Latest Insights from The EV Project and ChargePoint America PEV Infrastructure Demos

John Smart
Idaho National Laboratory

USDRIVE Grid Interaction Tech Team meeting
Idaho Falls, ID
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INL is a primary partner in two national electric vehicle (EV) charging infrastructure demonstrations

**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:

**ChargePoint America**
- Deploy 4,700+ 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
Charging Units Reporting Data Nationally

- 107 DC Fast Charge
- 443 Private Nonresidential AC Level 2
- 3,555 Publicly Accessible AC Level 2
- 8,251 Residential AC Level 2
- 12,356 Total
Infrastructure Deployment in ChargePoint America through December 2013

Charging Units* Reporting Data Nationally

- 39 Not specified
- 264 Private Nonresidential
- 2,508 Publicly Accessible
- 1,836 Residential
- 4,647 Total

* All units are AC Level 2. Dual-port units count as 2 units.
Measures of “Goodness”

There are numerous ways to assess how “good” public charging sites are:

• Charging frequency: **number of charge events per day or week**
• Charging time: hours connected
• Charging energy: **kWh consumed** / EV miles provided
• Parking time: time spent in parking space / in store
• Charging site host may want electric vehicle supply equipment (EVSE) for other reasons, such as image or cool factor
• etc.
Terminology

Charging site

- Dual-port DC fast charge EVSE unit or charging station
- Single-port AC Level 2 EVSE unit or charging station

Charging site

- Dual-port AC Level 2 EVSE unit or charging station
- Dual-port AC Level 2 EVSE unit or charging station
Public EVSE Usage Fees

Blink

- Public AC Level 2 fees started Jul – Aug 2012
  - Varies from $1.00 to $2.00 per hour connected
  - 16% of sites were still free as of Dec 31, 2013 (per local site host discretion)
- DC Fast Charger fees started Jul 2013
  - $5 for Blink member / $8 for non-member per session

ChargePoint

- Vary by site (per local site host discretion)
- Many are free (rumored 70% free / 30% cost)

AeroVironment in WA/OR

- Free prior to Apr 1, 2014
- After Apr 1, 2014 – Monthly subscription fee of $19.99 for unlimited usage or “drive up” fee of $7.50 per session for DCFC and $4 per session for L2
Summary of INL Data Sets in This Presentation

- Blink Level 2: All Free vs. 80% Cost / 15% Free / 5% ?
- Blink DCFC: Free vs. Cost
- ChargePoint Level 2: XX% Cost / XX% Free
- AeroVironment DCFC & Level 2: Free
- Nissan Leaf
- Chevrolet Volt – Basic set vs. Full set (EV mi)

Years:
- 2011
- 2012
- 2013
Outline

• How has public AC level 2 EVSE and DC fast charger (DCFC) usage changed over time?
  – What was the impact of implementing payment for use of DCFC

• Electric vehicle miles traveled (eVMT)
  – Leaf vs. Volt eVMT
  – Did Leaf eVMT change as public infrastructure usage changed?

• Workplace charging
  – Charge triangle
  – Facebook case study

• Which public charging sites are used most frequently?
  – By EVSE make and cost
  – By charging level and venue

• Determining hot spots using vehicle data
  – Bay Area examples

• I5 Corridor EVSE usage preview

• Future work
How has public AC level 2 EVSE and DC fast charger (DCFC) usage changed over time?
Usage Frequency of Public Level 2 EVSE and DC Fast Chargers

Charging Frequency by EVSE Type

Number of charging events per EVSE day

Q4 2012  Q1 2013  Q2 2013  Q3 2013  Q4 2013

Blink DCFC
ChargePoint Residential
Blink Residential
ChargePoint Public L2
Blink Public L2

Charging Energy by EVSE Type

Energy per EVSE day (kWh)

Q4 2012  Q1 2013  Q2 2013  Q3 2013  Q4 2013

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

Charging Frequency by EVSE Type

Number of charging events per EVSE day

Q4 2012 | Q1 2013 | Q2 2013 | Q3 2013 | Q4 2013

- Blink DCFC
- ChargePoint Residential
- Blink Residential
- ChargePoint Public L2
- Blink Public L2
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

Also Nissan DCFCs introduced; free use

Number of charging events per EVSE day

Q4 2012  Q1 2013  Q2 2013  Q3 2013  Q4 2013

Blink DCFC
ChargePoint Public L2
Blink Public L2
Usage Frequency of Public Level 2 EVSE and DC Fast Chargers by Region

Charging Frequency by EVSE Type and Region
Total Energy Consumption at Blink Stations in San Francisco

Energy Consumed by Public Level 2 EVSE and DCFC in San Francisco Region by Month

- Energy Consumed by Blink DCFC
- Energy Consumed by Blink Public Level 2 EVSE
- Number of Blink DCFC
- Number of Blink Public Level 2 EVSE
Total Energy Consumption at Blink and ChargePoint Stations in San Francisco

Energy Consumed by Public Level 2 EVSE and DCFC in San Francisco Region by Month
Unintended Consequence of Per-session Fee

- Pricing model leads to an “all-you-can-eat” mentality
- Tapering SOC increase vs. time gives diminishing returns for time invested

14% increase in energy consumption

18% increase in charge session time
Infrastructure Usage by EV Project Leafs

- 4719 vehicles contributing data in vehicle months where home location is known

3 months before DCFC fees (4/1/2013 – 7/1/2013)

- 83.6% Home L1/L2
- 14.9% Away L1/L2
- 1.4% Away DCFC

3 months after DCFC fees (9/1/2013 – 12/1/2013)

- 84.7% Home L1/L2
- 14.3% Away L1/L2
- 1.0% Away DCFC
## Before and After DCFC Fees: Leafs Which Most Often Fast Charged

### 106 Leafs with >= 10% of charging events at DCFC in Q2 2013

<table>
<thead>
<tr>
<th></th>
<th>Before DCFC Cost 4/1/2013-7/1/2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of charging events</td>
</tr>
<tr>
<td>DCFC Usage</td>
<td>1,304</td>
</tr>
<tr>
<td>Away L1/L2 Usage</td>
<td>1,051</td>
</tr>
<tr>
<td>Home L1/L2 Usage</td>
<td>3,841</td>
</tr>
<tr>
<td>Total</td>
<td>6,196</td>
</tr>
</tbody>
</table>

### DCFC “super users”
## Before and After DCFC Fees: Leafs Which Most Often Fast Charged

**106 Leafs with \(\geq 10\%\) of charging events at DCFC in Q2 2013**

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<thead>
<tr>
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<th>After DCFC Cost 9/1/2013-12/1/2013</th>
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<tbody>
<tr>
<td></td>
<td>Number of charging events</td>
<td>Percent of charging events</td>
</tr>
<tr>
<td>DCFC Usage</td>
<td>1,304</td>
<td>21%</td>
</tr>
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<td>1,051</td>
<td>17%</td>
</tr>
<tr>
<td>Home L1/L2 Usage</td>
<td>3,841</td>
<td>62%</td>
</tr>
<tr>
<td>Total</td>
<td>6,196</td>
<td>23%</td>
</tr>
</tbody>
</table>

- **Big drop in DCFC usage**
- **Not much change in away L1/L2 usage**
- **Increase in home charging**
- **Decrease in overall charging**
Before and After DCFC Fees: Leaves Which Most Often Fast Charged

<table>
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<tr>
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<td>4/1/2013-7/1/2013</td>
<td>9/1/2013-12/1/2013</td>
</tr>
<tr>
<td>Number of</td>
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<td>charging events</td>
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<tr>
<td>Energy consumed</td>
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<td>during charging</td>
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<tr>
<td>(SOC%)</td>
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<tr>
<td>Percent of</td>
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<tr>
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<tr>
<td>energy</td>
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</tbody>
</table>

DCFC Usage: 1,304 events, 21% of events, 49,595 kWh, 21% of energy, 436 events, 8% of events, 16,913 kWh, 8% of energy.

Away L1/L2 Usage: 1,051 events, 17% of events, 33,979 kWh, 14% of energy, 850 events, 16% of events, 31,078 kWh, 15% of energy.

Home L1/L2 Usage: 3,841 events, 62% of events, 154,741 kWh, 65% of energy, 3,958 events, 76% of events, 156,187 kWh, 77% of energy.

Total: 6,196 events, 238,315 kWh, 5,244 events, 204,178 kWh.

Charges per Driving Day: 1.27 before, 1.22 after.

Miles per Driving Day: 42.0 before, 36.4 after.

Driving Days: 4,856 before, 4,294 after.

This small group of DCFC “super users” changed their driving behavior dramatically after the onset of Blink DCFC fees: less miles on fewer days.
Electric Vehicle Miles Traveled
# Leaf vs. Volt Average Monthly eVMT

Oct 1, 2012 through Dec 31, 2013

<table>
<thead>
<tr>
<th></th>
<th>Nissan Leaf</th>
<th>Chevrolet Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of vehicles</strong></td>
<td>4,039</td>
<td>1,867</td>
</tr>
<tr>
<td><strong>Number of vehicle months</strong></td>
<td>35,294</td>
<td>20,545</td>
</tr>
<tr>
<td><strong>Total distance traveled (miles)</strong></td>
<td>28,520,792</td>
<td>20,950,967</td>
</tr>
<tr>
<td><strong>Distance traveled in EV mode (miles)</strong></td>
<td>28,520,792</td>
<td>15,599,508</td>
</tr>
<tr>
<td><strong>Percent of distance traveled in EV mode</strong></td>
<td>100%</td>
<td>74.5%</td>
</tr>
<tr>
<td><strong>Average monthly total VMT</strong></td>
<td>808.1</td>
<td>1,019.8</td>
</tr>
<tr>
<td><strong>Average monthly eVMT</strong></td>
<td>808.1</td>
<td>759.3</td>
</tr>
</tbody>
</table>

Leaf only 6% more eVMT per month
Leaf vs. Volt Distribution of Monthly eVMT

Overlap of blue and green curves means many Volts averaged the same or more electric miles than Leafs.

Overlap of blue and red curves means many Leafs averaged the same or more total miles than Volts.

Distribution of vehicle average monthly eVMT and VMT, where each data point in the distributions represents a single vehicle’s average over the entire study period.
EV Project Leaf Monthly eVMT vs. Nationwide Blink DCFC Usage

Aggregate eVMT does not appear to be tied to Blink DCFC usage…

… because most EV Project Leaf drivers did not charge away from home very much
Charging Location Preference – Nissan Leaf

707 Nissan Leafs with Access to Workplace Charging, 2012 – 2013

Overall Charging Frequency by Location (to scale)

- Home - 65%
- Work - 32%
- Other - 3%

Careful!
How important is this 3% to individual drivers’ mobility needs?

How does cost to use workplace charging influence this behavior?
Charging Location Preference – Chevy Volt

96 Chevrolet Volts with Access to Workplace Charging, 2013

Overall Charging Frequency by Location (to scale)

- Home - 57%
- Work - 39%
- Other - 4%

How does cost to use workplace charging influence this behavior?
Workplace Charging Case Study: Facebook

- Menlo Park, CA office campus
- May 1, 2013 to Aug 15, 2013
- 10 Blink Level 2 units (which were later replaced with ChargePoint units)
- 12 ChargePoint units with Level 2 cord and Level 1 outlet
- 1 Blink DC fast charger
- Publicly accessible
- Blink/CP L2 units free
- DCFC Blink network fees instituted Jul 2013
Frequency distributions of number of charging events per cord or outlet per work day for different charge power levels.
Time Connected at Facebook

Frequency distributions of time Level 1 outlets and Level 2 cords were connected to a vehicle per charging event.
Time Drawing Power at Facebook

Frequency distributions of time Level 1 outlets and Level 2 cords transferred power to a vehicle per charging event.
Energy Consumption at Facebook

Distribution of energy consumed per charging event by charge power level.
ChargePoint Level 1 / Level 2 EVSE Usage

• Data were collected from 12 charging units at this work site that were capable of both AC Level 1 and AC Level 2 charging.

• Drivers overwhelmingly preferred AC Level 2 cords over AC Level 1 outlets:
  – When drivers arrived at these units and both Level 1 and Level 2 options were available, they chose to use the Level 2 cord 98% of the time.

• Drivers may have consciously chosen the faster charge rate or they may have been motivated simply by convenience:
  – The Level 2 cord was available on the EVSE, but a driver needed to retrieve their own Level 1 cord to plug into the Level 1 outlet on the EVSE.
DC Fast Charger Usage

- The DC fast charger (DCFC) was typically used between 2 and 6 times per work day for 24 minutes or less per charging event.
- 11% of the time when a DC fast charge event ended and another event began on the same work day, a vehicle was already connected to the second DC fast charger cord prior to the end of the first vehicle’s charging event.
Company Policies & Practices

- Facebook followed a few simple guidelines to encourage employees to self-manage electric vehicle supply equipment (EVSE) usage
- First, charging units were installed to allow access from multiple parking spaces
- Drivers wanting a charge would park close to EVSE in use and leave their charge port door open
- Drivers were encouraged to plug in neighboring vehicles after their vehicle completed charging
- Second, employees were provided with an online message board – a Facebook page – allowing them to coordinate charging station usage
Company Policies & Practices

• Data from the EVSE suggest that drivers leveraged these resources to minimize the time EVSE were not in use
  – 37% of the time when one charging event ended and the next began at the same AC Level 2 EVSE during the same work day, less than 30 seconds elapsed between the two charging events
  – 60% of the time, less than 3 minutes elapsed between consecutive charging events
Which public charging sites are used most frequently?
Usage of Publicly Accessible Level 2 Sites

Cumulative Distribution of Charging Frequency of Blink and ChargePoint Level 2 Publicly Accessible Sites

- 28% of public sites had greater than our arbitrary minimum threshold (> 3 events / week)
- 16% of public sites had greater than 7 events / week
- 8% of public sites had greater than 14 events / week
- 4% of public sites had greater than 14 events / week

9/1/2012 to 1/1/2014
Usage of Publicly Accessible Level 2 Sites

Cumulative Distribution of Charging Frequency of Blink and ChargePoint Level 2 Publicly Accessible Sites

- Blink Free L2 sites (N = 212)
- ChargePoint L2 sites (N = 1159)
- Blink For-cost L2 sites (N = 1127)
- Blink DCFC sites (N = 94)

Blink for-cost L2 sites used much less than free L2 sites

9/1/2012 to 1/1/2014
Distribution of Usage Frequency of Blink & ChargePoint Level 2 EVSE Sites by Venue

- **Parking Lots/Garages**: 9.4
- **Transportation Hub**: 9.3
- **Workplace**: 8.5
- **Public Municipal**: 7.6
- **Leisure Destination**: 7.2
- **Retail**: 7.2
- **Fleet**: 7.2
- **Non-profit**: 6.9
- **Hotels**: 6.6
- **Medical**: 6.5
- **Multi-Family**: 6.3
- **Education**: 6.2

+ Median site usage frequency

Data from 9/1/2012 to 1/1/2014; includes all sites meeting minimum usage threshold

Average number of charging events per site per week
Distribution of Usage Frequency of Blink & ChargePoint Level 2 EVSE Sites by Venue

Average number of charging events per site per week

- Parking Lots/Garages
- Workplace
- Public Municipal
- Leisure Destination
- Retail
- Fleet
- Non-profit
- Hotels
- Medical
- Multi-Family
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Distribution of Usage Frequency of Blink & ChargePoint Level 2 EVSE Sites by Venue

Average number of charging events per site per week

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- Leisure Destination
- Retail
Distribution of Usage Frequency of Blink & ChargePoint Level 2 EVSE Sites by Venue
Blink & ChargePoint Level 2 Sites – Parking Lots and Garages

77.5  Downtown Palo Alto
73.4  Fifth & Mission Garage, San Francisco
70.6  Downtown Palo Alto
60.9  Downtown Redwood City
58.3  Parking Structure, Irvine CA
51.8  Parking Structure, Irvine CA
51.4  Parking garage, San Francisco CA
50.7  Sutter Stockton Garage, San Francisco CA
**Blink & ChargePoint Level 2 Sites – Transportation Hubs**

- 53.0  San Francisco Airport
- 39.3  Anaheim Canyon Metrolink
- 32.3  Oceanside Transit Center Metrolink train /light-rail/bus station park and ride
- 21.9  Oakland International Airport parking
- 17.0  San Francisco Airport
- 15.6  Expresso Airport Parking, San Leandro CA
- 15.2  San Francisco Airport
- 13.3  MBTA Alewife Station, Cambridge MA
- 10.9  Long Beach airport parking garage; all-electric vehicles can park free at Long Beach Airport.
**Blink & ChargePoint Level 2 Sites – Public / Municipal**

- **76.7** SCAQMD HQ building, Diamond Bar CA
- **52.8** City library, Dublin CA
- **50.0** City library, Redwood City CA
- **39.3** City hall, Huntington Beach CA
- **37.7** Civic center, Campbell CA
- **37.3** City hall, Hermosa Beach CA
- **35.1** SCAQMD HQ building, Diamond Bar CA
- **34.6** City hall, Orange CA
**Blink & ChargePoint Level 2 Sites – Leisure**

- **30.3**  Rialto Sebastopol Cinemas, Sebastopol CA
- **25.7**  La Cienega Tennis Center, Beverly Hills CA
- **23.9**  Canal Park, Washington DC
- **20.8**  Post Office Square Garage, Boston MA
- **18.2**  Red Morton Community Center, Redwood City CA
- **14.4**  San Diego Zoo
- **11.7**  Balboa Park Air & Space Museum, Automotive Museum, gymnasium, Starlight theatre, etc.
Blink & ChargePoint Level 2 Sites – Retail

<table>
<thead>
<tr>
<th>Location</th>
<th>Average Charging Events per Site per Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail-Small (Becker Surfboards), Hermosa Beach CA</td>
<td>50.1</td>
</tr>
<tr>
<td>Mall (Bella Terra Shopping Ctr), Huntington Beach CA</td>
<td>49.9</td>
</tr>
<tr>
<td>Mall (Westfield Galleria Mall), Roseville CA</td>
<td>45.5</td>
</tr>
<tr>
<td>Mall (The Grove), Los Angeles CA</td>
<td>40.7</td>
</tr>
<tr>
<td>Mall (The Americana at Brand), Glendale CA</td>
<td>40.3</td>
</tr>
<tr>
<td>Mall (Stanford Shopping Center), Palo Alto CA</td>
<td>32.1</td>
</tr>
<tr>
<td>Mall, Beverly Hills CA</td>
<td>30.4</td>
</tr>
<tr>
<td>Mall (Fashion Valley Mall), San Diego CA</td>
<td>27.5</td>
</tr>
<tr>
<td>Retail-Small (Ralph’s grocery store), Marina Del Ray CA</td>
<td>26.6</td>
</tr>
<tr>
<td>Retail-Small (Mollie Stone's Market grocery store), Saulsallito CA</td>
<td>23.4</td>
</tr>
<tr>
<td>Retail-Big (Kohl's), Yorba Linda CA</td>
<td>23.0</td>
</tr>
<tr>
<td>Electric Lodge Performing Arts Center (dance and fitness center), Venice CA</td>
<td>22.8</td>
</tr>
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</table>
Distribution of Usage Frequency of Blink DCFC Sites by Venue

- Public Municipal: 15.6
- Parking Lots/Garages: 12.3
- Workplace: 12.1
- Hotels: 12.1
- Education: 11.1
- Multi-Family: 9.3
- Retail: 9.1

Median site usage frequency

8/1/2013 to 1/1/2014 (after Blink network fees were instituted)
Distribution of Usage Frequency of Blink DCFC Sites by Venue

Average number of charging events per site per week

Venue: Public Municipal, Parking Lots/Garages, Workplace, Hotels, Education, Multi-Family, Retail

Frequency: 0, 20, 40, 60, 80, 100, 120
Distribution of Usage Frequency of Blink DCFC Sites by Venue
Distribution of Usage Frequency of Blink DCFC Sites by Venue

Average number of charging events per site per week

<table>
<thead>
<tr>
<th>Venue</th>
<th>Average Number of Charging Events per Site per Week</th>
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<td>Transportation Hub</td>
<td></td>
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<tr>
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</tr>
<tr>
<td>Leisure Destination</td>
<td></td>
</tr>
<tr>
<td>Retail</td>
<td></td>
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</tbody>
</table>

L2
Blink DCFC Sites – Public / Municipal

- 22.0 City hall, Hayward CA
- 16.6 South Coast AQMD HQ, Diamond Bar CA
- 12.5 Petaluma Visitors Center near 101, Petaluma CA
Blink DCFC Sites – Parking Lots and Garages

<table>
<thead>
<tr>
<th>Average number of charging events per site per week</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>42.3</td>
<td>Downtown Seattle WA</td>
</tr>
<tr>
<td>29.2</td>
<td>Downtown Seattle WA</td>
</tr>
<tr>
<td>16.0</td>
<td>Downtown Los Angeles CA</td>
</tr>
<tr>
<td>12.3</td>
<td>Public Library, park, shopping center, Santa Clara CA</td>
</tr>
<tr>
<td>6.9</td>
<td>Public parking, Azusa CA</td>
</tr>
<tr>
<td>5.9</td>
<td>Downtown San Francisco CA</td>
</tr>
<tr>
<td>4.6</td>
<td>Business park, South San Francisco CA</td>
</tr>
</tbody>
</table>
Blink DCFC Sites – Retail

<table>
<thead>
<tr>
<th>Average number of charging events per site per week</th>
<th>Location and City/State</th>
</tr>
</thead>
<tbody>
<tr>
<td>54.4</td>
<td>Tahoma Market on I5, Tacoma WA</td>
</tr>
<tr>
<td>35.0</td>
<td>Fred Meyer, Kirkland WA</td>
</tr>
<tr>
<td>30.4</td>
<td>Nissan dealership, Bellevue WA</td>
</tr>
<tr>
<td>23.1</td>
<td>Fred Meyer, Hillsboro OR</td>
</tr>
<tr>
<td>22.8</td>
<td>Fred Meyer, Seattle WA</td>
</tr>
<tr>
<td>22.6</td>
<td>Mall on I205, Happy Valley OR</td>
</tr>
<tr>
<td>20.9</td>
<td>Fred Meyer, Salem OR</td>
</tr>
<tr>
<td>19.1</td>
<td>Fred Meyer, Portland OR</td>
</tr>
<tr>
<td>16.5</td>
<td>Nissan dealership, Santa Rosa CA</td>
</tr>
<tr>
<td>16.4</td>
<td>Shopping center near I5, Wilsonville OR</td>
</tr>
<tr>
<td>16.0</td>
<td>United Markets (grocery store), San Rafael CA</td>
</tr>
<tr>
<td>12.7</td>
<td>Nissan dealership, Petaluma CA</td>
</tr>
</tbody>
</table>
Identifying Hot Spots Using Vehicle Data

- EV Project Leaf away-from-home parking location density in San Francisco Bay Area
- Cumulative through the end of 2013
REI, movie theater

Target, 
“everyday mall with some discount stores”

Trader Joe’s, Pier One, Yogurtland

Shopping center
Preview of Corridor EVSE Usage in Oregon and Washington
AeroVironment and Blink DCFCs along OR & WA Corridors

- AeroVironment provided INL data from DCFCs and Level 2 units that were installed as part of the Washington & Oregon West Coast Electric Highway
AeroVironment and Blink DCFCs along OR & WA Corridors

- 9/1/2012 to 1/1/2014
- Highest usage in metro areas
- State of Oregon’s Electric Byways are attracting users off the I5 corridor
Future Work
Tasks for rest of FY14 and FY15

Leaf and Volt travel studies

• Leaf and Volt away-from-home infrastructure usage vs. eVMT
  – Day-time vs. night-time; home vs. away from home; L1 vs. L2 vs. DCFC
  – Update Volt Aug and Sep 2013 papers

• Leaf driving range
  – How often do they drive beyond single charge range?
  – When they do, what infrastructure do they use? How far from home do they drive?
  – How important are DCFCs for range extension?
Tasks for rest of FY14 and FY15 (cont.)

Workplace charging

• Longitudinal driving and charging behavior of drivers with access to WP charging
  – How many WP charging users “need” it based on commuting patterns?
  – Are they off-setting home off-peak charging with WP on-peak charging?
• Vehicle charging frequency at small, medium, large companies with WP charging
• Additional case studies
Tasks for rest of FY14 and FY15 (cont.)

EVSE usage by venue
- Venue definitions paper
- Overall comparison of usage by venue
- Deep dives by venue (airports, retail, leisure, etc.)

EVSE usage and PEV travel on inter-city corridors
- OR/WA I5
- San Diego/LA
- Nashville/Knoxville (?)
- Chattanooga/Atlanta (?)

EVSE installation costs vs. use ("bang for buck" analysis)
Tasks for rest of FY14 and FY15 (cont.)

Demand charge impact

• DCFCs
• Banks of Level 2 EVSE

Grid demand and vehicle states as inputs to models

• Use EV Project and ChargePoint America data to support Collaborative PEV Smart Grid Integration Requirements and Opportunities Study
For all EV Project and ChargePoint America publications, visit

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

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Smart Boys Like EV Charging Infrastructure

(Now if only Dad would buy them an EV…)

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