New EVSE Analytical Tools/Models:
Electric Vehicle Infrastructure Projection Tool (EVI-Pro)

SAE Government/Industry Meeting
Electric Drive Part 2 – Infrastructure
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PEV Charging Analysis – NREL Objective

Provide guidance on plug-in electric vehicle (PEV) charging infrastructure to regional/national stakeholders to:

- Reduce range anxiety as a barrier to increased PEV sales
- Ensure effective use of private/public infrastructure investments

Some key questions related to investment in PEV charging stations...

Recent Studies
- California (2014)
- Seattle, WA (2015)
- Massachusetts (2017)
- Colorado (2017)
- National PEV Infrastructure Analysis (2017)
- Columbus, OH (2018, forthcoming)
- California (2018, forthcoming)
Consumers demand for PEV charging is coverage-based
“Need access to charging anywhere their travels lead them”

Infrastructure providers make capacity-driven investments
“Increase supply of stations proportional to utilization”

A “utilization gap” persists in a low vehicle density environment making it difficult to justify investment in new stations when existing stations are poorly utilized (see: chicken & egg)

This work quantifies non-residential PEV charging requirements necessary to meet consumer coverage expectations (independent of PEV adoption level) and capacity necessary to meet consumer demand in high PEV adoption scenarios

Coverage and capacity estimates are made both for interstate corridors, cities, towns, and rural areas
Foundational Assumptions

- Future PEVs 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
Commercial GPS dataset (developed by INRIX) from Columbus, OH used to characterize daily travel patterns

Complemented public travel data from California and Massachusetts

By the numbers:
12 months of trips (all of 2016)
All trips intersecting Columbus region
Driving mode imputed by INRIX trip engine

- 7.82M device ids
- 32.9M trips
- 1.04B miles
- 2.58B waypoints
<table>
<thead>
<tr>
<th>Destination</th>
<th>Departure</th>
<th>Arrival</th>
<th>Drive Miles</th>
<th>Dwell Hours</th>
<th>Simulated Charging</th>
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<td>Work</td>
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<td>9:00 AM</td>
<td>32.8</td>
<td>5.00</td>
<td>L2</td>
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<td>3:30 PM</td>
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<td>0.25</td>
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<td>0.25</td>
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<td>7:30 PM</td>
<td>46.8</td>
<td>12.83</td>
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</table>

**Simulated charging behavior for a BEV100 under an example travel day**

**Bottom-up simulations** are used to estimate percent of vehicles participating in non-residential charging, derive aggregate load profiles, and investigate spatial distribution of demand.
Hypothetical DCFC Network

DCFC Scenario 5

18 existing DCFC stations
31 new interstate stations
47 new highway stations
50 new “traffic-based” stations
DCFC Scenario 5 + BEV200

Marker size proportional to station utilization

Simulated Station Utilization
Long Distance Travel Data From FHWA
Traveler Analysis Framework (TAF)

**TAF Auto Trips by Census Division**
Implies that the majority of long distance auto travel is regional and limited to intra-division movements.
Coming soon… Online version of EVI-Pro

Alternative Fuels Data Center

EV Infrastructure Projection Tool (EVI-Pro)
This tool provides a simple way to estimate how much electric vehicle charging you might need at a city- and state-level.

How Much Electric Vehicle Charging Do I Need in My Area?

EVI-Pro is a tool developed by the National Renewable Energy Laboratory to estimate consumer demand for charging infrastructure. Developed with the support of the California Energy Commission and the U.S. Department of Energy’s Vehicle Technologies Office, EVI-Pro uses detailed data on personal vehicle travel patterns, electric vehicle attributes, and charging station characteristics in bottom-up simulations to estimate the quantity and type of charging infrastructure necessary to support regional adoption of electric vehicles. EVI-Pro has been used for detailed planning studies in Massachusetts, Columbus (forthcoming), California (forthcoming), and for a National Analysis of U.S. communities and corridors.
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 TNC dataset currently available to researchers
Electrification of TNCs: Preliminary Results

- Residential locations are significant trip generators
  - Approximately evenly split between apartments and single family homes
- Commercial locations are largest land use type
- Airport may be underrepresented due to local knowledge of RideAustin

- Time of day activity shifts much later in the day than traditional vehicle activity patterns
- Approximately 90% of shifts are less than 150 mi
- Approximately 50% of drivers have no shifts above 200 mi
  - All shift totals include dead-heading and commuting
This work was funded by the US Department of Energy Vehicle Technologies Office, the California Energy Commission, and the Colorado Department of Transportation.