TRENDS OBSERVED IN PLUG-IN ELECTRIC VEHICLE INFRASTRUCTURE DEMONSTRATIONS

John Smart, Idaho National Laboratory

SAE Government/Industry Meeting
January 23, 2014
Washington, DC
Idaho National Laboratory

U.S. Department of Energy (DOE) federal laboratory
890 square mile site with 4,000 staff

Support DOE’s strategic goal

- Increase U.S. energy security and reduce the nation’s dependence on foreign oil

Multi-program DOE laboratory

- Nuclear Energy
- Fossil, Biomass, Wind, Geothermal and Hydropower Energy
- Advanced Vehicles and Battery Development
- Homeland Security and Cyber Security
The EV Project
Purpose is to build mature EV charging infrastructure in 17 US regions and study:

- Infrastructure deployment process
- Customer driving and charging behavior
- Impact on electric grid

12,000+ AC level 2 charging units, 100+ DC fast chargers
8,000+ Electric drive vehicles
INL data collection Jan 2011 – Dec 2013

Project partners

[Logos of various partners]
Vehicle Enrollment in The EV Project

Nissan Leafs and Chevrolet Volts Reporting Data in The EV Project through September 2013

Total
5,778 Leaf
2,021 Volt
416 Smart Electric Drives
ChargePoint America

Deploy 4,600+ residential and public AC level 2 charging units in 11 US regions

Study customer usage of residential and public infrastructure

INL data collection May 2011 – Dec 2013

Project Partners
Infrastructure Deployment in ChargePoint America
(all units are AC level 2)

ChargePoint America Charging Units By Type - Through September 2013

Total
33 Unspecified
238 Private Commercial
2,148 Public
1,834 Residential
Conventional wisdom
People spend most of their time at home and work, so most charging will be done there.
This presentation
Provides some insights from these infrastructure demos on actual charging behavior

- How much are vehicles charged at home vs. away from home?
- How much are Volts charged at level 1 vs. level 2 rates?
- What do we know about workplace charging?
- How often are public level 2 and DC fast charging units being used?
- What are the most popular public charging venues?
- How far are Leafs traveling from home?
Actual vehicle charging locations between Jul 2013 – Sep 2013 in The EV Project

Based on 256,288 charging events from 4,036 Leafs and 179,681 charging events from 1,812 Volts in Q3 2013. Additional 15,099 Leaf and 11,579 Volt charging events occurred at unknown locations.
Away-from-home Charging Frequency for Volts in The EV Project

Charging data from 1,405 Volts in 18 regions from Oct 2012 – May 2013
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## Effect of Away-from-home Charging for Volts in The EV Project

Charging data from 1,405 Volts in 18 regions from Oct 2012 – May 2013

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This group supplemented home charging with a little away-from-home charging.

This group drove a little more each day.

Additional charging provided energy for more EV miles per day.
Effect of Away-from-home Charging for Volts in The EV Project

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Compared to vehicles with no away-from home charging...

This group supplemented home charging with a lot of away-from-home charging...

This group drove a lot more each day...

Additional charging provided energy for many more EV miles per day (53% increase)
## Effect of Away-from-home Charging for Volts in The EV Project

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Compared to vehicles with no away-from home charging…

This group supplemented away-from-home charging with some home charging

This group drove a little more each day

Additional charging provided energy for a little more EV miles per day
Charging data from 1,405 Volts in 18 regions from Oct 2012 – May 2013

• About 50/50 level 1 vs. level 2 split when charging away from home
• Energy per event is about equal for level 1 and level 2, even though level 1 charge rate is half as fast
Workplaces identified where EV Project participant vehicles have parked and charged a significant number of times (excluding fleet vehicles)

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of work sites</th>
<th>Charging locations per site</th>
<th>Types of companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knoxville, TN</td>
<td>2</td>
<td>1, 4</td>
<td>Officesties, manufacturing plants, and R&amp;D facilities of companies in computer, telecom, pharmaceutical, biotech, automotive, aerospace, and other industries</td>
</tr>
<tr>
<td>Nashville, TN</td>
<td>6</td>
<td>1 - 6</td>
<td></td>
</tr>
<tr>
<td>Portland, OR</td>
<td>2</td>
<td>1, 4</td>
<td></td>
</tr>
<tr>
<td>Phoenix, AZ</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>San Diego, CA</td>
<td>11</td>
<td>1 - 15</td>
<td></td>
</tr>
<tr>
<td>San Francisco, CA</td>
<td>51</td>
<td>1 - 10</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>73</strong></td>
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Workplace Charging Case Studies – Commuting Distance

86% of EV Project Leafs parking at worksites identified average 30 miles or less between home and work.
Usage Frequency of AC Level 2 EVSE and DC Fast Chargers

Charging Frequency by EVSE Type

Charging Energy by EVSE Type
Usage Frequency of AC Level 2 EVSE and DC Fast Chargers

Charging Frequency by EVSE Type

Roll-out of Blink DCFC usage fees during Q3
Usage Frequency of Public Level 2 EVSE and DC Fast Chargers

Charging Frequency by EVSE Type

Roll-out of Blink DCFC usage fees during Q3

- Blink DCFC
- ChargePoint Public L2
- Blink Public L2

Number of charging events per EVSE day

Q4 2012 | Q1 2013 | Q2 2013 | Q3 2013
Usage Frequency of Public Level 2 EVSE and DC Fast Chargers

Blink Charging Frequency by EVSE Type and Region

Number of charging events per EVSE day

Q4 2012 | Q1 2013 | Q2 2013 | Q3 2013

DCFC
Public L2
Usage Frequency of Public Level 2 EVSE and DC Fast Chargers

Blink Charging Frequency by EVSE Type and Region

- DCFC (Q3)
- WA (5.2)
- SF (3.2)
- LA (2.6)
- OR (2.5)
- US (2.3)
- SD (1.8)
- PHX (0.7)

Number of charging events per EVSE day

Q4 2012 to Q3 2013
Usage Frequency of Public Level 2 EVSE and DC Fast Chargers

Blink Charging Frequency by EVSE Type and Region

- **DCFC (Q3)**
  - WA (5.2)
- **Public L2 (Q3)**
  - SF (0.55)
  - SD (0.48)
  - ATL (0.48)
  - LA (0.41)
  - US (0.26)
  - WA (0.24)

Legend:
- **DCFC**
- **Public L2**
Where are the most popular public charging venues?

Based on Blink public level 2 EVSE data from 9/1/2012 through 12/21/2013
Excludes first 4 weeks in service
Where are the most popular public charging venues?

Usage frequency of top 5 for-cost Blink public level 2 EVSE in each venue category from 9/1/2012 to 12/15/2013

Average number of charging events per site per week
Where is the best place to put public charging stations?

DC area away-from-home parking locations for Volts that average > 35 mi per day (excluding parking locations of single vehicles)
Leaf Travel Extents in the Seattle Area

- DC Fast Chargers
- Public Level 2
- Nissan Leaf Parking Locations
Parking locations of Nissan Leafs based in Seattle Region
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Sep 2012

INL
Idaho National Laboratory
10/23/2013
INL/MIS-13-30487
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May 2013

DC Fast Chargers
- Public Level 2
- Parking locations of Nissan Leafs based in Seattle Region

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Publications coming soon:

- Q4 2013 reports
- White papers on
  - Leaf L2 vs. DCFC usage,
  - public charging venues,
  - workplace charging case studies
  - EVSE installation costs
- and more

For all EV Project and ChargePoint America publications, visit

avt.inl.gov/evproject.shtml
avt.inl.gov/chargepoint.shtml

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