

Overview of 2020 Annual Energy Report and Carbon Model

DEPARTMENT OF PUBLIC SERVICE

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Purpose of Annual Energy Report

Provide update on progress toward Comprehensive Energy Plan goals:

- 90% renewable by 2050, all sectors
- 2025 Interim Goals
 - Electricity: 67% renewable by 2025
 - Thermal: 30% renewable by 2025
 - Transportation: 10% renewable by 2025
- GHG reduction goal of 40% below 1990 levels by 2030

Electric Sector

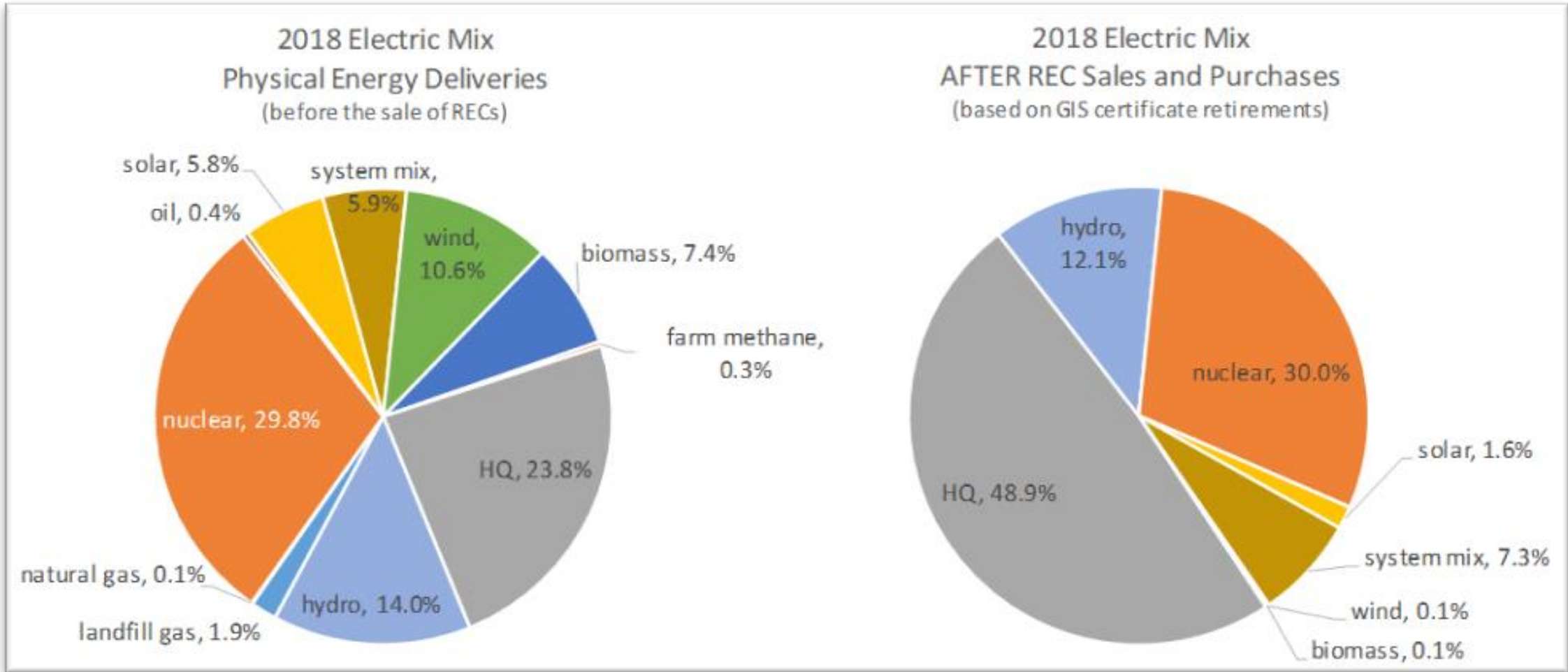
Renewable Energy Standard sets the pace for renewable energy in the electric sector

- “Power supply questions now revolve around the most cost-effective way to meet the RES requirements, not around how much renewable energy to acquire.” 2016 CEP at 277.

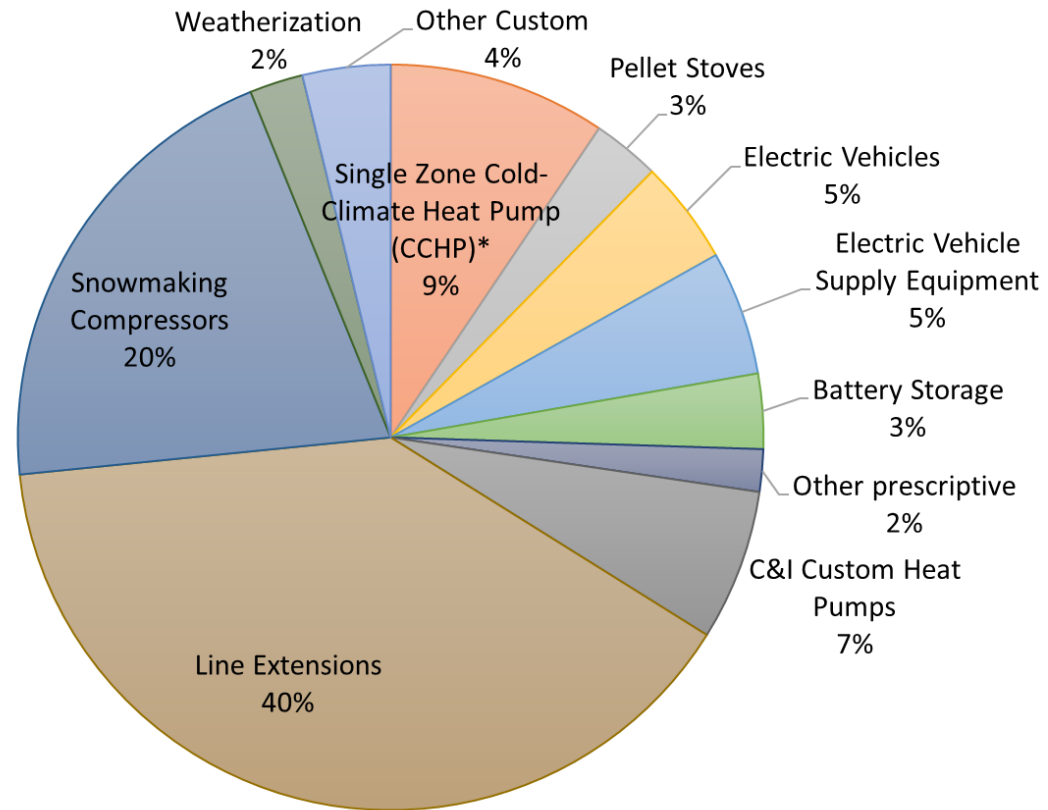
63% renewable in 2019

Maintaining affordable electric rates is critical for electrification of transportation and thermal sectors, and therefore GHG reduction goals

Electric Power Supply Sources



Tier III – Energy Transformation



Thermal Sector

27% renewable

- Primarily cordwood

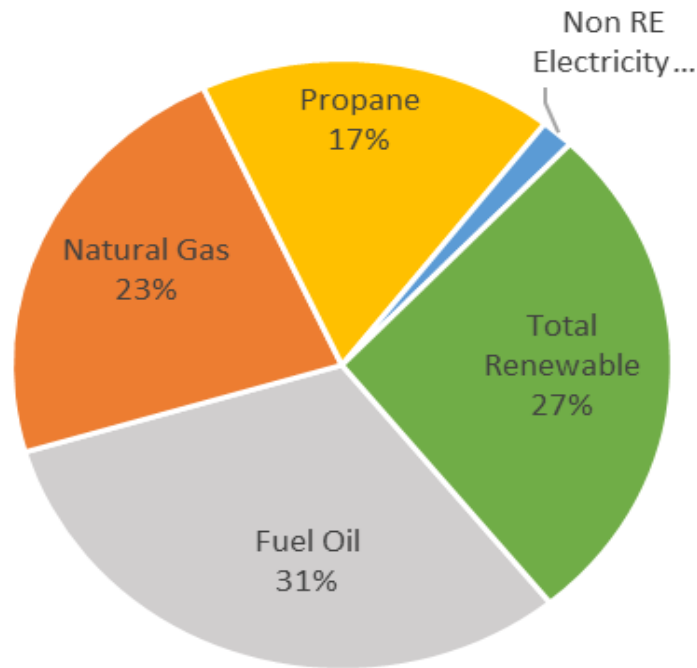
Well behind on weatherization goals

- 10 V.S.A. 581 calls for 80,000 buildings by 2020
- 27,186 buildings weatherized by end of 2018

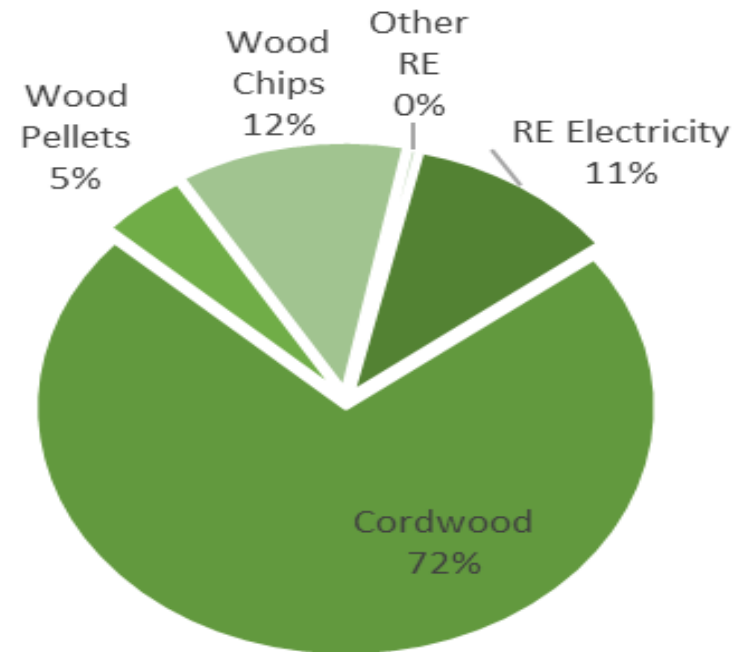
Heat Pumps Increasing Penetration

Thermal Renewable Supply

Thermal Site-Energy Fuel Use Percentages



Renewable Energy Portion Percentages



Comprehensive Weatherization Retrofits

Figure 1: Cumulative Housing Units Retrofit by Provider 2008-2018

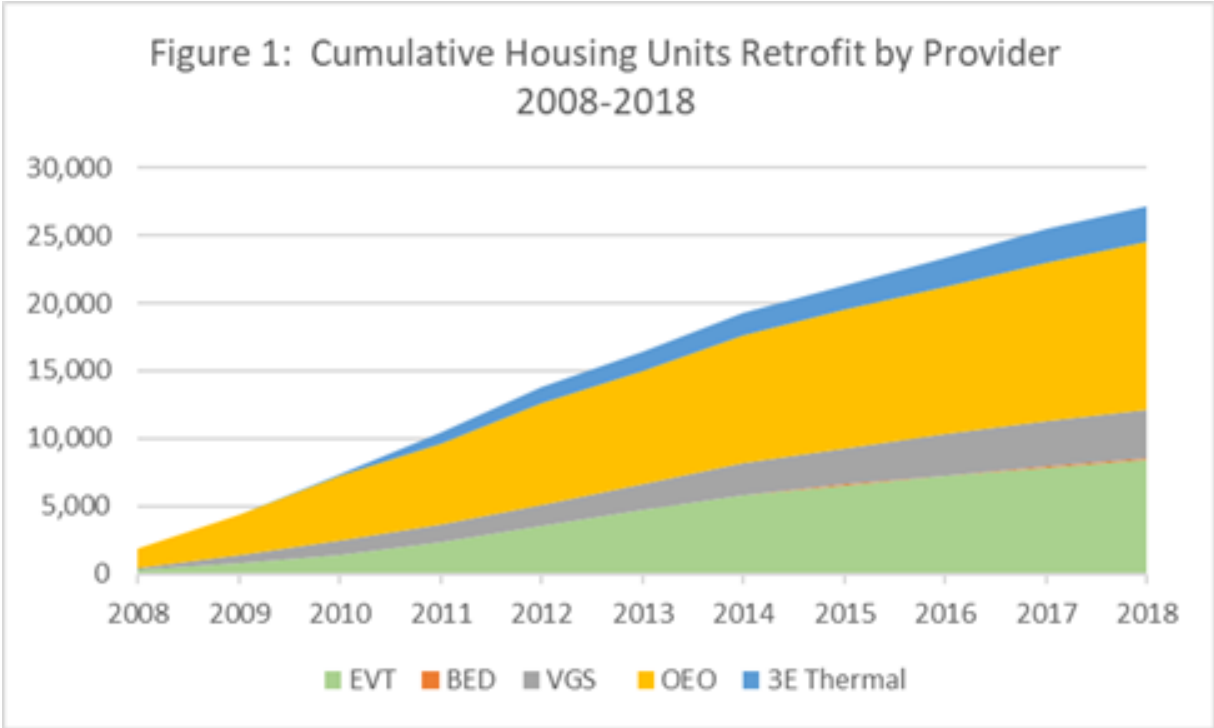
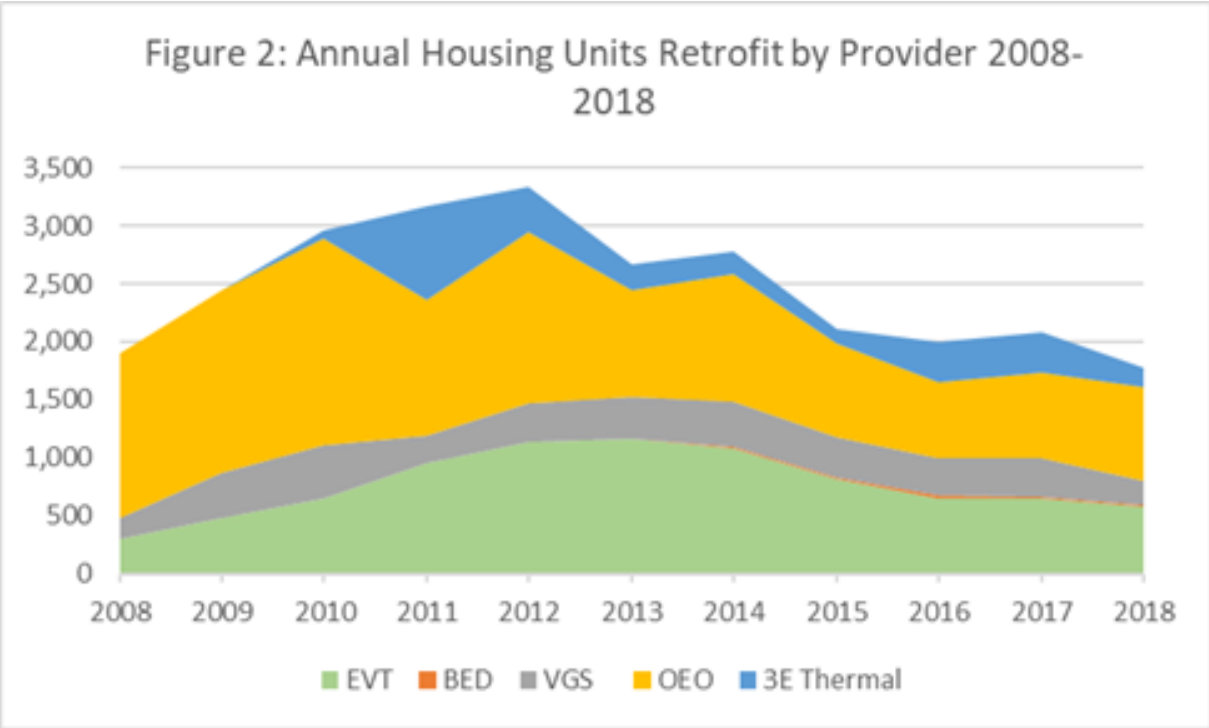
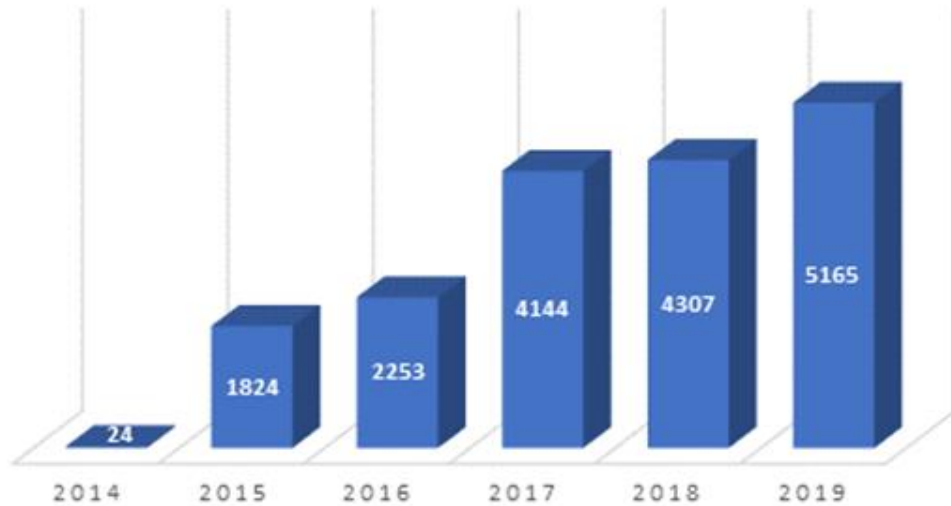


Figure 2: Annual Housing Units Retrofit by Provider 2008-2018



ANNUAL HEAT PUMP SALES IN VT



Year	Annual ASHP Installs (Thousands)						ISO-NE
	CT	MA	ME	NH	RI	VT	
2020	5.0	23.0	13	3	0.4	5.7	50
2021	5.8	27.6	16	3.4	0.6	6.1	59
2022	6.6	33.1	19.5	3.8	0.9	6.7	71
2023	7.6	39.7	23	4.2	1.4	7.1	83
2024	8.7	47.7	27.5	4.7	2.0	7.8	99
2025	10.1	57.2	28.9	5.3	3.0	8.4	113
2026	11.6	68.7	30.3	5.9	4.6	9.0	130
2027	13.3	82.4	31.8	6.6	6.8	9.7	151
2028	15.3	98.9	33.4	7.4	10.3	10.4	176
2029	17.6	118.7	35.1	8.3	15.4	11.1	206
Cumulative Total	101.5	597.0	258.6	52.6	45.3	82.1	1,137
Approx. Share of Households with ASHP in 2029 (%) *	6.9%	20.5%	42.8%	8.8%	10.0%	29.4%	18.0%
Approx. Share of Legacy Electric Heat Replacement **	16%	15%	6%	9%	10%	5%	13%

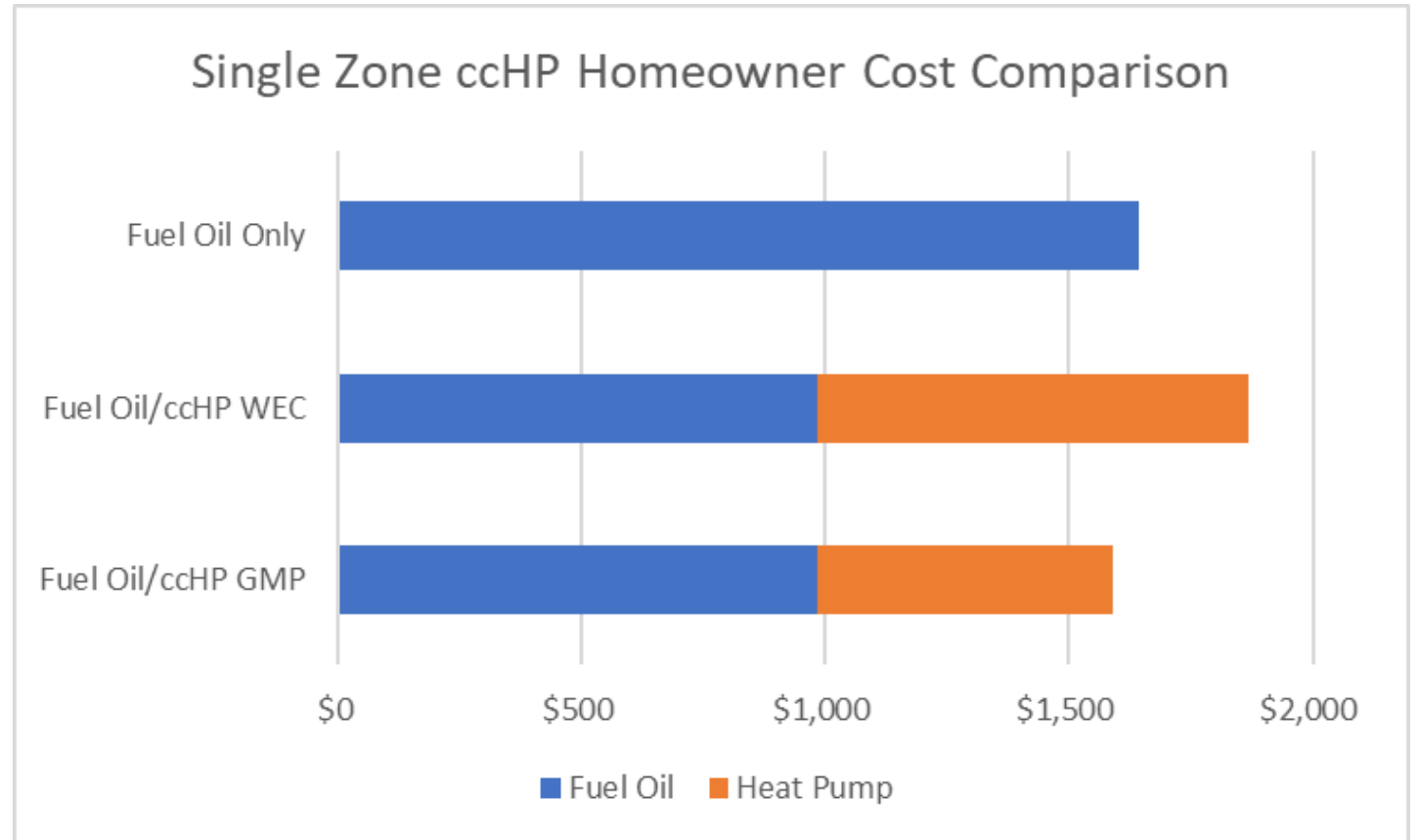
* Assumes one ASHP/household; Based on Moody's Analytics October 2019 forecasts of number of households by state

** Source: U.S. Census Bureau, Selected Housing Characteristics, 2013-2017 American Community Survey 5-year Estimates

Increasing Heat Pump Penetration

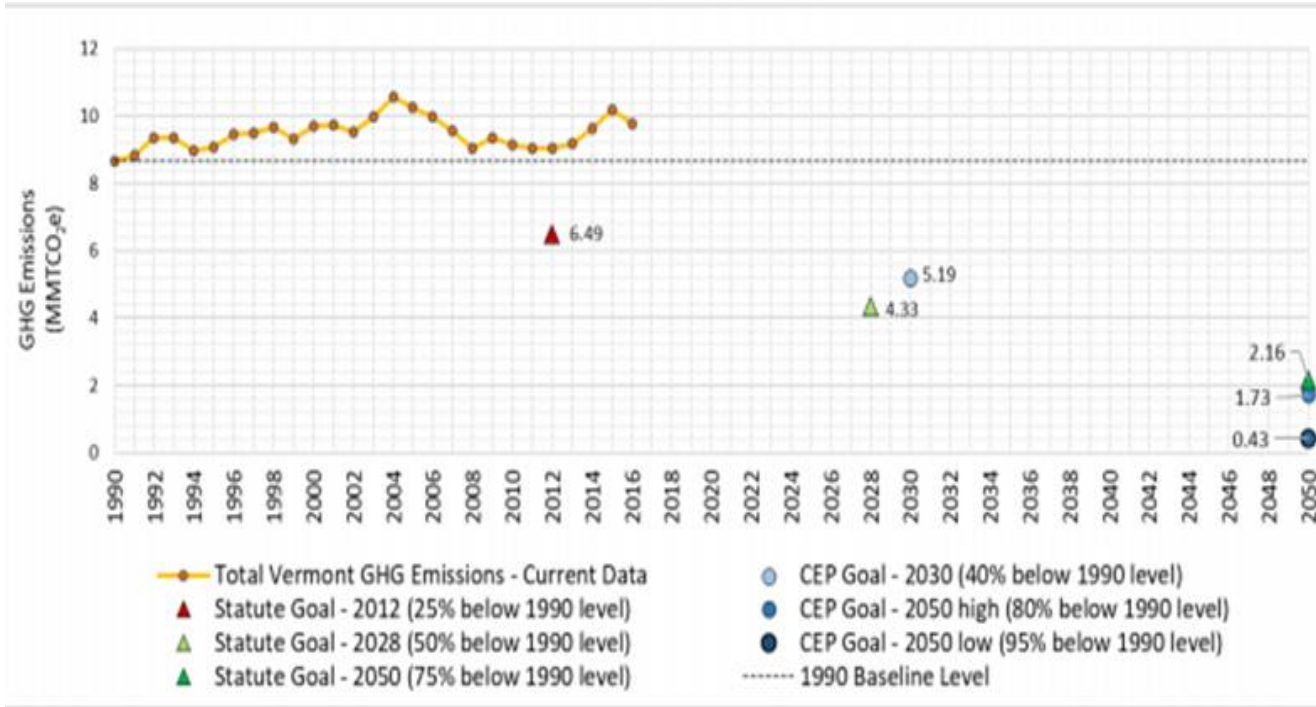
Heat Pumps can save customers money – if rates are low

- Assumptions below can create a range of outcomes. Following were used:
- GMP \$0.16893/kWh
- WEC \$0.25341/kWh
- EVT \$0.1187/kWh
- Fuel Oil Price Assumed \$2.74 gallon
- Heat Pump COP: 250%
- Fuel Oil Burner Efficiency 85%
- MMBtu Displaced by ccHP: 40%
- Total Home Heat Load 83 mmBtu
- Operational Costs only are depicted here.

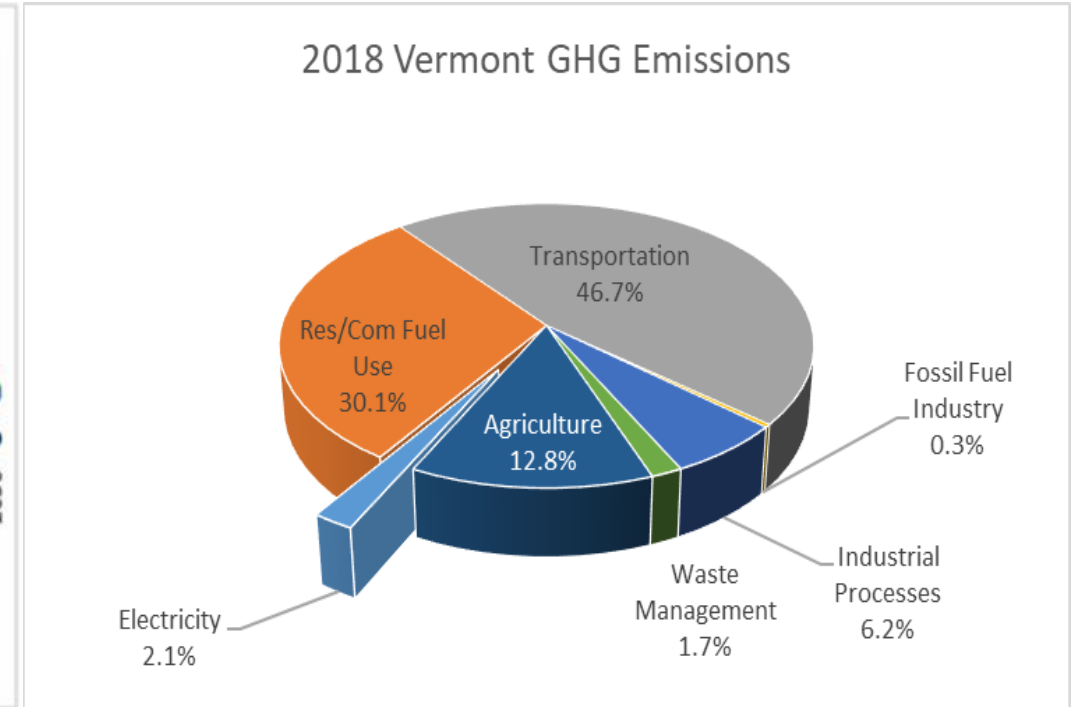


GHG Emissions

Vermont GHG Emissions Compared to 1990 Baseline



Estimated 2018 GHG Emissions

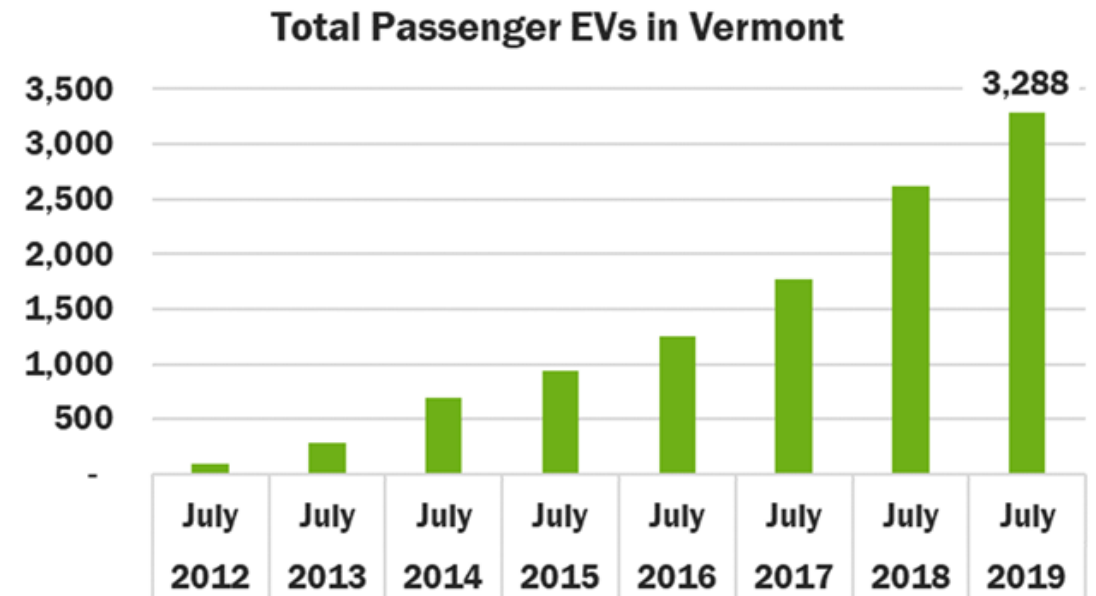
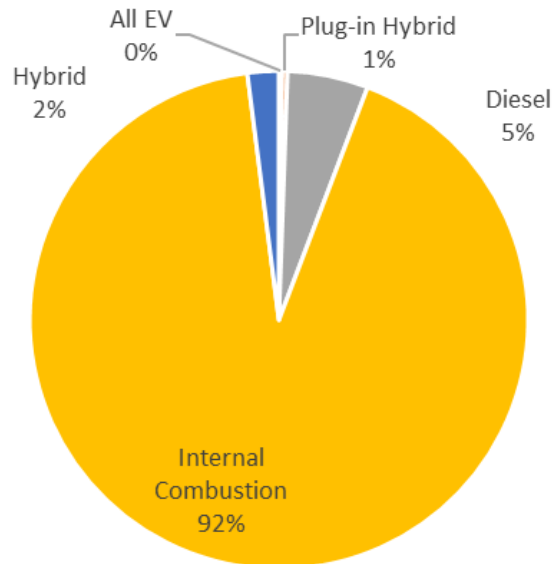


Transportation Sector

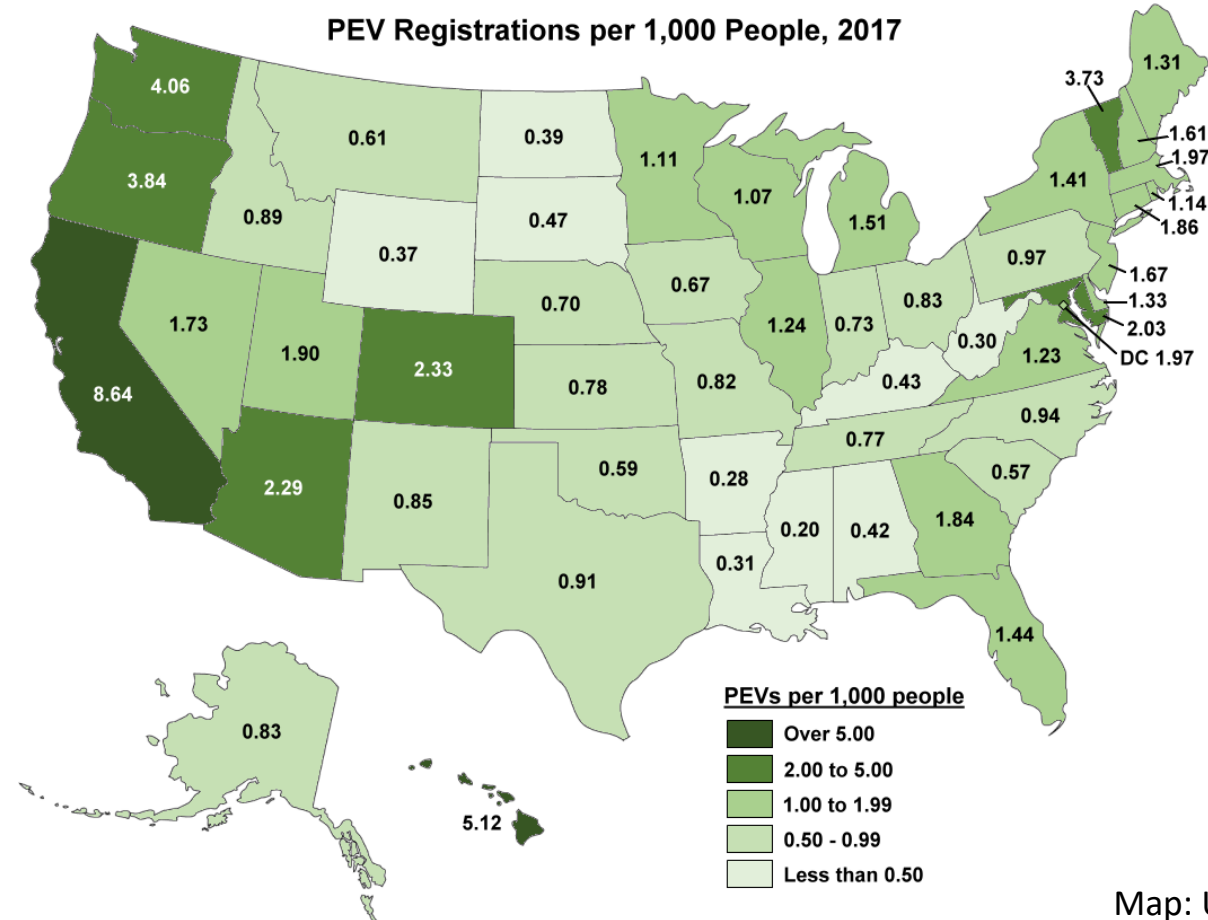
5.9% renewable overall

- Mostly ethanol in gasoline

Transportation sector remains the largest contributor to GHG



EV Registrations per capita



Map: US DOE Vehicle Technologies Office, FOTW 1059

Cost of Carbon Model

WHAT: The Department developed a flexible tool that estimates the lifetime \$/CO₂e saved from programs/measures under a variety of scenarios

WHY: Given need to address greenhouse gas emissions to meet our goals, and limited funds to support programs, need the ability to compare programs across sectors using available data

HOW: Calculate readily quantifiable benefits and costs

- Use Public Data, Technical Reference Manual and Tier III Technical Advisory Group savings values where possible
- Directly attributable economic costs and benefits accruing to Vermonters (externalities excluded); closest to Resource Cost Test
- Flexible using selectable options for incentive amount, equipment size, etc.

Caveats & Considerations

Limited to select carbon reduction measures

- Carbon reduction is not usually the primary objective for each measure/program

Variety of assumptions for each measure

- Future costs may decrease (EV) or performance may improve (heat pumps)

Some societal benefits are excluded, such as comfort and health impacts.

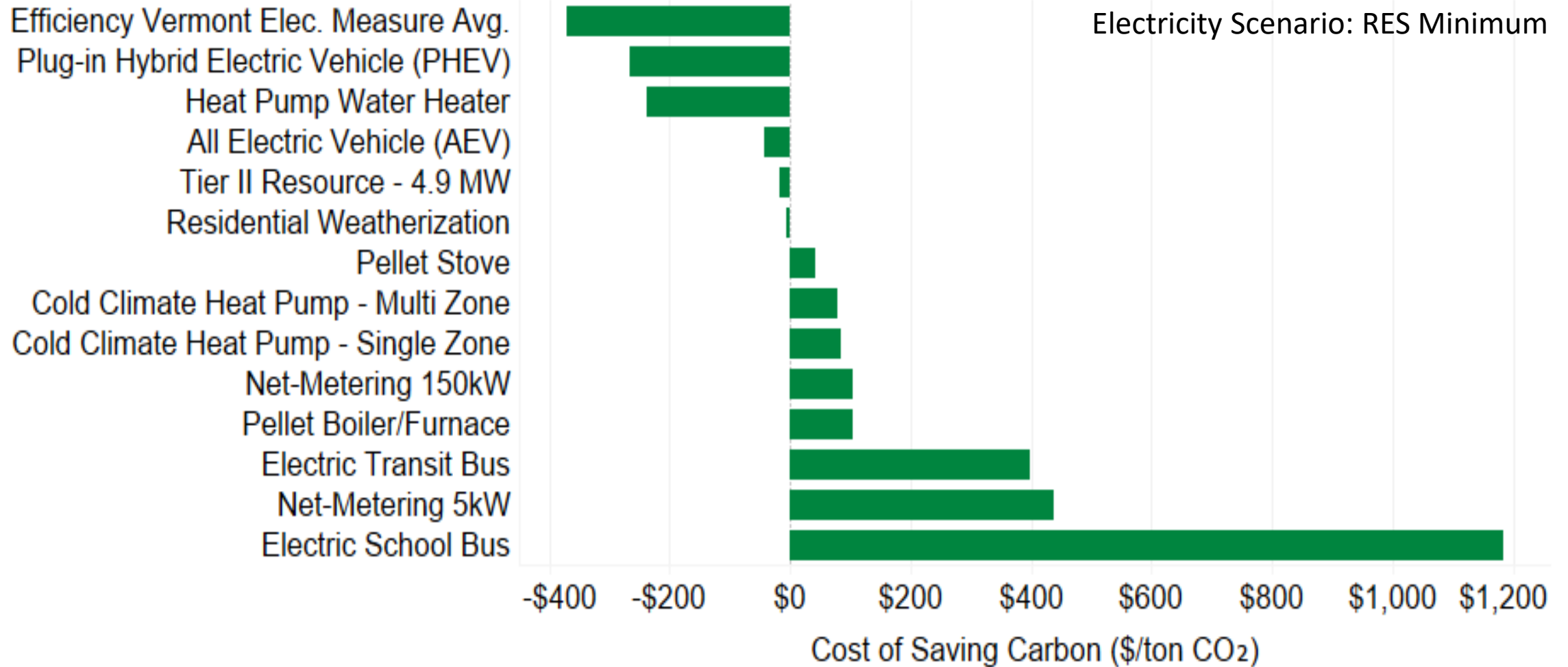
Serving the most vulnerable, Energy affordability, economic development not considered.

Estimates are a snapshot in time; based on 2018 data

- Increasingly renewable grid is included
- Distribution system upgrade costs are not included

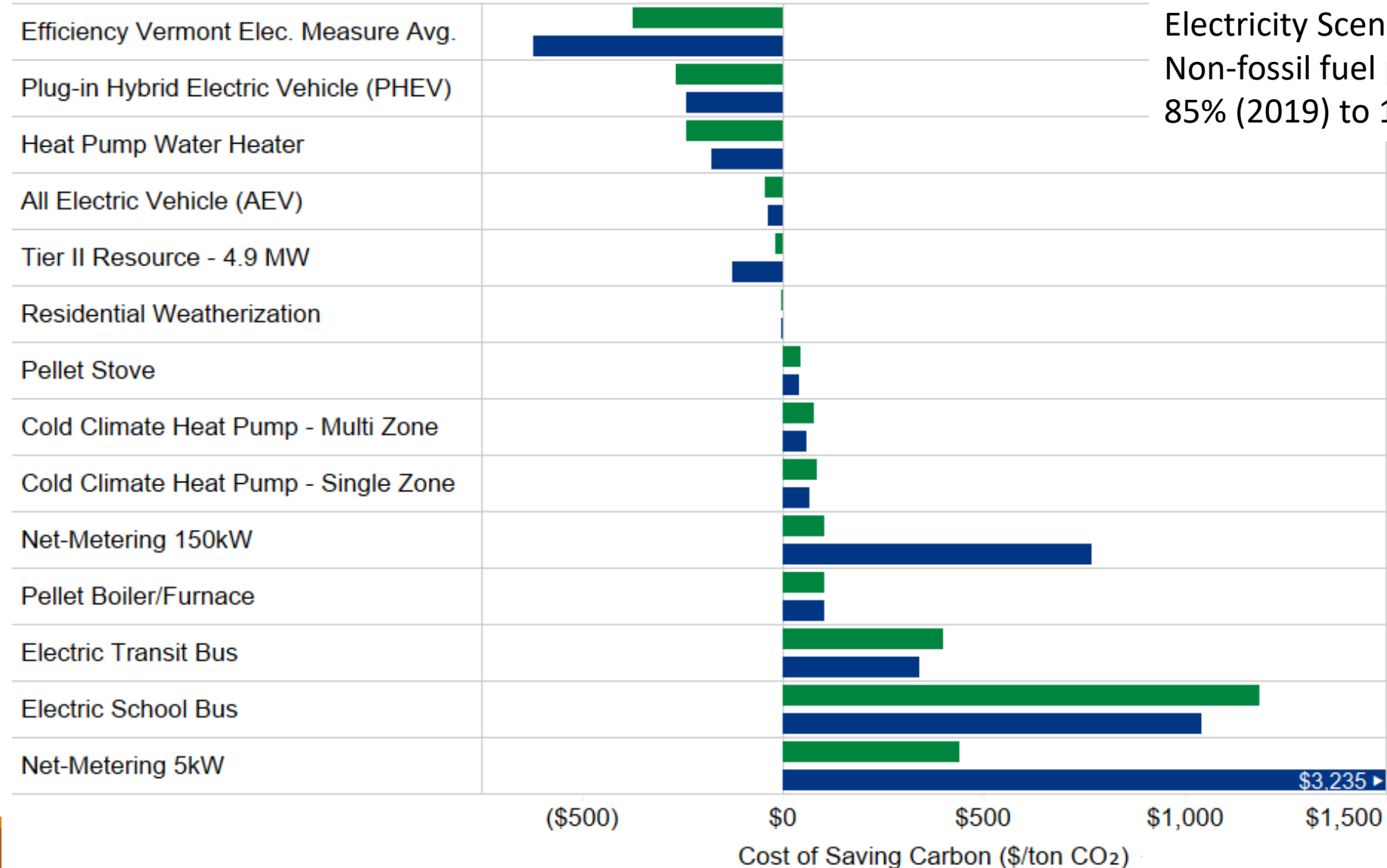
Diversity of complimentary programs/measures important

Results – Relative Cost of Carbon Reduction



Results – Relative Cost of Carbon Reduction

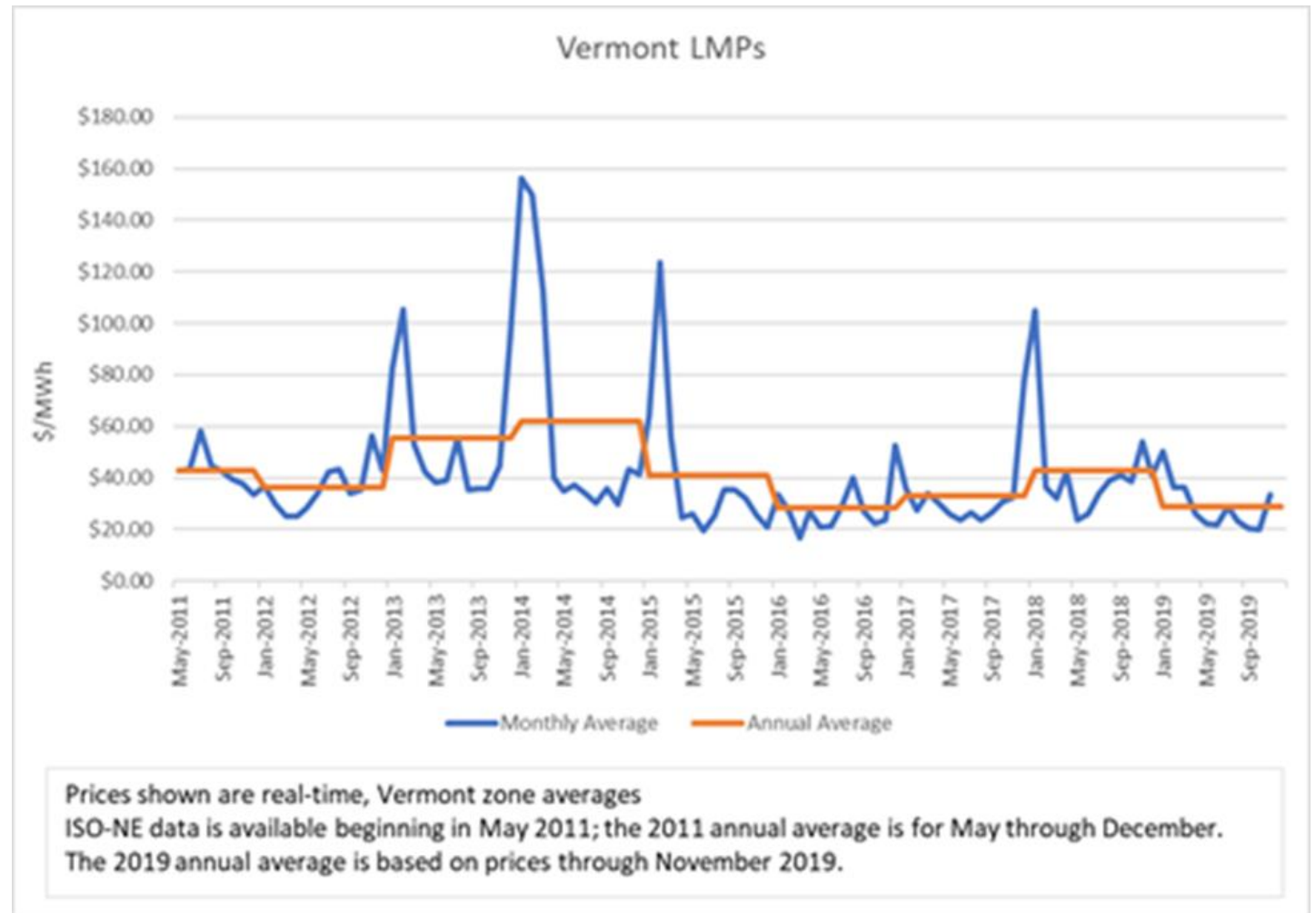
Electricity Scenario: High Case
 Non-fossil fuel portion increasing
 85% (2019) to 100% (2030)



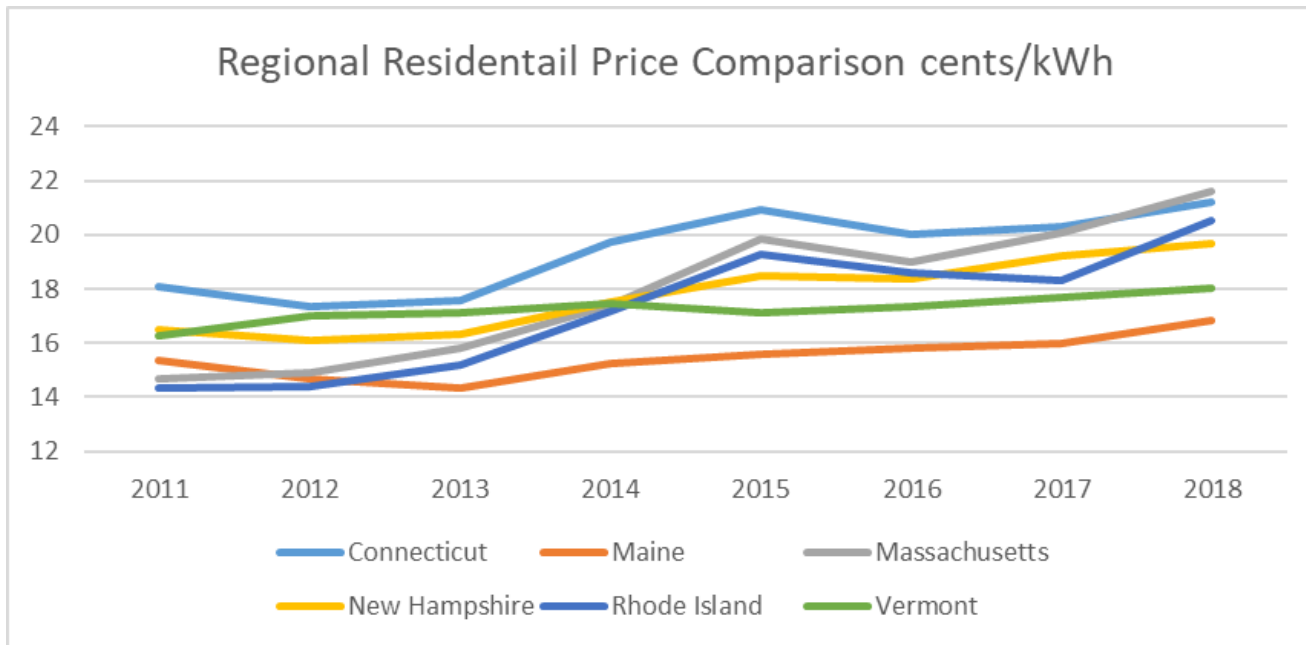
Q&A

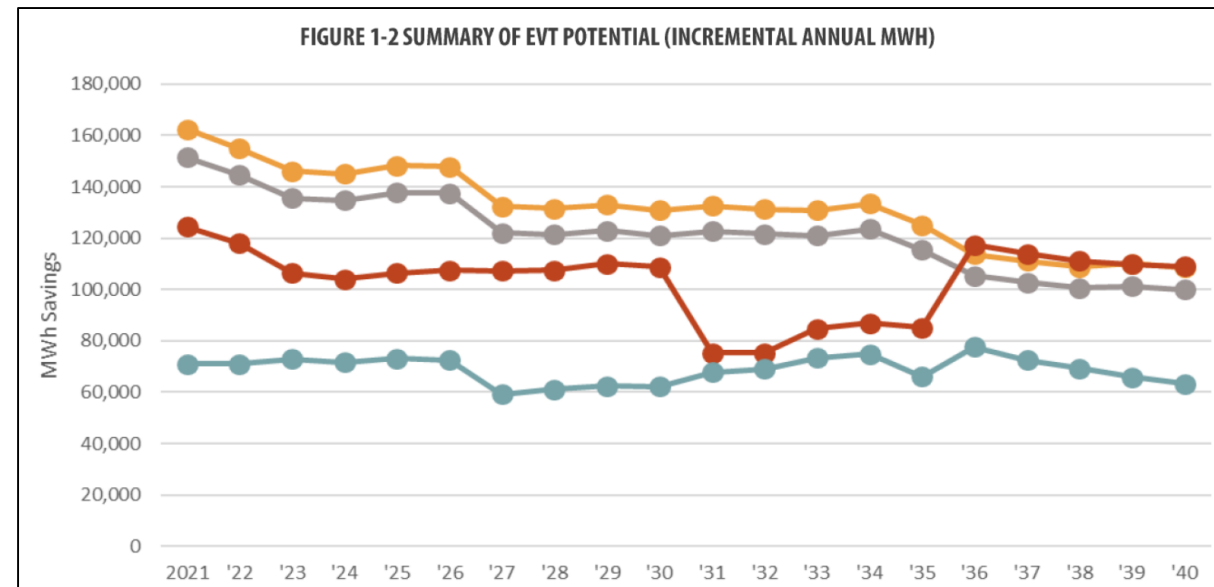
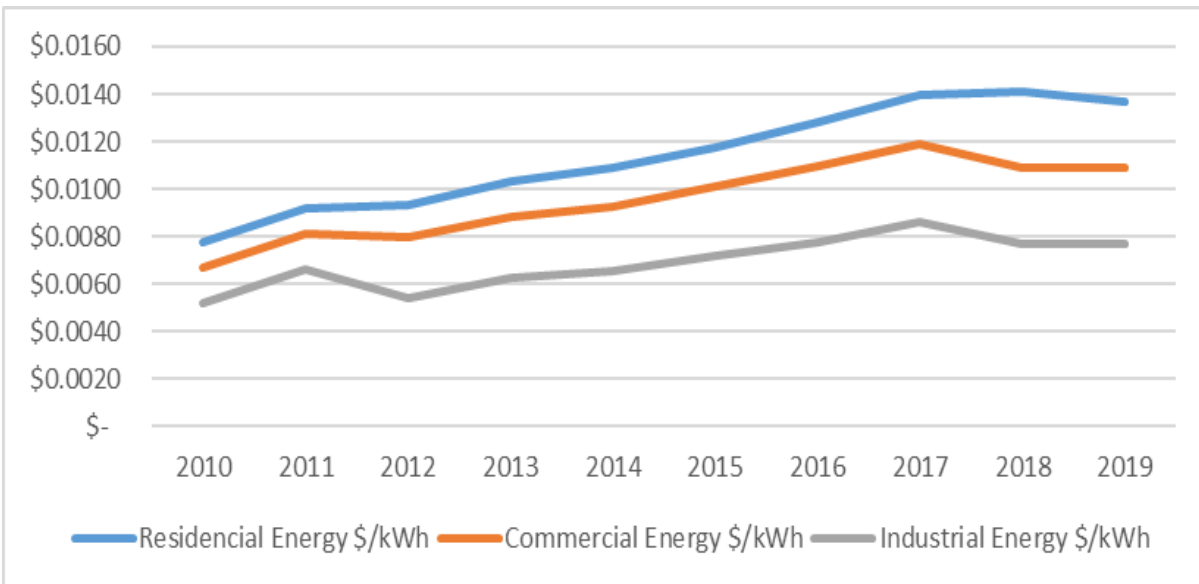
Appendix Follows

Wholesale Energy Prices for Vermont



Residential Retail Rates





Efficiency Vermont Electric Efficiency Charge Rates and Potential