U.S. Department of Energy’s Vehicle Technologies Program

NYC TLC - Plug-in Electric Vehicle Infrastructure and Usage Information

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NYC Taxi and Limousine Commission
New York, New York
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This presentation does not contain any proprietary or sensitive information
Idaho National Laboratory

- U.S. Department of Energy (DOE) 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
AVTA Participants

- The Advanced Vehicle Testing Activity (AVTA) is the U.S. Department of Energy, Vehicle Technologies Program’s (VTP) singular field, tract, and laboratory based source of testing light-duty whole vehicle systems and subsystems
  - Idaho National Laboratory manages the AVTA for VTP
  - ECOtality provides testing support via a competitively bid NETL (National Energy Testing Laboratory) contract
- For the EV Project, ECOtality is the project lead and INL provides data collection, analysis and dissemination support
- Test partners include electric utilities, Federal, state and local government agencies, private companies, and individual vehicle owners
AVTA Goals

• The AVTA goals
  – Petroleum reduction and energy security
  – Benchmark technologies that are developed via DOE research investments

• Provide benchmark data to DOE, National Laboratories (ANL, NREL, ORNL, PNNL), Federal Agencies (DOD, DOI, DOT, EPA, USPS), technology modelers, R&D programs, vehicle manufacturers (via USCAR’s VSATT, EESTT, GITT), and target and goal setters

• Assist fleet managers, via Clean Cities, FEMP and industry gatherings, in making informed vehicle and infrastructure deployment and operating decisions
Vehicle / Infrastructure Testing Experience

- 82 million test miles accumulated on 11,200 electric drive vehicles representing 115 models. 1 million miles / week
- EV Project: 7,700 Leafs, Volts and Smart EVs, 10,076 EVSE and DC Fast Chargers (DCFC), 64 million test miles
- ChargePoint: 3,908 EVSE reporting 761,000 charge events
- PHEVs: 14 models, 430 PHEVs, 4 million test miles
- EREV: 1 model, 150 EREV, 900,000 test miles
- HEVs: 21 models, 52 HEVs, 6.2 million test miles
- Micro hybrid (stop/start) vehicles: 3 models, 7 MHVs, 509,000 test miles
- NEVs: 24 models, 372 NEVs, 200,000 test miles
- BEVs: 47 models, 2,000 BEVs, 5 million test miles
- UEVs: 3 models, 460 UEVs, 1 million test miles
- Other testing includes hydrogen ICE vehicle and infrastructure testing

Note: all 4th quarter 2012 data is preliminary and subject to change
INL Vehicle/EVSE Data Management Process

Process Driven by Disclosure Agreements

Data quality reports

INL Vehicle Data Management System

Individual vehicle reports

Report generator

Fleet summary Reports - Public

File server

Focused technical analyses and custom reports

SQL Server data warehouse

Modeling and simulation input

HICEVs

HEVs

PHEVs

BEVs & EREVs

EVSE & Chargers

Parameters range check
Lame data check
Missing/empty parameter check
Conservation of energy check
SOC continuity

Transit completion

Parameters range check
Lame data check
Missing/empty parameter check
Conservation of energy check
SOC continuity

Trip Fuel Economy (mpg)

Log. (CD trips)
Log. (CD/CS trips)

Avg Hourly Vehicle Charging Demand

Mon AM - Tues AM
Tue AM - Wed AM
Wed AM - Thu AM
Thu AM - Fri AM
Fri AM - Sat AM
Sat AM - Sun AM
Sun AM - Mon AM

CD trips
CD/CS trips
CS trips

Time of Day

6:00-6:59
7:00-7:59
8:00-8:59
9:00-9:59
10:00-10:59
11:00-11:59
12:00-12:59
13:00-13:59
14:00-14:59
15:00-15:59
16:00-16:59
17:00-17:59
18:00-18:59
19:00-19:59
20:00-20:59
21:00-21:59
22:00-22:59
23:00-23:59
0:00-0:59
1:00-1:59
2:00-2:59
3:00-3:59
4:00-4:59
5:00-5:59

Modeling and simulation input
Protected Data

Vehicle and Charger Data

Access restricted by firewall rules

EV Project FTPS/SFTP Server

OEM Data Management Systems

OEM pushes using FTPS/SFTP

INL pulls with encrypted transmission

INL Protect Enclave - EV Project member access only

INL Internal firewall

INL DMZ Firewall – Public has access to AVT.INL.GOV

Vehicle and Charger Data

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INL Data Management System - Push
(Nissan, GM, Chrysler, Coulomb, Aerovironment)

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INL Data Management System - Push
(Nissan, GM, Chrysler, Coulomb, Aerovironment)
INL Data Management System - Pull
(ECOtality, Ford, conversion PHEVs, HEVs, HICEs)

Protected Data

Vehicle and Charger Data

OEM Data Management Systems

INL pulls with encrypted transmission

INL transmits reports to DOE and OEMs

INL Protect Enclave - EV Project member access only

INL DMZ Firewall – Public has access to AVT.INL.GOV

INL Internal firewall

Fleet summary reports - public

AVT.INL.GOV

INL Pulls with encrypted transmission

Parameters range check
Lame data check
Missing/empty parameter check
Conservation energy check
SOC continuity
Transfer completion

INL Internal firewall

INL Protect Enclave - EV Project member access only

INL DMZ Firewall – Public has access to AVT.INL.GOV
Data Collection, Security and Protection

• All vehicle, EVSE, and PII raw data is legally protected by NDAs (Non Disclosure Agreements) or CRADAs (Cooperative Research and Development Agreements)
  – Limitations on how proprietary and personally identifiable information can be stored and distributed
  – Raw data, in both electronic and printed formats, is not shared with DOE in order to avoid exposure to FOIA
  – Vehicle and EVSE data collection would not occur unless testing partners trust INL would strictly adhere to NDAs and CRADAs
  – Raw data cannot be legally distributed by INL
EV Project Goal, Locations, Participants, and Reporting

- **Goal:** Build and study mature charging infrastructures and take the lessons learned to support the future streamlined deployment of grid-connected electric drive vehicles.
- **ECOtality** is the EV Project lead, with INL, Nissan and Onstar/GM as the prime partners, with more than 40 other partners such as electric utilities.
- **EV Project** reporting requires INL to blend three distinct data streams from ECOtality, Nissan and Onstar/GM.
- **40 different EV Project reports** are generated quarterly for the general public, DOE, ECOtality, project participants, industry, regulatory organizations, as well as per special requests.
EV Project – EVSE Data Parameters Collected per Charge Event

- Data from ECOtality’s Blink EVSE network
- Connect and Disconnect Times
- Start and End Charge Times
- Maximum Instantaneous Peak Power
- Average Power
- Total energy (kWh) per charging event
- Rolling 15 Minute Average Peak Power
- Date/Time Stamp
- Unique ID for Charging Event
- Unique ID Identifying the EVSE
- And other non-dynamic EVSE information (GPS, ID, type, contact info, etc.)
EV Project – Vehicle Data Parameters Collected per Start/Stop Event

- Data is received via telematics providers from Chevrolet Volts and Nissan Leafs
- Odometer
- Battery state of charge
- Date/Time Stamp
- Vehicle ID
- Event type (key on / key off)
- GPS (longitude and latitude)
- Recorded for each key-on and key-off event

- Additional data is received monthly from Car2go for the Smart EVs
EV Project Vehicles / Miles, end of 2012

- 7,346 vehicles reporting data
  - 5,801 Leafs. 79%
  - 1,215 Volts. 17%
  - 330 Smart EVs. 4%
- 60.1 million total miles
- 150,000 test miles per day
EV Project EVSE Deployed / Use end of 2012

- 9,493 total EVSE
  - 6,864 (72%) Residential EVSE
  - 2,575 (27%) non-residential EVSE
  - 54 (1%) DCFC

- 1.7 million charge events
  - 1,579,894 (92%) Residential EVSE
  - 131,298 (8%) non-residential EVSE
  - 8,820 (1%) DCFC
EV Project Charge Energy (MWh) end of 2012

- 14,418 MWh total electricity charged
  - 13,328 MWh (92%) residential
  - 1,029 MWh (7%) non-residential
  - 61 MWh (0.4%) DCFC

- Vehicle efficiency cannot be accurately calculated using total vehicle miles and total energy
  - Non-EV Project vehicles sometimes charge at EV Project EVSE
  - EV Project vehicles may charge at 110V or other 240V non-EV Project EVSE
EV Project Overview Report 4th Quarter 2012

- San Francisco has 17% of all EVSE 30% of all Leafs
- Washington DC has 16% and Texas has 18% of all Volts
## EV Project – National Data

### 4rd quarter 2012 Data Only

<table>
<thead>
<tr>
<th></th>
<th>Leafs</th>
<th>Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of vehicles</td>
<td>3,762</td>
<td>1,021</td>
</tr>
<tr>
<td>Number of Trips</td>
<td>969,853</td>
<td>369,118</td>
</tr>
<tr>
<td>Distance (million miles)</td>
<td>6.7</td>
<td>3.0</td>
</tr>
<tr>
<td>Average (Ave) trip distance</td>
<td>6.9 mi</td>
<td>8.1 mi</td>
</tr>
<tr>
<td>Ave distance per day</td>
<td>29.2 mi</td>
<td>40.5 mi</td>
</tr>
<tr>
<td>Ave number (#) trips between charging events</td>
<td>3.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Ave distance between charging events</td>
<td>26.3 mi</td>
<td>28.2 mi</td>
</tr>
<tr>
<td>Ave # charging events per day</td>
<td>1.1</td>
<td>1.4</td>
</tr>
</tbody>
</table>

* Note that per day data is only for days a vehicle is driven.
EV Project – Leaf Operations Trends

- Some decreases in average miles per day and average miles per charge

| Number of Leafs reporting each quarter with matched EVSE data |
|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 35                | 956            | 2,394          | 2645           | 2987           | 2911           | 3200           | 3762           |
EV Project – **Leaf** Charging Location Trends

- 9% increase in home charging and 10% decrease in non-home charging as a revenue model is introduced

### Nissan Leaf Driver Charging Behavior

- **Percent home charging**
- **Percent away from home charging**
- **Percent unknown locations**

### Number of Leafs reporting each quarter with matched EVSE data

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Number of Leafs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1Q 2011</td>
<td>35</td>
</tr>
<tr>
<td>2Q 2011</td>
<td>956</td>
</tr>
<tr>
<td>3Q 2011</td>
<td>2,394</td>
</tr>
<tr>
<td>4Q 2011</td>
<td>2,645</td>
</tr>
<tr>
<td>1Q 2012</td>
<td>2,987</td>
</tr>
<tr>
<td>2Q 2012</td>
<td>2,911</td>
</tr>
<tr>
<td>3Q 2012</td>
<td>3,200</td>
</tr>
<tr>
<td>4Q 2012</td>
<td>3,762</td>
</tr>
</tbody>
</table>
EV Project – **Volt** Operations Trends

- Average quarterly increases in miles per day and per charge have decreased most recently

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**Chevy Volt Driver Operations Behavior**

- Avg Trip Distance - Miles
- Avg Miles per day
- Ave Trips Between Charges
- Ave Miles per Charge
- Ave # Charges per Day

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**Number of Volts reporting each quarter with matched EVSE data**

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>317</td>
<td>408</td>
<td>809</td>
<td>1021</td>
<td></td>
</tr>
</tbody>
</table>
EV Project – Volt Charging Location Trends

- 3% increase in home charging and 1% decrease in non-home charging as a revenue model is introduced
EV Project – Residential EVSE L2 Use Trends

- Continued gradual increases in time vehicles connected per charge and in AC KWh transferred per charge event

Residential EVSE Infrastructure Use Trends

Number of Residential EVSE Level reporting each quarter

<table>
<thead>
<tr>
<th>Quarter</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>35</td>
<td>955</td>
<td>2413</td>
<td>2704</td>
<td>3324</td>
<td>3338</td>
<td>4020</td>
<td>4819</td>
</tr>
</tbody>
</table>

Residential EVSE Level 2 = R2, Weekend = WE, Weekday = WD
EV Project – Public EVSE L2 Use Trends

- Increases in kWh per charge and time energy is drawn
- Average time vehicle connected appears to be rising this last quarter

<table>
<thead>
<tr>
<th>Number of Public EVSE Level reporting each quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>170</td>
</tr>
</tbody>
</table>

Public EVSE Level 2 = P2, Weekend = WE, Weekday = WD
EV Project – EVSE Infra. Summary Report

- Percent of public L2 EVSE deployed is now 30% of all L2 EVSE

- As measured by kWh use and number of charge events, revenue model may be decreasing public L2 EVSE use
**EV Project Public L2 EVSE Usage end of 2012**

- Contribution of Car Sharing Fleets is significant

<table>
<thead>
<tr>
<th>All territories</th>
<th>Car sharing fleet</th>
<th>Nissan Leaf</th>
<th>Chevrolet Volt</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicles Charged</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of charging events</td>
<td>25%</td>
<td>21%</td>
<td>5%</td>
<td>49%</td>
</tr>
<tr>
<td>Percent of kWh consumed</td>
<td>38%</td>
<td>17%</td>
<td>3%</td>
<td>41%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>San Diego</th>
<th>300 Car2Go fleet</th>
<th>Nissan Leaf</th>
<th>Chevrolet Volt</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicles Charged</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of charging events</td>
<td>59%</td>
<td>16%</td>
<td>2%</td>
<td>23%</td>
</tr>
<tr>
<td>Percent of kWh consumed</td>
<td>72%</td>
<td>11%</td>
<td>1%</td>
<td>16%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Oregon (Car2Go in Portland)</th>
<th>30 Car2Go fleet</th>
<th>Nissan Leaf</th>
<th>Chevrolet Volt</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicles Charged</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of charging events</td>
<td>5%</td>
<td>29%</td>
<td>4%</td>
<td>61%</td>
</tr>
<tr>
<td>Percent of kWh consumed</td>
<td>11%</td>
<td>27%</td>
<td>4%</td>
<td>58%</td>
</tr>
</tbody>
</table>
EV Project – EVSE Infra. Summary Report

- National Residential and Public Level 2 Weekday EVSE 4th Quarter 2012

- Residential and public connect time and energy use are fairly opposite profiles. Note different scales

National Residential Connect Time

National Public Connect Time

National Residential Demand

National Public Demand
EV Project – EVSE Infra. Summary Report

- Residential Level 2 Weekday EVSE 4th Quarter 2012
- San Diego and San Francisco, with residential L2 TOU rates, are similar to national and other regional EVSE connect profiles

San Diego

Los Angeles

San Francisco

Washington State
EV Project – EVSE Infra. Summary Report

- Residential Level 2 Weekday EVSE 4th Quarter 2012
- TOU kWh rates in San Diego and San Francisco clearly impact when vehicle charging start times are set

San Diego

Los Angeles

San Francisco

Washington State
• 54 DCFCs connected and demand profiles

Weekday Connected Profile

• 1.9 average charge events per day per DCFC
• Leafs 43% charge events and 45% energy
• Unknowns other charge events and energy

Weekday Demand Profile

• 19.3 minutes average time connected
• 19.3 minutes average time drawing energy
• 7.2 kWh average energy consumed per charge
L2 Access Fees Structure

- **4th Quarter is first widespread implementation of simple and low cost access fees**
- **Blink member**
  - Affiliate credit card with free Blink RFID “In Card”
  - Level 2 access fee of $1.00 per hour of connect time
- **Guest - No Blink RFID “In Card” required**
  - Guest Code using quick reservation code or website
  - Level 2 access fee of $2.00 per hour of connect time
- **Future pricing**
  - Pricing to reflect regional electricity rates
  - Cover electricity costs in all cases
DC Fast Charge (DCFC) Fees Structure

• Encourage DCFC use with initial free charging
• Implement DCFC access fees by region in 1st Quarter 2013 with beta testing currently underway
• Initial fee structure simple and low cost
  – Accommodate varying vehicle charge rates
  – Accommodate select limitation of charging output power
• Blink member
  – $25 per month unlimited use or $5.00 per session
• Guest
  – $8.00 per session
Residential Lessons Learned

- Permit timeliness has not been a problem
- Majority are over-the-counter
- Permit fees vary significantly- $7.50 to $500.00

<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>
</tr>
<tr>
<td>San Francisco</td>
<td>401</td>
<td>$147.57</td>
<td>$29.00</td>
<td>$500.00</td>
</tr>
<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>
</tr>
<tr>
<td>Washington</td>
<td>497</td>
<td>$78.27</td>
<td>$27.70</td>
<td>$317.25</td>
</tr>
</tbody>
</table>
Residential Lessons Learned

- **Average residential installation cost ≈$1,375**
- **Individual installations vary widely**
- **Some user bias to lower costs**

<table>
<thead>
<tr>
<th>Marlets In Ascending Order Of Residential Installation Cost</th>
<th>Number of Installations</th>
<th>Average Installation Cost</th>
<th>Variation From Project Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tennessee (entire State)</td>
<td>542</td>
<td>$1,113.07</td>
<td>-19.0%</td>
</tr>
<tr>
<td>Arizona (Phoenix &amp; Tucson)</td>
<td>357</td>
<td>$1,148.88</td>
<td>-16.4%</td>
</tr>
<tr>
<td>Washington DC</td>
<td>3</td>
<td>$1,197.44</td>
<td>-12.9%</td>
</tr>
<tr>
<td>Oregon (Portland, Eugene, Coralvis &amp; Salem)</td>
<td>465</td>
<td>$1,229.06</td>
<td>-10.6%</td>
</tr>
<tr>
<td>Washington (Seattle &amp; Olympia)</td>
<td>730</td>
<td>$1,289.56</td>
<td>-6.2%</td>
</tr>
<tr>
<td>Maryland</td>
<td>39</td>
<td>$1,311.75</td>
<td>-4.5%</td>
</tr>
<tr>
<td>Washington</td>
<td>80</td>
<td>$1,321.36</td>
<td>-3.8%</td>
</tr>
<tr>
<td>Virginia</td>
<td>38</td>
<td>$1,341.01</td>
<td>-2.4%</td>
</tr>
<tr>
<td>San Fransisco</td>
<td>1254</td>
<td>$1,386.13</td>
<td>0.9%</td>
</tr>
<tr>
<td>Texas (metro Houston &amp; Dallas)</td>
<td>128</td>
<td>$1,422.77</td>
<td>3.5%</td>
</tr>
<tr>
<td>San Diego</td>
<td>726</td>
<td>$1,593.91</td>
<td>16.0%</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>415</td>
<td>$1,791.64</td>
<td>30.6%</td>
</tr>
</tbody>
</table>
Commercial Lessons Learned

- **ADA significantly drives cost**
  - Accessible charger
  - Van accessible parking
  - Accessible electric and passage routes to facility

- **Permit fees and delays can are significant**
  - Load studies
  - Zoning reviews
Commercial Lessons Learned

- Commercial permits range $14 to $821

<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>72</td>
<td>$228</td>
<td>$35</td>
<td>$542</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>17</td>
<td>$195</td>
<td>$67</td>
<td>$650</td>
</tr>
<tr>
<td>San Diego</td>
<td>17</td>
<td>$361</td>
<td>$44</td>
<td>$821</td>
</tr>
<tr>
<td>Texas</td>
<td>47</td>
<td>$150</td>
<td>$37</td>
<td>$775</td>
</tr>
<tr>
<td>Tennessee</td>
<td>159</td>
<td>$71</td>
<td>$19</td>
<td>$216</td>
</tr>
<tr>
<td>Oregon</td>
<td>102</td>
<td>$112</td>
<td>$14</td>
<td>$291</td>
</tr>
<tr>
<td>Washington</td>
<td>33</td>
<td>$189</td>
<td>$57</td>
<td>$590</td>
</tr>
</tbody>
</table>
Commercial Lessons Learned

- **Demand and energy costs are significant for some utilities**
  - 25¢/kWh
  - $25/kW
- **Some utilities offer commercial rates without demand charges**
- **Others incorporate 20 kW to 50 kW demand thresholds**
- **Nissan Leaf is demand charge free in some electric utility service territories**

<table>
<thead>
<tr>
<th>State</th>
<th>Utilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>Pacific Gas &amp; Electric, City of Palo Alto, Alameda Municipal Power, Silicon Valley Power</td>
</tr>
<tr>
<td>AZ</td>
<td>Tucson Electric Power</td>
</tr>
<tr>
<td>OR</td>
<td>Eugene Water &amp; Electric Board, Lane Electric Co-op</td>
</tr>
<tr>
<td>TN</td>
<td>Middle Tennessee Electric, Duck River Electric, Harriman Utility Board, Athens Utility Board, Cookeville Electric Department, Cleveland Utilities, Nashville Electric Service, EPB Chattanooga, Lenoir City Utility Board, Volunteer Electric Cooperative, Murfreesboro Electric, Sequachee Valley Electric Cooperative, Knoxville Utility Board, Maryville, Fort Loudoun Electric, Memphis Light Gas and Water Division</td>
</tr>
</tbody>
</table>
Commercial Lessons Learned

- **Recurring Nissan Leaf DC fast charge demand charges are significant in many utility service territories**

<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 Power</td>
<td>$700.00</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>
**ChargePoint America ARRA Project**

- Conducted by Coulomb
- Project to Dec. 2012
- 3,908 EVSE installed and reporting data
  - 1,763 Residential
  - 193 Private / commercial
  - 1,940 Public
  - 12 unknown
- 760,995 charge events
- 5,359 AC MWh

---

### ChargePoint America Vehicle Charging Infrastructure Summary Report

**Project Status to Date through: June 2012**

<table>
<thead>
<tr>
<th>Charging Unit - By State</th>
<th>Residential</th>
<th>Private Commercial</th>
<th>Public</th>
<th>Not Specified</th>
<th>Charging Units Installed to Date</th>
<th>Number of Charging Events Performed</th>
<th>Electricity Consumed (AC MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>791</td>
<td>39</td>
<td>518</td>
<td>3</td>
<td>1,351</td>
<td>213,758</td>
<td>1,487.7</td>
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<tr>
<td>Connecticut</td>
<td>11</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>11</td>
<td>2,569</td>
<td>15.1</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>-</td>
<td>16</td>
<td>15</td>
<td>-</td>
<td>32</td>
<td>718</td>
<td>5.4</td>
</tr>
<tr>
<td>Florida</td>
<td>40</td>
<td>10</td>
<td>228</td>
<td>2</td>
<td>263</td>
<td>9,320</td>
<td>55.2</td>
</tr>
<tr>
<td>Maryland</td>
<td>18</td>
<td>7</td>
<td>74</td>
<td>-</td>
<td>71</td>
<td>4,945</td>
<td>47.6</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>23</td>
<td>7</td>
<td>74</td>
<td>-</td>
<td>104</td>
<td>4,133</td>
<td>35.5</td>
</tr>
<tr>
<td>Michigan</td>
<td>29</td>
<td>14</td>
<td>172</td>
<td>-</td>
<td>438</td>
<td>60,436</td>
<td>407.1</td>
</tr>
<tr>
<td>New Jersey</td>
<td>51</td>
<td>2</td>
<td>17</td>
<td>-</td>
<td>70</td>
<td>15,397</td>
<td>95.7</td>
</tr>
<tr>
<td>New York</td>
<td>23</td>
<td>86</td>
<td>182</td>
<td>-</td>
<td>213</td>
<td>17,401</td>
<td>139.6</td>
</tr>
<tr>
<td>Texas</td>
<td>51</td>
<td>9</td>
<td>227</td>
<td>-</td>
<td>287</td>
<td>17,759</td>
<td>114.4</td>
</tr>
<tr>
<td>Virginia</td>
<td>23</td>
<td>17</td>
<td>43</td>
<td>-</td>
<td>63</td>
<td>10,061</td>
<td>65.0</td>
</tr>
<tr>
<td>Washington</td>
<td>12</td>
<td>7</td>
<td>123</td>
<td>-</td>
<td>142</td>
<td>8,150</td>
<td>50.0</td>
</tr>
<tr>
<td>Total</td>
<td>1,298</td>
<td>216</td>
<td>1,666</td>
<td>6</td>
<td>3,085</td>
<td>365,664</td>
<td>2,508.7</td>
</tr>
</tbody>
</table>

*Includes all charging units that were in use by the end of the reporting period.

*A charging event is defined as the period when a vehicle is connected to a charging unit, during which period some power is transferred.*
ChargePoint America ARRA Project

- Oct - Dec 2012 data
- 3,541 units
- Percent time vehicle connected
  - Residential 47%
  - Private/com 24%
  - Public 9%
- Percent time drawing power
  - Residential 9%
  - Private/com 5%
  - Public 4%
- EVSE data only
• Public is open access. Commercial are limited access
• Public and commercial reflect at work charging
• Residential reflects end of day return-to-home charging
• Note difference in scales
EVSE Testing

• AC energy consumption at rest and during Volt Charging benchmarked

• Steady state charge efficiency benchmarked

Most EVSE consume 13 W or less at rest. Higher watt use tied to more EVSE features

Most EVSE under 30 W during charge

Most EVSE 99+% efficient during steady state charge of a Volt
Hasetec DC Fast Charging Nissan Leaf

- 53.1 AC kW peak grid power
- 47.1 DC kW peak charge power to Leaf energy storage system (ESS)
- 15.0 Grid AC kWh and 13.3 DC kWh delivered to Leaf ESS
- 88.7% Overall charge efficiency (480VAC to ESS DC)
Conductive System Benchmarking

Entire report can be found at: http://avt.inel.gov/pdf/phev/EfficiencyResultsChevroletVoltOnBoardCharger.pdf
Additional Testing

• Initiated field and lab DC Fast Charge and Level 2 charging study of impacts on battery life in 6 Nissan Leafs
  – Two vehicles driven on road and L2 charged
  – Two driven identical routes DCFC charged
  – One L2 and 1 DCFC in battery lab
  – At 10k miles each vehicle similar minimal capacity fade

• INL conducting with the NFPA and US DOT, PEV traction battery fire demonstrations and suppression project

• INL initiated ~400 New York EVSE data collection with NYSERDA, NYPA, Port Authority of NY/NJ, and Energetics

• INL initiated DOE’s wireless charging test program
Summary

• EV Project vehicles connected much longer than needed to recharge - opportunities to shift charging times
• Significant residential Level 2 EV Project charging occurs off-peak with charge starts at midnight per TOU rates indicates consumers are price sensitive
• Revenue models for public charging are currently being introduced – long term impacts?
• Only about 60% of EV Project data collected to date
• DCFC charge events have significant demand impacts but this is an electric utility policy decision
• How, where, when we measure EVSE and vehicle system charging efficiencies results in significantly different results
Acknowledgement
This work is supported by the U.S. Department of Energy’s EERE Vehicle Technologies Program

More Information
http://avt.inl.gov

This presentation will be posted in the publications section of the above website

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