANDING; SMALL HYDROELECTRIC PROJECTS

~~**1. (e) No later than January 15, 2014 and annually by each second January 15 thereafter, the commissioner shall submit a written report to the general assembly detailing the progress of the MOU program, including an identification of each hydroelectric project participating in the program. After five hydroelectric projects participating in the program are approved and commence operation, reports filed under this subsection shall evaluate and provide lessons learned from the program, including recommendations, if any, on how to improve procedures for**~~

~~**obtaining approval of micro hydroelectric projects (100 kilowatts capacity or less). The provisions of 2 V.S.A. §20(d) (expiration of required reports) shall not apply to the report to be submitted under this subsection.**~~

b. Village Green Report

In 2009, the Legislature enacted Chapter 93 of Title 30 to promote the creation of "Vermont village green renewable projects." These are defined as:

> *district heating, either with or without district power, to serve a downtown development district designated as such pursuant to 24 V.S.A. § 2793 or a growth center designated as such pursuant to 24 V.S.A. § 2793c. As long as the end uses served by the project are within such a district or center, the generation of heat and power may be outside the district or center.*

Under Section 8105(b), the Department is required to submit an annual report to provide an update on progress made in the development of the Vermont village green renewable projects authorized under this chapter. The report is to also include an analysis of the costs and benefits of the projects as well as any recommendations consistent with the purposes of this chapter.

In 2012 the City of Montpelier applied for and achieved certification for their downtown district heating system as a Vermont village green renewable energy project. After the close-out of the Montpelier grant the full $100,000 required to be used as incentives by the Clean Energy Development Fund (CEDF) in support of the Vermont Village Pilot Project was expended and no further activities in the program have occurred.

Now that the $100,000 allocated for incentives in the program have been fully expended and the CEDF is providing support for advanced wood heating, including district heating projects, there is no need for the Vermont Village Green Pilot Program to exist in statute. The PSD recommends deleting Chapter 93 from VSA 30. If the entire Chapter 93 is not deleted the PSD recommends deleting the reporting requirement contained in Section 8105; unless changes are made to the Chapter, as the report will be the same every year and is thus not a productive exercise.

Section 3. 30 V.S.A. §8105 is amended to read:

~~**(a) A host community for which a Vermont village green renewable project has been certified under this chapter shall file a report to the Commission and the Commissioner of Public Service by December 31 of each year following certification. The report shall contain such information as is required by the Commission and the Commissioner. The report shall include at a minimum sufficient information for the Commissioner of Public Service to submit the report required by subsection (b) of this section.**~~
~~**(b) Beginning March 1, 2010, and annually thereafter, the Commissioner of Public Service shall submit a report to the Senate Committees on Economic Development, Housing and General Affairs, on Finance, and on Natural Resources and Energy, the House Committees on Ways and Means, on Commerce and Economic**~~

~~**Development, and on Natural Resources and Energy, and the Governor which shall include an update on progress made in the development of the Vermont village green renewable projects authorized under this chapter. The report also shall include an analysis of the costs and benefits of the projects as well as any recommendations consistent with the purposes of this chapter. The provisions of 2 V.S.A. § 20(d) (expiration of required reports) shall not apply to the report to be made under this subsection.**~~

c. Fuel Efficiency Fund Report

30 V.S.A. § 203a requires the Department, beginning on January 15, 2010 and annually thereafter, to report to the General Assembly on the expenditure of funds from the Fuel Efficiency Fund. When created, the Fund was to contain such sums as appropriated by the General Assembly or as otherwise provided by law, in addition to revenues from the sale of credits under the RGGI cap and trade program. However, per 30 V.S.A. § 255, the net proceeds above costs from the sale of carbon credits under the RGGI cap and trade program are now deposited into the Electric Efficiency Fund established under 30 V.S.A. § 209(d)(3) and no funds have been appropriated by the General Assembly to the Fuel Efficiency Fund. The Department recommends removing the annual reporting requirement; and replace it with a requirement that, if the legislature appropriates funds for the Fuel Efficiency Fund, the Department would report on any activity in its Annual Energy Report.

Sec. 2. 30 V.S.A. § 203a (c) is amended to read:

§ 203a. FUEL EFFICIENCY FUND

§ 203a. Fuel Efficiency Fund

(a) Fuel Efficiency Fund. There is established the Fuel Efficiency Fund to be administered by a fund administrator appointed by the Commission. Balances in the Fund shall be ratepayer funds, shall be used to support the activities authorized in this subsection, and shall be carried forward and remain in the Fund at the end of each fiscal year. These monies shall not be available to meet the general obligations of the State. Interest earned shall remain in the Fund. The Fund shall contain such sums as appropriated by the General Assembly or as otherwise provided by law, in addition to revenues from the sale of credits under the RGGI cap and trade program as provided for under section 255 of this title.

(b) Use of the Fund. The Fuel Efficiency Fund shall be used to support the delivery of energy efficiency services to Vermont heating and process fuel consumers and to carry out cost-effective efficiency measures and reductions in greenhouse gas emissions from those sectors. These energy efficiency services shall be delivered by the service provider or providers selected by the Department of Public Service under section 235 of this title to perform these functions.

~~**(c) Report. On or before January 15, 2010, and annually thereafter, the Department of Public Service shall report to the General Assembly on the expenditure of funds from the Fuel Efficiency Fund to meet the public's needs for energy efficiency**~~

~~**services. The provisions of 2 V.S.A. § 20(d) (expiration of required reports) shall not apply to the report to be made under this subsection.**~~

2. Streamlining Recommendation:

The Department is required to submit several different reports that often have overlapping content and analysis. Additionally, these reports are on timelines that don't always coincide in a manner that enables efficiency of analysis and reporting. The Department recommends that the reporting efforts under 8005b(b), 8005b(c), and 8010(d) be combined into to Annual Energy Report required under 202b(e). The Annual Energy Report would include the elements of the 8005 reports on the reporting timelines established under those statutes, but the Department recommends that the 8010 reporting timeline be amended to commence in 2021 and occur every two years thereafter to coincide with the required reporting and analyses the Department conducts to support the biennial review of net-metering rates under the PUC's net metering rule. The rule requires an analysis of rates every two years which began in the spring of 2018. The analysis supporting the Department's participation in this effort would be very helpful when conducting the reporting required under 8010. Remaining on the existing 8010 timeline would require the Department to conduct analyses and reporting on disparate timelines resulting in inefficiencies.

a. RES Reports - 30 V.S.A. 8005b(b) and 8005b(c)

§ 8005b. Renewable energy programs; reports

(a) The Department shall file reports with the General Assembly in accordance with this section.

(1) The House Committees on Commerce and Economic Development and on Energy and Technology and the Senate Committees on Economic Development, Housing and General Affairs, on Finance, and on Natural Resources and Energy each shall receive a copy of these reports.

(2) The Department shall include the components of ~~file the report under~~ subsection (b) of this section in its Annual Energy Report (30 VSA 202b(e)) ~~annually each January 15~~ commencing in 2018 through 2033.

(3) The Department shall include the components of ~~file the report under~~ subsection (c) of this section in its Annual Energy Report (30 VSA 202b(e)) on a biennial basis commencing in 2017 through 2033.

30 V.S.A. 8005b(b)

(b) The annual report under this section shall include at least each of the following:

(1) An assessment of the costs and benefits of the RES based on the most current available data, including rate and economic impacts, customer savings, technology deployment, greenhouse gas emission reductions actually achieved, fuel price stability, effect on transmission and distribution upgrade costs, and any recommended changes based on this assessment.

(2) Projections, looking at least 10 years ahead, of the impacts of the RES.

(A) The Department shall employ an economic model to make these projections, to be known as the Consolidated RES Model, and shall consider at least three scenarios based on high, mid-range, and low energy price forecasts.

(B) The Department shall make the model and associated documents available on the Department's website.

(C) In preparing these projections, the Department shall:

(i) characterize each of the model's assumptions according to level of certainty, with the levels being high, medium, and low; and

(ii) provide an opportunity for public comment.

(D) The Department shall project, for the State, the impact of the RES in each of the following areas: electric utility rates; total energy consumption; electric energy consumption; fossil fuel consumption; and greenhouse gas emissions. The report shall compare the amount or level in each of these areas with and without the program.

(3) An assessment of whether the requirements of the RES have been met to date, and any recommended changes needed to achieve those requirements.

30 V.S.A. 8005b(c)

(c) The biennial report under this section shall include at least each of the following:

(1) The retail sales, in kWh, of electricity in Vermont during the two preceding calendar years. The report shall include the statewide total and the total sold by each retail electricity provider.

(2) Commencing with the report to be filed in 2019, each retail electricity provider's required amount of renewable energy during the two preceding ~~calendar~~ years <u>using the most recent available data for</u> each category of the RES as set forth in section 8005 of this title.

(3) For the two preceding calendar years, the amounts of renewable energy and tradeable renewable energy credits eligible to satisfy the requirements of sections 8004 and 8005 of this title actually owned by the Vermont retail electricity providers, expressed as a percentage of retail kWh sales. The report shall include the statewide total and the total owned by each retail electricity provider for each of these amounts and shall discuss the progress of each provider toward achieving each of the categories set forth in section 8005 of this title. The report shall summarize the energy transformation projects undertaken pursuant to section 8005 of this title, their costs and benefits, their claimed avoided fossil fuel consumption and greenhouse gas emissions, and, if applicable, claimed energy savings.

(4) A summary of the activities of the Standard Offer Program under section 8005a of this title, including the number of plants participating in the Program, the prices paid by the Program, and the plant capacity and average annual energy generation of the participating plants. The report shall present this information as totals for all participating plants and by category of renewable energy technology. The report also shall identify the number of applications received, the number of participating plants under contract, and the number of participating plants actually in service.

(5) An assessment of the energy efficiency and renewable energy markets and recommendations to the General Assembly regarding strategies that may be necessary to encourage the use of these resources to help meet upcoming supply requirements.

(6) An assessment of whether Vermont retail electric rates are rising faster than inflation as measured by the CPI, and a comparison of Vermont's electric rates with electric rates in other New England states and in New York. If statewide average rates have risen faster than inflation over the preceding two or more years, the report shall include an assessment of the contributions to rate increases from various sources, such as the costs of energy and capacity, costs due to construction of transmission and distribution infrastructure, and costs due to compliance with the requirements of sections 8004 and 8005 (RES) and section 8005a (standard offer) of this title. Specific consideration shall be given to the price of renewable energy and the diversity, reliability, availability, dispatch flexibility, and full life cycle cost, including environmental benefits and greenhouse gas reductions, on a net present value basis of renewable energy resources available from suppliers. The report shall include any recommendations for statutory change that arise from this assessment. If electric rates have increased primarily due to cost increases attributable to nonrenewable sources of electricity or to the electric transmission or distribution systems, the report shall include a recommendation regarding whether to increase the size of the annual increase described in subdivision 8005a(c)(1) (standard offer; cumulative capacity; pace) of this title.

(7)(A) Commencing with the report to be filed in 2019, an assessment of whether strict compliance with the requirements of sections 8004 and 8005 (RES) and section 8005a (standard offer) of this title:

(i) has caused one or more providers to raise its retail rates faster over the preceding two or more years than statewide average retail rates have risen over the same time period;

(ii) will cause retail rate increases particular to one or more providers; or

(iii) will impair the ability of one or more providers to meet the public's need for energy services in the manner set forth under subdivision 218c(a)(1) of this title (least-cost integrated planning).

(B) Based on this assessment, consideration of whether statutory changes should be made to grant providers additional flexibility in meeting requirements of sections 8004 and 8005 or section 8005a of this title.

(8) Any recommendations for statutory change related to sections 8004, 8005, and 8005a of this title.

b. 30 V.S.A. 8010(d) – Net Metering Report

This section of statute requires the Department to report on net metering beginning in 2020 and every three years thereafter. The PUC's net metering rules also require a biennial analysis of rates that would inform this reporting effort and includes much of the same analysis needed to support this report. The timing of this reporting requirement should be adjusted so that it syncs up with the biennial analysis in the net metering rules. To accomplish this goal, the first report should be required in 2021 and subsequent reports required every 2 years thereafter.

30 V.S.A. 8010(d)

d) Commencing in ~~On or before January 15, 2020~~ 2021 and on a biennial basis thereafter, the Department shall include the following in its Annual Energy Report (pursuant to 30 V.S.A. 202b(e)). In addition to submitting to the Committees listed under 30 V.S.A 202b(e), the Department shall also submit its evaluation of the current state of net metering in Vermont to the Commission. ~~a report that evaluates the current state of net metering in Vermont. The Department shall make this report publicly available. The report shall:~~

(1) analyze the current pace of net metering deployment, both statewide and within the service territory of each retail electricity provider;

(2) after considering the goals and policies of this chapter, of 10 V.S.A. § 578 (greenhouse gas reduction), of section 202a (State energy policy) of this title, and of the Electrical Energy and Comprehensive Energy Plans under sections 202 and 202b of this title, recommend the future pace of net metering deployment statewide and within the service territory of each provider;

(3) analyze the existence and degree of cross-subsidy between net metering customers and other customers on a statewide and on an individual provider basis;

(4) evaluate the effect of net metering on retail electricity provider infrastructure and revenue;

(5) evaluate the benefits to net metering customers of connecting to the provider's distribution system;

(6) analyze the economic and environmental benefits of net metering, and the short- and long-term impacts on rates, both statewide and for each provider;

(7) analyze the reliability and supply diversification costs and benefits of net metering;

(8) evaluate the ownership and transfer of the environmental attributes of energy generated by net metering systems and of any associated tradeable renewable energy credits; and

(9) examine and evaluate best practices for net metering identified from other states.

Appendix C – Additional Data – Electricity

Forecasted Summer Peak (MW)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Vermont	981.2	980.3	979.0	974.8	974.5	973.9	980.3	982.9	986.7	985.7
New England	26,482	26,458	26,409	26,298	26,213	26,167	26,155	26,176	26,228	26,310

Source: Vermont data from: Vermont System Planning Committee, Load Forecast Subcommittee (available at: https://www.vermontspc.com/vspc-at-work/subcommittees/lfc-data)

New England data from: 2017 ISO-NE CELT Report (available at https://www.iso-ne.com/system-planning/system-plans-studies/celt)

Forecasted Winter Peak (MW)

	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27
Vermont	979	985	986	986	986	990	997	1,001	1,004	1,007
New England	21,197	21,009	20,947	20,648	20,451	20,293	20,164	20,063	19,984	19,931

Source: Vermont data from: Vermont System Planning Committee, Load Forecast Subcommittee (available at: https://www.vermontspc.com/vspc-at-work/subcommittees/lfc-data)

New England data from: 2017 ISO-NE CELT Report (available at https://www.iso-ne.com/system-planning/system-plans-studies/celt)

Energy use is estimated to be relatively flat over the next ten years. The Vermont forecast specifically anticipates electrification in the heating and transportation sectors, while the ISO-NE load does not account for electrification. This explains why Vermont's load shows a slight increase at the end of the ten-year period, while New England load continues to decline.

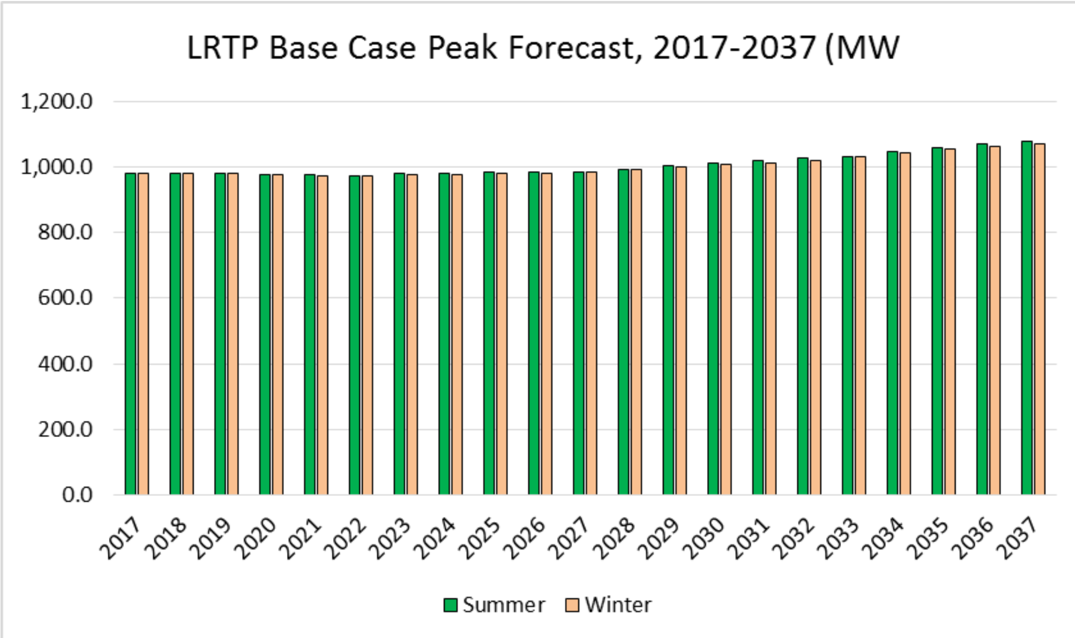
Forecasted Annual Energy Use (GWh)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Vermont	5,942	5,898	5,844	5,795	5,750	5,732	5,732	5,739	5,745	5,755
New England	126,786	126,426	125,736	124,440	122,977	121,859	120,994	120,349	119,911	119,680

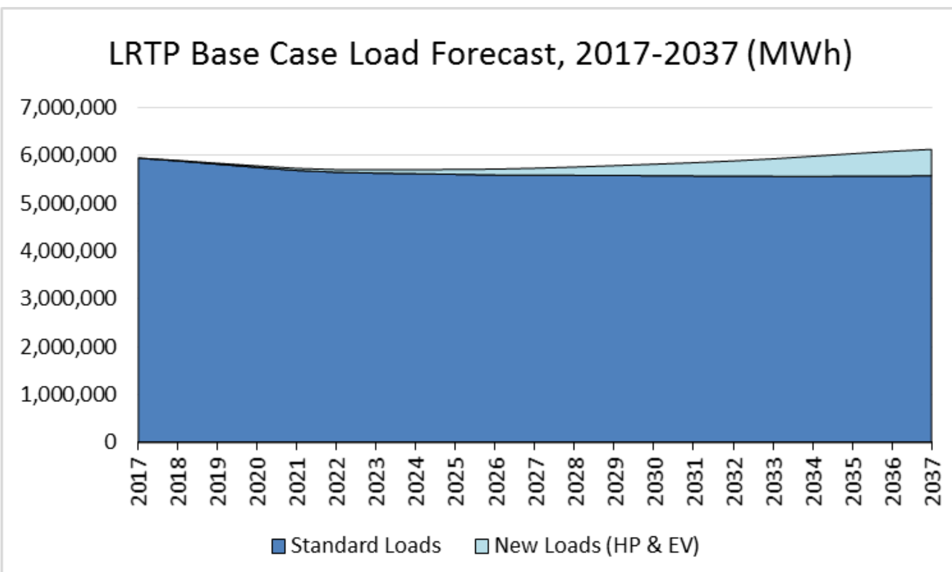
Source: Vermont data from: Vermont System Planning Committee, Load Forecast Subcommittee (available at: https://www.vermontspc.com/vspc-at-work/subcommittees/lfc-data)

New England data from: 2017 ISO-NE CELT Report (available at https://www.iso-ne.com/system-planning/system-plans-studies/celt)

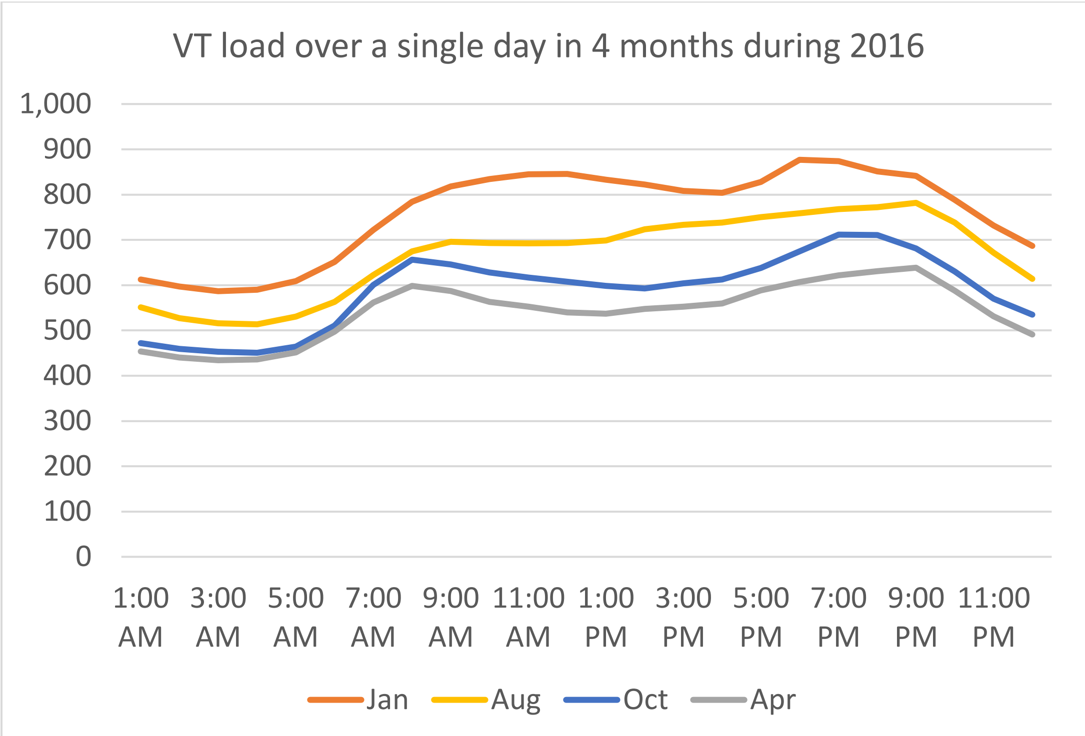
VELCO LRTP Peak Forecast



VELCO LRTP Load Forecast

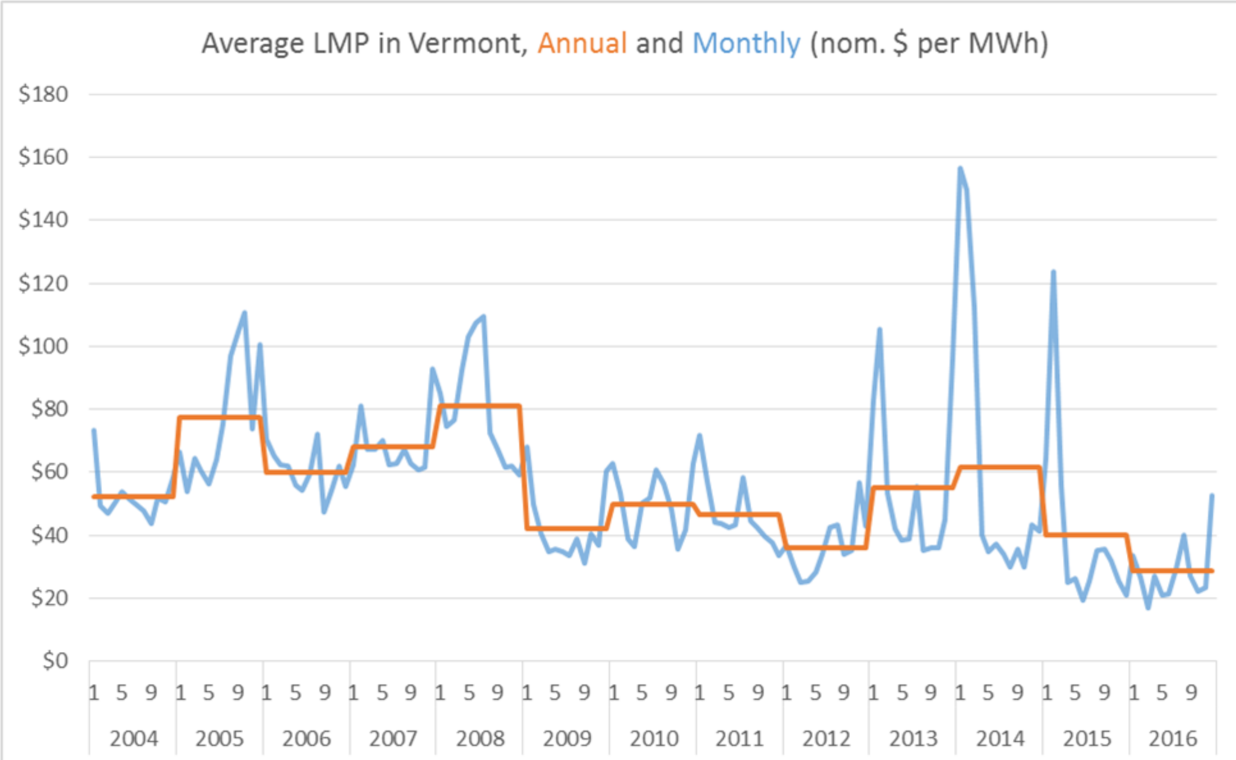


Vermont Seasonal Load Profiles



Wholesale Energy Prices

The chart below, illustrates both the annual and monthly wholesale energy prices since January 1, 2004. As can be seen in this chart, in the past five years, prices spike considerably during the winter and then are considerably lower for the rest of the year. New England experienced particularly mild weather in 2016, which resulted in the lowest average annual prices since the start of the wholesale markets.



Vermont Power Supply Mix (MWh) (before REC sales), 2016

Energy Source	Purchased	Generated	Std. Offer	PURPA	Ryegate	Net Metered	TOTAL	Share
Biomass	0	306,611	4,075	0	154,784	0	465,470	8%
Distillate	85	7,203	0	0	0	0	7,288	0%
Farm Methane	0	0	22,674	0	0	0	22,674	0%
HQ System Mix	1,347,714	0	0	0	0	0	1,347,714	22%
Hydropower	207,206	391,878	7,755	100,000	0	13,550	720,389	12%
Landfill Methane	42,003	53,156	775	0	0	0	95,934	2%
Natural Gas	4,281	13,485	0	0	0	0	17,766	0%
Nuclear	615,916	157,789	0	0	0	0	773,705	13%
Solar	18,134	3,848	66,099	0	0	168,753	256,834	4%
ISO System	1,844,584	0	0	0	0	0	1,844,584	31%
Wind	316,135	157,694	0	0	0	3,504	477,332	8%
TOTAL	4,396,058	1,091,663	101,378	100,000	154,784	185,807	6,029,690	100%

Source:

Appendix D – Additional Data – Transportation

The Table Below is from VTrans' 2017 Transportation Energy Profile and includes the CEP's Transportation related goals and estimated progress towards those goals.

Table E-1. Current Progress toward Achieving CEP Transportation Targets

	2016 CEP Transportation Targets	Baseline		Most Recent		Average Rate of Change[1]		
		Value[3]	Year	Value	Year	Period	Target	To Date
Goals for 2025	1. Reduce energy use by 20%	49.1	2015	49.1	2015	'16-'25	-1.09[3]	N/A
	2. Increase the share of renewable energy to 10%	5.5%	2015	5.5%	2015	'16-'25	0.5%[3]	N/A
	3. Reduce GHGs emissions by 30% from 1990 levels	3.22	1990	3.67	2013	'16-'25	-0.16[3]	N/A
Supporting Objectives for 2025 and 2030	1. Hold VMT/capita stable	11,402	2011	11,680	2015	'11-'30	0	69.5
	2. Reduce the share of SOV commute trips by 20%	79.5%	2011	80.7%	2015	'11-'30	-1.1%	0.3%
	3. Increase the share of bicycle/ pedestrian commute trips to 15.6%	7.2%	2011	7.1%	2015	'11-'30	0.4%	-.03%
	4. Increase state park-and-rides spaces to 3,426	1,142	2011	1,525	2017	'11-'30	120	64
	5. Increase annual transit ridership to 8.7 million trips	4.58	2011	4.71	2016	'11-'30	0.22	0.03
	6. Increase annual Vermont-based passenger-rail trips to 400,000	91,942	2011	92,422	2016	'11-'30	16,214	96
	7. Double the rail-freight tonnage in the state	6.6	2011	7.3	2014	'11-'30	0.35	0.23
	8. Increase electric vehicle registrations to 10% of fleet	0.0%	2011	0.3%	2016	'11-'25	0.7%	0.05%
	9. Increase renewably powered heavy duty vehicles to 10% of fleet	Since diesel vehicles can run on conventional diesel and biodiesel, this objective cannot be tracked without tracking biodiesel fuel sales						

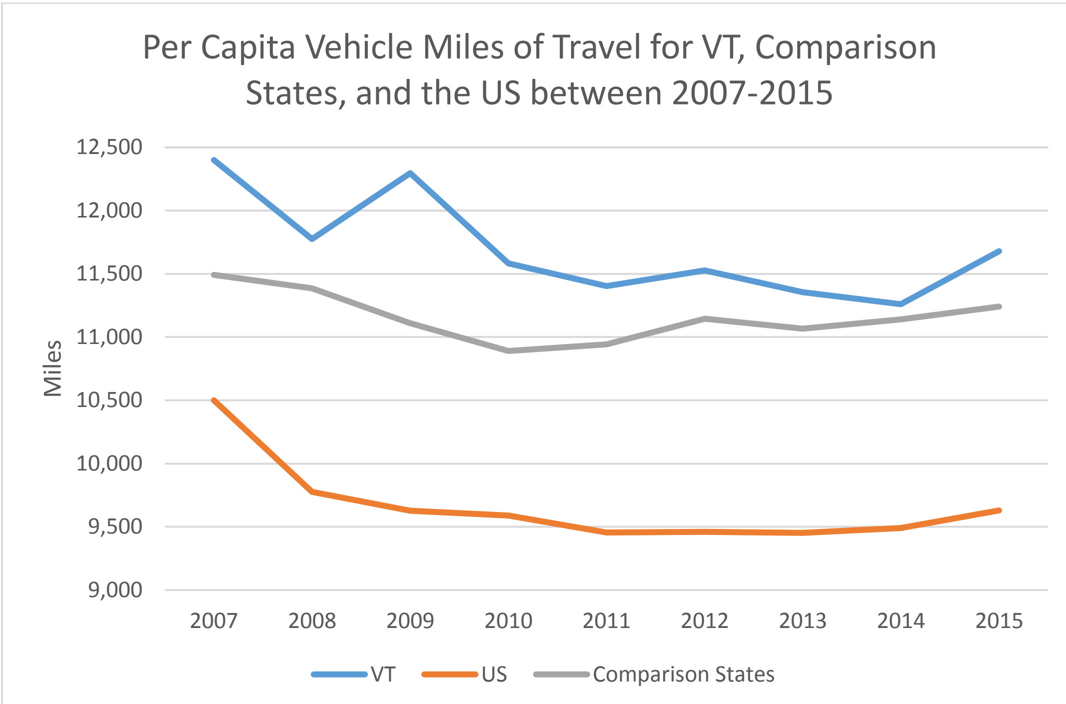
[1] Rates of change are annual averages. Target rates are calculated for the period shown and indicate the average annual rate of change required to meet the CEP target. Rates of change for Objectives 2-3 are measured as the change in percent of total commute trips. Objective 8 is measured as the change in the percent of the total vehicle fleet.

[2] Units: Goal 1 - trillion Btu; Goal 3 - MMTCO2e; Obj. 5 - millions of riders; Obj. 7 - millions of tons

[3] Preliminary target rate of change assumes 2016 value is equal to the most recent value.

Vehicle Miles of Travel Trends

As shown by the figure below, per capita vehicle miles traveled (VMT) in Vermont has steadily decreased since 2009. However, according to the most recent data available VMT increased between 2014-2015. Recent fuel price trends may help to explain this increase.



Mode share and trends

Another factor that affects the energy consumed in the transportation sector are the mode shares, i.e. the method of transport that people choose. The more people choose less energy intensive forms of transportation such as carpooling, biking or walking, and riding public transit, the less energy will be consumed in the transportation sector. The table below shows that most people still choose to drive alone, with moderate increases in the percentage choosing to do so in the last few years.

Comparison of Commuter Mode Share (%) for Vermonters, 2009-2015

Commuting Modes	NHTS 2009	ACS (5-Year Estimates) 2009	2010	2011	2012	2013	2014	2015
Drive Alone	82.7%	79.3%	79.4%	79.5%	79.7%	80.1%	80.5%	80.7%
Carpool	11.7%	11.4%	11.3%	11.1%	11.0%	10.8%	10.4%	10.1%
Public Transportation	0.6%	1.0%	1.1%	1.2%	1.2%	1.3%	1.3%	1.3%
Walk	3.1%	6.6%	6.6%	6.4%	6.4%	6.1%	6.0%	6.2%
Bicycle	0.9%	0.6%	0.6%	0.8%	0.9%	0.9%	0.9%	0.9%
Taxi, Motorcycle, Other	0.1%	1.1%	1.0%	1.1%	1.0%	0.9%	0.9%	0.9%

Table 19: Commuter Mode Share, 2009-2015[63]

[63] Vermont Agency of Transportation, *The 2017 Vermont Transportation Energy Profile,* September, 2017.