

# Regional Effects of Ambient Temperature on Electric Vehicle Efficiency, Range, and Emissions in the US

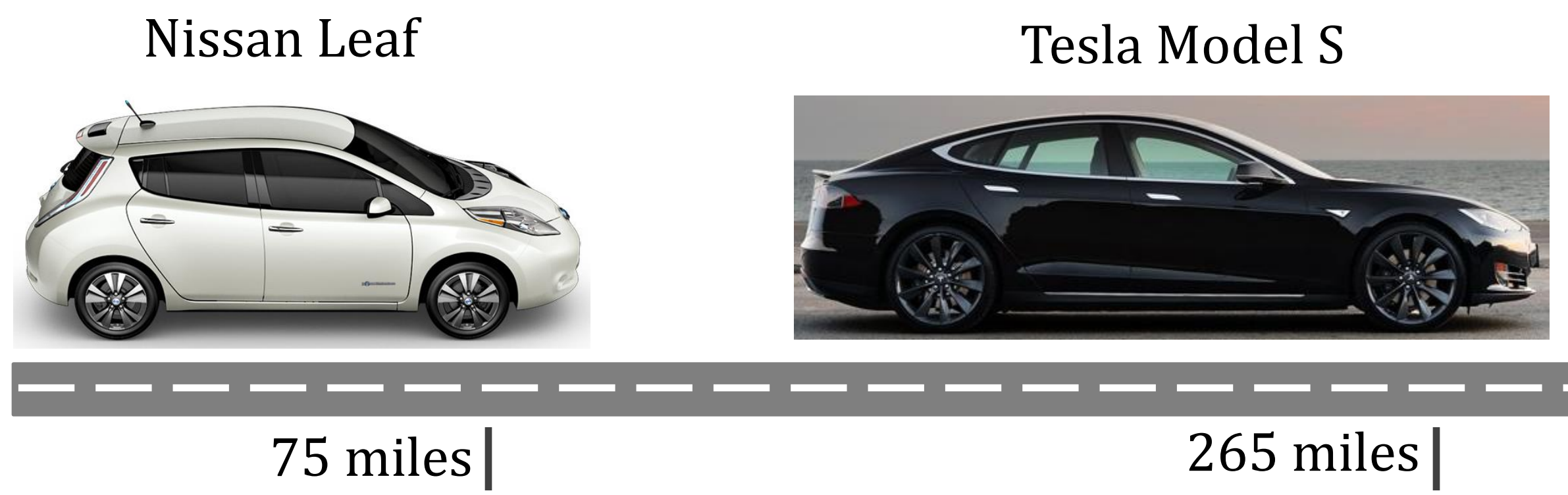


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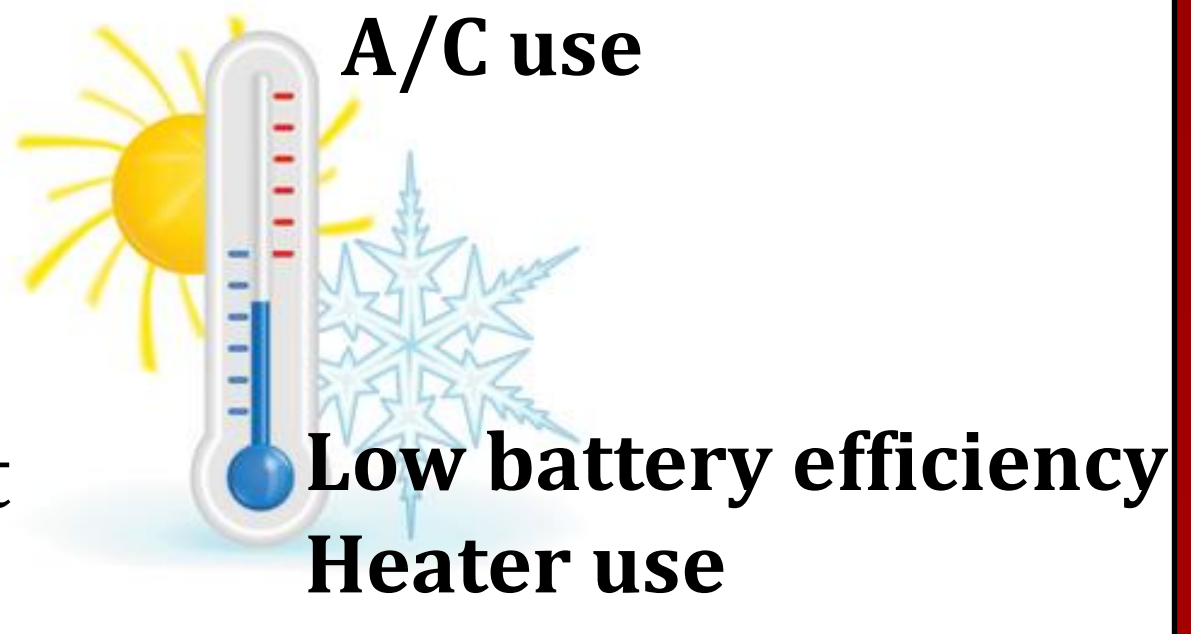
Electric vehicles (EVs) have great potential to reduce GHG emissions



**But range is not constant!**  
 Energy consumption varies with various factors, changing the range and emission benefits



**Climate effect:**  
 Worse energy efficiency  
 Lower range

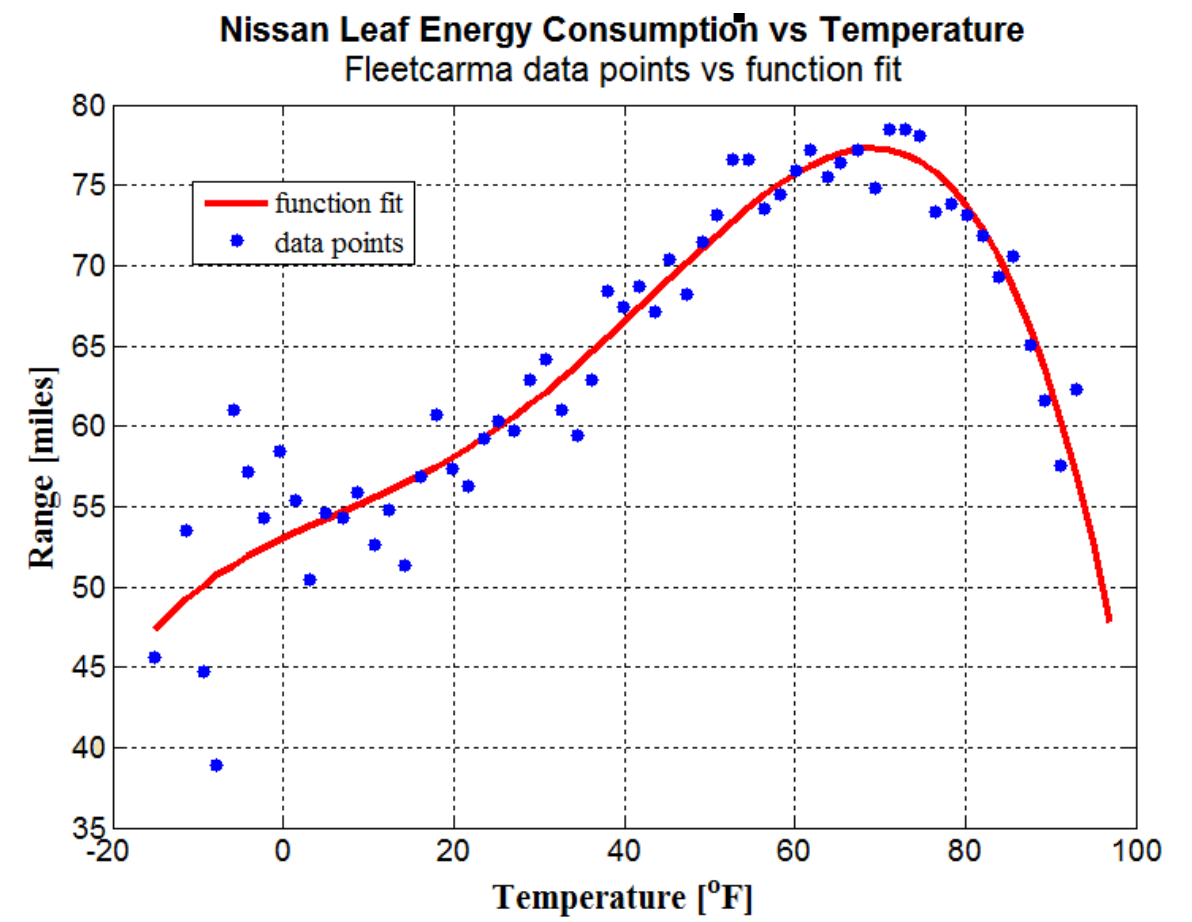
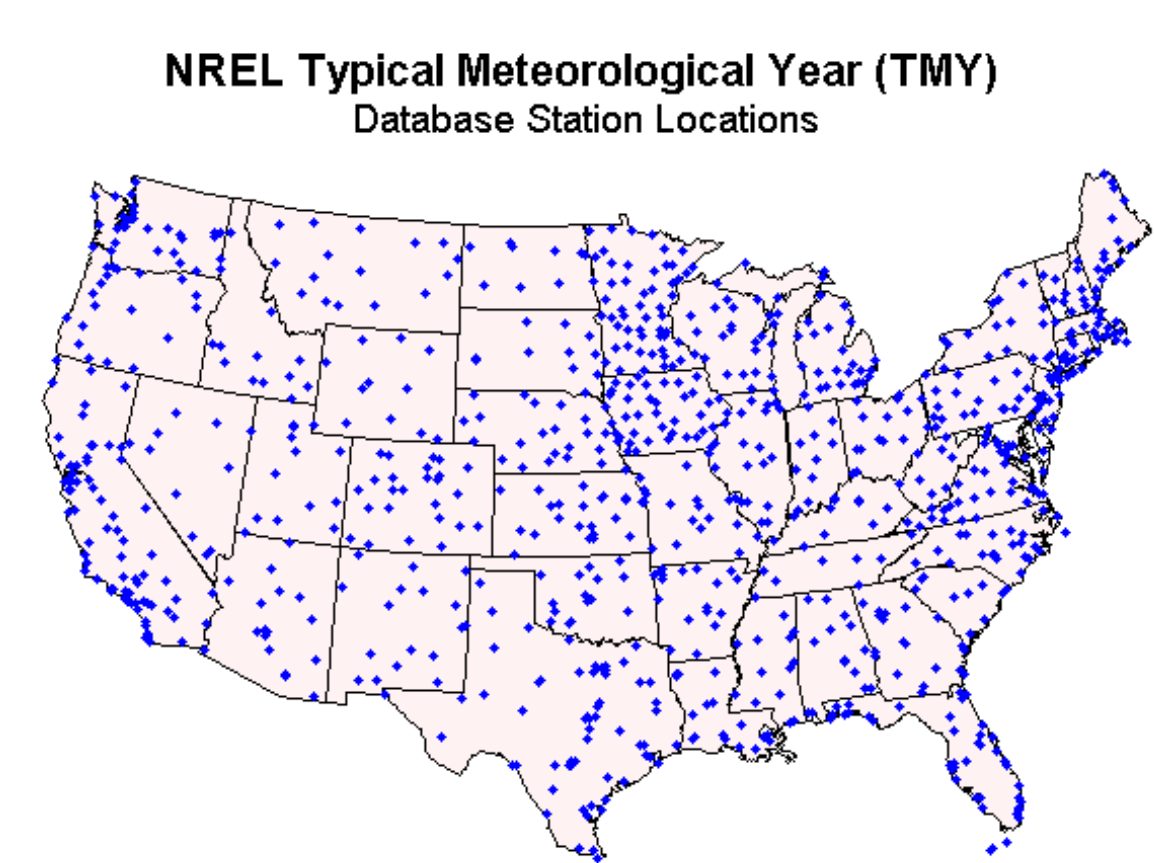


**Question:** How does this affect environmental benefits?

**Goal:**  
 To analyze the regional effects of ambient temperature on electric vehicle efficiency, range and emissions in US

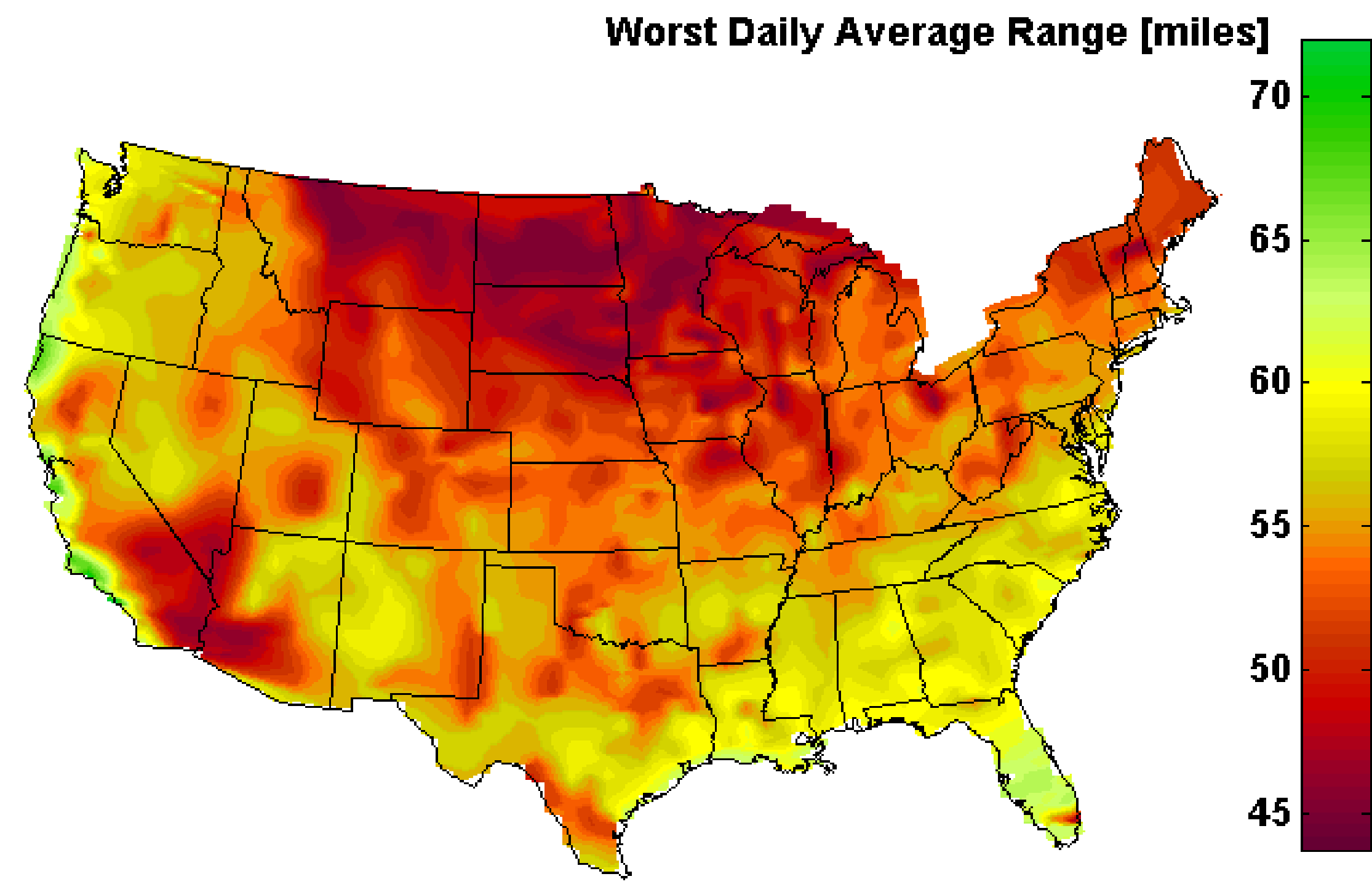
**Real World Data:**

- Fleetcarma<sup>1</sup> : Nissan Leaf Range with temperature
- NREL TMY Database<sup>2</sup> : Ambient temperature profiles
- NHTS 2009<sup>3</sup> : Trip data
- Marginal Emission Factors<sup>4</sup>: overall CO<sub>2</sub> emissions

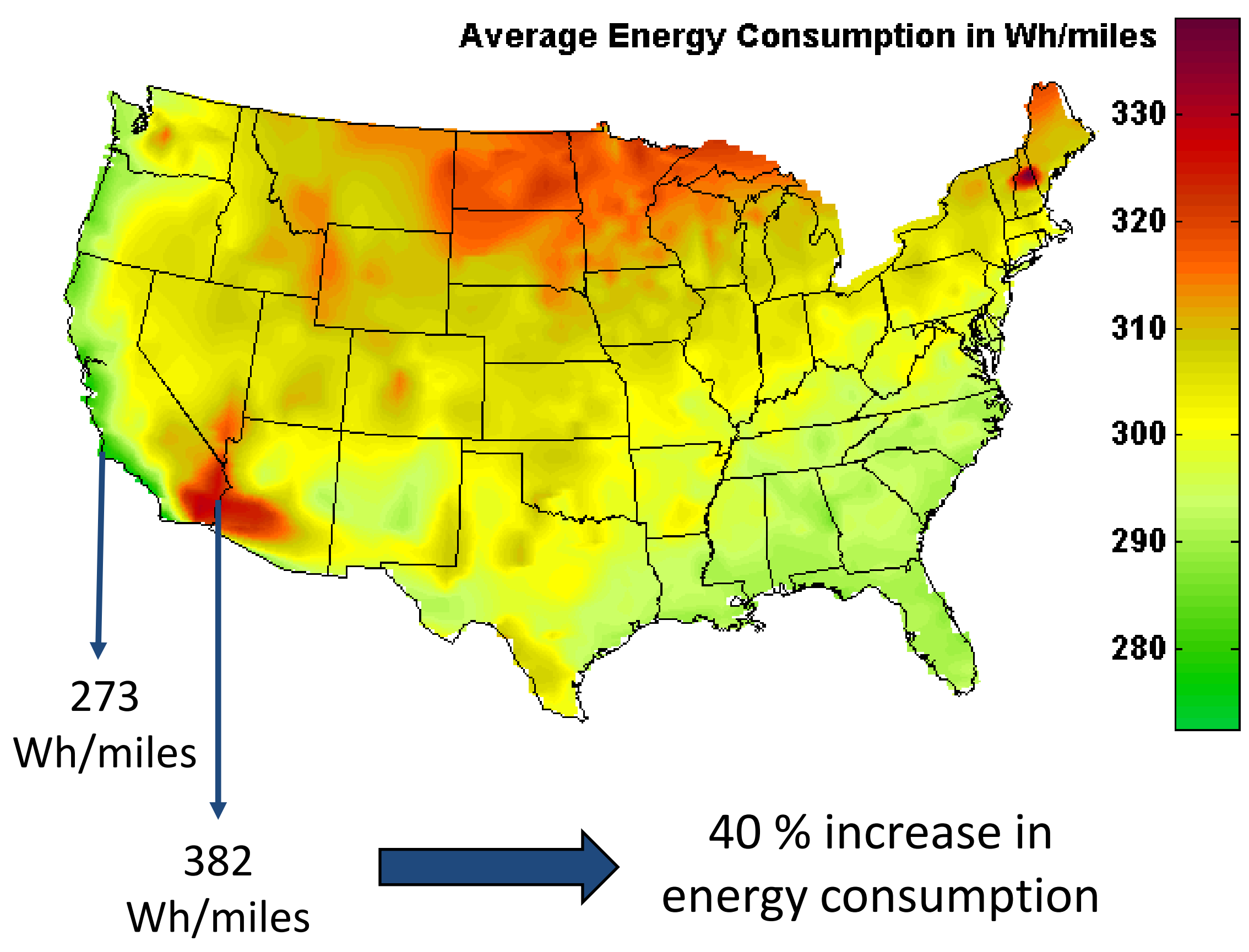
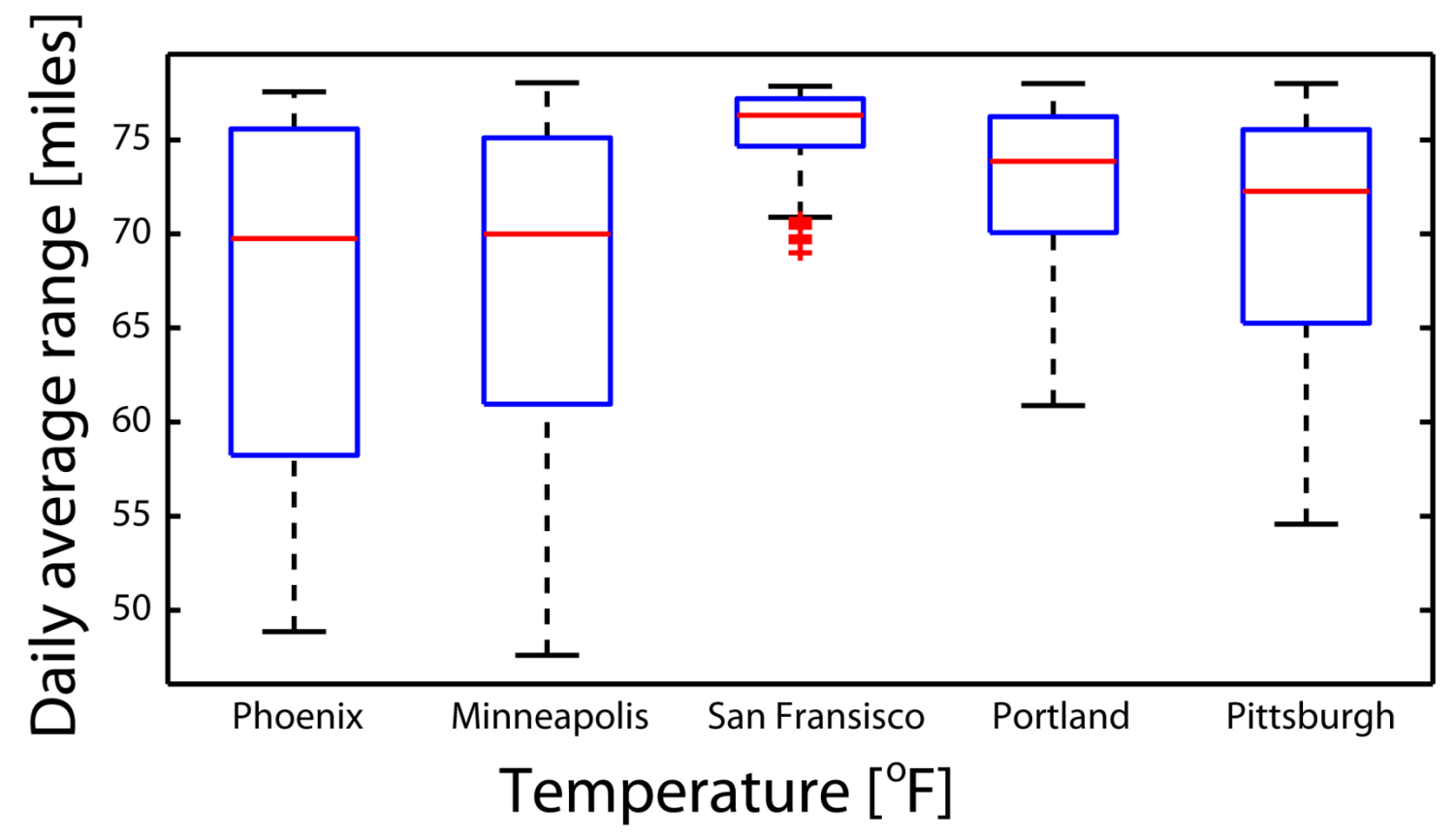


**Preliminary Results**

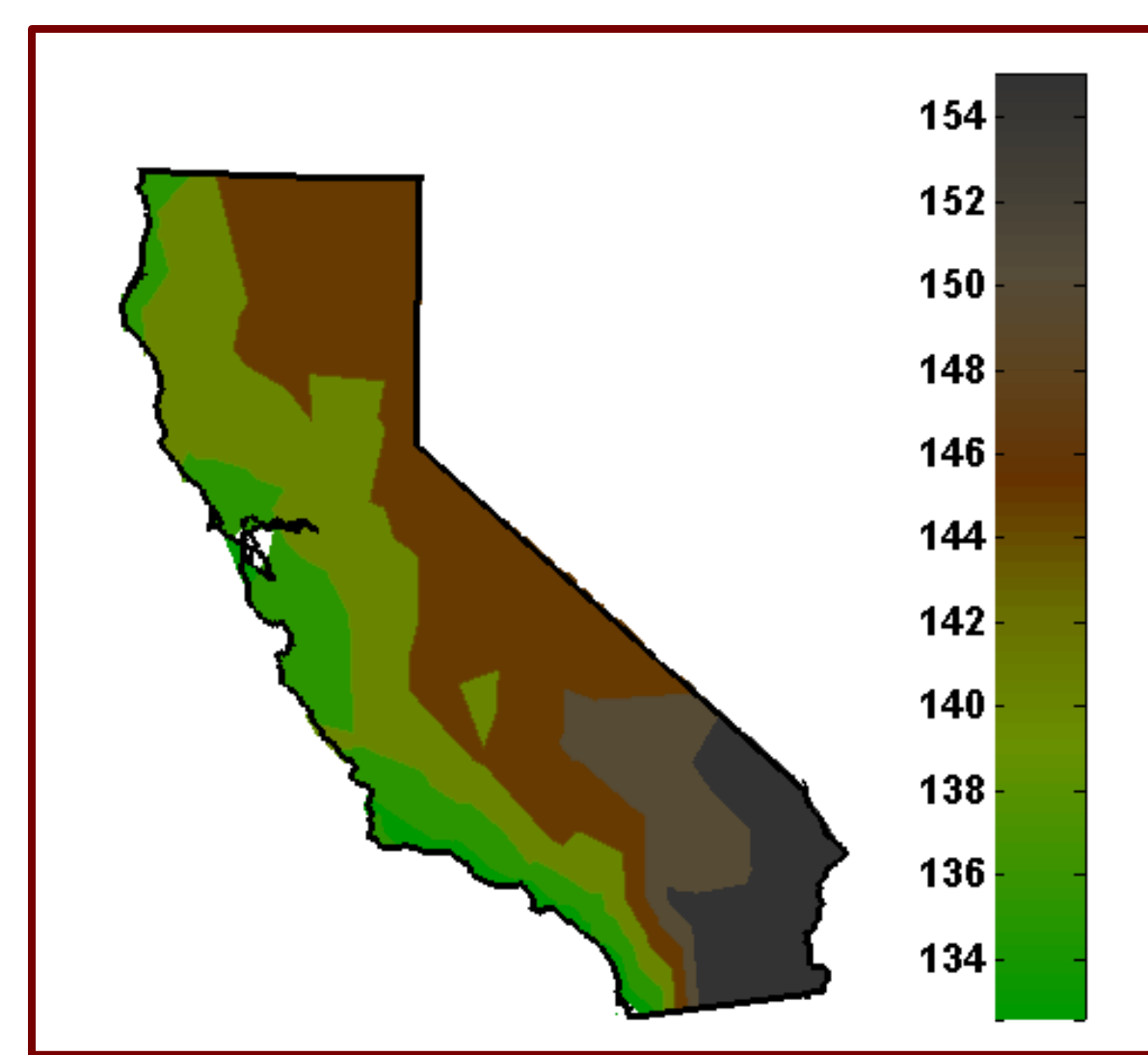
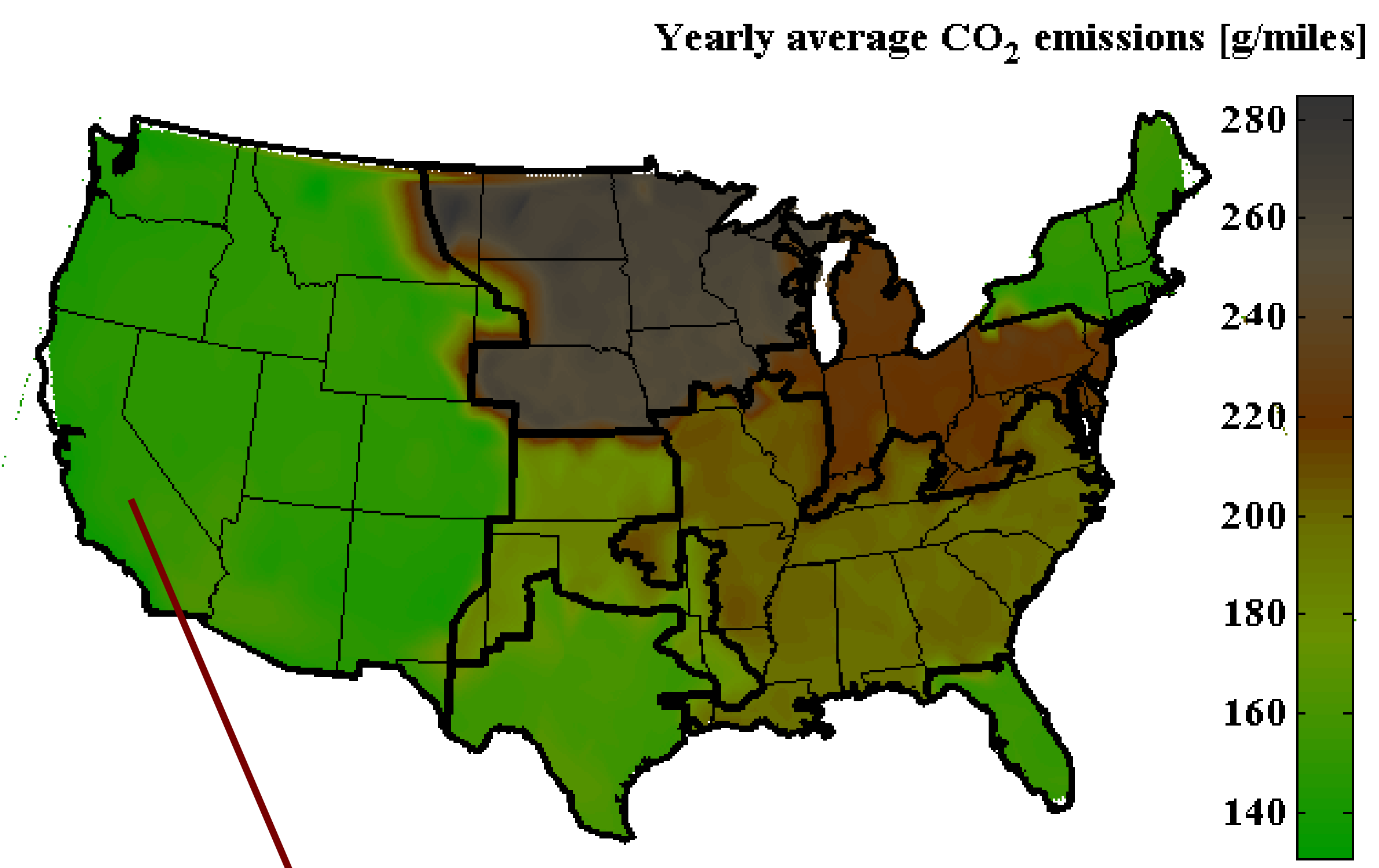
Nissan Leaf range can drop from 70 miles in moderate regions to only 42 miles in hot or cold regions.



Only mild climate locations experience ranges around 70 miles throughout the year.



Regional grid mix is the dominant factor in the variation of emissions across the country. Up to 100% increase in emissions can be observed.



However, there is still 20% increase in CO<sub>2</sub> emissions in the same state just due to temperature difference.

**Conclusion**

- Regional temperature substantially affects vehicle range, energy efficiency, and emissions.
- EVs are more beneficial in some regions than others, but to quantify this effect we need to also understand the effect of ambient temperature on gasoline vehicle operations.

<sup>1</sup> <http://www.fleetcarma.com/nissan-leaf-chevrolet-volt-cold-weather-range-loss-electric-vehicle/>  
<sup>2</sup> [http://rredc.nrel.gov/solar/old\\_data/nsrdb/1991-2005/tmy3/](http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/)  
<sup>3</sup> <http://nhts.ornl.gov/>  
<sup>4</sup> Siler-Evans, K.; Azevedo, I. L.; Morgan, M. G. Marginal emissions factors for the U.S. electricity system. *Environ. Sci. Technol.* **2012**, *46*, 4742–4748