Lessons Learned – Deployment Barriers

EUEC 2013

Session E8

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ECOtality North America

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Publicly Traded Company [NASDAQ:ecty]
- Formed in 1989
Advanced vehicle testing and evaluation
- 12+ million miles of advanced vehicle testing
- Electric, CNG, hydrogen, diesel
Industrial vehicle infrastructure
- 6,000+ chargers installed
- Distribution warehouses, factories and airports
On road infrastructure
- Planning, engineering, construction, operation, maintenance
- EV Project
EV Project Objectives

- Identify Infrastructure Deployment Barriers
- Demonstrate Infrastructure Technologies
- Evaluate Infrastructure Business Models
- Develop Guidance For Future Infrastructure Deployment
60+ EV Project Partners Include:

U.S. Department of Energy

NISSAN

Chevrolet

Idaho National Laboratory

THE Project

EV Project
Blink Chargers

- Smart UI
- Internet Connectivity
- Energy/Power Metering
- Access Control
- Business Model Support
Deployment Status

- **Residential**: 6,322 (78%) of 8,000
- **Commercial**: 2,840 (55%) of 5,000
- **DC FC**: 48 (24%) of 200
Qualifier - What do we know? We only do infrastructure!

Divergent Standards
- Fast charge
  - CHAdeMO
  - SAE J1772 “Combo Connector”
- Wireless charging

Technology Issues

Desire To Use Electric Fuel

Vehicle Barriers – Observations
Electric Fuel Use

38 miles all electric
- Avg distance traveled per day (mi): 41.2
- Avg trip distance (mi): 8.3
- Avg # of trips between charging: 3.5
- Avg distance between charging (mi): 29.3
- Avg # of charging events/day: 1.4

73 miles all electric
- Avg distance traveled per day (mi): 30
- Avg trip distance (mi): 7.2
- Avg # of trips between charging: 3.9
- Avg distance between charging (mi): 27.9
- Avg # of charging events/day: 1.1
Leaf Use

Battery State of Charge (SOC) at the Start of Charging Events

- Home location
- Away-from-home location

Percent of Charging Events

Charging Event Starting SOC (%)

0% < 10% 10% < 20% 20% < 30% 30% < 40% 40% < 50% 50% < 60% 60% < 70% 70% < 80% 80% < 90% ≥ 90%

THE Project
Volt Use

Battery State of Charge (SOC) at the Start of Charging Events

- Home location
- Away-from-home location

Percent of Charging Events

Charging Event Starting SOC (%)

0-10, 10-20, 20-30, 30-40, 40-50, 50-60, 60-70, 70-80, 80-90, >90

The EV Project
Objective Should Be To Maximize Electric Transportation Fuel Use

- Higher power chargers – all about energy throughput
- Blink Lifestyle – opportunity charge
- Infrastructure is not the “Field of Dreams”

The Past Does Not Predict The Future Of Infrastructure Use

- Do not rely solely on ICE data
- Do not ignore behavior change

Value Remains King

- Societal costs are not part of the value determination
Deployment Barriers - Observations

- Residential Permit Timeliness
  - Most cities have positively embraced PEVs
    - EV Project outreach
    - DOE Clean Cities
  - Majority of permits are over-the-counter
  - Several Cities allow self inspection
    - Eliminates wait time for a City inspector
    - Reduces City cost
  - This is not currently an issue
Deployment Barriers - Observations

- Residential Permit Cost
  - Permit fees vary significantly
  - Fees are often a significant portion of installation cost

<table>
<thead>
<tr>
<th>Region</th>
<th>Count of Permits</th>
<th>Average Permit Fee</th>
<th>Minimum Permit Fee</th>
<th>Maximum Permit Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>66</td>
<td>$96.11</td>
<td>$26.25</td>
<td>$280.80</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>109</td>
<td>$83.99</td>
<td>$45.70</td>
<td>$218.76</td>
</tr>
<tr>
<td>San Diego</td>
<td>496</td>
<td>$213.30</td>
<td>$12.00</td>
<td>$409.23</td>
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<tr>
<td>San Francisco</td>
<td>401</td>
<td>$147.57</td>
<td>$29.00</td>
<td>$500.00</td>
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<tr>
<td>Tennessee</td>
<td>322</td>
<td>$47.15</td>
<td>$7.50</td>
<td>$108.00</td>
</tr>
<tr>
<td>Oregon</td>
<td>316</td>
<td>$40.98</td>
<td>$12.84</td>
<td>$355.04</td>
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<tr>
<td>Washington</td>
<td>497</td>
<td>$78.27</td>
<td>$27.70</td>
<td>$317.25</td>
</tr>
</tbody>
</table>
Deployment Barriers - Observations

- Non-Residential Permitting
  - Costs and delays are significant
  - Load studies
  - Zoning reviews
  - Moving video

- Municipal Sites
  - Statutory delays
  - Legal barriers
  - Street side locations very limited
Deployment Issues - Observations

- Non-Residential Cost
  - Hosts are value sensitive
    - Cost is a major driver
    - Revenue centric
    - Image counts
  - ADA compliance
    - Major cost implication
    - No uniform application
    - Accessibility issue
    - Parking space count
    - DOJ guidance critical
Residential Chargers
- Cost is significant but not limiting
- External factors drive cost
  - Permit fees and inspection costs

Non-Residential Chargers
- Not a “Field of Dreams”
- ROI is everything
  - Cash
  - Intangibles
- Permitting drives cost and delays
- Lack of clear regulation drives cost
  - ADA
  - Connection standards
- Revenue will be critical
Utility commercial electricity rates do NOT promote PEVs

Demand costs are significant at many utilities

Some utilities offer commercial rates without demand charges

Others incorporate a 20 kW to 50 kW demand threshold

Demand rates can be as much as $25/kW per month

<table>
<thead>
<tr>
<th>No Demand Charges - Nissan Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
</tr>
<tr>
<td>Pacific Gas &amp; Electric</td>
</tr>
<tr>
<td>City of Palo Alto</td>
</tr>
<tr>
<td>Alameda Municipal Power</td>
</tr>
<tr>
<td>Silicon Valley Power</td>
</tr>
<tr>
<td>AZ</td>
</tr>
<tr>
<td>Tucson Electric Power</td>
</tr>
<tr>
<td>OR</td>
</tr>
<tr>
<td>Eugene Water &amp; Electric Board</td>
</tr>
<tr>
<td>Lane Electric Co-op</td>
</tr>
<tr>
<td>TN</td>
</tr>
<tr>
<td>Middle Tennessee Electric</td>
</tr>
<tr>
<td>Duck River Electric</td>
</tr>
<tr>
<td>Harriman Utility Board</td>
</tr>
<tr>
<td>Athens Utility Board</td>
</tr>
<tr>
<td>Cookeville Electric Department</td>
</tr>
<tr>
<td>Cleveland Utilities</td>
</tr>
<tr>
<td>Nashville Electric Service</td>
</tr>
<tr>
<td>EPB Chattanooga</td>
</tr>
<tr>
<td>Lenoir City Utility Board</td>
</tr>
<tr>
<td>Volunteer Electric Cooperative</td>
</tr>
<tr>
<td>Murfreesboro Electric</td>
</tr>
<tr>
<td>Sequachee Valley Electric Coop</td>
</tr>
<tr>
<td>Knoxville Utility Board</td>
</tr>
<tr>
<td>Maryville</td>
</tr>
<tr>
<td>Fort Loudoun Electric</td>
</tr>
<tr>
<td>Memphis Light Gas and Water Division</td>
</tr>
</tbody>
</table>
Monthly demand charges result in significant operating costs in many utility service territories.

<table>
<thead>
<tr>
<th>Utility Demand Charges - Nissan Leaf</th>
<th>Cost/mo.</th>
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</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>
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<tr>
<td>Los Angeles Department of Water and Power</td>
<td>$700.00</td>
</tr>
<tr>
<td>Burbank Water and Power</td>
<td>$1,052.00</td>
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<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>
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<td>The Salt River Project</td>
<td>$210.50</td>
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<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>
Non-residential charging is inherently more expensive than home charging
- Equipment
- Installation
- Energy

Higher costs of non-residential charging must be reduced
- Vehicles will tether to home
- Market limited to homeowners

Commercial energy costs are universally higher than residential energy costs – particularly with residential TOU
Time-of-use rates are very effective in moving residential transportation energy use to preferred times.

- Time available to charge is much greater than the time required to charge (even with only a 3.3 kW charger).
- Even modest on peak to off peak price ratios drive charging to off peak times.
- Convenient charge scheduling facilitates matching vehicle charging times to off peak times.
EV chargers potentially represent the first wide – scale deployment of smart devices incorporating energy storage.

Faster is better – at least for EV charging.

Existing utility rate structures cannot take advantage of the inherent flexibility EV charging can provide.

- Carrot and stick rates used to promote efficiency and transfer cost
- Tiered whole house rates
- Inability to handle embedded meters
- Significant demand costs

Real-time cost based rates for transportation energy are required.
Business Models - Observations

- Competition is Home Charging, Not Gasoline
  - Lowest energy costs
  - Special EV charging rates to encourage off peak use
- Free Charging Is Not Sustainable
- Access Fees Only Don’t Work
  - Energy costs greater than home
  - Demand charges don’t exist at home
  - Equipment costs greater than home
  - Maintenance costs greater than home
Other value chains must support user and host value
- Branding
- Network services
- Grid services
- Advertising
Network Services

Connect.
Available on most phones and tablet devices.

Locate a charger.
Find the closest charging station using your phone or tablet.

Be notified.
Securely access your account and be notified by SMS or email.

View charging status.
Check the status of your charge - from anywhere!
Grid Services

- Grid Connection
  - Cloud-to-Cloud
  - Utility AMI
  - Meter direct

- Dispatchable Load
  - Demand reduction
  - Renewables absorption
  - Economic dispatch
Our mission and vision is simple. Blink anywhere you go.
Information Dissemination

- 62 million miles in database
- ≈100 million miles by end of EV Project
- 1.5 million charge events
- 10,000 MWh of electric fuel consumed
- Quarterly reporting of information
- Quarterly presentation of observations from data
- White papers present lessons learned and results
- Final report presents conclusions

THE EV Project

ecotality NORTH AMERICA
## EV Project Overview Report

Project to date through September 2012

### Charging Infrastructure

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of EV Project Charging Units</th>
<th>Number of Charging Events</th>
<th>Electricity Consumed (AC MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phoenix, AZ Metropolitan Area</td>
<td>661</td>
<td>84,521</td>
<td>626.03</td>
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<tr>
<td>Tucson, AZ Metropolitan Area</td>
<td>182</td>
<td>22,424</td>
<td>157.89</td>
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<tr>
<td>Los Angeles, CA Metropolitan Area</td>
<td>752</td>
<td>98,736</td>
<td>865.76</td>
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<tr>
<td>San Diego, CA Metropolitan Area</td>
<td>1,089</td>
<td>227,990</td>
<td>2,046.84</td>
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<tr>
<td>San Francisco, CA Metropolitan Area</td>
<td>1,428</td>
<td>264,138</td>
<td>2,536.02</td>
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<tr>
<td>Washington, D.C. Metropolitan Area</td>
<td>196</td>
<td>25,758</td>
<td>164.35</td>
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<tr>
<td>Oregon</td>
<td>892</td>
<td>128,122</td>
<td>984.63</td>
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<td>Chattanooga, TN Metropolitan Area</td>
<td>126</td>
<td>13,226</td>
<td>109.19</td>
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<tr>
<td>Knoxville, TN Metropolitan Area</td>
<td>258</td>
<td>25,091</td>
<td>214.85</td>
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<tr>
<td>Memphis, TN Metropolitan Area</td>
<td>75</td>
<td>8,462</td>
<td>71.85</td>
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<tr>
<td>Nashville, TN Metropolitan Area</td>
<td>603</td>
<td>50,360</td>
<td>705.92</td>
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<tr>
<td>Columbus, OH, Cincinnati Area</td>
<td>303</td>
<td>22,321</td>
<td>158.65</td>
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<td>Columbus, OH, Columbus Area</td>
<td>141</td>
<td>14,547</td>
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<tr>
<td>Columbus, OH, Columbus Area</td>
<td>1,089</td>
<td>189,174</td>
<td>1,565.86</td>
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<td>Chicago, IL Metropolitan Area</td>
<td>9</td>
<td>58</td>
<td>0.22</td>
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<td>Atlanta, GA Metropolitan Area</td>
<td>6</td>
<td>29</td>
<td>0.24</td>
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<tr>
<td>Philadelphia, PA Metropolitan Area</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
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<tr>
<td>Total</td>
<td>7,798</td>
<td>1,226,954</td>
<td>10,315.59</td>
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### Vehicles

<table>
<thead>
<tr>
<th>Region</th>
<th>EV Project Nissan Leafs Enrolled to Date</th>
<th>EV Project Chevrolet Volts Enrolled to Date</th>
<th>EV Project Smart Electric Drives Enrolled to Date</th>
<th>Distance Driven (mi)</th>
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</thead>
<tbody>
<tr>
<td>Phoenix, AZ Metropolitan Area</td>
<td>259</td>
<td>83</td>
<td>—</td>
<td>2,938,251</td>
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<td>Tucson, AZ Metropolitan Area</td>
<td>79</td>
<td>7</td>
<td>—</td>
<td>602,174</td>
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<td>Los Angeles, CA Metropolitan Area</td>
<td>465</td>
<td>146</td>
<td>—</td>
<td>4,138,739</td>
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<td>San Diego, CA Metropolitan Area</td>
<td>657</td>
<td>153</td>
<td>300</td>
<td>8,379,969</td>
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<td>San Francisco, CA Metropolitan Area</td>
<td>1,441</td>
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<td>—</td>
<td>11,573,530</td>
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<tr>
<td>Washington, D.C. Metropolitan Area</td>
<td>7</td>
<td>177</td>
<td>—</td>
<td>1,203,109</td>
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<tr>
<td>Oregon</td>
<td>469</td>
<td>87</td>
<td>0</td>
<td>4,207,080</td>
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<td>Chattanooga, TN Metropolitan Area</td>
<td>50</td>
<td>11</td>
<td>—</td>
<td>488,318</td>
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<tr>
<td>Knoxville, TN Metropolitan Area</td>
<td>88</td>
<td>17</td>
<td>—</td>
<td>960,641</td>
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<tr>
<td>Memphis, TN Metropolitan Area</td>
<td>39</td>
<td>19</td>
<td>—</td>
<td>310,755</td>
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<tr>
<td>Nashville, TN Metropolitan Area</td>
<td>394</td>
<td>29</td>
<td>—</td>
<td>3,363,328</td>
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<tr>
<td>Dallas/Ft. Worth, TX Metropolitan Area</td>
<td>0</td>
<td>133</td>
<td>—</td>
<td>985,715</td>
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<tr>
<td>Houston, TX Metropolitan Area</td>
<td>1</td>
<td>69</td>
<td>—</td>
<td>691,625</td>
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<td>Washington State</td>
<td>747</td>
<td>88</td>
<td>—</td>
<td>6,685,449</td>
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<td>Chicago, IL Metropolitan Area</td>
<td>2</td>
<td>19</td>
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<td>51,824</td>
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<td>Atlanta, GA Metropolitan Area</td>
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<td>5</td>
<td>—</td>
<td>14,589</td>
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<td>Philadelphia, PA Metropolitan Area</td>
<td>4</td>
<td>9</td>
<td>—</td>
<td>24,536</td>
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<tr>
<td>Total</td>
<td>4,719</td>
<td>1,052</td>
<td>300</td>
<td>46,709,592</td>
</tr>
</tbody>
</table>

**Note:** EV Project charging units may be used by vehicles that are not part of the EV Project. Likewise, EV Project vehicles may connect to non-EV Project charging units. Therefore vehicle and charging infrastructure usage shares on this report are not directly comparable.

**¹** Regions: Oregon region includes the Greater Corvallis, Eugene, Portland, and Salem Metropolitan Areas

**²** Vehicle enrollment numbers refer to the EV Project only. Numbers do not reflect total regional or national vehicle sales or production.

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EV Project White Papers

- DC Fast Charge-Demand Charge Reduction (May 2012)
- The EV Micro-Climate Planning Process (May 2012)
- Signage (April 2012)
- Greenhouse Gas Avoidance and Fuel Cost Reduction (June 2012)
- First Responder Training (March 2011)
- Accessibility at Public EV Charging Locations (October 2011)
- Battery Electric Vehicle Driving and Charging Behavior Observed Early in The EV Project (April 2012)
**EV Project Website**

**EV Project Documents**

**EV Project Quarterly Reports**
- EV Project EVSE and Vehicle Usage Report: 2nd Quarter 2011
- EV Project EVSE and Vehicle Usage Report: 3rd Quarter 2011
- EV Project EVSE and Vehicle Usage Report: 4th Quarter 2011
- EV Project EVSE and Vehicle Usage Report: 1st Quarter 2012
- EV Project EVSE and Vehicle Usage Report: 2nd Quarter 2012

**Electric Vehicle Charging Infrastructure Deployment Guidelines**
- Electric Vehicle Charging Infrastructure Deployment Guidelines for the Central Puget Sound Area (May 2010)
- Electric Vehicle Charging Infrastructure Deployment Guidelines for the Oregon I-5 Metro Areas of Portland, Salem, Corvallis and Eugene (April 2010)
- Electric Vehicle Charging Infrastructure Deployment Guidelines for the Greater Tucson Area (April 2010)
- Electric Vehicle Charging Infrastructure Deployment Guidelines for the State of Tennessee (May 2010)
- Electric Vehicle Charging Infrastructure Deployment Guidelines for the Greater San Diego Area (May 2010)
- Electric Vehicle Charging Infrastructure Deployment Guidelines for the Greater Phoenix Area (April 2010)
Much More to Come

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