Electric Vehicle Charging Infrastructure Usage Observed in Large-scale Charging Infrastructure Demonstrations

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NAS Committee on Overcoming Barriers to EV Deployment open-session meeting

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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

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

aho National Laboratory

- Study customer usage of residential and public infrastructure
- INL data collection May 2011 Dec 2013



Infrastructure Deployment in The EV Project Idaho National Laboratory

Blink Charging Units Reporting Data in The EV Project through September 2013





ChargePoint America Charging Units By Type - Through September 2013





Outline

Questions to answer

- What are the key differences in charging station use between regions?
- Which stations are used most frequently, and which least frequently?
- How are drivers using the stations?
- Quantitative results
- Qualitative observations



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





Charging Frequency by EVSE Type









Charging Frequency by EVSE Type





Charging Frequency by EVSE Type





Charging Frequency by EVSE Type and Region





Charging Frequency by EVSE Type and Region - SF, LA, WA



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Charging Frequency by EVSE Type and Region - SF, LA, WA





Blink Charging Unit Usage



Average time connected per charging event (hr)



Blink Charging Unit Usage



15



Blink Residential EVSE Usage

Q4 2013 Residential EVSE Usage Frequency and Duration





Blink Charging Unit Usage





Blink Public Level 2 EVSE Usage



18



Blink Public Level 2 EVSE Usage





Blink Charging Unit Usage



20



Blink DC Fast Charger Usage

Q4 2013 DCFC Usage Frequency and Duration



Idaho National Laboratory

Distribution of Blink & ChargePoint Public Level 2 EVSE Usage Frequency by Region and Metropolitan Area in 2013





Top 20 Most Frequently Used Public Level 2 Charging Sites

Date Range	1/1/2013 – 1/1/2014
Total Charging Events per Site	2500 - 6300
Average Number of Charging Events per Week per Site	60 -120
Sites by State	 19 in California 1 in Tennessee
Venues of the Top 20	 Parking Garage (8) Business Office (5) Public / Municipal (3) Mall (2) University (1) Manufacturing plant (1)



Multiple Cases at Same Public Charging Site

- Public charging venue is not always clear indicator of how the charging units will be used
- Example: EVSE in public parking garage in urban center may serve multiple types of customers
 - Workplace parking / charging
 - 4 to 16 hrs
 - Restaurant or retail customer parking / charging
 - 0.5 to 2+ hrs
 - Car sharing fleet vehicles
 - 0.5 to 100+ hrs

Public Level 2 Charging Examples in San Diego



San Diego State University



Top 20 Most Frequently Used Public DC Fast Charging Sites

Range Of Use	1/1/2013 – 1/1/2014
Total Charging Events per Site	1400 - 3000
Average Number of Charging Events per Week per Site	23 - 52
Sites by State	 11 in California 7 in Washington 2 in Oregon
Venues of the top 20	 Business Office (5) Retail / Mall (6) University (3) Public / Municipal (2) Auto Dealership (2) Recreation / Museum (1) Multi-Family (1)



EV Project Nissan Leaf DC Fast Charger Usage



47% of fast charges were performed on round-trip outings of 60 miles or less



EV Project Nissan Leaf DC Fast Charger Usage



Vehicles had 30% or lower SOC at the start of 42% of fast charges



Charging Site Location Considerations

- EVSE installations with respect to Amercians with Disabilities Act (ADA) requirements are not consistent
 - "Charger is between 2 handicap spaces. To charge and not get ticketed you need to park behind the charger in any of 3 spaces closest to the elevator / entrance in non EV dedicated spots. Good Luck."
 - Comment from plugshare.com user
- Parking lot or garage may have
 - limited hours of operation
 - parking fees
 - restricted access





Charging Site Location Considerations

- Parking spaces in front of charging units may not always be accessible
 - Construction
 - Non-electric vehicle in parking spot ("you've been ICE'd")
 - Electric vehicles in parking spots but not charging





Fred Meyer in Seattle, WA

Photos from plugshare.com



Charging Site Location Considerations

- Charging unit maintenance and reliability is a big factor
 - "Both sides [of the DC fast charger] and level 2 not working. Had no electrics left. AAA couldn't send out the EV rescue truck because according to them they didn't have a tech trained to use it on hand. I ended up towing my car home. Not a good night."
 - Comment from plugshare.com user





Comments on Cost of DC Fast Charging

- "One of the DC fast chargers is now open and responsive. When I swiped card, it indicated a charge of \$5 would be levied, and since my car was nearly fully charged, I opted not to charge. The other DC fast charger and the Level 2 charger are still inaccessible." Comment from plugshare.com user
- "Did a quick charge on blink card, worked great. Was out if charge, so quickly charging up for \$5 was OK." – Comment from plugshare.com user
- "The quick charger here is awesome! I can go into the Fred Meyer and have lunch and have my car fully charged by the time I'm done. This makes having an EV more practical as I had to commute to Redmond from Everett with an already low charge. Definitely worth \$5" – Comment from Plugshare.com user

Workplace Charging Examples









EVSE User Turnover at Work Sites

Distribution of Number of Distinct Users per EVSE Day at 5 Worksites with Level 2 EVSE



Conclusion



Questions to answer

- What are the key differences in charging station use between regions?
 - San Francisco and Los Angeles areas lead the country in use
 - San Diego use high because of Car2Go Car Sharing vehicle charging
 - Atlanta stands out for increasing trend
- Which stations are used most frequently, and which least frequently?
 - Most frequently used sites identified
 - Workplace charging is popular for level 2 charging, as expected
 - Cannot rush to judgment on infrequently used sites
- How are drivers using the stations?
 - Multiple users per day at workplaces
 - Cost matters, but hard to say how much at this point
 - Multiple use cases for same charging site
- Factors that complicate public charging
 - ADA considerations
 - Parking spots can be "ICE'd", blocked by construction, etc.
 - Parking lot/garage may have hours of operation, parking fees which impact usage of charging units



Additional Information

- 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 publications, visit

avt.inl.gov/evproject.shtml

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Additional Context

Number of public charging sites nationwide

- Blink: 1,793
- ChargePoint: 1,302

Blink usage fees

- Public Level 2 fees started Jul Aug 2012
 - Varies from \$1.00 to \$2.00 / hr
 - 16% of sites are still free (per local site host discretion)
- DC Fast Charger (DCFC) fees started Jun Aug 2013
 - \$5 for Blink member / \$8 for non-member per session

ChargePoint usage fees

- Vary by site (per local site host discretion)
- Many are free