Research Question

How to model PEV charging infrastructure needs that considers:
1. Current market trends & future scenarios
2. Spatio-temporal heterogeneity
3. PEV adoption rates and penetration
4. Fulfils driving needs
   - Daily averages
   - Long-distance, corridor, inter/intra state travel

Contemporary Approaches

Travel Behavior → Charging Requirements → Driving Behavior → Candidate Locations → Charger Siting and Sizing

Next Steps
1. Integrate travel data (NHTS, CHTS etc.), DOE AFDC and end-use household level energy consumption survey data
2. Econometric modeling of access to charging infrastructure probability at household level
   - HH heterogeneity, socio-economics, and demographics, existing PEV and infrastructure
3. Explore trade-offs between complexity, fidelity, and explicitness
4. Capture the trajectory of PEV adoption and infrastructure build out for future scenarios
5. Evaluate charging behavior impacts on charging infrastructure needs and power grid
6. Integrate transportation sector with energy economics, and demographics, existing PEV and infrastructure

Illustration: State of CA

Table 1 PEV and Plug Counts (All Available Public and Private Plugs)

<table>
<thead>
<tr>
<th>Num of Zip Codes Without any Registered PEVs</th>
<th>Num L1 Plugs</th>
<th>Num L2 Plugs</th>
<th>Num DCFC Plugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>59</td>
<td>432</td>
<td>93</td>
</tr>
<tr>
<td>455</td>
<td>21481</td>
<td>15594</td>
<td>37075</td>
</tr>
</tbody>
</table>

Fig. 6 Regression Between Total PEVs and Plugs

Assuming Average Urban Driving

- Majority of studies assume representative DVMT as average urban driving (<40 miles, 4 trips )
- Missing: the tail of daily VMT (short trips and long-distance), intraday dwelling time variations, type of day, type of road network

Fig. 8 % of Cars Parked (2009 NHTS)

- Differences due to population density, dwelling unit splits
  - home or public/workplace dominant charging decision
  - Design infrastructure for peak demand or nominal demand or coverage?

Contemporary Approaches

- Travel Behavior
- Charging Requirements
- Driving Behavior
- Candidate Locations
- Charger Siting and Sizing

How to model PEV charging infrastructure needs that considers:
1. Current market trends & future scenarios
2. Spatio-temporal heterogeneity
3. PEV adoption rates and penetration
4. Fulfils driving needs
   - Daily averages
   - Long-distance, corridor, inter/intra state travel

Market Trends

Fig. 1 2011-2016 Top 10 PEVs Sold (% Share)

- ZEV Mandate States: 15.4% of total sales by 2025
- Infrastructure Readiness, Planning and Assessment is Crucial

Fig. 3 Top 10 Urban Areas (UA) by Plugs/1000 PEVs

- USA Chicago IL-JN 96 Plugs (L2+DCFC)/1000 PEVs for 91000 PEVs
- USA Los Angeles-Long Beach-Anaheim has 57 Plugs (L2+DCFC)/1000 PEVs for 85500 PEVs

Fig. 4 States with ZEV Mandates

- 2016 Top 10 PEVs Sold (% Share)
- Infrastructure Readiness, Planning and Assessment is Crucial

ZEV Mandate States: 15.4% of total sales by 2025
Infrastructure Readiness, Planning and Assessment is Crucial