

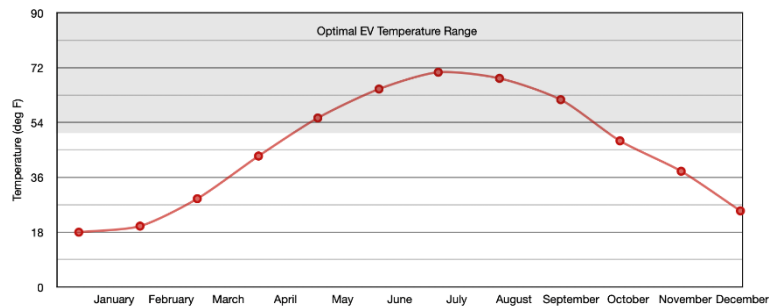
# **Evaluation of Battery Electric Vehicle Performance in Mountainous Regions and Cold Climates**

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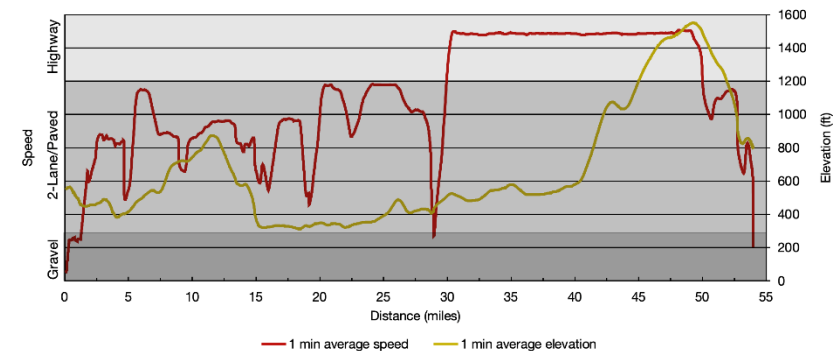
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# Background

- This study aims to investigate the compounded impact that climate, terrain, and road classification have on the overall performance (range) of battery electric vehicles (BEVs).
  - Test vehicle is a 2024 Tesla Model Y Long Range.
- The real-world range of BEVs will directly impact the charging infrastructure required to provide energy for/to BEVs.



**Figure 1. Average monthly temperatures for Montpelier, VT.<sup>1</sup>**



**Figure 2. One-minute average speed and elevation profile for daily commute.**

# Range Impacts



Temperature: Range decreases as temperatures vary outside of the optimal range of 50-90 °F.<sup>2</sup>

The average daily temperature in Montpelier, VT,<sup>1</sup> is below the optimal BEV operating range for 7 months of the year.



Elevation: Range decreases as the terrain becomes more mountainous.

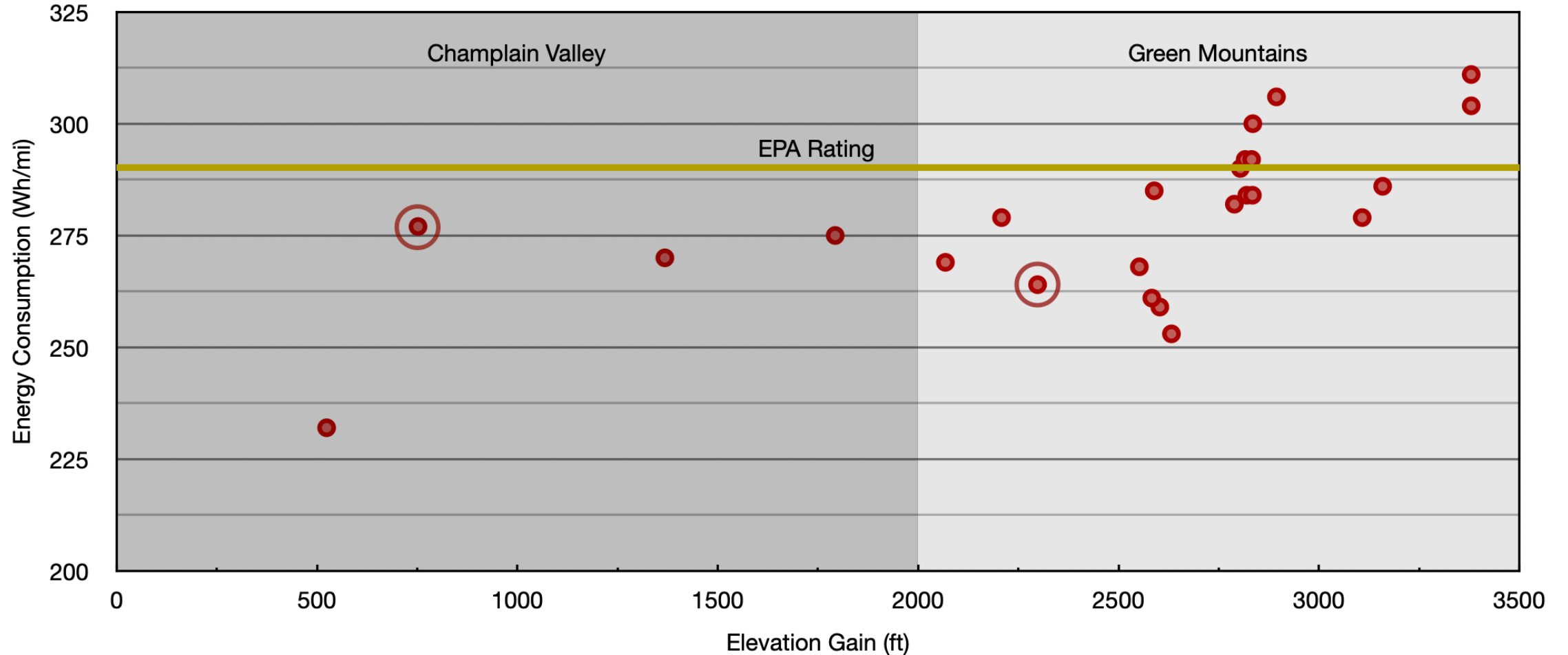
Commutes outside the Champlain and Upper Valleys encounter large elevation gains (up to 3400 ft in Figure 3).



Speed: Range decreases at a rate of 4% for each 5 mph above 50 mph.<sup>2</sup>

Commutes in VT consist of varying road classifications, ranging from gravel roads with a 35 mph speed limit to 2-lane roads with a 50 mph speed limit to 4-lane highways with a 65 mph speed limit.

# Energy consumption for Tesla Model Y Long Range BEV



# Future Work

Vehicle energy consumption will be evaluated as a function of temperature, elevation gain, and average speed.

The compound effect of temperature, elevation, and speed will be quantified.

The impact that varying driving conditions and road classification have on vehicle safety systems and self-driving performance may also be assessed.

Vehicle range data will be used to explore the optimal spatial distribution of BEV charging stations throughout Vermont, emphasizing ensuring rural areas subject to environmental justice considerations.

Optimal distribution will be the product of GIS and AI evaluations, with the goal of eliminating barriers to electric vehicle uptake.



## Acknowledgments

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# References

1. [https://weatherspark.com/y/25716/Average-Weather-in-Montpelier-Vermont-United-States-Year-Round#google\\_vignette](https://weatherspark.com/y/25716/Average-Weather-in-Montpelier-Vermont-United-States-Year-Round#google_vignette) (accessed September 4, 2024)
2. <https://www.geotab.com/blog/ev-range-impact-of-speed-and-temperature/> (accessed September 4, 2024)

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