• This presentation was given for the Navigant Research Webinar on Fast DC Charging for Electric Vehicles

• [http://www.navigantresearch.com/webinar/fast-dc-charging-for-electric-vehicles](http://www.navigantresearch.com/webinar/fast-dc-charging-for-electric-vehicles)

• April 9, 2013
Lessons Learned on the EV Project and DC Fast Charging

Garrett Beauregard
Executive Vice President and General Manager, eTec Labs

April 9, 2013
ECOtality Company Overview

Leading Hardware, Software and R&D for electric transportation
Diversified revenue base of 3 complementary business segments

**Blink**
- Residential, public & commercial EV charging solutions
- Contracted by U.S. Dept. of Energy for The EV Project (~$115M)
- Over 11,000 chargers installed as of April 2013

**Minit-Charger**
- Fast charging electric material handling and ground support equipment
- 5,600+ chargers deployed in warehouse and distribution centers
- Reduces fuel costs while enhancing productivity and safety

**ETEC Labs**
- 20+ years of consulting for Advanced Transportation Testing, Evaluation, Research & Analysis
- Awarded $26.4M by U.S. Dept. of Energy for advanced vehicle testing
- 86 million+ miles of testing on advanced vehicles & infrastructure
Blink EV Charge Stations

Membership Card

Level 2 Residential

Level 2 Commercial

DC Fast Charger
The EV Project
The largest Department of Energy EV Infrastructure Program

PROJECT MANAGER: ECOtality North America (eTec)

PROJECT SCOPE: Approx. 13,000 Charging Stations
8,300 Nissan LEAFs, GM Volts, Smart ForTwo

TOTAL VALUE: $230 million project
($115m grant from US DoE, $115m ECOtality/Partner match)

OBJECTIVES:
• Plan, build and evaluate mature EV charge infrastructure
• Collect and analyze data on EV driving and charging
• Evaluate business models for public EVSE
• Generate lessons learned to guide policy makers, industry planners and investors
• Lay foundation for shift to EVs in broader market
The EV Project
Quarterly Reports Lessons Learned

EV Project Quick Facts

- Over 78,000,000 miles recorded on EVP vehicles to date
- Approximately 2,500,000 gallons of gasoline saved
- 2.2 million residential charge events
- Over 19,600 MWh energy charged into Project vehicles
- 5,700 metric Tons CO₂ avoided
Quarterly Reports Lessons Learned

Chevrolet Volt

- Avg distance traveled per day (mi): 40.5
- Avg trip distance (mi): 8.1
- Avg # of trips between charging: 3.5
- Avg distance between charging (mi): 28.2
- Avg # of charging events/day: 1.4

Nissan Leaf

- Avg distance traveled per day (mi): 29.2
- Avg trip distance (mi): 6.9
- Avg # of trips between charging: 3.8
- Avg distance between charging (mi): 26.3
- Avg # of charging events/day: 1.1

4th Quarter 2012 Data
• 69 DC Fast Chargers installed
• Dual port dispenser design
• Real time communications
  • 3G or Ethernet
• Certified utility meter
• CHAdeMo Certified
• ADA compliant
• 42” Color Monitor (optional); specified advertising space
## DC Fast Charge Locations

<table>
<thead>
<tr>
<th>Region</th>
<th>State</th>
<th>DC FC Installed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle</td>
<td>WA</td>
<td>5</td>
</tr>
<tr>
<td>Tacoma</td>
<td>WA</td>
<td>1</td>
</tr>
<tr>
<td>Portland</td>
<td>OR</td>
<td>11</td>
</tr>
<tr>
<td>Salem</td>
<td>OR</td>
<td>3</td>
</tr>
<tr>
<td>Santa Rosa</td>
<td>CA</td>
<td>4</td>
</tr>
<tr>
<td>North Bay Area</td>
<td>CA</td>
<td>2</td>
</tr>
<tr>
<td>Palo Alto</td>
<td>CA</td>
<td>5</td>
</tr>
<tr>
<td>East Bay Area</td>
<td>CA</td>
<td>3</td>
</tr>
<tr>
<td>San Jose</td>
<td>CA</td>
<td>3</td>
</tr>
<tr>
<td>Lost Angeles</td>
<td>CA</td>
<td>2</td>
</tr>
<tr>
<td>Santa Ysabel</td>
<td>CA</td>
<td>1</td>
</tr>
<tr>
<td>San Diego</td>
<td>CA</td>
<td>1</td>
</tr>
<tr>
<td>Phoenix</td>
<td>AZ</td>
<td>14</td>
</tr>
<tr>
<td>Nashville</td>
<td>TN</td>
<td>4</td>
</tr>
<tr>
<td>Chatanooga</td>
<td>TN</td>
<td>6</td>
</tr>
<tr>
<td>Knoxville</td>
<td>TN</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>69</strong></td>
</tr>
</tbody>
</table>

See [www.blinknetwork.com/blinkMap.html](http://www.blinknetwork.com/blinkMap.html)
DC Fast Charge Facts

Greatest use of Fast Chargers as of the end of Q4 2012

- Seattle – 423 charge events per EVSE
- Los Angeles – 314
- San Francisco – 280

Highest Total AC Consumption for DC Fast Chargers

- San Francisco – 18.2 MWhr
- Oregon - 13.4
- Seattle – 10.4
DC Fast Usage

Charge Events per EVSE
Project to End of Quarter

Average Charging Events per EVSE

- Phoenix
- Tucson
- Los Angeles
- San Diego
- San Francisco
- Oregon
- Wash State
- Chattanooga
- Knoxville
- Memphis
- Nashville
- Dallas/FW
- Houston
- Wash DC
- Atlanta
- Chicago
- Philadelphia

- Public Level 2
- DCFC
DC Fast Usage

Q4 2012 DCFC Usage Frequency and Duration

- Washington State
- San Francisco
- Los Angeles
- Phoenix
- Nashville
- San Diego
- Chattanooga
- Knoxville

Number of charging events / EVSE day vs. Average time connected per charging event (min)
DC Fast Charge Barriers

- Demand and energy costs are significant for some utilities
  - 25¢/kWh (cost of energy)
  - $25/kW (demand charges per kW)
- DC FC is demand charge free in a few service territories
- Many utility service territories have significant Demand charges

<table>
<thead>
<tr>
<th>Utility Demand Charges - Nissan Leaf</th>
<th>Cost/mo.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA Glendale Water and Power</td>
<td>$16.00</td>
</tr>
<tr>
<td>Hercules Municipal Utility:</td>
<td>$377.00</td>
</tr>
<tr>
<td>Los Angeles Department of Water and</td>
<td>$700.00</td>
</tr>
<tr>
<td>Power</td>
<td></td>
</tr>
<tr>
<td>Burbank Water and Power</td>
<td>$1,052.00</td>
</tr>
<tr>
<td>San Diego Gas and Electric</td>
<td>$1,061.00</td>
</tr>
<tr>
<td>Southern California Edison</td>
<td>$1,460.00</td>
</tr>
<tr>
<td>AZ TRICO Electric Cooperative</td>
<td>$180.00</td>
</tr>
<tr>
<td>The Salt River Project</td>
<td>$210.50</td>
</tr>
<tr>
<td>Arizona Public Service</td>
<td>$483.75</td>
</tr>
<tr>
<td>OR Pacificorp</td>
<td>$213.00</td>
</tr>
<tr>
<td>WA Seattle City Light</td>
<td>$61.00</td>
</tr>
</tbody>
</table>
DC Fast Charge Barriers

- Demand charges can have a drastic effect on per charge costs
- Example analysis using $12/kW demand charge

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Number of Vehicles Charged/ Month</th>
<th>Meter Charge</th>
<th>Demand Charge</th>
<th>Energy Charge</th>
<th>Monthly Total</th>
<th>Cost per Vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>$200</td>
<td>$0</td>
<td>$0</td>
<td>$200</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>$200</td>
<td>$600</td>
<td>$2.20</td>
<td>$802.20</td>
<td>$802.20</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>$200</td>
<td>$600</td>
<td>$22</td>
<td>$822</td>
<td>$82.20</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>$200</td>
<td>$600</td>
<td>$220</td>
<td>$1,020</td>
<td>$10.20</td>
</tr>
<tr>
<td>5</td>
<td>250</td>
<td>$200</td>
<td>$600</td>
<td>$550</td>
<td>$1,350</td>
<td>$5.40</td>
</tr>
<tr>
<td>6</td>
<td>500</td>
<td>$200</td>
<td>$600</td>
<td>$1,100</td>
<td>$1,900</td>
<td>$3.80</td>
</tr>
</tbody>
</table>
Mitigation Technologies

• **Limit demand of DC FCs**
  - 20 kW maximum charge rate
  - Other output rates (25, 30 kW?)
  - 5 kWh in any 15 minute period
  - Incorporate w/ facility energy management systems
    • Variable TOU restrictions by site
    • Utilize up to the peak capacity

*Publicly Available EVSE Demand*
Mitigation Technologies

- **Energy Storage assisted DC FC**
  - Demand reduction
  - Grid ancillary services
  - Renewables absorption

- **Revised Utility Tariffs**
  - Demand responsive charging
  - Aggregated charger loads
  - Longer term--PUCs
North American Standardization

- DC Fast Charge standard confusion
  - Some Japanese OEMs have adopted the CHAdeMO standard
  - Other OEMs will adopt SAE COMBO standard
- VHS vs Beta, again
  - Will take 5-10 years to get to one common standard
Global Standardization Challenges

- Risk of stranding EV first adopters
- Lack of standard stalls deployment
- Expensive to convert & recertify DC Fast Charge equipment
- OEM & industry cooperation
Stay Tuned!

- Another year of collecting data
- More Leafs and Volts participating
- 17 more DC FC installed Q1 2013 toward 200 total
- More lessons to be learned
- Q1 2013 report released soon
- www.TheEVProject.com

This material is based upon work supported by the Department of Energy under Award Number DE-EE0002194. The project is a public-private partnership, funded in part by the U.S. Department of Energy through a federal stimulus grant and made possible by the American Recovery and Reinvestment Act (ARRA).

www.ECOtality.com    www.blinknetwork.com