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

Tugce Yuksel
Department of Mechanical Engineering
Carnegie Mellon University

Jeremy J. Michalek
Department of Engineering and Public Policy, Department of Mechanical Engineering
Carnegie Mellon University

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

**Real World Data:**
- Fleetcarma\(^1\): Nissan Leaf Range with temperature
- NREL TMY Database\(^2\): Ambient temperature profiles
- NHTS 2009\(^3\): Trip data
- Marginal Emission Factors\(^4\): overall CO\(_2\) emissions

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

<table>
<thead>
<tr>
<th>Nissan Leaf</th>
<th>Tesla Model S</th>
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<tr>
<td>75 miles</td>
<td>265 miles</td>
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**But range is not constant!**
Energy consumption varies with various factors, changing the range and emission benefits

- Climate
- Driving style
- Ancillary loads

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

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

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

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

**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.