This presentation does not contain any proprietary, confidential, or otherwise restricted information.
### Timeline
- Project Start: 10/1/09
- Project End: 9/30/13
- Percent Complete: 48%

### Budget
- Total Project: $218,700,268
- DOE Share: $100,196,560
- Contractor: $118,503,708
- ORNL FWP: $6,800,000
- INL FWP: $7,803,440

### Barriers
- Slow Deployment of Vehicles
- Permitting Requirements
- Utility Demand Charges

### Partners
- Nissan North America
- General Motors
- 21 Cities
- 13 Electric Utilities
- 2 Universities
OBJECTIVES

- Establish mature charge infrastructures in diverse geographies
- Deploy grid-connected electric vehicles to utilize infrastructure
- Collect data characterizing infrastructure & vehicle utilization
- Evaluate means to improve infrastructure effectiveness
- Evaluate means to increase vehicle utilization
- Identify and resolve barriers to infrastructure deployment
- Develop models to support future infrastructure deployment
MILESTONES

- Project initiation 10/01/09 (complete)
- Complete 10-year plans 06/30/10 (complete)
- Complete EV Micro-Climates 08/30/10 (complete)
- Initial residential infrastructure 11/01/10 (complete)
- Initial vehicle deliveries 12/01/10 (complete)
- Initial commercial infrastructure 06/06/11 (complete)
- Initial DC fast charge infrastructure 10/24/11 (complete)
- Infrastructure deployments complete 12/31/12
- Data collection complete 09/30/13
INFRASTRUCTURE PLANNING

- Organize regional stakeholders
  - Government
  - Utilities
  - Employers

- Develop long-range Plan
  - Deployment area
  - Vehicle penetration
  - Infrastructure requirements

- Develop EV Micro-Climate
  - Support initial deployment
  - Provide deployment areas
INFRASTRUCTURE DEPLOYMENT

- Develop mature infrastructures
  - Install residential EVSE For Leaf & Volt Vehicles
  - Install level 2 commercial EVSE
  - Install DC fast charge in cities and on transportations routes

- Utilize Certified Contractor Network
  - Develop permitting and installation experience
  - Create jobs
DATA COLLECTION

- Collect vehicle data using vehicle telematics system
  - Vehicle Data Set On Key On/Key Off Event
  - Vehicle Identification Number
  - Time & Date
  - Location (GPS Coordinates)
  - Indicated Battery State-of-Charge
- Collect charge data using cellular/WiFi based network
  - Power and energy data using integral meter
  - Event data using network synchronized clock
- All data merged and stored at INL for analysis
SMART GRID INTEGRATION

- Charge control integration with electric utility
  - Demand reduction
  - Ancillary services
- Grid studies
  - Off peak price elasticity
  - Distribution transformer loading
PROJECT MANAGEMENT

- Project Staffing Complete (>100 new personnel)
- Project Offices Established (7 regional offices)
- Integration with Nissan & GM
  - Vehicle sales process
  - Vehicle telematics
- Certified Contractor Network operational (38 contractors)
- Infrastructure planning complete
- Cities added to deployment
  - CA – San Francisco & Los Angeles
  - TX – Dallas, Fort Worth & Houston
  - TN – entire state
HARDWARE DEPLOYMENT

- 4,424 Level 2 residential EVSE installed concurrent with vehicle sales as of 3/16/12
  - 4,033 Leaf
  - 391 Volt
- 1,349 Level 2 commercial EVSE installed as of 3/16/12
  - 558 sites
  - 782 additional units in progress
- 16 DC fast chargers installed as of 3/16/12
  - 32 additional units in progress
NETWORK IMPLEMENTATION

- Communications Network Established
  - WiFi residential network
  - M2M cellular commercial network
- Web portals established
  - Residential vehicle owner
  - Charger host
  - Electric utility
- Mobile application established
  - SMS notifications
  - Charger location mapping
DATA COLLECTION

- Vehicle data (12/31/11)
  - 13.7 million miles
  - 1.4 million trips
  - Distance between charges (Q4)
    - Volt 27.1 miles
    - Leaf 27.7 miles
DATA COLLECTION

- Charge data (12/31/11)
  - 370K charge events
  - 2.8 GWh consumed
BARRIER IDENTIFICATION

- AHJ inspector training
- ADA requirements
- Charge station signage
- Utility demand charges
- Residential metering
- Utility notification
- Cluster overloading
- Fast charge connector & communication standard
UL CERTIFICATION

- UL Joined EV Project As Partner
- UL Certification To New Standard 2594
  - Level 2 EVSE
  - DC Fast Charger
- Collaboration On Installer Standards
- Collaboration On Certification Issues
  - Plug-Connected EVSE
  - Meter Certification
SPECIAL EV RATES

- Collaboration With San Diego Gas & Electric
  - Test Four Different Time-of-Use Rates
  - Peak To Off Peak Ratios Vary From 2:1 To 6:1
- California Public Utilities Commission Approval
  - Implement With EV Project
  - Provide Rate Design Data For All California Utilities
- Validation of EVSE meter data
  - Both utility meter and EVSE meter data collected
  - Data compared to validate EVSE sub-meter
SOFT INFRASTRUCTURE

- AHJ Permit Process
  - Involvement in infrastructure planning
  - Training of inspector personnel
  - Early warning of install schedule
  - Ongoing development of permitting requirements

- Participation In CPUC regulatory process
  - Phase 1 OIR – are charge providers regulated
  - Phase 2 OIR – establishing policies to overcome barriers to EV deployment and complying with PUC Code 740.2
    - Rate design
    - Sub-metering
ADA REQUIREMENTS

- Coordinate Requirements With States
- ADA white paper issued
  - First EVSE Handicap Accessible
  - Van Accessibility Not Required
  - Building Accessibility Not Required
- Accommodating variant AHJ requirements
Future Work

EVSE ACCESS FEES

- Answer key questions regarding EV charging use patterns
- Comprehensively introduce fees for commercial EVSE
- Encourage the use of commercial EVSE
- Demonstrate value to charger hosts
- Evaluate business model sustainability
- Evaluate pricing model variants
- Keep it simple
DEMAND RESPONSE

- Utility Data Generation
  - Load Duration
  - Energy Use
  - EV Project Data
  - 10-Year Projections
- Demand Response
  - EVSE Control
  - User Transparency Evaluation
- GIS Based Data
  - Distribution Effects
  - Clustering

Weekday

Weekend
LESSONS LEARNED

- EV infrastructure planning
- Permitting
- EVSE installation cost
  - Residential
  - Commercial
- Use of commercial charging
- EVSE access pricing
- Utility regulatory issues
- EVSE theft & vandalism
- EVSE etiquette
- Smart versus dumb EVSE
SUMMARY

- EV Project hardware developed, certified, in production
- Infrastructure installation contractors onboard
- Vehicle and infrastructure deployment underway
- Data collection underway
- Barriers identified – many resolved
- Lessons learned developing
- Data analysis underway
### LEAF

**EV Project Nissan Leaf Vehicle Summary Report**

**Region:** ALL
**Number of Vehicles:** 2346
**Reporting period:** October 2011 through December 2011

#### Vehicle Usage

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average daily range (mi)</td>
<td>73.2</td>
<td>Change in the Nissan Leaf's driving range</td>
</tr>
<tr>
<td>Total distance traveled (mi)</td>
<td>46,759</td>
<td>Distance covered by the Nissan Leaf</td>
</tr>
<tr>
<td>Average distance per day when the vehicle was driven</td>
<td>60.8</td>
<td>Distance covered per day</td>
</tr>
<tr>
<td>Average distance traveled per day (mi)</td>
<td>50.0</td>
<td>Distance covered per day</td>
</tr>
<tr>
<td>Average distance between charging events (mi)</td>
<td>4.8</td>
<td>Distance between charging events</td>
</tr>
<tr>
<td>Average number of charging events per day when the vehicle was driven</td>
<td>27.7</td>
<td>Number of charging events per day</td>
</tr>
</tbody>
</table>

#### Charging Location and Type

<table>
<thead>
<tr>
<th>Location and Type</th>
<th>Number of Charging Events</th>
<th>Percent of All Charging Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>1,571</td>
<td>74%</td>
</tr>
<tr>
<td>Work</td>
<td>364</td>
<td>17%</td>
</tr>
<tr>
<td>Public</td>
<td>388</td>
<td>5%</td>
</tr>
</tbody>
</table>

### VOLT

**EV Project Chevrolet Volt Vehicle Summary Report**

**Region:** ALL
**Number of Vehicles:** 45
**Reporting period:** October 2011 through December 2011

#### Vehicle Usage

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average daily range (mi)</td>
<td>73.2</td>
<td>Change in the Chevrolet Volt's driving range</td>
</tr>
<tr>
<td>Total distance traveled (mi)</td>
<td>156,115</td>
<td>Distance covered by the Chevrolet Volt</td>
</tr>
<tr>
<td>Average distance per day when the vehicle was driven</td>
<td>14.4</td>
<td>Distance covered per day</td>
</tr>
<tr>
<td>Average distance traveled per day (mi)</td>
<td>13.9</td>
<td>Distance covered per day</td>
</tr>
<tr>
<td>Average distance between charging events (mi)</td>
<td>10.3</td>
<td>Distance between charging events</td>
</tr>
<tr>
<td>Average number of charging events per day when the vehicle was driven</td>
<td>1.4</td>
<td>Number of charging events per day</td>
</tr>
</tbody>
</table>

#### Charging Location and Type

<table>
<thead>
<tr>
<th>Location and Type</th>
<th>Number of Charging Events</th>
<th>Percent of All Charging Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>67%</td>
<td></td>
</tr>
<tr>
<td>Work</td>
<td>23%</td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>10%</td>
<td></td>
</tr>
</tbody>
</table>