

# Overview of 2020 Annual Energy Report and Carbon Model

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DEPARTMENT OF PUBLIC SERVICE

TJ POOR, DIRECTOR OF EFFICIENCY & ENERGY SERVICES

ED MCNAMARA, DIRECTOR OF PLANNING



# Purpose of Annual Energy Report

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Provide an 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

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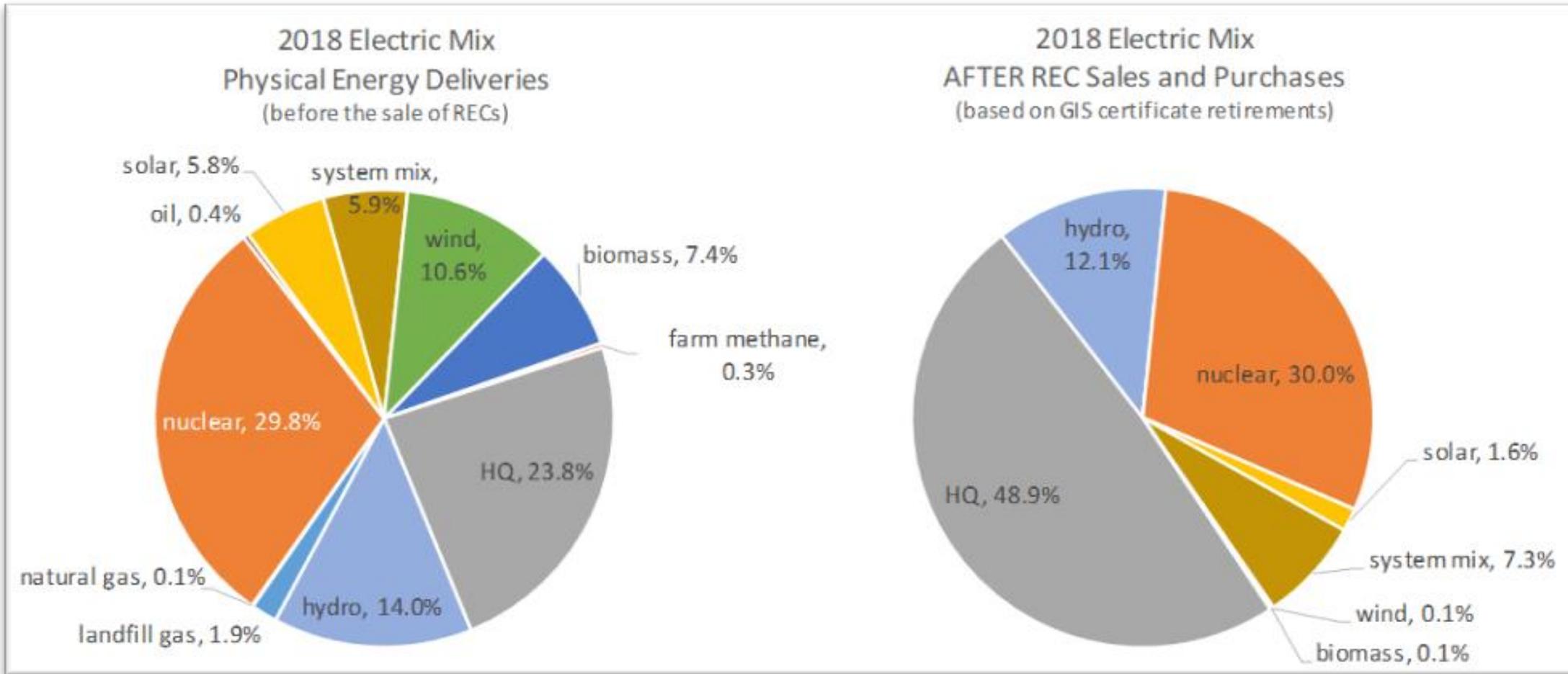
Renewable Energy Standard sets the pace for renewable energy in the electric sector

- “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



# Thermal Sector

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27% renewable

- Primarily cordwood

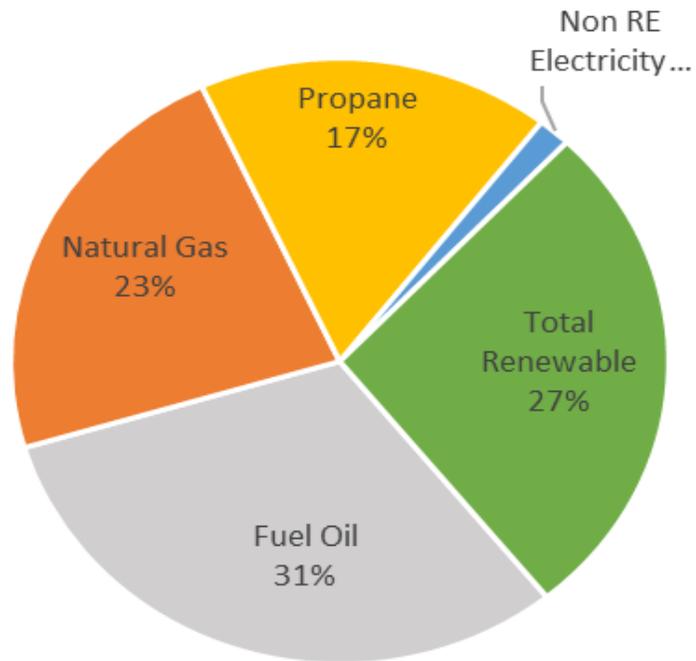
Well behind on weatherization goals

- 80,000 buildings by 2020
- 27,186 buildings actually weatherized by end of 2018

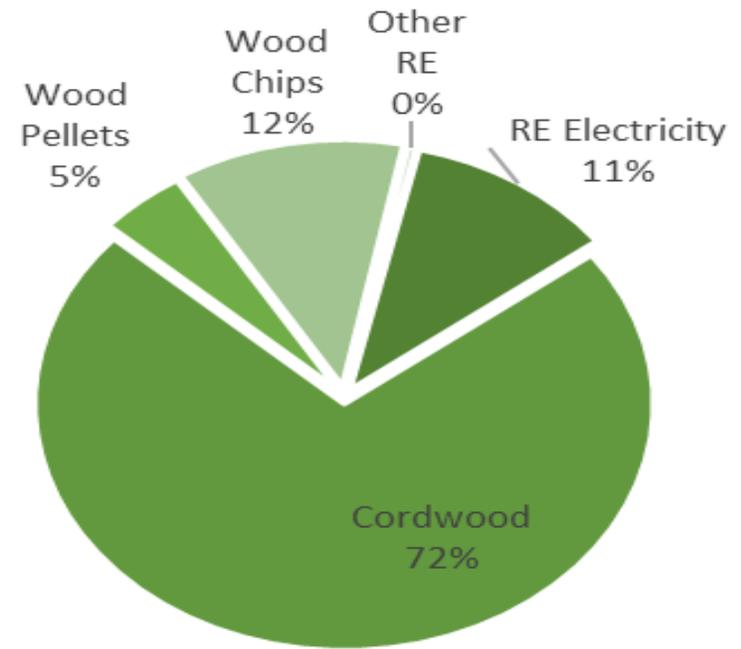
# Thermal Renewable Supply

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Thermal Site-Energy Fuel Use Percentages



Renewable Energy Portion Percentages



# Weatherization

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

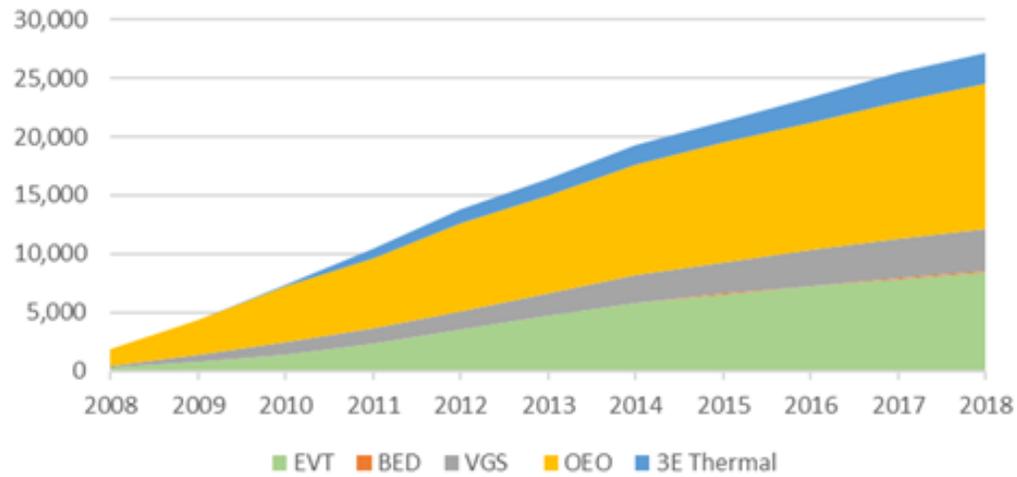
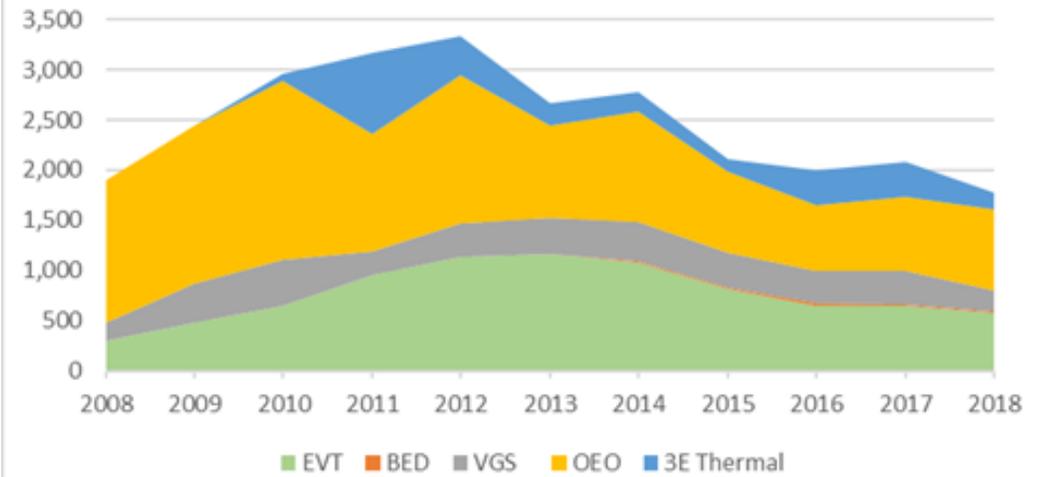


Figure 2: Annual Housing Units Retrofit by Provider 2008-2018



# Transportation Sector

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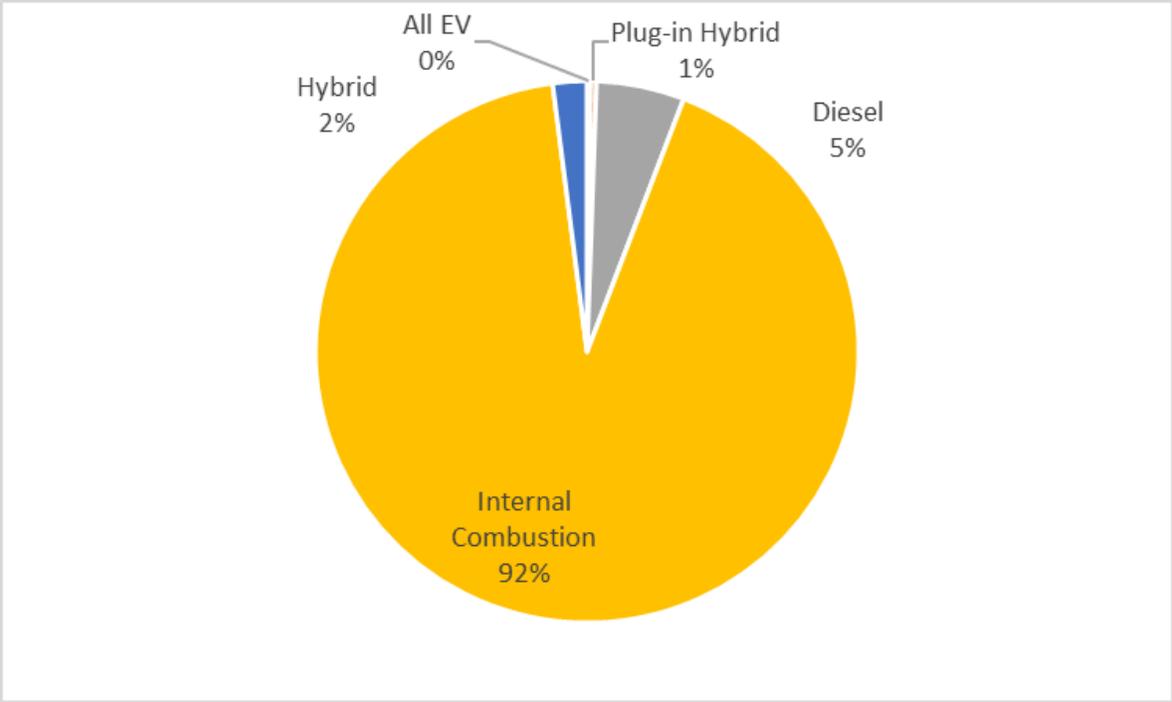
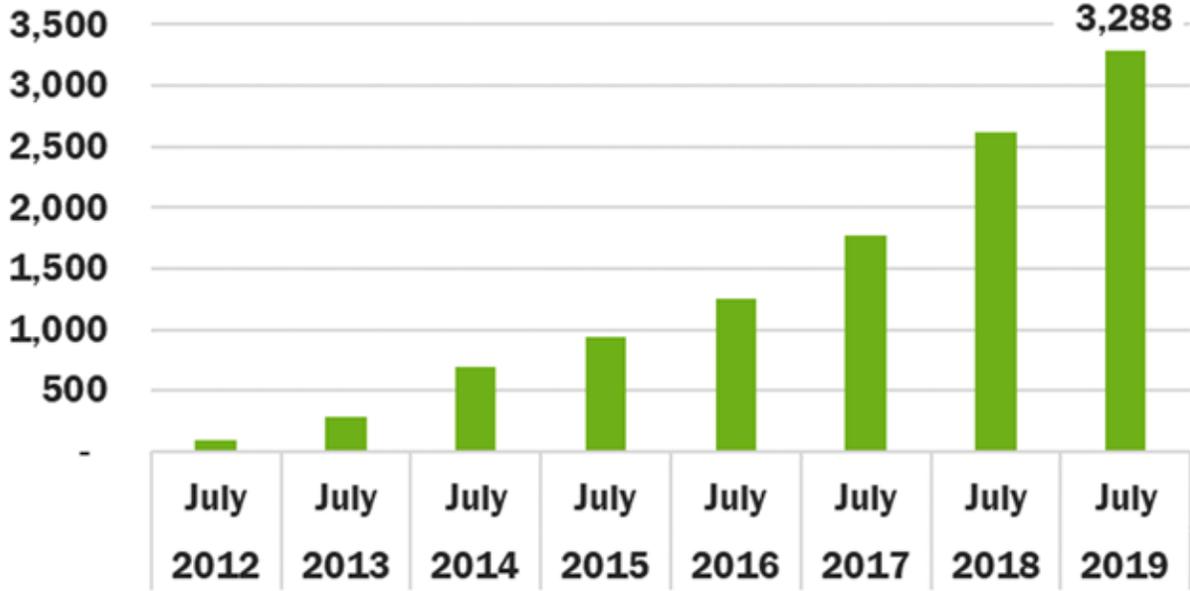
5.9% renewable

- Mostly ethanol in fuel

Remains largest contributor to GHG

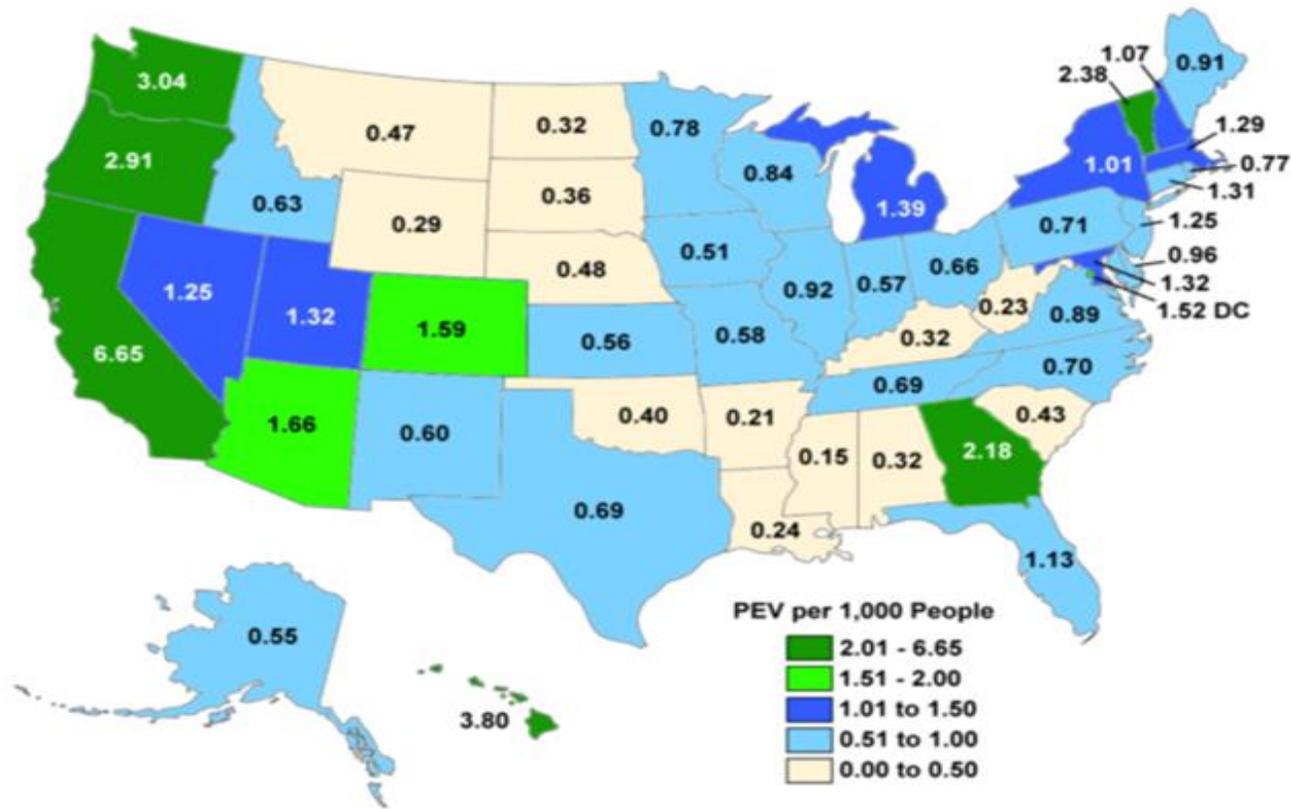
# EV Deployment

Total Passenger EVs in Vermont



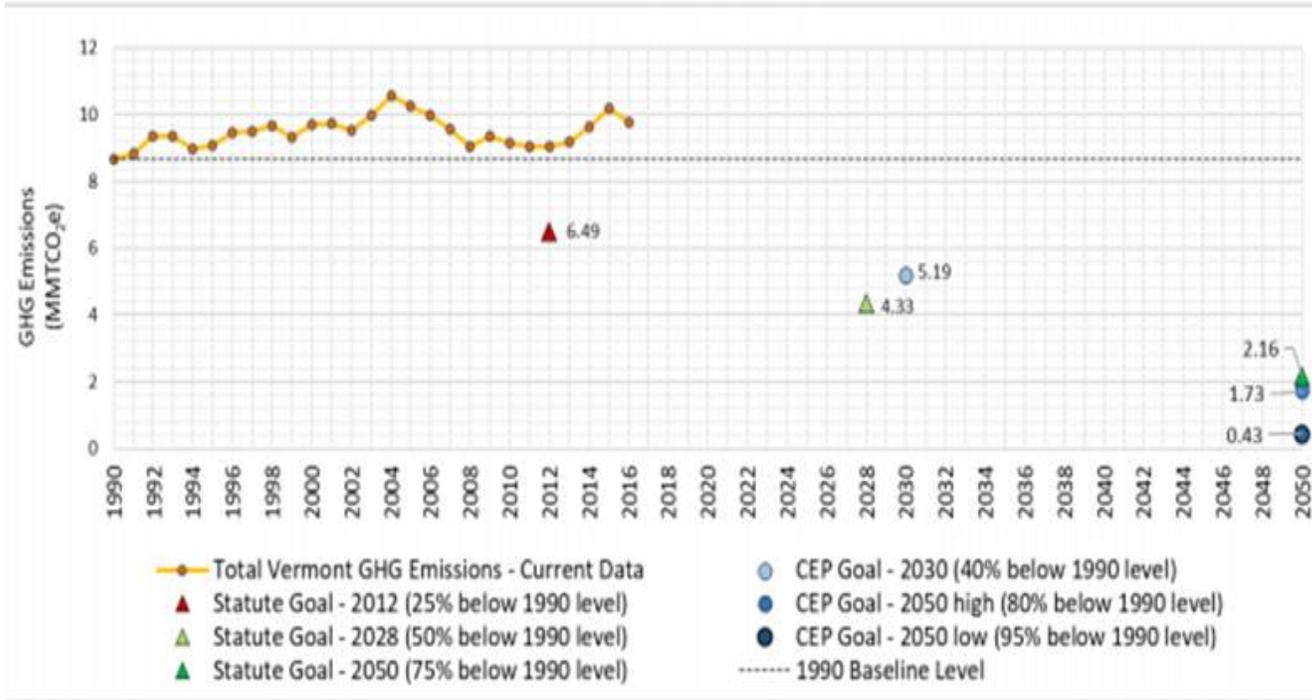
# EV Registrations per capita

PEV Registrations per 1,000 People by State, 2016

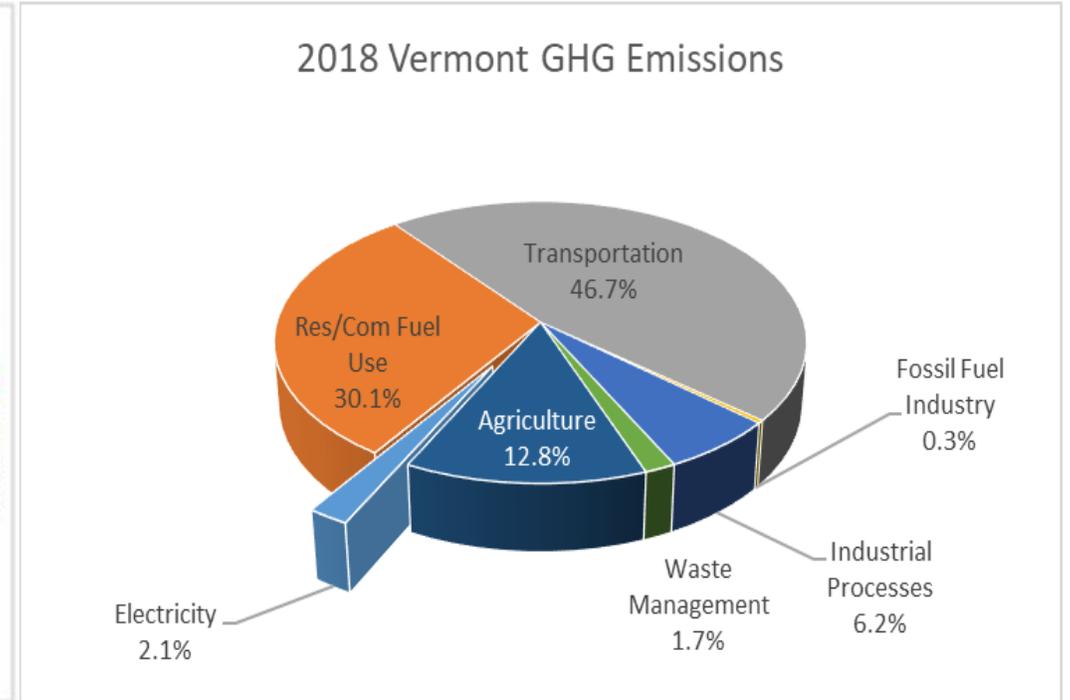


# GHG Emissions

## Vermont GHG Emissions Compared to 1990 Baseline



## Estimated 2018 GHG Emissions



# Cost of Carbon Model

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**WHAT:** The Department developed a flexible tool that estimates the lifetime \$/CO<sub>2</sub>e 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

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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.

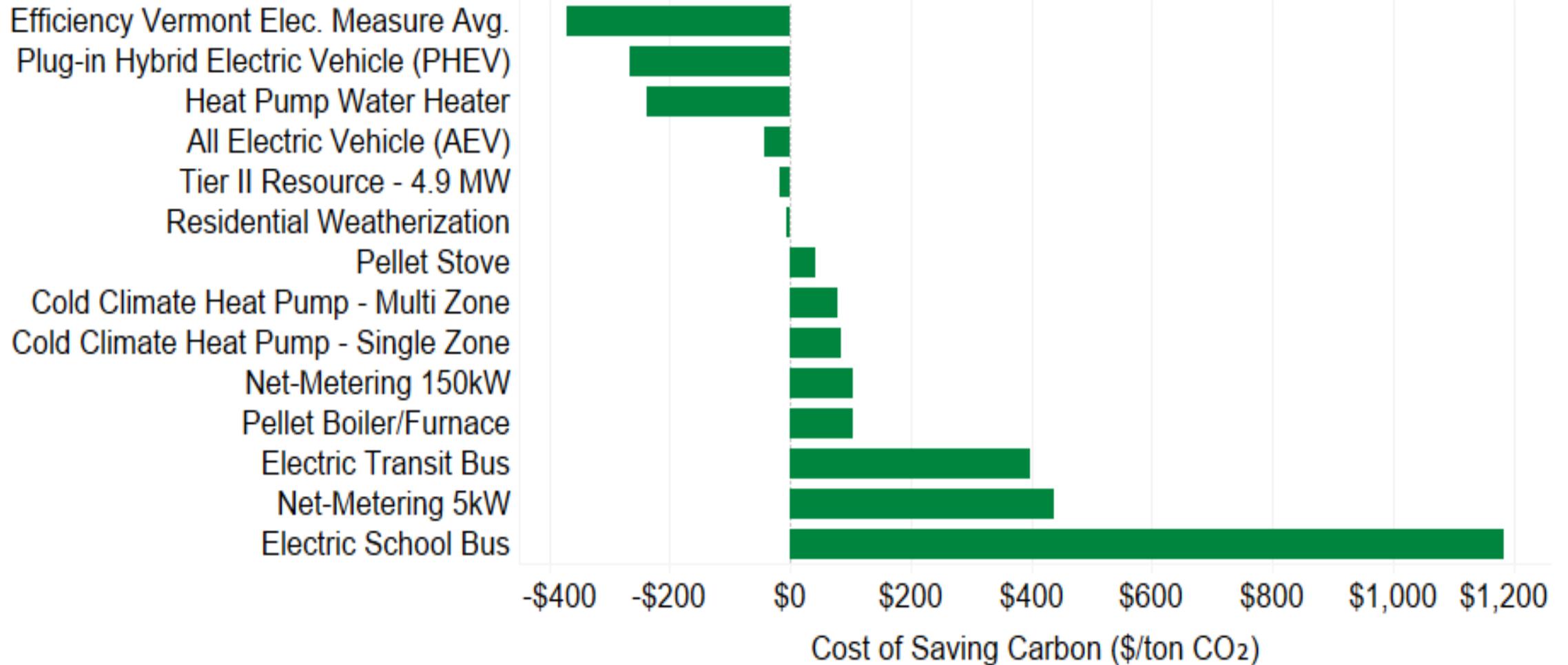
Serving the most vulnerable, Energy affordability, economic development not considered.

Estimates are a snapshot in time; based on 2018 data

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

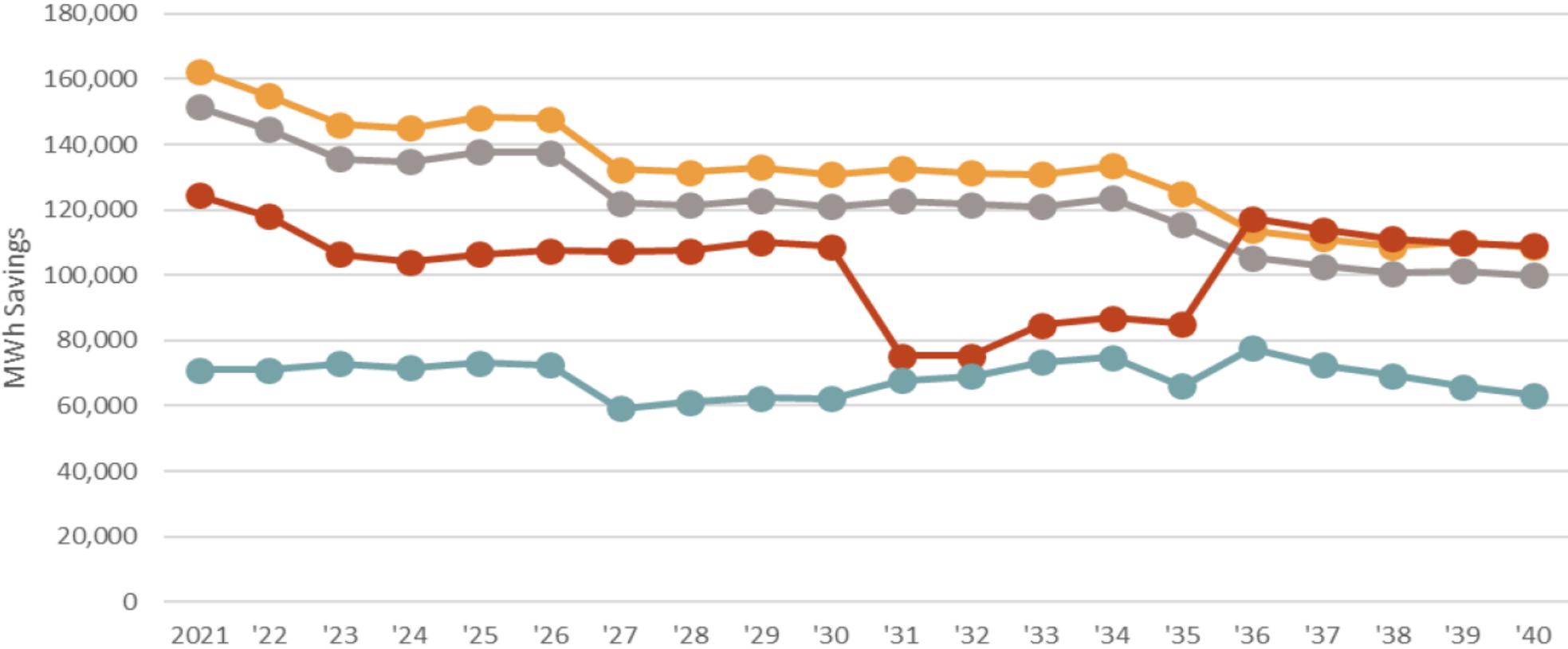
Diversity of complimentary programs/measures important

# Results – Relative Cost of Carbon Reduction



# Electric Energy Efficiency Potential

FIGURE 1-2 SUMMARY OF EVT POTENTIAL (INCREMENTAL ANNUAL MWH)

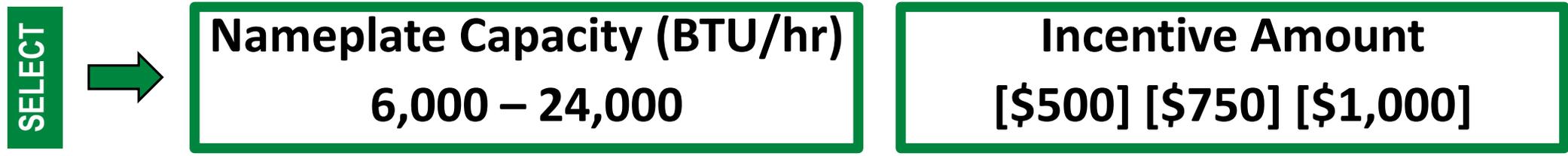


# Q&A

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Appendix Follows

# Carbon Model Example Measure: Cold Climate Heat Pump (Single Zone)



| Net Costs | Costs                           | Benefits                  |
|-----------|---------------------------------|---------------------------|
|           | Purchase Price & Installation   | Avoided Fossil Fuel Costs |
|           | Electricity Costs for Heat Pump |                           |

| Net Carbon | Carbon Increases  | Carbon Reductions  |
|------------|---|--|
|            | Added Electricity Consumption<br>(kWh * ISO New England Marginal Emissions Rate<br>* Share of Electricity Fossil Free Generation) | Avoided Fossil Fuel Combustion<br>(EIA CO <sub>2</sub> Emissions Coefficients) |

# Carbon Model Example Measure (2) : Cold Climate Heat Pump (Single Zone)

|  |                 |                        |             |  |                         |             |             |             |             |             |             |  |  |  |  |  |  |  |  |  |
|--|-----------------|------------------------|-------------|--|-------------------------|-------------|-------------|-------------|-------------|-------------|-------------|--|--|--|--|--|--|--|--|--|
| <b>Societal Test - Cold-Climate Heat Pump</b>      |                 | <b>Incentive Level</b> |             |  |                         |             |             |             |             |             |             |  |  |  |  |  |  |  |  |  |
|  |                 | \$500                  | Select One  |  |                         |             |             |             |             |             |             |  |  |  |  |  |  |  |  |  |
|  |                 | Low                    |             | \$500                                      |                         |             |             |             |             |             |             |  |  |  |  |  |  |  |  |  |
|  |                 | Med                    |             | \$750                                      |                         |             |             |             |             |             |             |  |  |  |  |  |  |  |  |  |
|  |                 | High                   |             | \$1,000                                    |                         |             |             |             |             |             |             |  |  |  |  |  |  |  |  |  |
| <b>Nameplate Capacity - Btu/hr</b>                 |                 | 12000                  | Select One  |  |                         |             |             |             |             |             |             |  |  |  |  |  |  |  |  |  |
|  |                 |                        |             |  | Total Installation Cost |             | \$3,352     |             |             |             |             |  |  |  |  |  |  |  |  |  |
|  |                 |                        |             |  | Lifetime Fuel Savings   |             | \$2,495     |             |             |             |             |  |  |  |  |  |  |  |  |  |
| <b>ccHP Societal Cost Test</b>                     |                 | <b>Totals</b>          |             | <b>Single Zone ccHP Resource Cost Test</b> |                         |             |             |             |             |             |             |  |  |  |  |  |  |  |  |  |
| <b>Year</b>  | <b>15</b>       | <b>2019</b>            | <b>2020</b> | <b>2021</b>                                | <b>2022</b>             | <b>2023</b> | <b>2024</b> | <b>2025</b> | <b>2026</b> | <b>2027</b> | <b>2028</b> |  |  |  |  |  |  |  |  |  |
| <b>MWH Consumed</b>                                | <b>28.35625</b> | 1.89                   | 1.89        | 1.89                                       | 1.89                    | 1.89        | 1.89        | 1.89        | 1.89        | 1.89        | 1.89        |  |  |  |  |  |  |  |  |  |
| <b>NEPOOL GIS Residual Mix - lbs/MWH</b>           |                 | 732                    | 732         | 732  | 732                     | 732         | 732         | 732         | 732         | 732         | 732         |  |  |  |  |  |  |  |  |  |
| <b>Utilities Fossil Free Percentage</b>            |                 | 55%                    | 59%         | 59%  | 59%                     | 63%         | 63%         | 63%         | 67%         | 67%         | 67%         |  |  |  |  |  |  |  |  |  |
| <b>MWH Not Covered by RES/FFF</b>                  |                 | 0.8507                 | 0.7751      | 0.7751                                     | 0.7751                  | 0.6995      | 0.6995      | 0.6995      | 0.6238      | 0.6238      | 0.6238      |  |  |  |  |  |  |  |  |  |
| <b>Emissions from non-Covered MWH - lbs of CO2</b> | <b>5,795</b>    | 623                    | 567         | 567  | 567                     | 512         | 512         | 512         | 457         | 457         | 457         |  |  |  |  |  |  |  |  |  |
| <b>Annual MMBtu Avoided</b>                        | <b>236</b>      | 16                     | 16          | 16   | 16                      | 16          | 16          | 16          | 16          | 16          | 16          |  |  |  |  |  |  |  |  |  |
| <b>Avoided Fossil Fuel Emissions - lbs of CO2</b>  | <b>27,471</b>   | 2,301                  | 2,301       | 2,301                                      | 2,301                   | 2,301       | 2,301       | 2,301       | 2,301       | 2,301       | 2,301       |  |  |  |  |  |  |  |  |  |
| <b>Avoided FF Costs</b>                            | <b>\$4,684</b>  | \$334                  | \$347       | \$355                                      | \$363                   | \$373       | \$388       | \$398       | \$405       | \$414       | \$418       |  |  |  |  |  |  |  |  |  |
| <b>Added Electric Costs</b>                        | <b>\$2,189</b>  | \$130                  | \$153       | \$167                                      | \$171                   | \$180       | \$190       | \$191       | \$194       | \$200       | \$204       |  |  |  |  |  |  |  |  |  |
| <b>Total Emissions - Lbs of CO2</b>                |                 | 21,676                 |             |  |                         |             |             |             |             |             |             |  |  |  |  |  |  |  |  |  |
| <b>Cost - \$/Ton CO2</b>                           |                 | \$79.07                |             |  |                         |             |             |             |             |             |             |  |  |  |  |  |  |  |  |  |