<table>
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<tr>
<td><strong>Docket Number:</strong> 19-IEPR-04</td>
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<tr>
<td><strong>Project Title:</strong> Transportation</td>
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<td><strong>Document Title:</strong> Presentation - Electrified Transportation Infrastructure Analysis</td>
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<td><strong>Description:</strong> National Renewable Energy Laboratory Presentation &quot;Electrified Transportation: Infrastructure Analysis&quot; at March 11 IEPR Staff workshop</td>
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<td><strong>Filer:</strong> Denise Costa</td>
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<td><strong>Organization:</strong> National Renewable Energy Laboratory (NREL)</td>
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Electric Vehicle Infrastructure Projection Tool (EVI-Pro)

**Foundational Assumptions**
- Future EVs will be driven in a manner consistent with present day gasoline vehicles.
- Consumers will prefer to perform the majority of charging at their home location.
- Charging at work/public L2 and corridor/community DCFC stations will be used as necessary to maximize eVMT.

**Diagram Notes:**
- PHEVs & BEVs
- Home/Work/Public & L1/L2/DCFC
- Real-world GPS data (mostly gasoline vehicles)
- Future PEV Stock (exogenously defined)
- Plug Counts (consumer demand)
In collaboration with Lawrence Berkley National Laboratory and Humboldt State University, load profiles from EVI-Pro were contrasted with the BEAM model. BEAM is an agent-based transportation simulator that has been used for EV infrastructure studies in the San Francisco Bay Area. A high degree of similarity in charging behavior and aggregate load profiles was observed between EVI-Pro and BEAM.
Load Flexibility: Managed Charging

Simulated load from 2M EVs

Typical Weekday (uncontrolled)

Typical Weekend (uncontrolled)

Typical Weekday (max delay @ home/work)

Typical Weekend (max delay @ home/work)
Isolate CHTS long distance car trips from San Francisco, Oakland, San Jose urban areas

Isolate CHTS long distance car trips from Los Angeles, Long Beach, Anaheim, Riverside, San Bernardino urban areas

Primary destinations include Los Angeles, Reno, Lake Tahoe, and San Luis Obispo (200-380 mile trips)

Primary destinations include San Francisco, Las Vegas, Phoenix, and Mammoth Lakes (270-380 mile trips)
Residential Charging Availability

Estimate of CA LDV stock by
- Housing density
- Residence type
- Tenure

ACS 2012-2016 PUMA Vehicle Counts By Household Density: California

<table>
<thead>
<tr>
<th>Household Sample Size</th>
<th>Weighted Vehicle Total</th>
<th>Single-Family Dwelling</th>
<th>Apartment</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>625,314</td>
<td>24,345,736</td>
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<table>
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<tr>
<th>Weighted Vehicle Total</th>
<th>Very Low (&lt;102 HH/mi²)</th>
<th>Low (102-800 HH/mi²)</th>
<th>Medium (800-2213 HH/mi²)</th>
<th>High (2213+ HH/mi²)</th>
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<tbody>
<tr>
<td>Owned</td>
<td>0.6%</td>
<td>0.8%</td>
<td>20.9%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Rented</td>
<td>0.8%</td>
<td>0.4%</td>
<td>15.8%</td>
<td>1.2%</td>
</tr>
</tbody>
</table>

- 0.1% Single-Family Dwelling
- 0.3% Apartment
- 0.2% Other
Electrification of TNCs: A Case Study on RideAustin

**By the numbers**
- Sample duration: 10 months
- Period: June 2016 to April 2017
- 4,961 unique drivers & vehicles
- 261,000 unique riders
- 1.49 million trips

Largest US TNC dataset currently available to researchers

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Heatmap of RideAustin trip destinations

Simulated Weekend Charging Loads
Technology Solutions to Reduce Cost of DCFC

- Analysis examines over 7,500 electricity rates to understand DCFC costs and mitigation opportunities.
- Demand charges are significant cost for low-utilization stations but become much less important as utilization increases.
- Energy storage (battery) can mitigate high demand charges.
- Photovoltaic (PV) energy can mitigate high energy charges, even in areas with lower solar irradiance (e.g., Vermont).

Technology solutions are effective at reducing electricity cost for DCFC:
- Co-location helps small stations (high fixed charges).
- PV and batteries can support locations with high energy and/or demand charges.
Thanks! Questions?

This work was funded by the California Energy Commission and the US Department of Energy Vehicle Technologies Office.