Overview of 2021 Annual Energy Report

January 20, 2021

DEPARTMENT OF PUBLIC SERVICE

BEFORE SENATE NATURAL RESOURCES 7 ENERGY

ED MCNAMARA, PHILIP PICOTTE

VERMONT
PUBLIC SERVICE DEPARTMENT

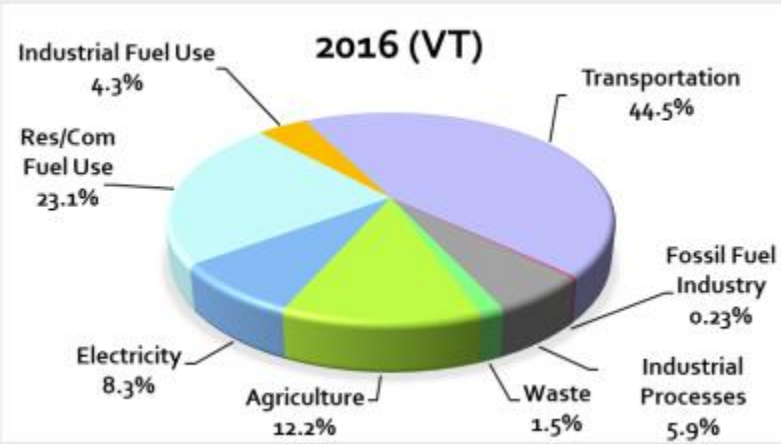
Topics Covered

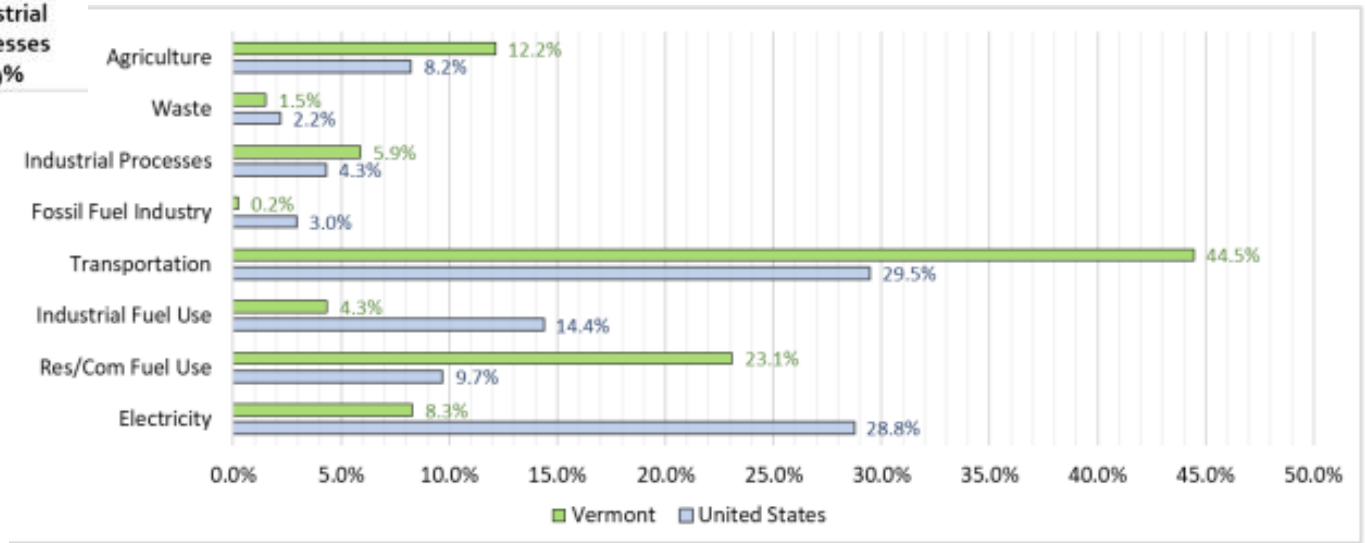
- Comprehensive Energy Plan goals
- Carbon emissions
- Household energy spending
- Electric sector
- Thermal sector
- Transportation sector
- Renewable Energy Programs Report
- Net metering Report

Comprehensive Energy Plan Goals

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

Carbon Emissions in Vermont





Cost of Carbon Reduction

Unit: Measure Cost NPV in $ ÷ Lifetime Reduction of CO_2

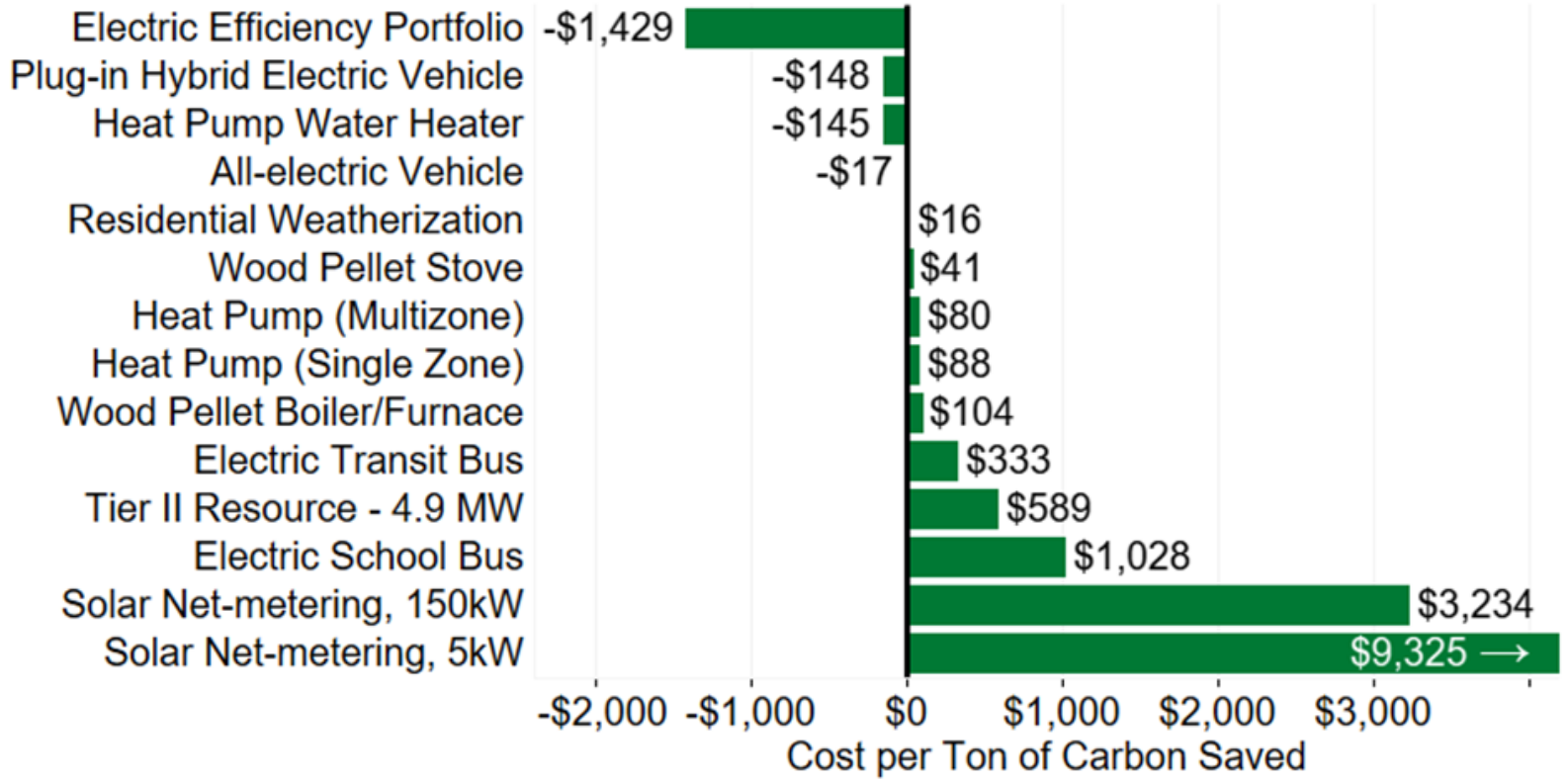
Net present value estimates net cost or benefit to Vermont as a whole (participant and ratepayers) for various measures

Lifetime Reduction of CO_2 estimates avoided emissions and accounts for increasing low carbon electric grid with expected renewable and nuclear purchases

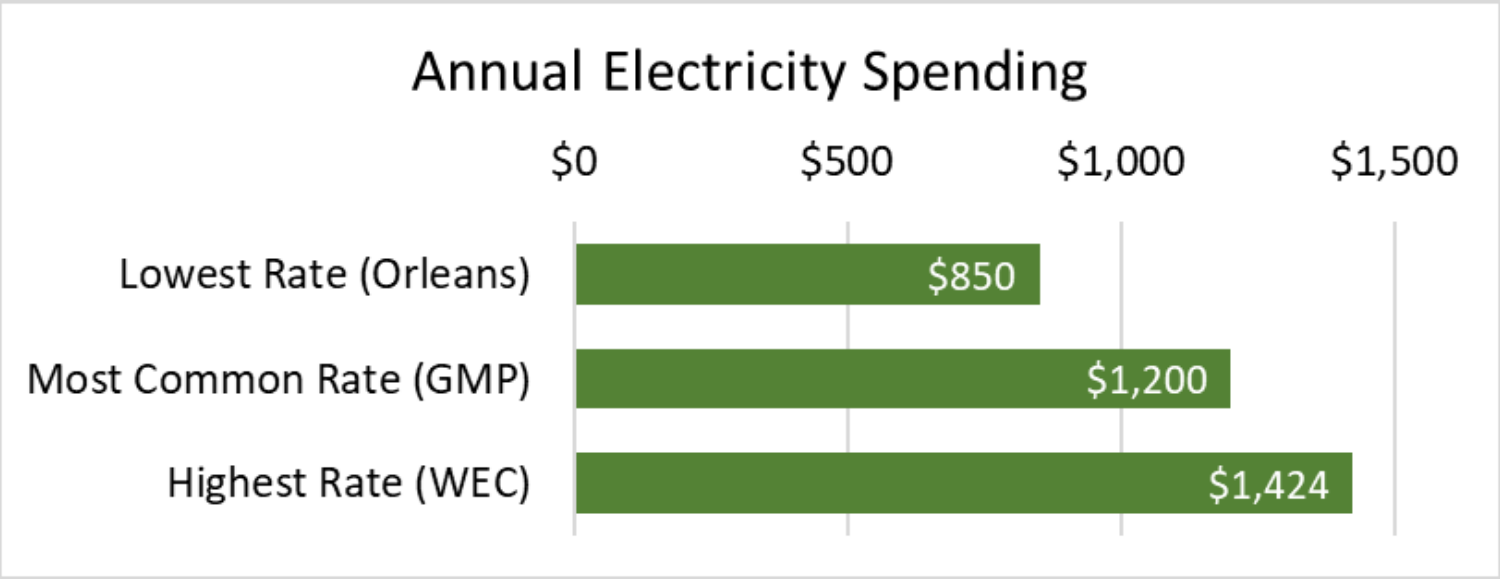
Measure life:

- 12 years (EVs, buses)
- 13 years (HPWH)
- 25 years (weatherization)
- 20 years (Tier II resources)
- 30 years (pellet boilers, furnaces, and stoves)

Cost of Carbon Reduction

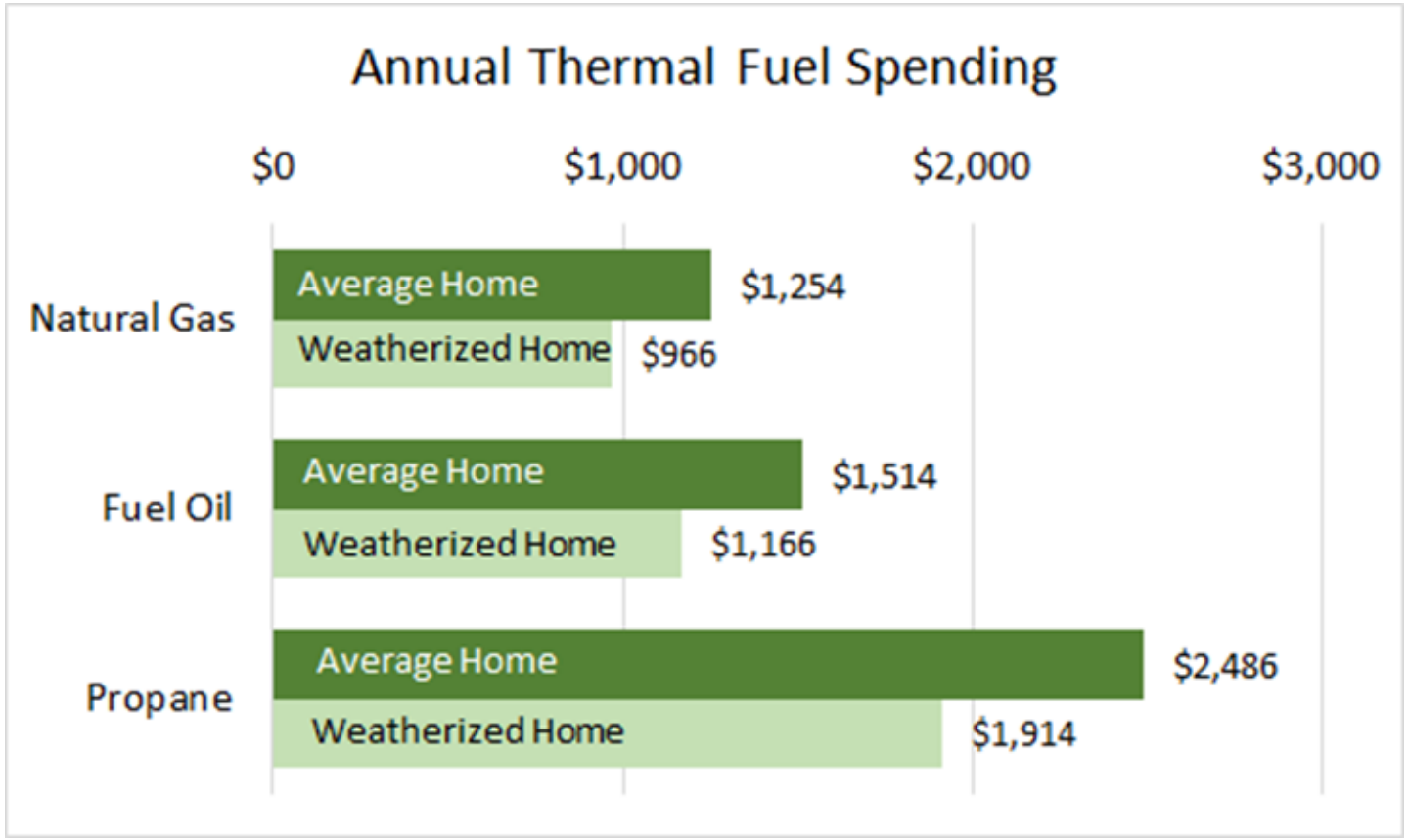


Household Spending on Electricity



Average Vermont residential annual electricity consumption: 6,592 kWh

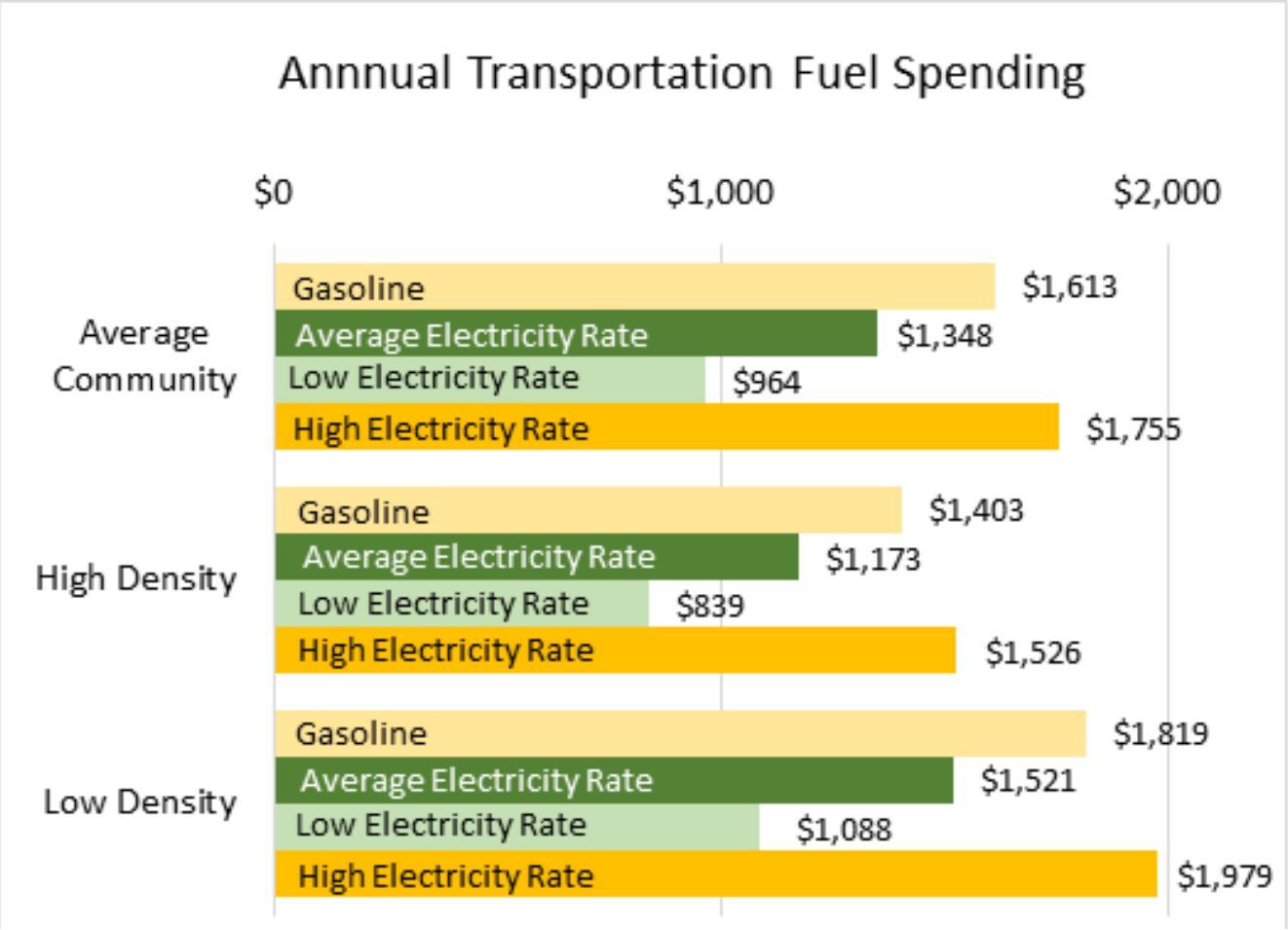
Household Thermal Fuel Spending



Average Vermont residential annual thermal energy consumption for single family homes: 95 MMBTU

After 23% weatherization savings: 73 MMBTU

Household Transportation Fuel Spending



Fuel Price Equivalents ($/gallon)	
Regular Gasoline	$2.15
Avg. Electricity Rate	$1.80
Low Electricity Rate	$1.29
High Electricity Rate	$2.34

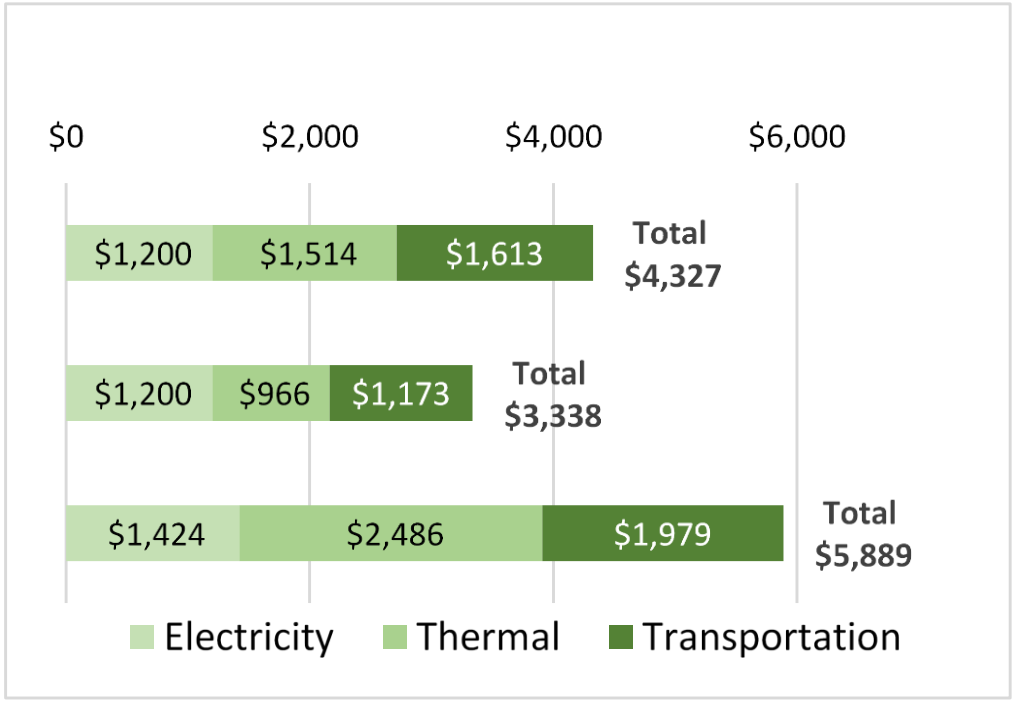
<u>Example Average Sedan</u>
30.8 miles per gallon

<u>Example Household VMT Estimates</u>
Statewide Average: 23,107
Barre City: 20,102
Bakersfield: 26,063

Household Spending on Energy

Total Annual Energy Spending

Utility	Heating Fuel	Home Efficiency	Vehicle Fuel	Miles per Year
GMP	Fuel Oil	Standard	Gas	Average
GMP	Nat. Gas	Weather-ized	Elec	Low
WEC	Pro-pane	Standard	Elec	High



Strategies for Achieving CEP Goals

Demand Reduction

- Electric efficiency
- Weatherization
- Reduce Vehicle Miles Traveled

Electrification

- EVs, heat pumps, line extensions

Load Management

- Choreographing flexible load to minimize peaks/utilize intermittent energy resources

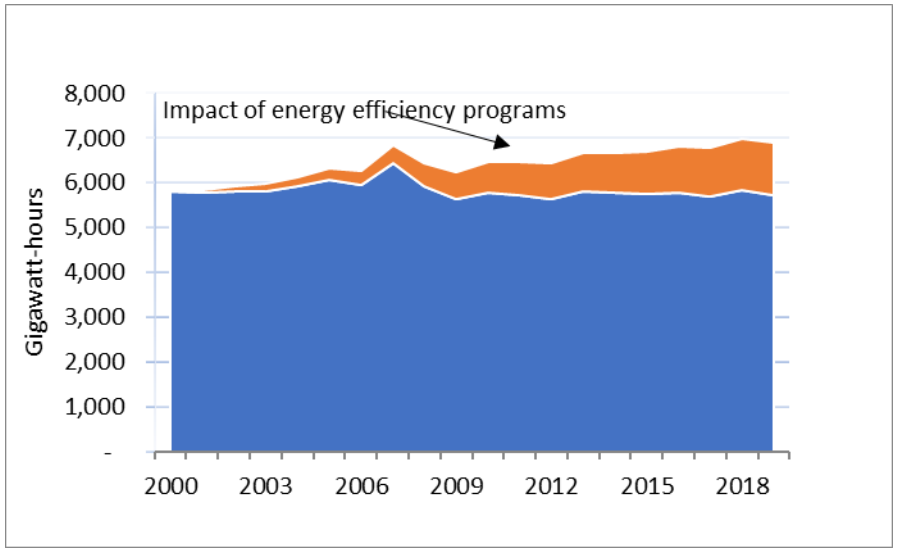
Develop renewable supply

- Consistent with least-cost planning

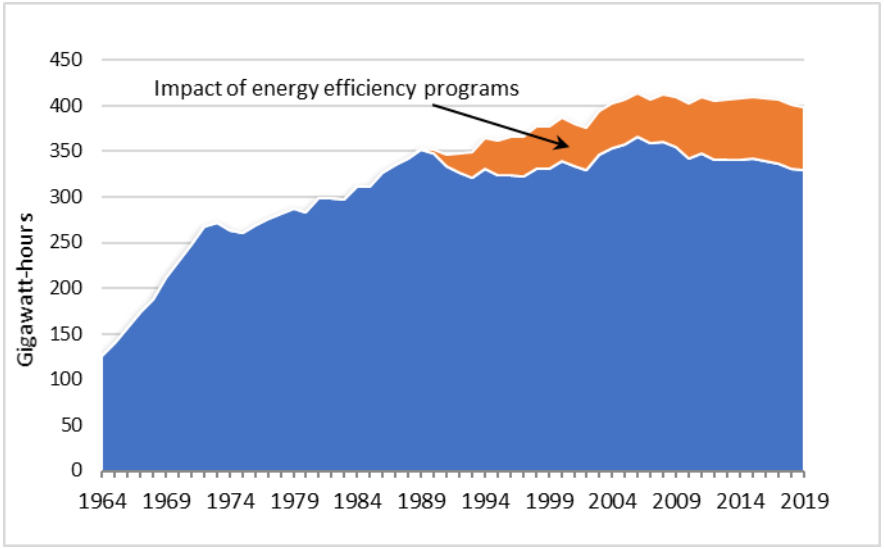
Electric Sector

Electric Efficiency

Efficiency Vermont



Burlington Electric Department

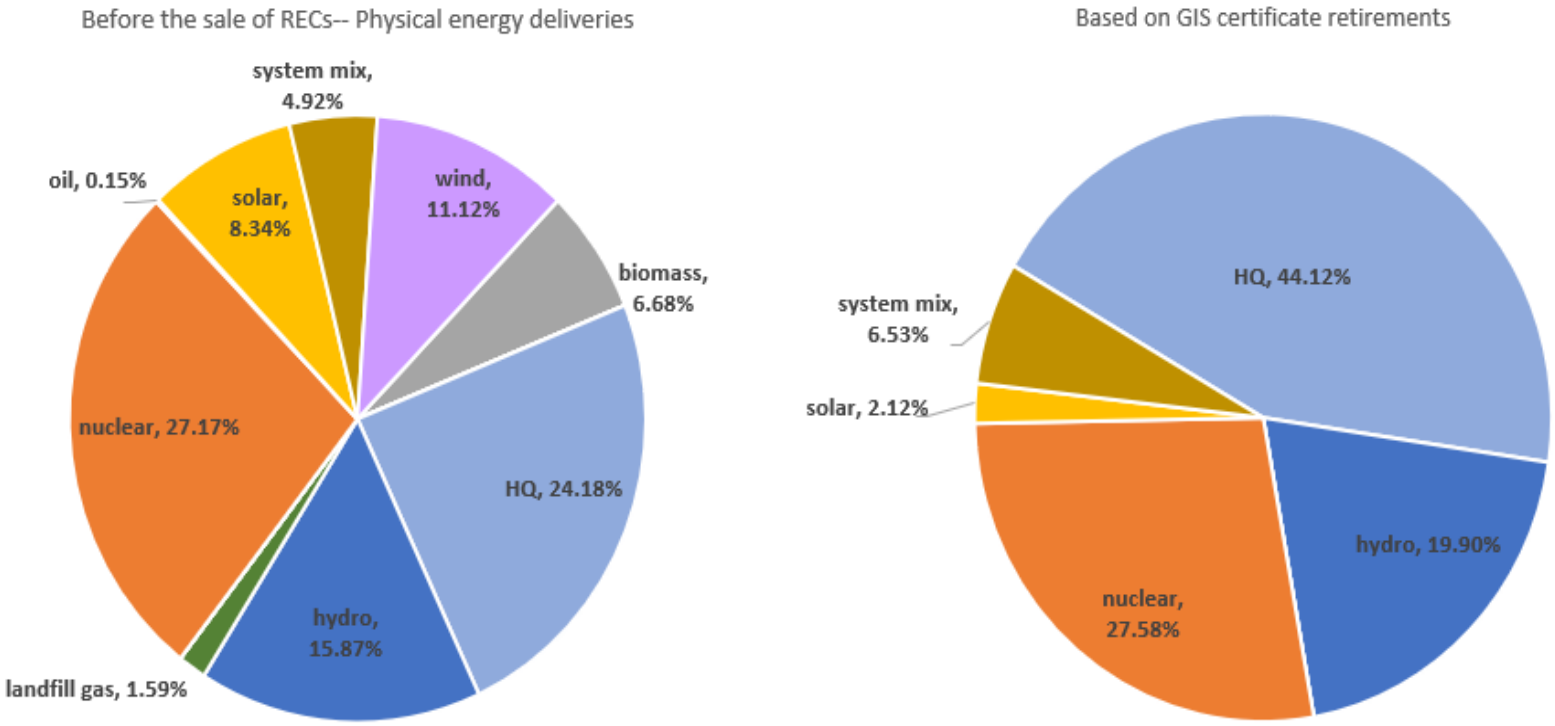


Electric Efficiency Budget

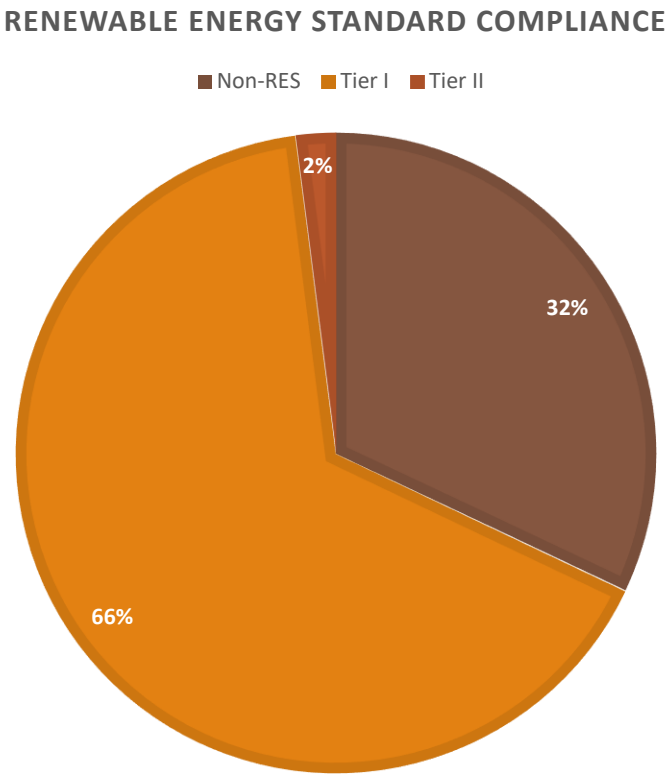
	2021	2022	2023	Total
EVT Electric Efficiency Budgets	$45,583,399	$45,719,158	$45,769,989	$137,072,546
BED Electric Efficiency Budgets	$2,661,737	$2,571,530	$2,631,882	$7,865,149
Total Electric Efficiency Budgets	$48,245,136	$48,290,688	$48,401,871	$144,937,695

Electric Supply

2019 Electric Mix

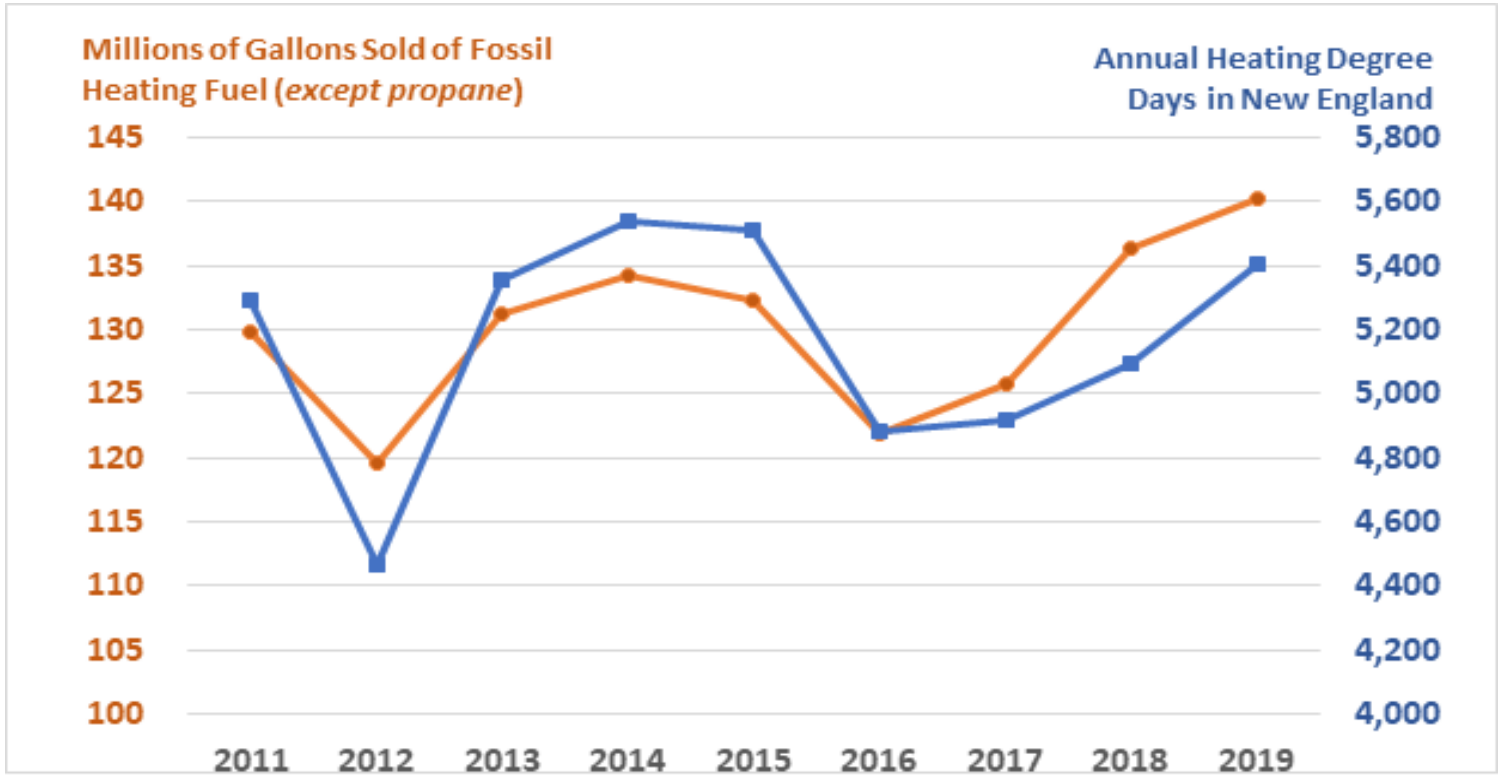


RES Compliance

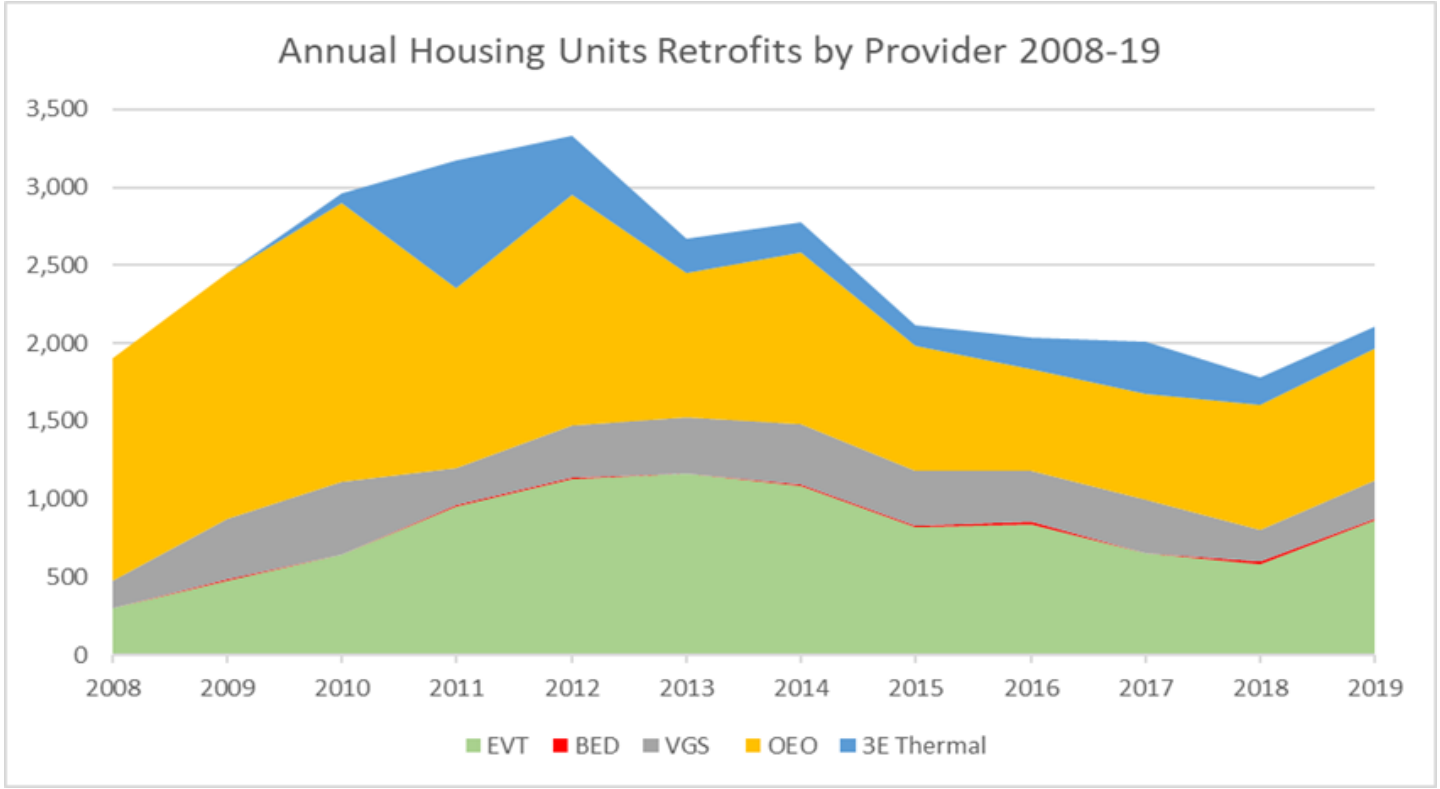


Thermal Sector

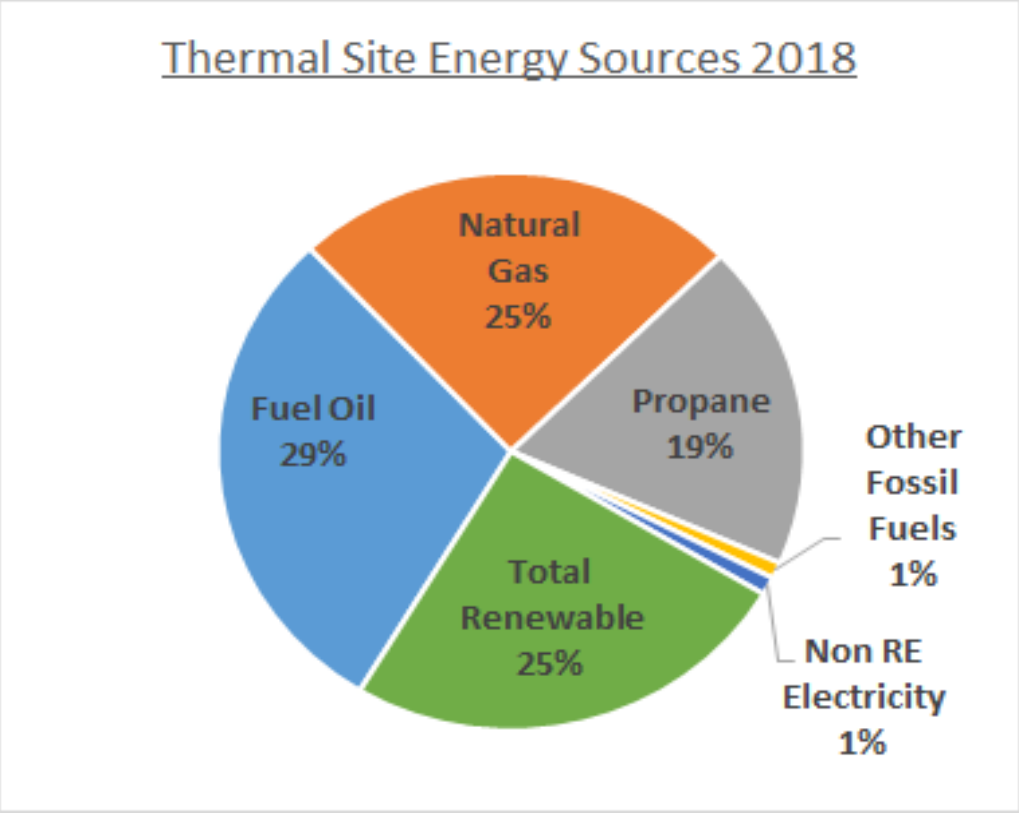
Weather and Fuel Use

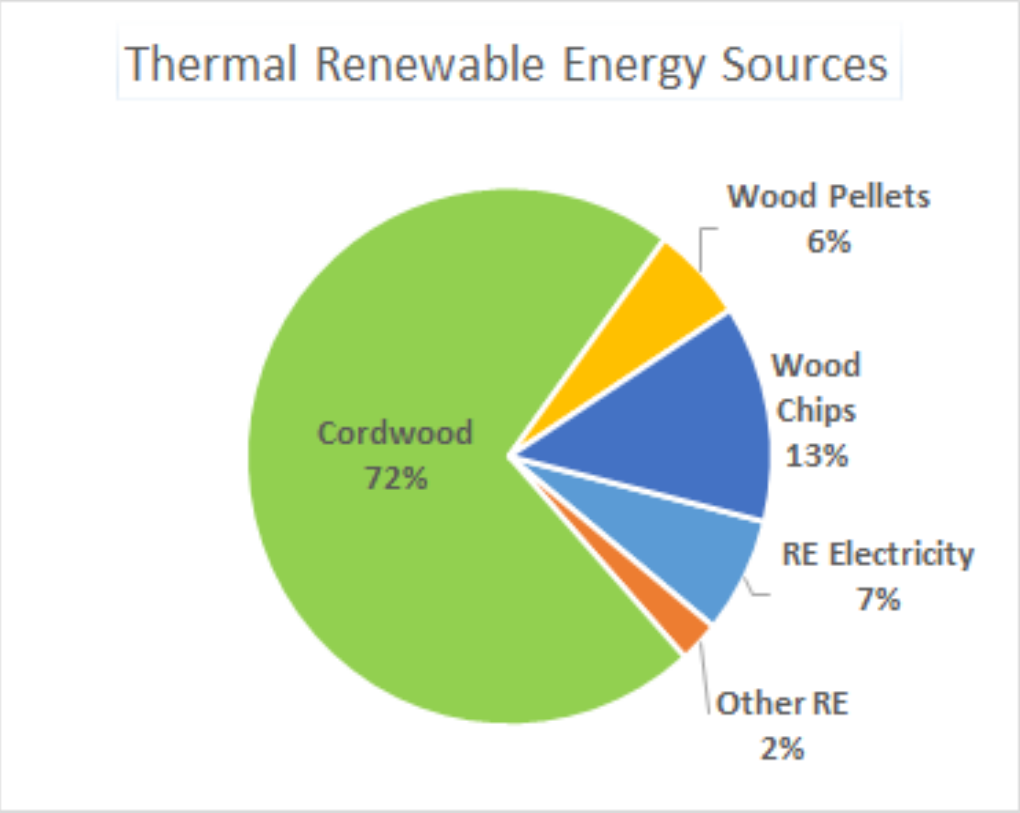


Weatherization

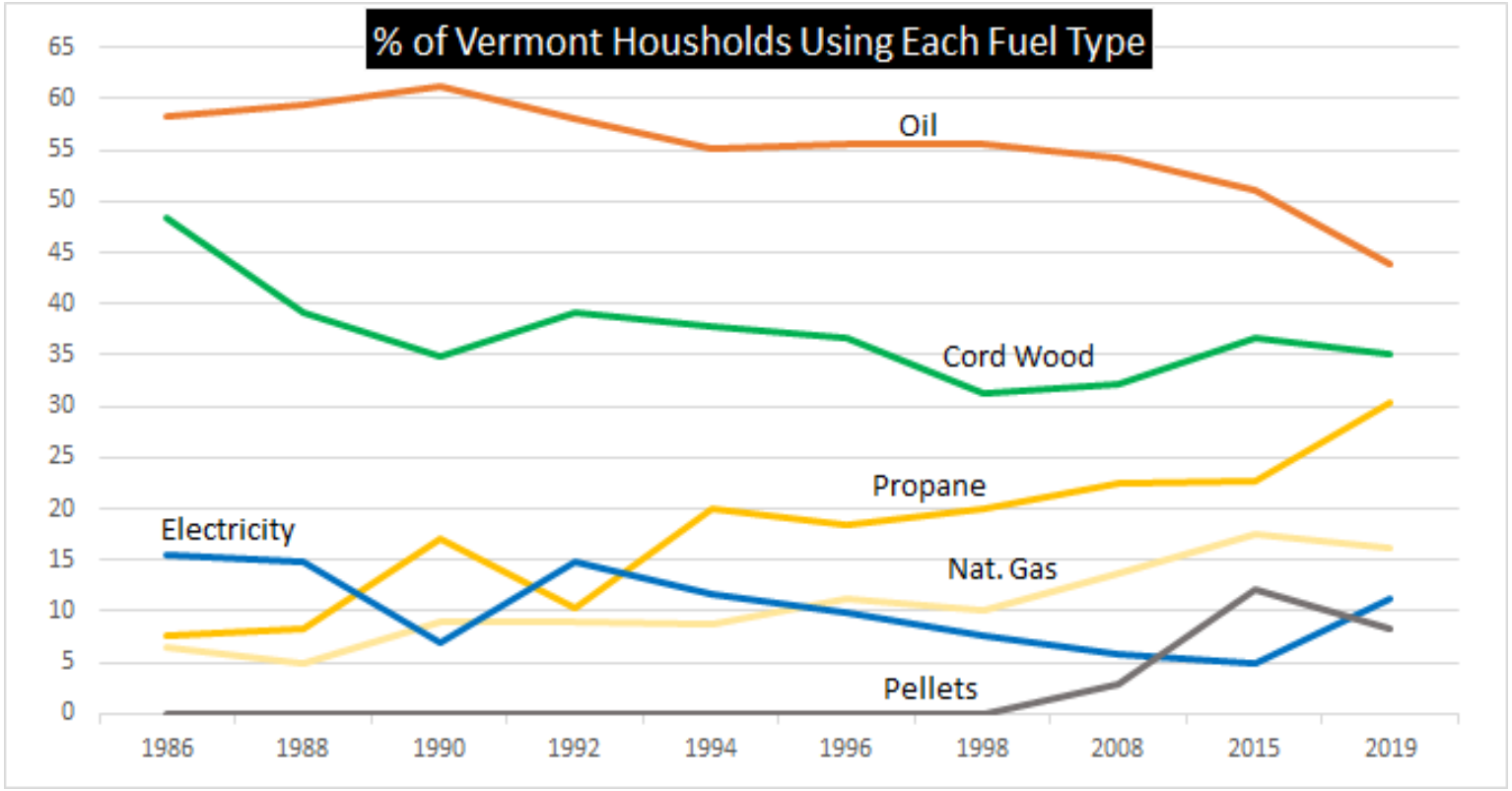


Thermal Supply

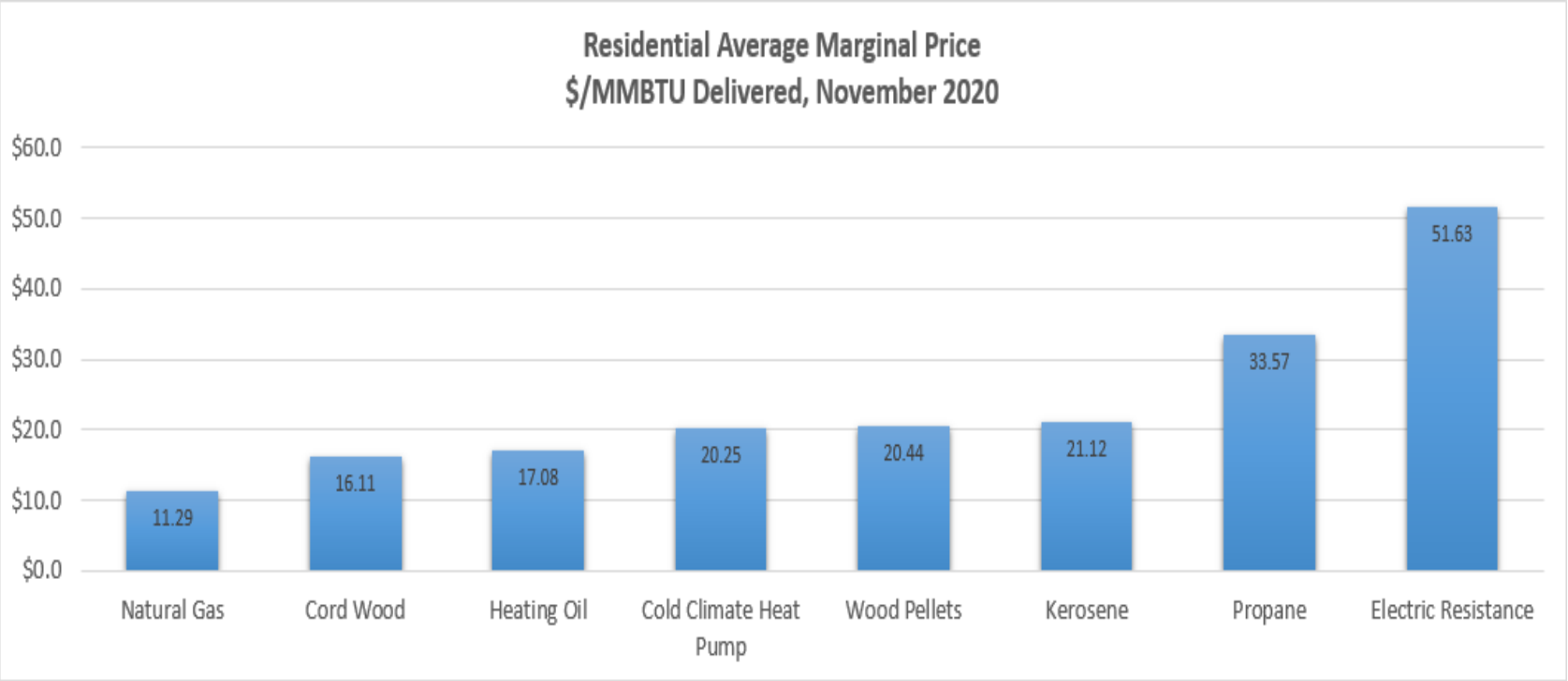




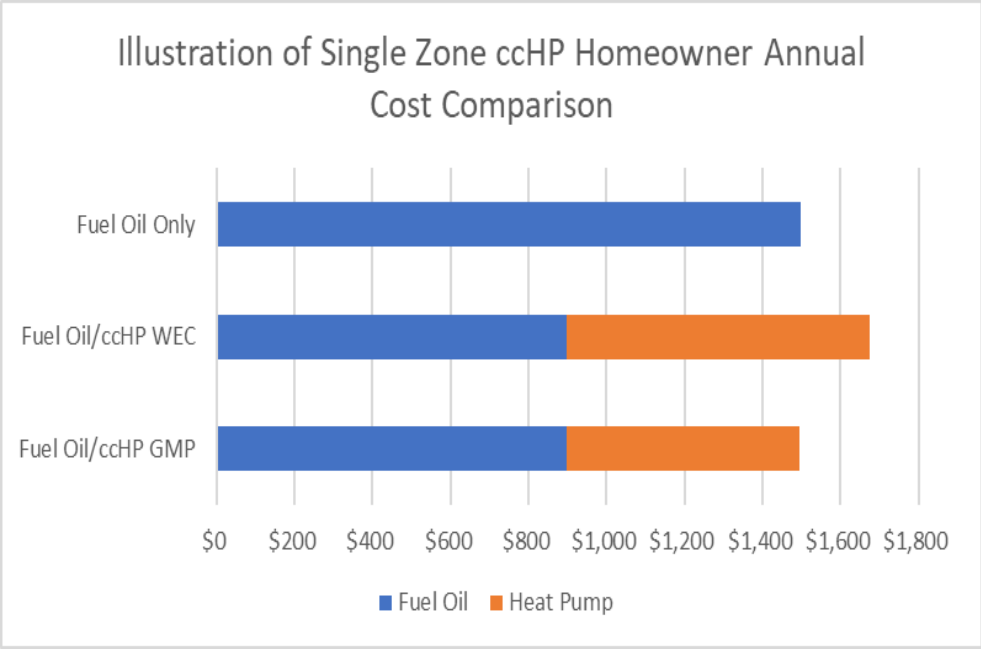
Thermal Supply



Thermal Supply Prices

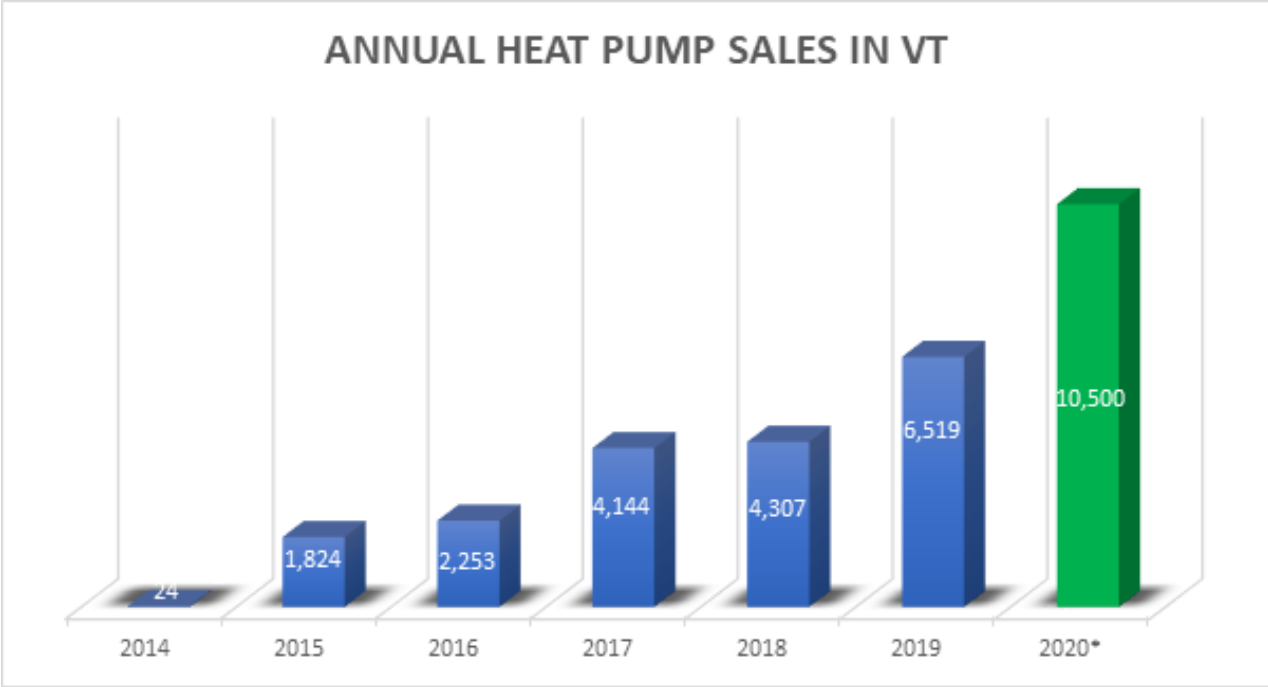


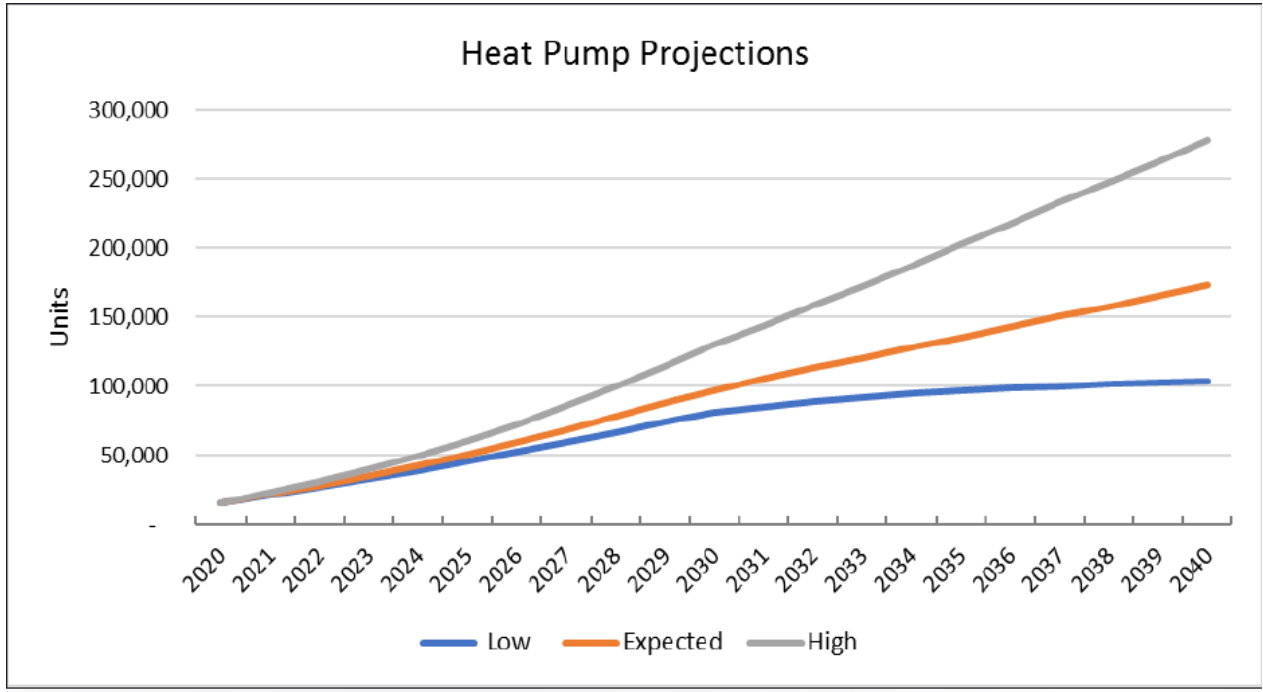
Heat Pump Cost Implications



* Heat Pump Example is over a single year, assuming $2.50/gallon fuel oil, 40% heat displacement, 2.5 COP

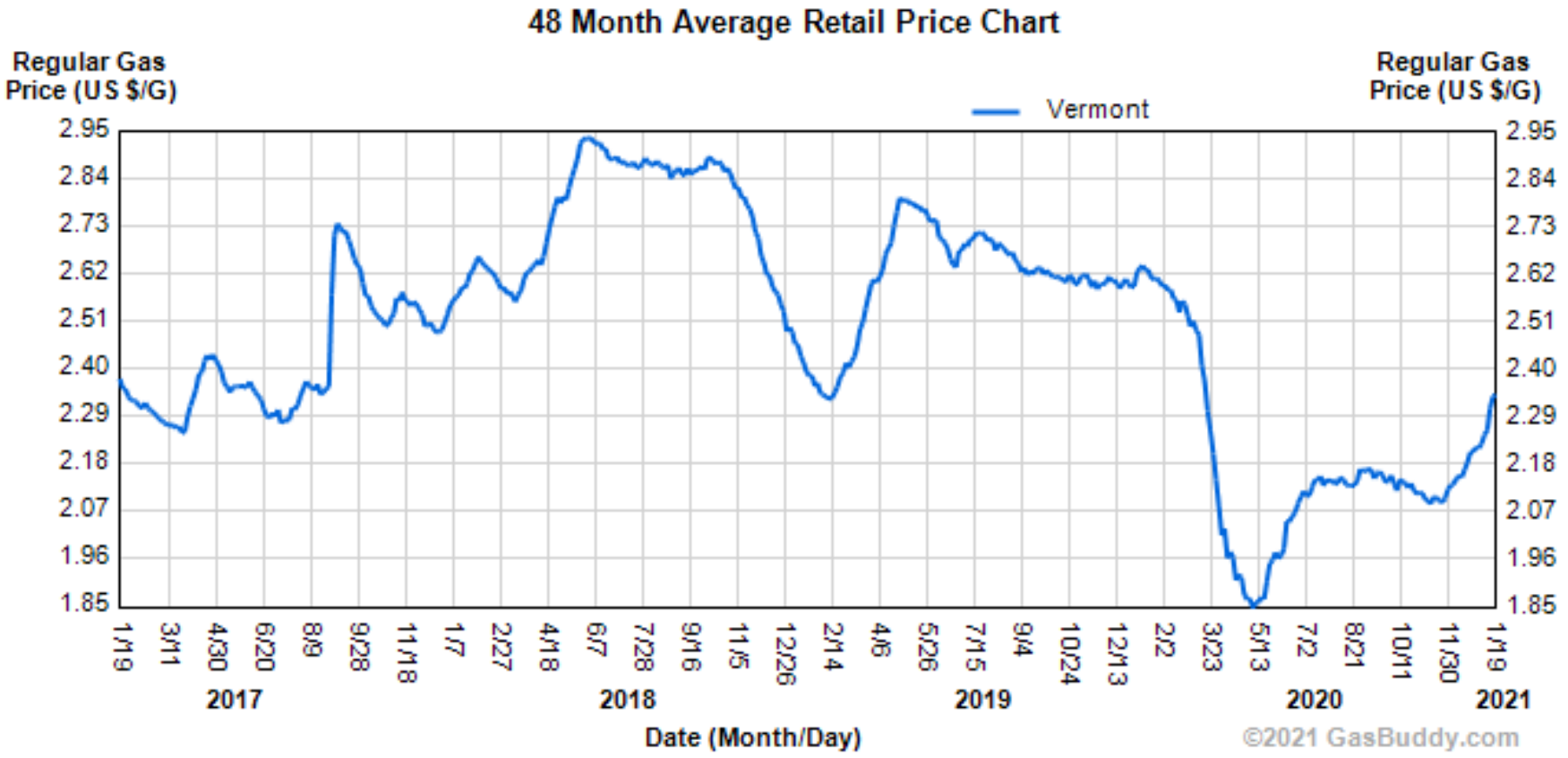
Heat Pumps


ANNUAL HEAT PUMP SALES IN VT
24
1,824
2,253
4,144
4,307
6,519
10,500
2014
2015
2016
2017
2018
2019
2020*


Heat Pump Projections
Units
300,000
250,000
200,000
150,000
100,000
50,000
-
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
Low
Expected
High

Transportation Sector

Gasoline Prices



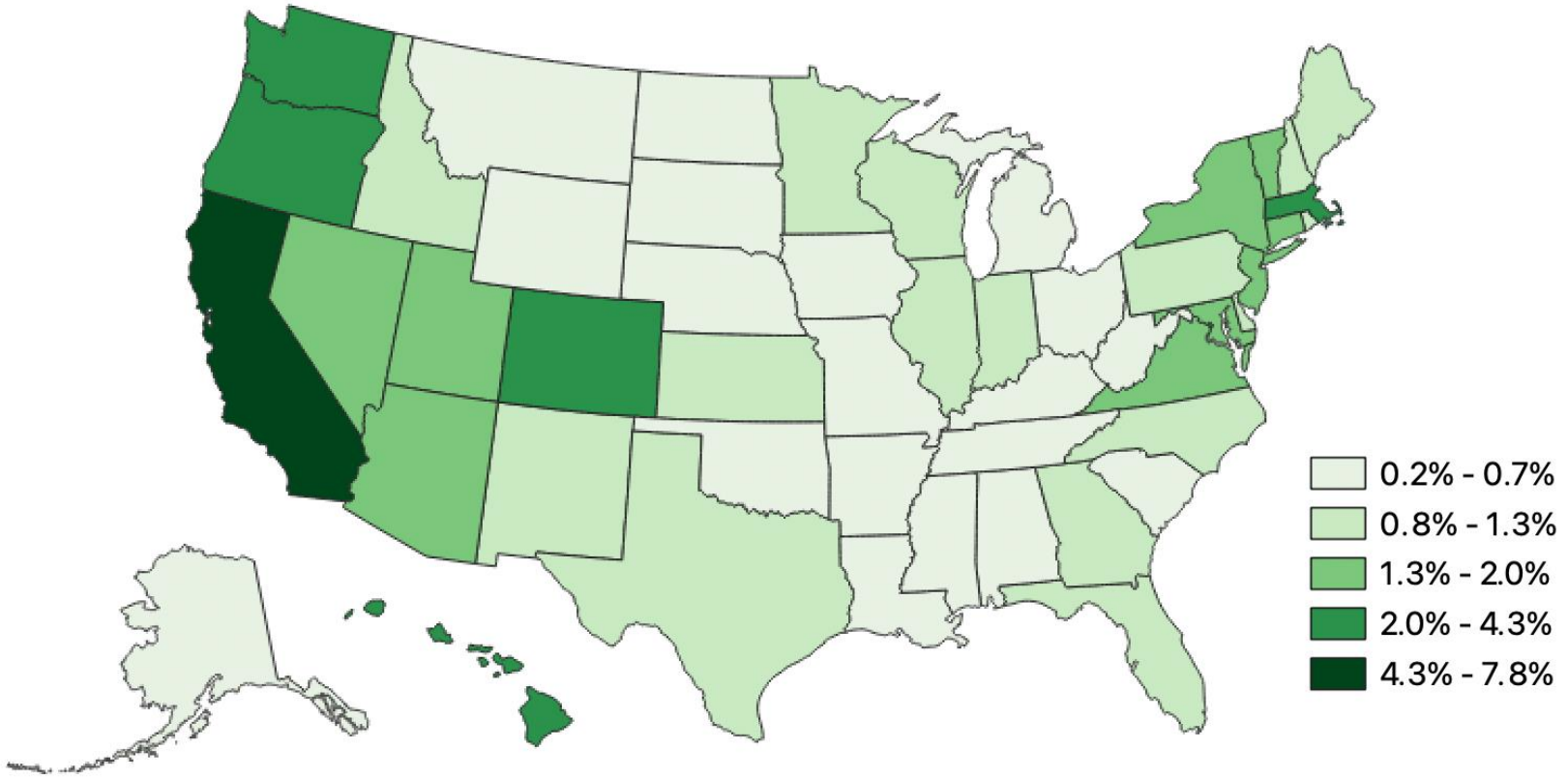
Source: GasBuddy, LLC, January 2021

Vermont Vehicles by Fuel Type, 2019

Fuel Type	Registered Vehicles	Share of Total	Example
Gasoline	547,199	92.2%	Subaru Forester
Diesel	31,107	5.2%	Chevy Silverado Diesel
Gasoline Hybrid	12,077	2.0%	Toyota Prius
Plug-in Hybrid Electric Vehicle (PHEV)	2,032	0.3%	Toyota RAV 4 Prime
All-electric Vehicle (AEV)	1,256	0.2%	Chevy Bolt
Propane or CNG	34	0.0%	UVM Campus Shuttle

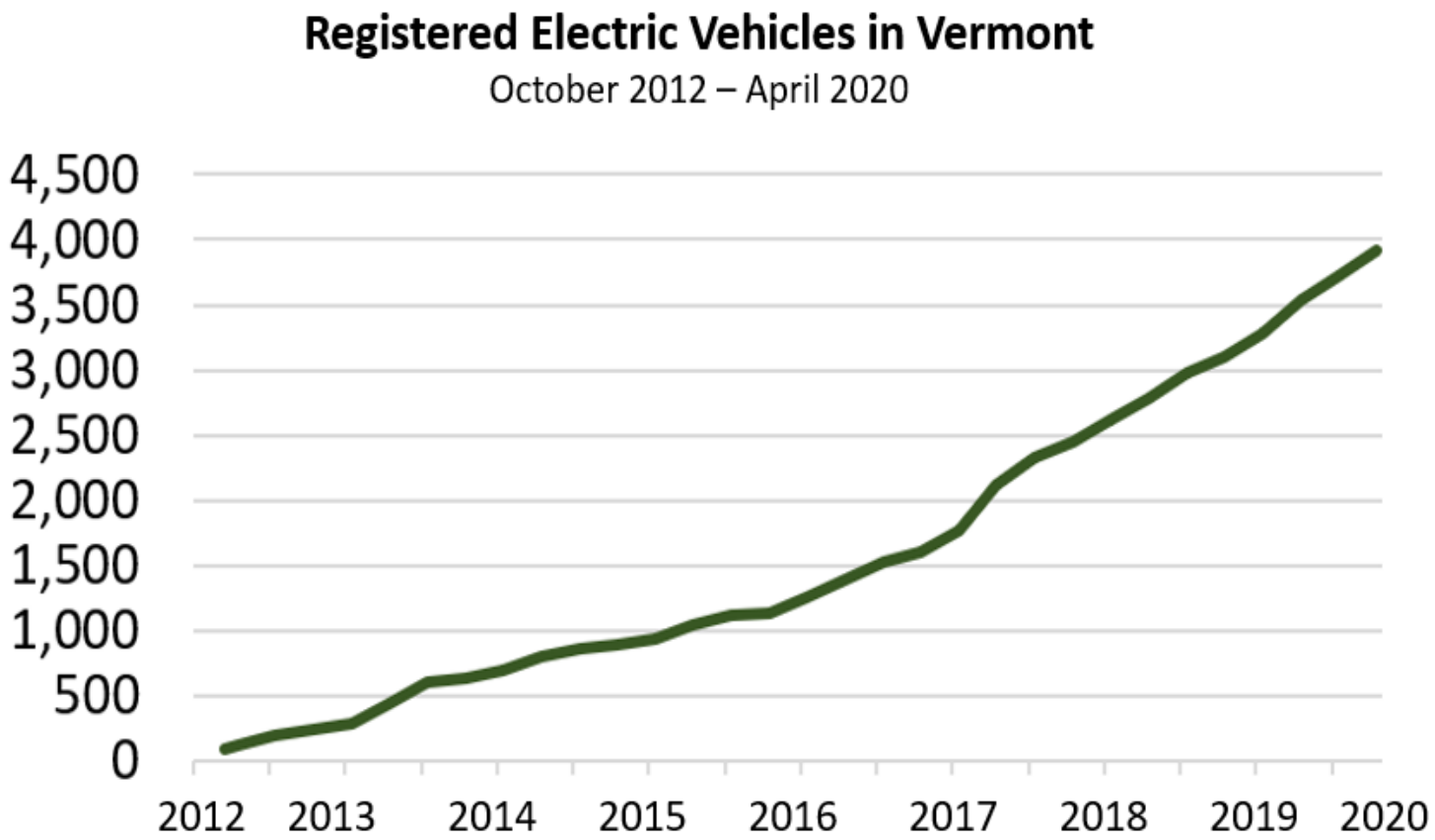
Source: Vermont Transportation Energy Profile, 2019, UVM TRC

EV Market Share by State, 2018



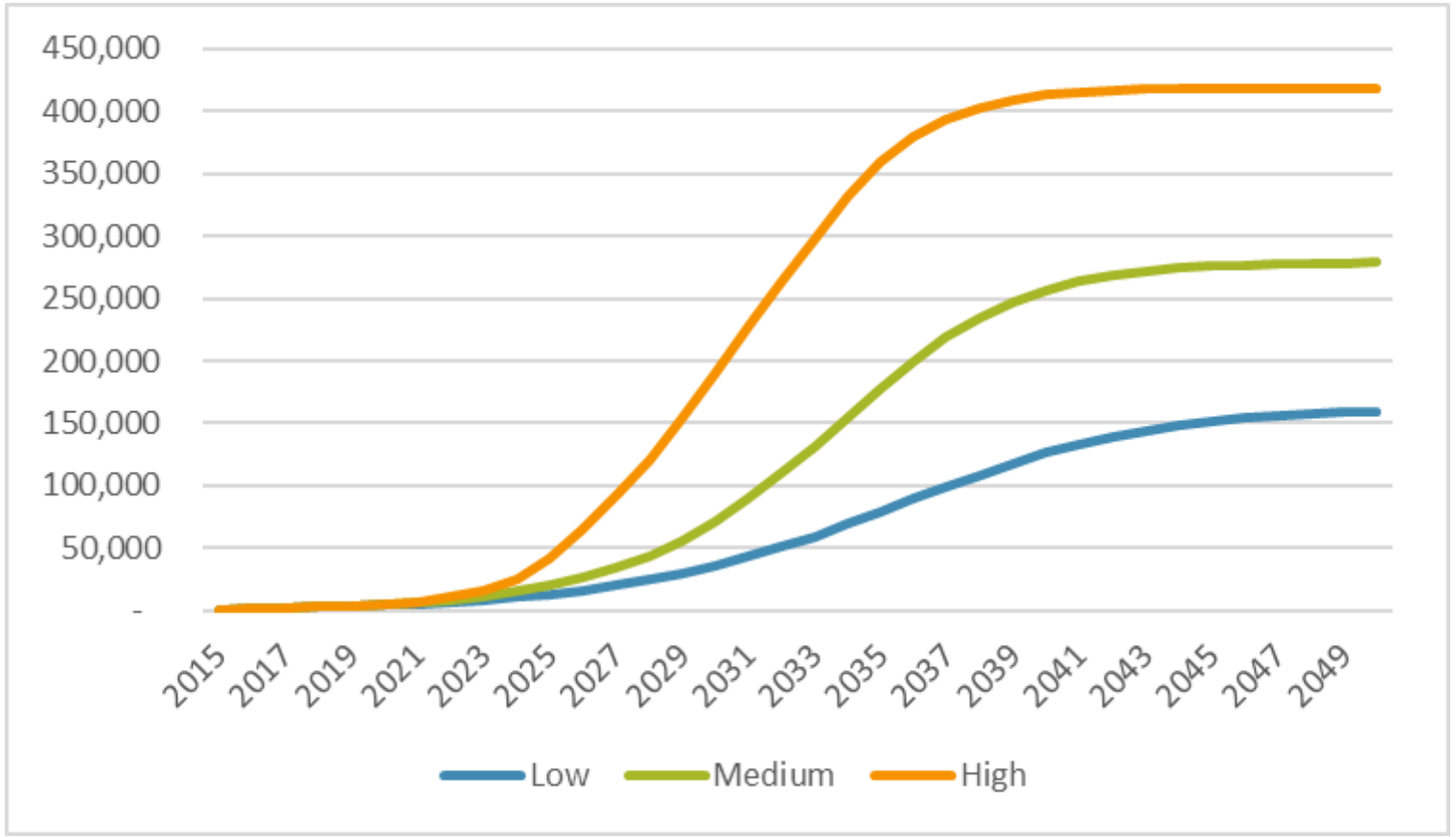
Source: EV Adoption, 2020. Map by VT PSD.

Registered Electric Vehicles



Source: Vermont DMV data analyzed by VT DEC Air Quality & Climate Division

Electric Vehicle Registration Forecast

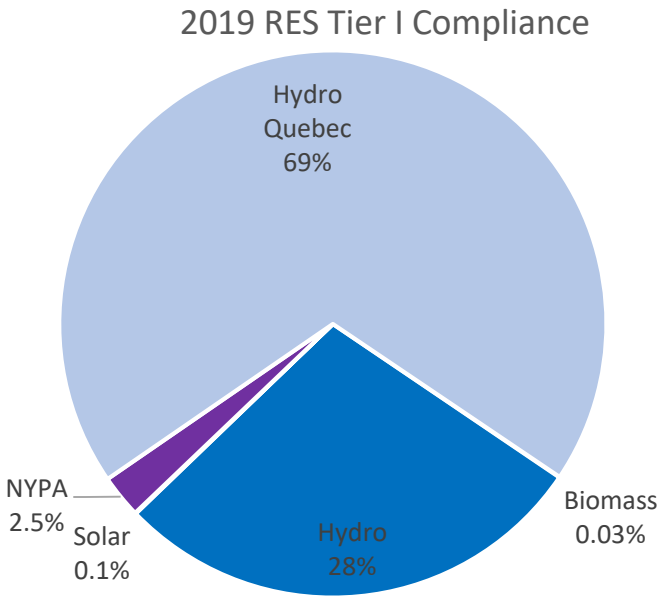


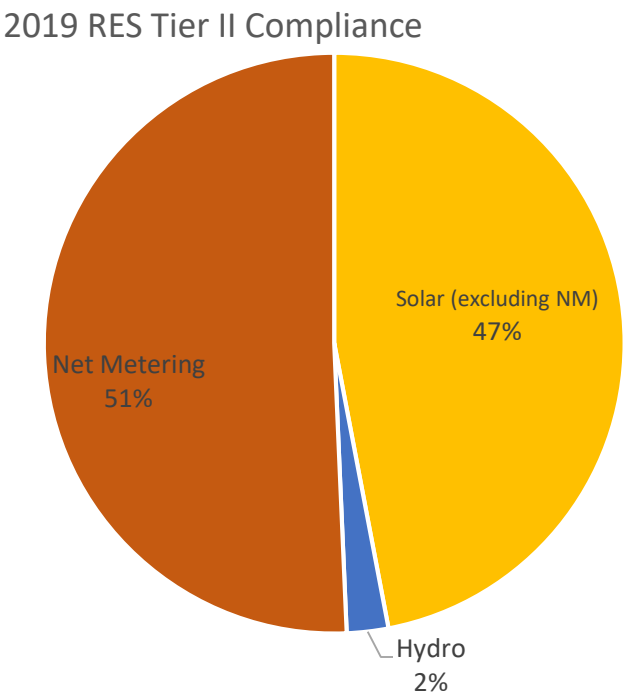
Source: Drive Electric Vermont, 2020, prepared for VELCO

Renewable Energy Programs Report

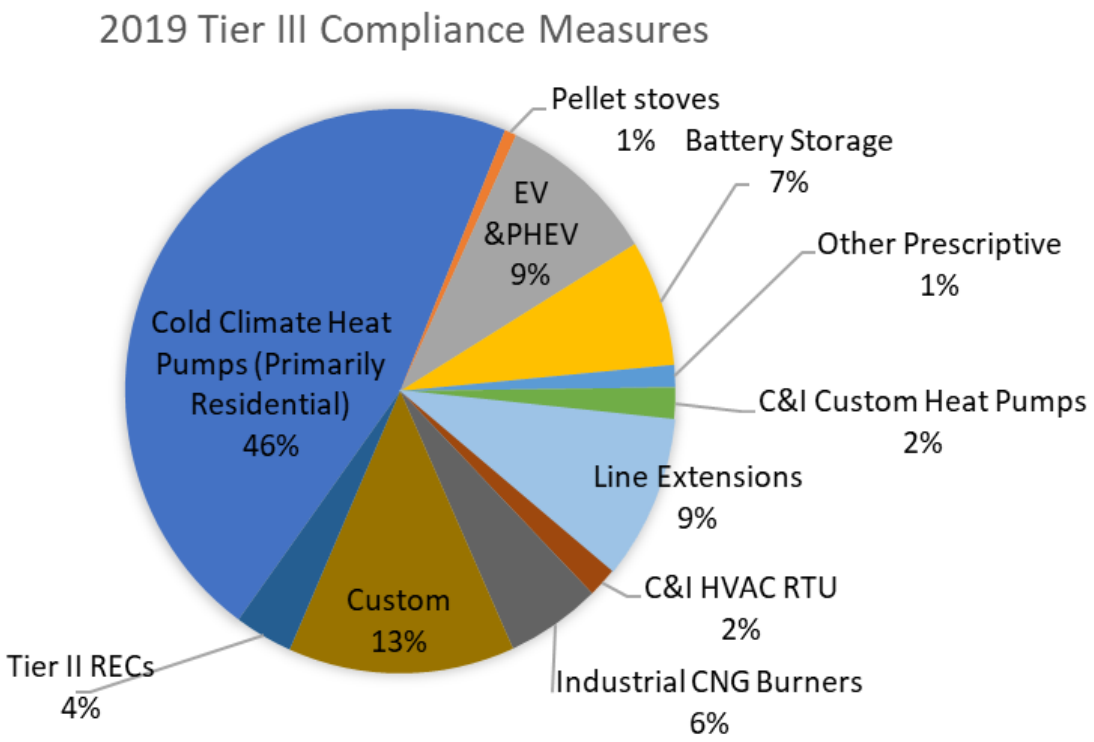
30 V.S.A. § 8005b

RES Tiers 1 & 2 Compliance





RES Tier 3 Compliance



2019 Cost of RES Compliance

2019 RES Performance			
	REC Retirements		Compliance Cost
Tier I	3,564,110	RECs	$1,240,000
Tier II	118,262	RECs	$4,650,000
Tier III	176,839	Mwhe	$6,030,000
Total Cost of Compliance			$11,920,000
Retail Sales	5,405,687	MWh	
Rate Pressure from RES Compliance	1.4%		
CO2 Reduction from RES	558,694	tons of CO2	
Vermont Emissions Profile	47	lbs per MWh	

Standard Offer Program

- Put in place in 2009 (pre-RES) and expanded in 2012
- Requires (most) Vermont utilities to purchase output from 127.5 MW of small-scale renewable resources

- Baseload renewable power portfolio requirement (Ryegate)
  - Contract ends in 2022.

Estimated ten-year compliance costs

	HIGH INCREMENTAL COST	LOW INCREMENTAL COST
REC Price Forecast	HIGH	LOW
NM Adoption Rate	HIGH	LOW
Peak contribution of New Load	90%	None
Fossil Fuel Price	LOW	HIGH
Tier 1 Cost	$136,000,000	$20,000,000
Tier 2 Cost	$63,000,000	$48,000,000
Tier 3 Net Cost	-$28,000,000	-$60,000,000
TOTAL Cost of RES	$171,000,000	$8,000,000
Rate Pressure	5.02%	0.56%

Standard Offer Project Summary

Technology	Contracted		Online		In Development	
	Capacity (kW)	Number of Projects	Capacity (kW)	Number of Projects	Capacity (kW)	Number of Projects
Biomass	865	1	865	1	0	0
Farm Methane	5,249	15	5,205	14	44	1
Food Waste	3,388	5	0	0	3,388	5
Hydroelectric	4,939	6	4,939	6	0	0
Landfill Methane	0	0	0	0	0	0
Large Wind	0	0	0	0	0	0
Small Wind	886	15	0	0	886	15
Solar PV	97,647	57	58,797	39	38,850	18
TOTAL	**112,974**	**99**	**69,806**	**60**	**43,168**	**39**

Standard Offer Program Production & Costs

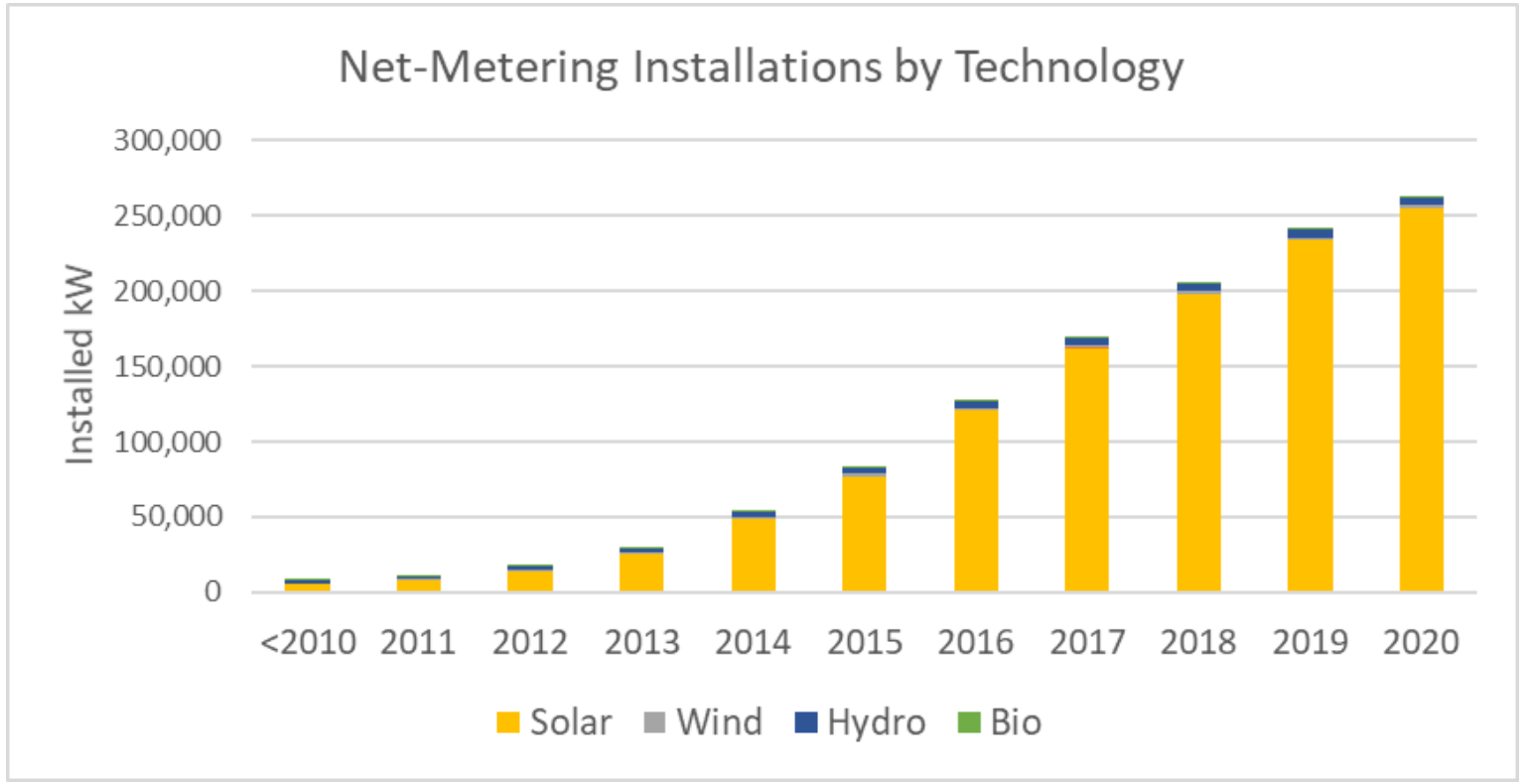
Year	MWh Generation	Program Cost	Average Price per MWh	Avg. Capacity Factor
2015	90,126	$20,100,371	$223	20.1%
2016	101,377	$22,042,023	$217	19.8%
2017	103,519	$21,342,884	$206	18.8%
2018	103,658	$21,250,884	$205	18.1%
2019	109,516	$21,991,994	$201	17.9%
2020	112,185	$22,273,981	$199	20.0%

Net Metering Report
30 V.S.A. § 8010

Overall Summary

- Net metering has resulted in significant expansion of distributed renewable resources
  - Largest resource for Vermont in terms of nameplate, exceeding HydroQuebec
  - Supports a number of jobs in Vermont
- Current net metering system is substantially different from initial intent
  - 77% of net metered generation is exported to the grid (I.e., not used onsite)
  - Solar is a mature technology that can stand on its own
- Substantial cost shift to non-participating customers
  - $0.17/kWh compared to $0.10/kWh or less
  - Economic analysis shows upfront development benefits and long-term drag on the Vermont economy
  - Overall cost shift increases as net metered customers add electric vehicles and heat pumps
- New compensation structure needed
  - Customers should be able to offset own usage and reduce electric bills
  - Customers should get paid for the exported solar at the value to Vermonters

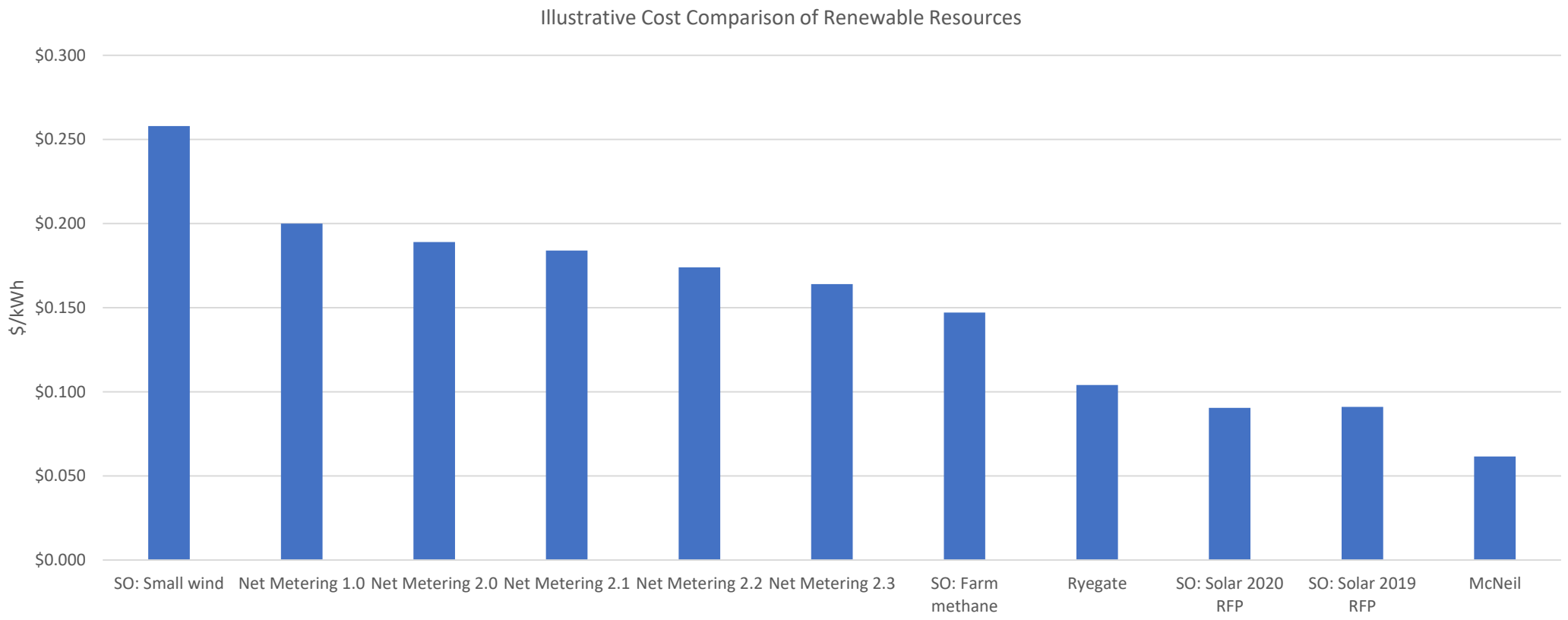
Net Metering Installations



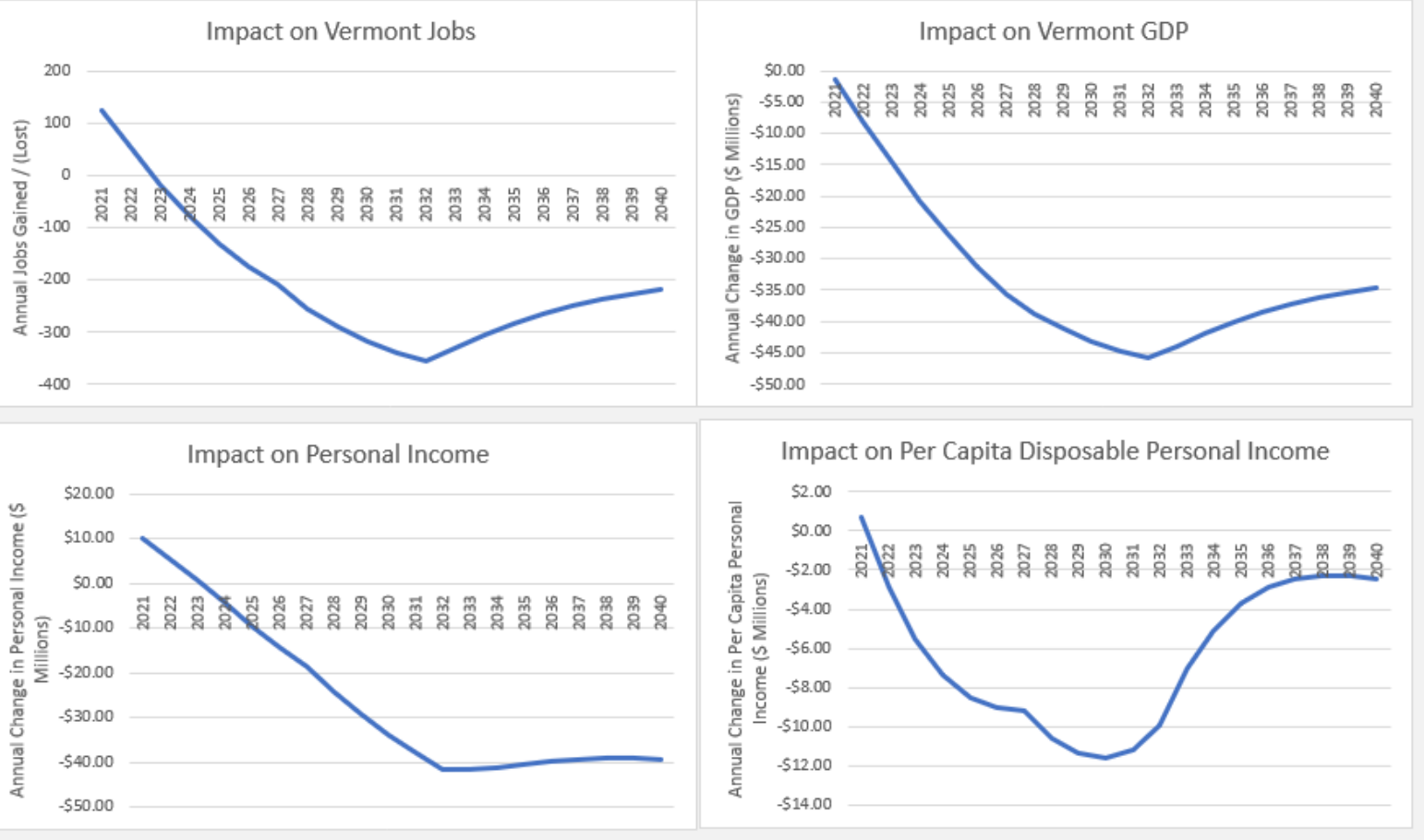
Net Metering by Utility

Utility	Total Installed NM (kW)	2019 Non-Coincident Peak	NM as % of Peak Load	Percent of NM Capacity	Percent of Retail Sales
Green Mountain **Power**	221,266	684,450	32%	84.2%	76.4%
Vermont Electric **Cooperative**	20,720	80,082	26%	7.7%	8.4%
Vermont Public **Power Supply Authority**	10,251	71,019	14%	4.0%	6.4%
Burlington Electric **Department**	4,718	63,076	7%	1.8%	6.0%
Washington Electric **Cooperative**	3,722	16,067	23%	1.4%	1.3%
Stowe Electric Department	1,645	17,655	9%	0.6%	1.4%
Hyde Park **Electric**	528	3,370	16%	0.2%	0.2%
TOTAL	262,850	909,433	29%	100%	100%

Cost Comparison of Renewable Resources

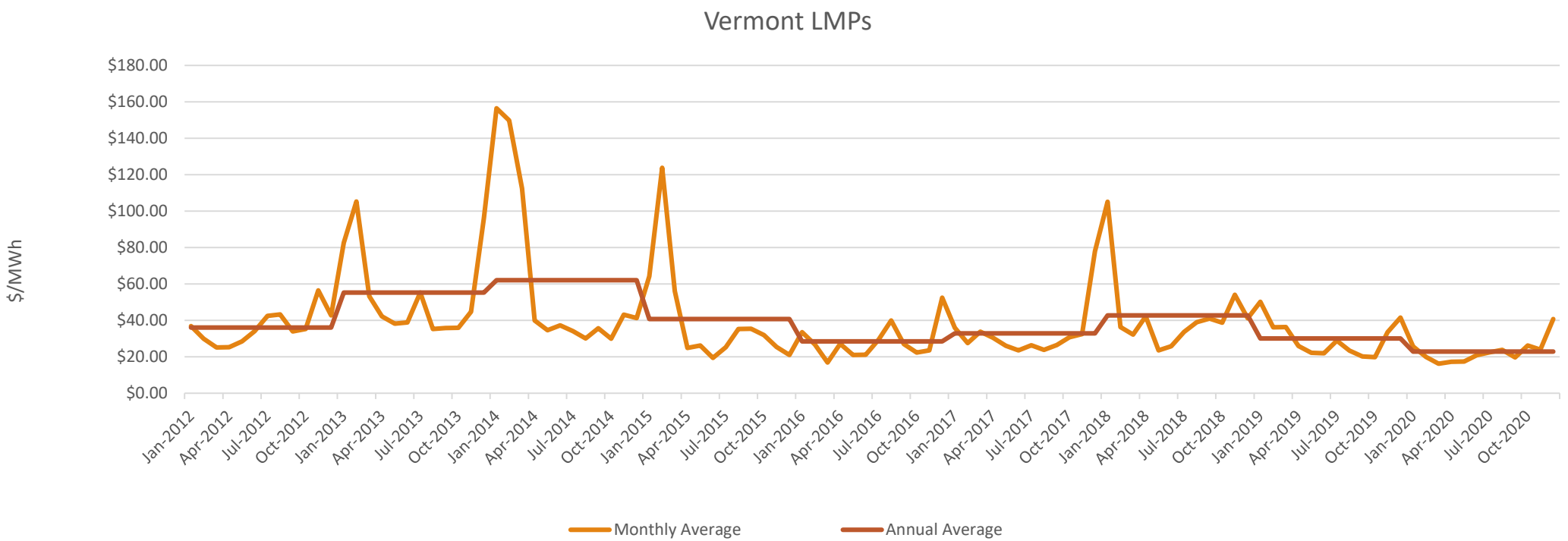


Economic Impact of Net Metering



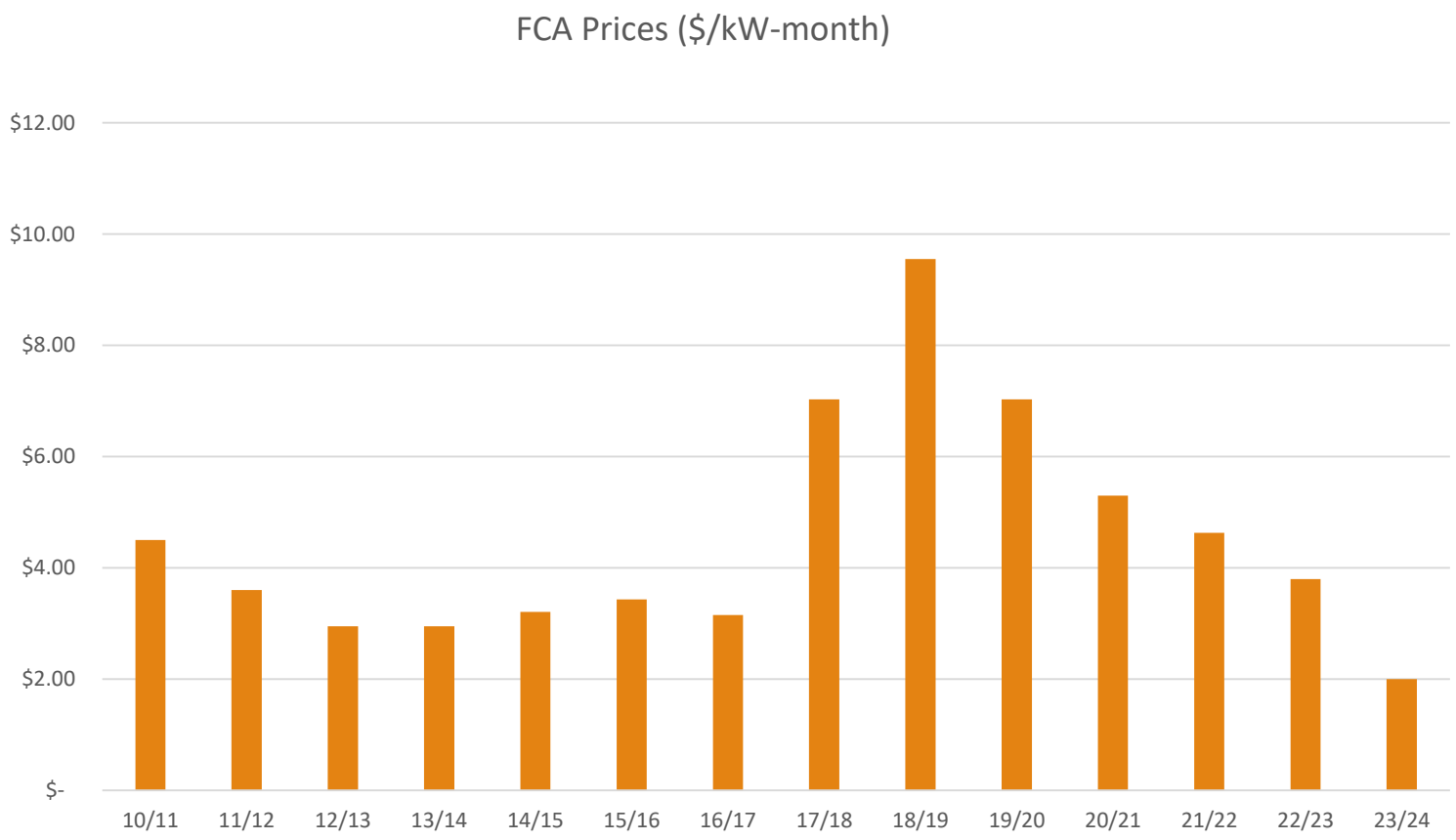
Appendices

New England Wholesale Energy Prices

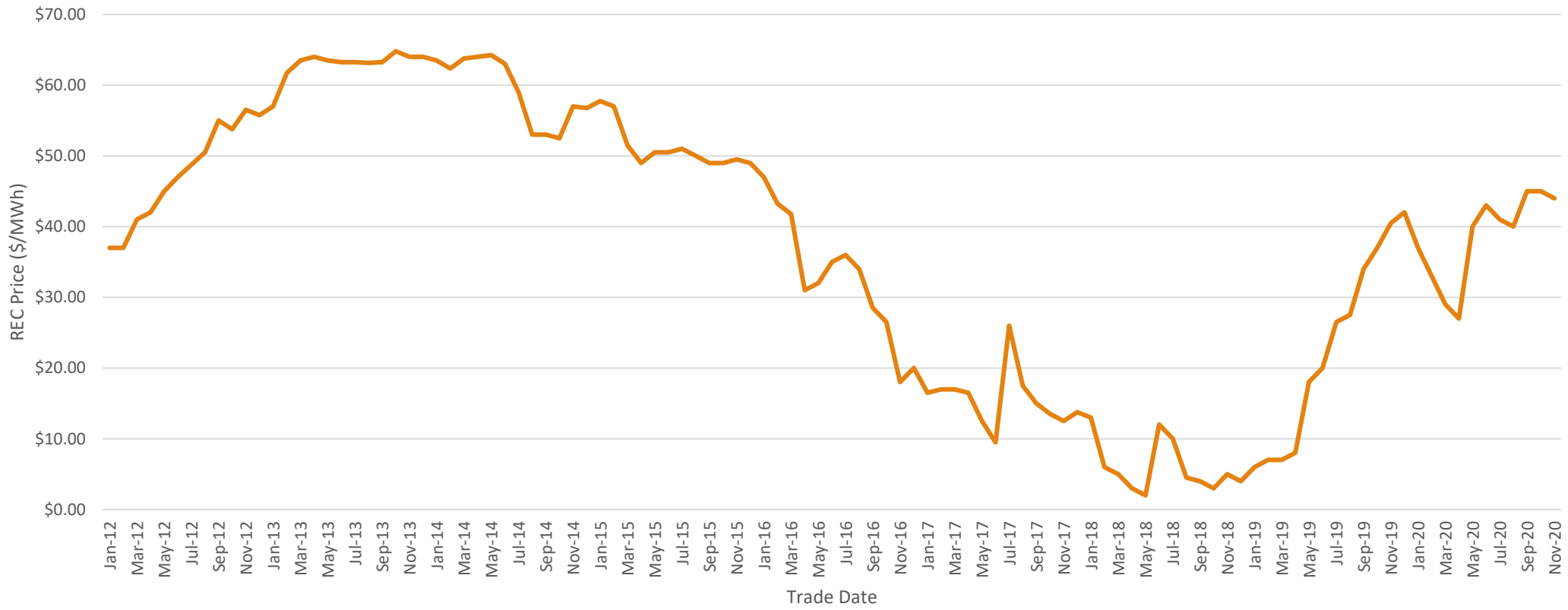


Prices shown are real-time, Vermont zone averages

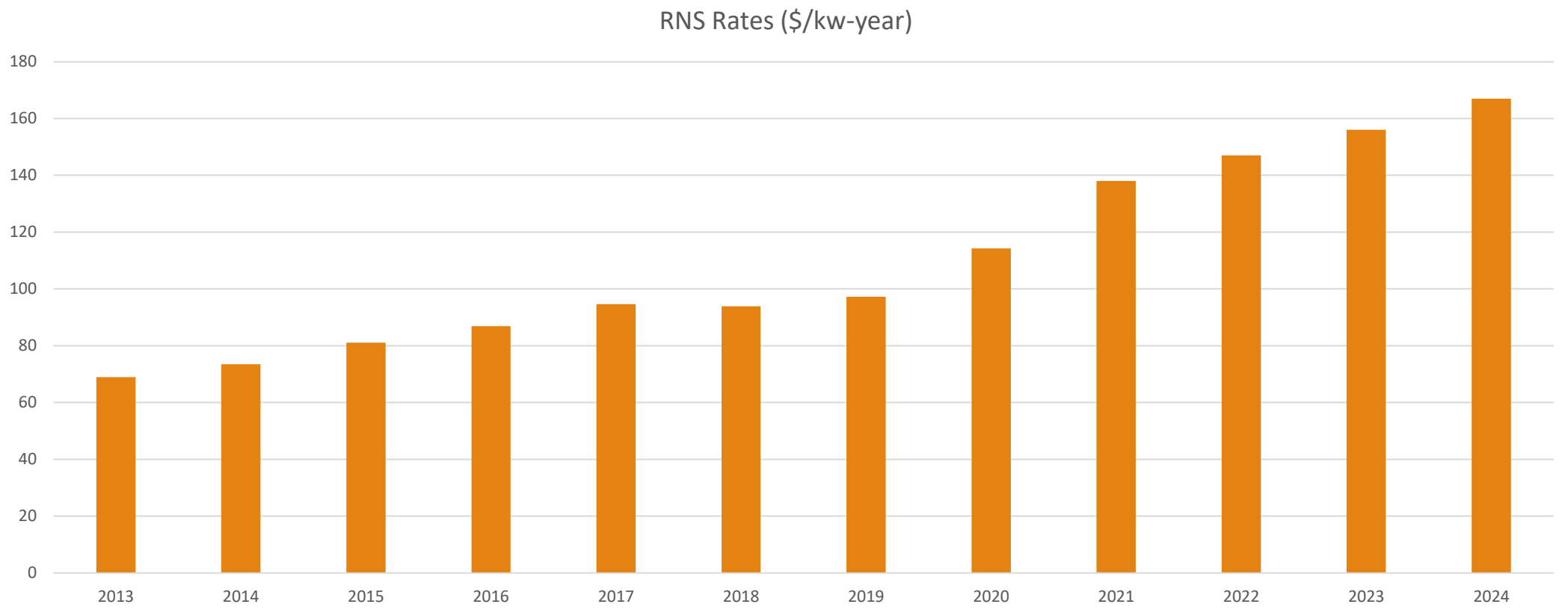
New England Capacity Prices



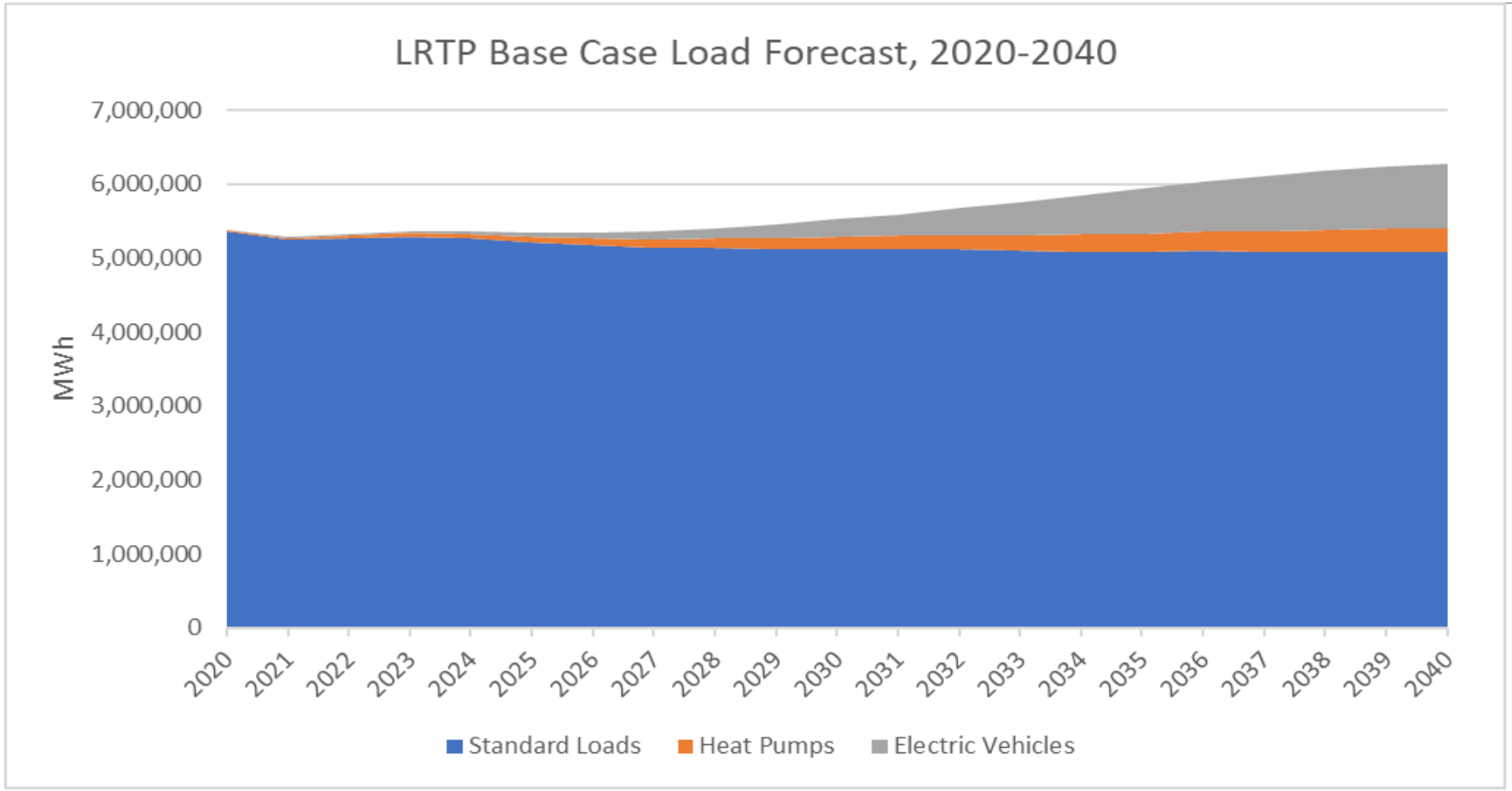
MA Regional Class I REC Prices



Regional Transmission Costs



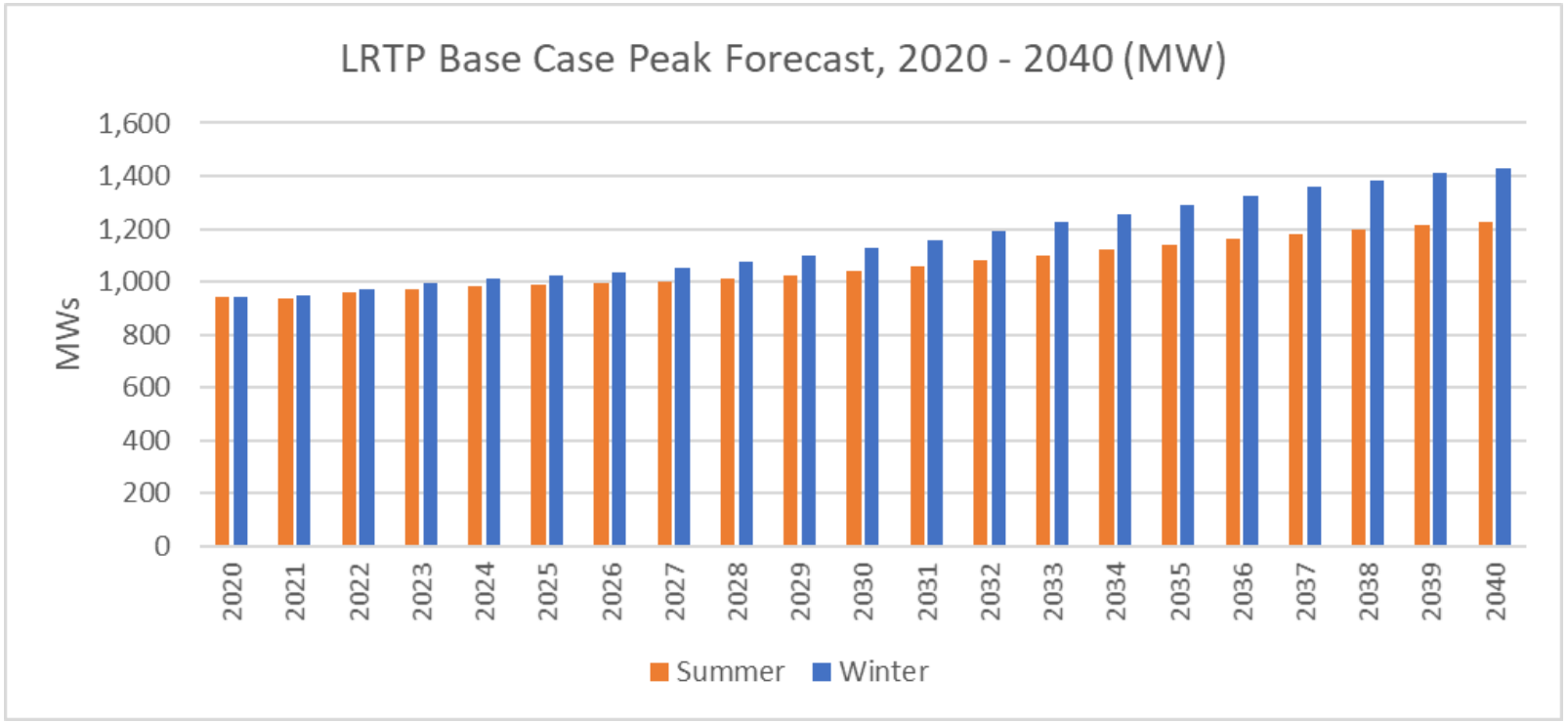
Vermont Load Forecast



Source: 2020 Long-Term Electric Energy and Demand Forecast Report, Vermont Electric Power Company, prepared by Itron (in press, but will be available at: https://www.vermontspc.com/)

Vermont Peak Load Forecast

- Includes base forecast of EVs, Heat Pumps, Solar
- Assumes NO load control



Vermont Seasonal Load Profiles