ELECTRIC DRIVE VEHICLE DEMONSTRATION AND VEHICLE INFRASTRUCTURE EVALUATION

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ECOTALITY NORTH AMERICA

MAY 17, 2012

ARRAVT066

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OVERVIEW

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

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Approach

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INFRASTRUCTURE DEPLOYMENT

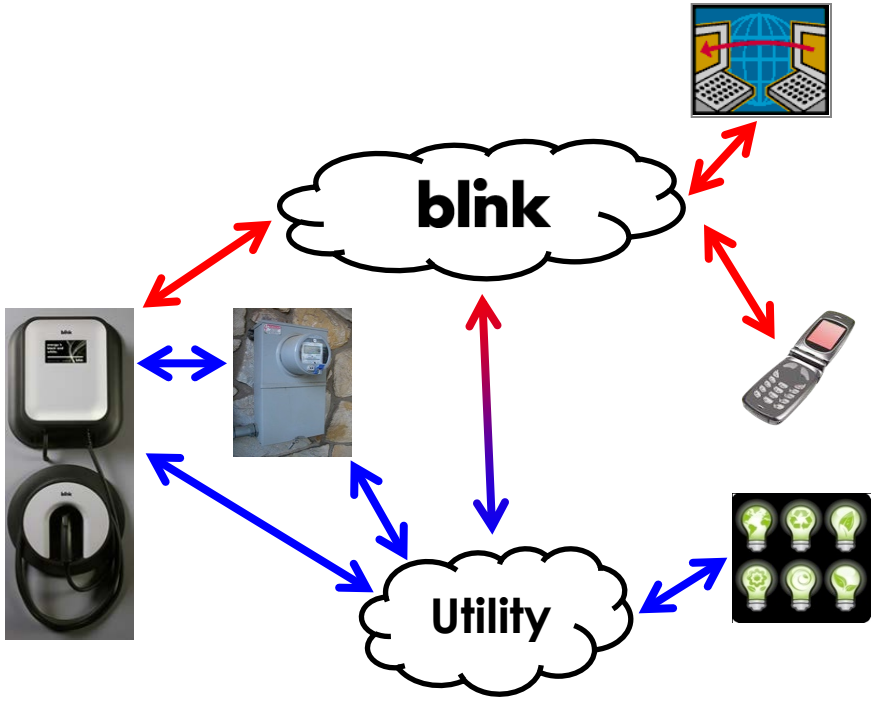
- Develop mature infrastructures
  - Install residential EVSE For Leaf & Volt Vehicles
  - Install level 2 commercial EVSE
  - Install DC fast charge in cities and on transportations routes
- Utilize Certified Contractor Network
  - Develop permitting and installation experience
  - Create jobs

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

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Accomplishments

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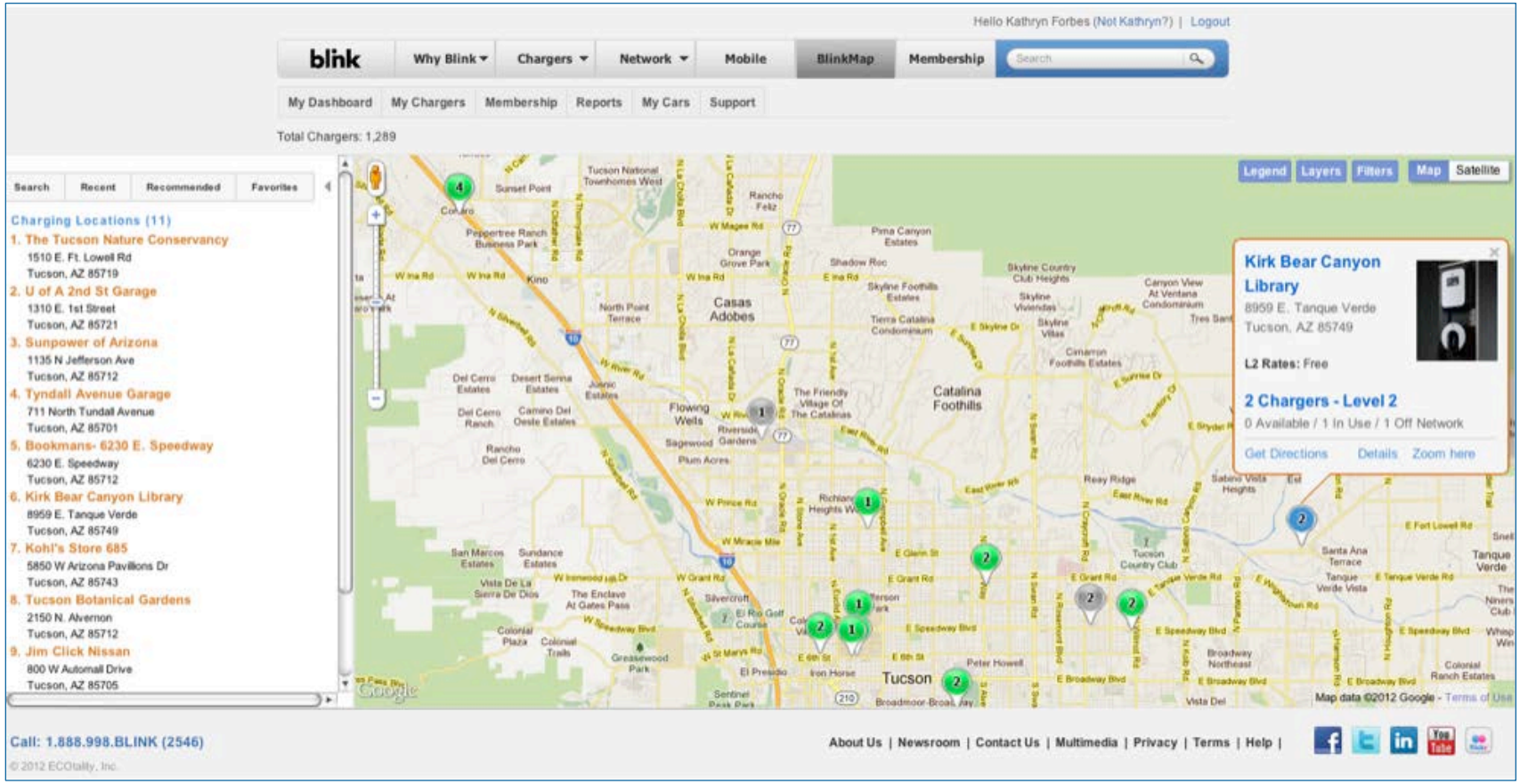
MAPPING IMPLEMENTATION



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Accomplishments

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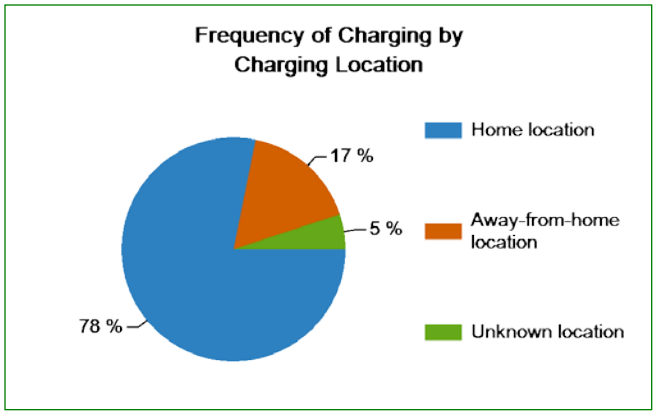
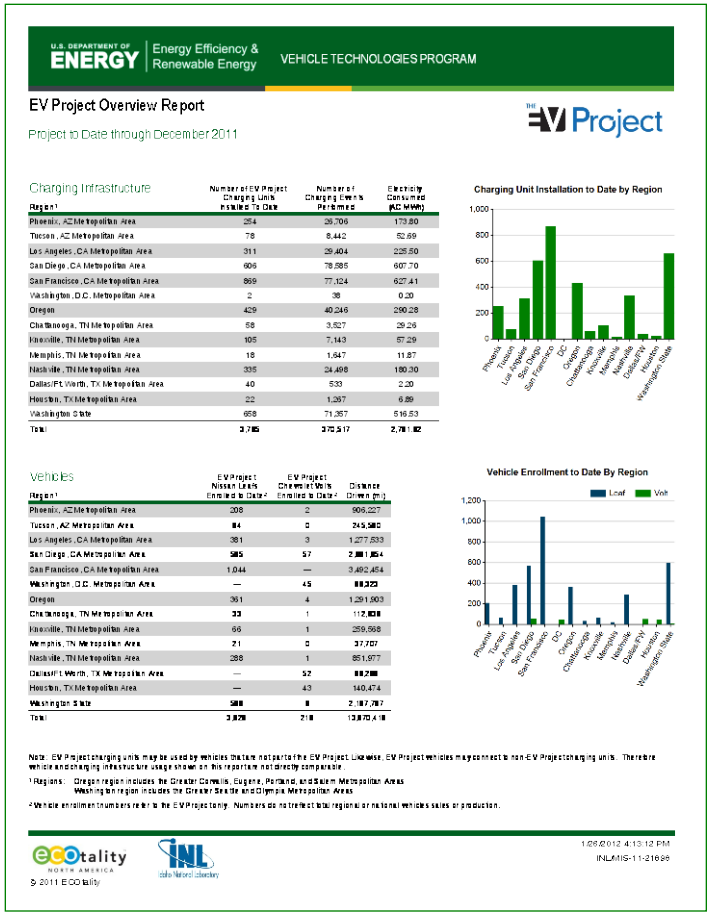
DATA COLLECTION

- 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

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EV Project Overview Report

Project to Date through December 2011

Charging Infrastructure

Region[1]	Number of EV Project Charging Units Installed To Date	Number of Charging Events Performed	Electricity Consumed (AC MWh)
Phoenix, AZ Metropolitan Area	254	26,706	173.80
Tucson, AZ Metropolitan Area	78	8,442	52.69
Los Angeles, CA Metropolitan Area	311	29,404	225.50
San Diego, CA Metropolitan Area	606	78,585	607.70
San Francisco, CA Metropolitan Area	869	77,124	627.41
Washington, D.C. Metropolitan Area	2	38	0.20
Oregon	429	40,246	290.28
Chattanooga, TN Metropolitan Area	58	3,827	29.26
Knoxville, TN Metropolitan Area	105	7,143	57.29
Memphis, TN Metropolitan Area	18	1,647	11.87
Nashville, TN Metropolitan Area	335	24,498	180.30
Dallas/Ft. Worth, TX Metropolitan Area	40	533	2.20
Houston, TX Metropolitan Area	22	1,267	6.89
Washington State	658	71,267	516.53
Total	3,785	370,517	2,781.82

Charging Unit Installation to Date by Region

Vehicles

Region[1]	EV Project Nissan Leafs Enrolled to Date[2]	EV Project Chevrolet Volts Enrolled to Date[2]	Distance Driven (mi)
Phoenix, AZ Metropolitan Area	208	2	906,227
Tucson, AZ Metropolitan Area	84	0	245,580
Los Angeles, CA Metropolitan Area	381	3	1,277,533
San Diego, CA Metropolitan Area	585	57	2,881,854
San Francisco, CA Metropolitan Area	1,044	—	3,492,454
Washington, D.C. Metropolitan Area	—	45	88,823
Oregon	361	4	1,291,903
Chattanooga, TN Metropolitan Area	33	1	112,838
Knoxville, TN Metropolitan Area	66	1	258,568
Memphis, TN Metropolitan Area	21	0	37,707
Nashville, TN Metropolitan Area	288	1	851,977
Dallas/Ft. Worth, TX Metropolitan Area	—	52	88,288
Houston, TX Metropolitan Area	—	43	140,474
Washington State	588	8	2,187,787
Total	3,879	218	13,870,418

Vehicle Enrollment to Date By Region

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 shown on this report are not directly comparable.

[1] Regions: Oregon region includes the Greater Corvallis, Eugene, Portland, and Salem Metropolitan Areas
Washington region includes the Greater Seattle and Olympia Metropolitan Areas

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

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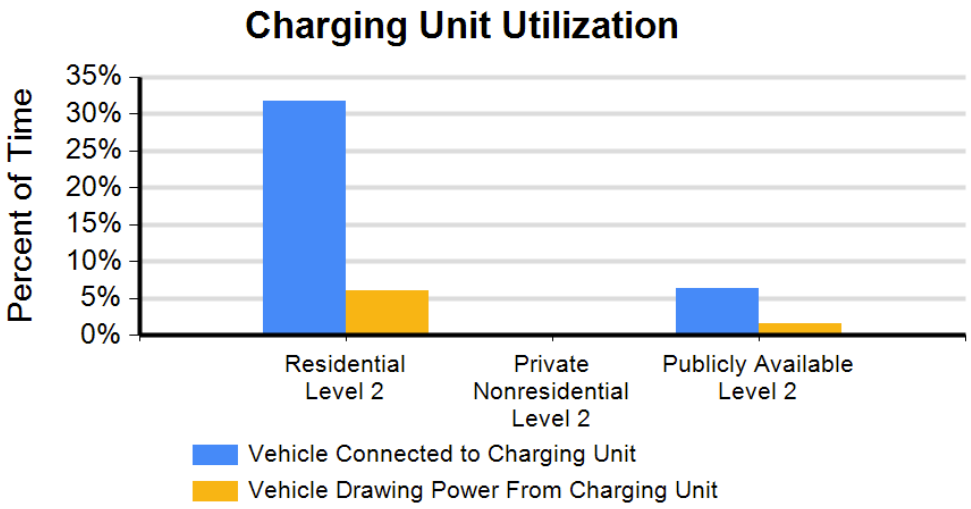
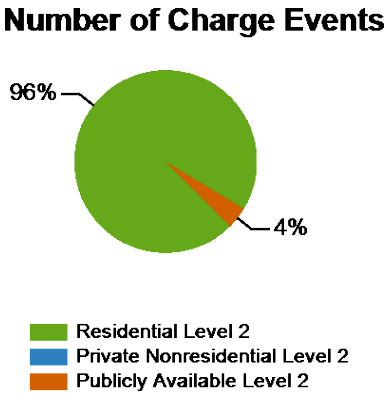
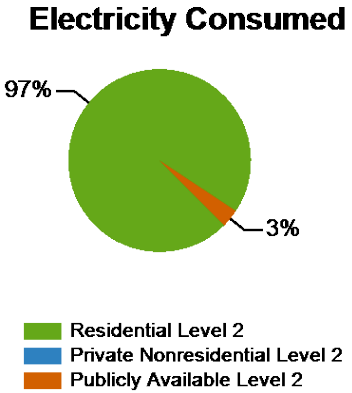
DATA COLLECTION

- 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

SOME EV PROJECT PARTNERS

Collaboration

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

UL Underwriters Laboratories

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 INFRASTRUCUTRE

- 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

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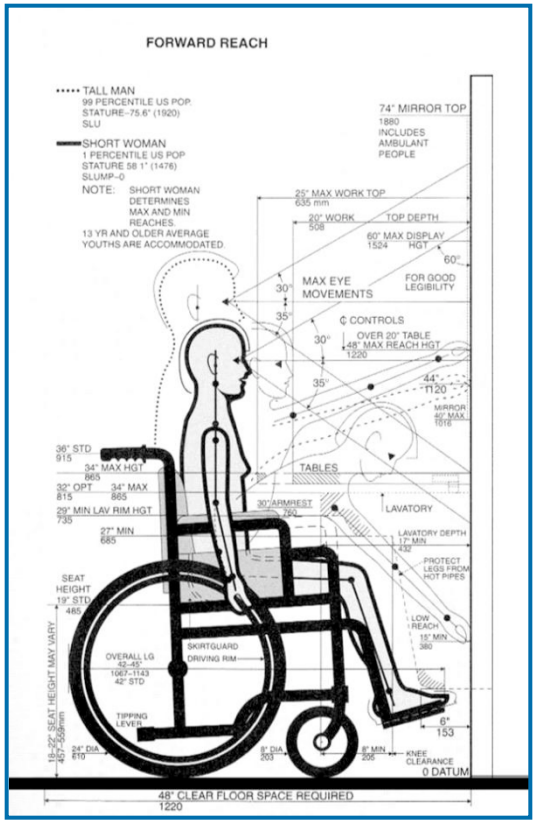
ADA REQUIREMENTS

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

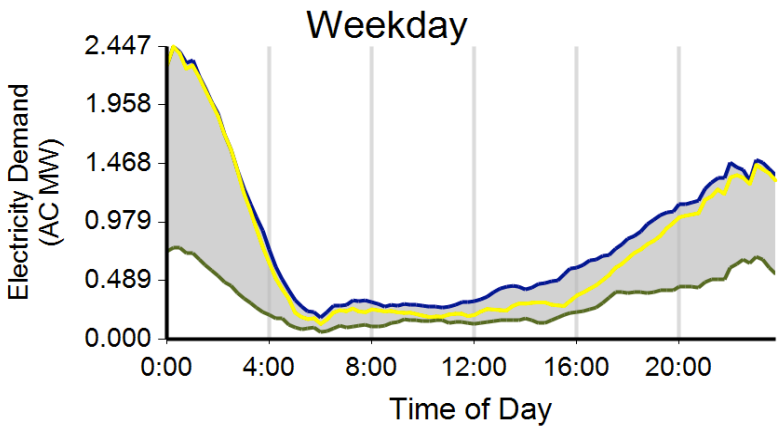


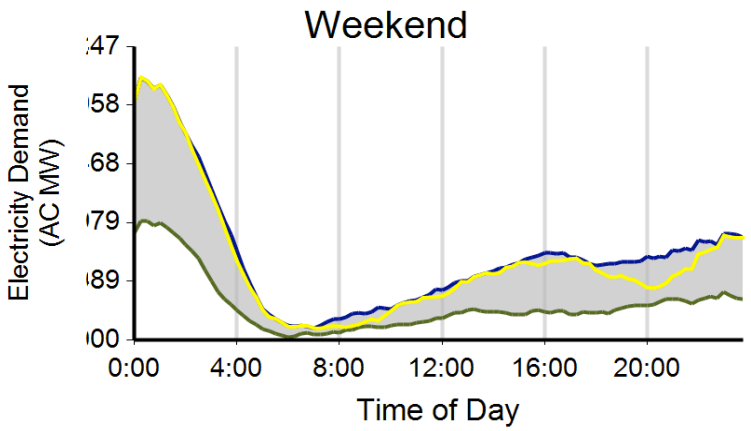
EVSE ACCESS FEES

- 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 Evaluatio
- GIS Based Data
  - Distribution Effects
  - Clustering





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

TECHNICAL BACKUP SLIDES

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CHARGER DATA Q4-2011

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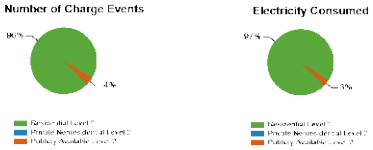
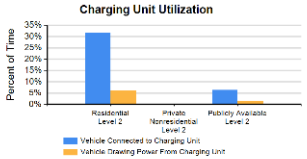
EV Project Electric Vehicle Charging Infrastructure Summary Report

THE EV Project

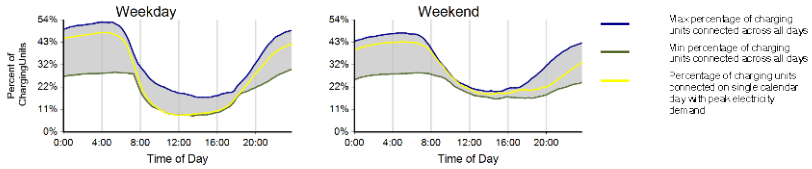
Region: ALL
Report period: October 2011 through December 2011
Number of EV Project vehicles in region: 2690

Charging Unit Usage	Residential Level 2	Private Nonresidential Level 2	Publicly Available Level 2	Publicly Available DC Fast	Total
Number of charging units[1]	2,704	0	438	0	3,142
Number of charging events[2]	159,225	0	6,372	0	165,597
Electricity consumed (AC MWh)	1,253.63	0.00	41.42	0.00	1,295.06
Percent of time with a vehicle connected to charging unit	32%	0%	6%	0%	29%
Percent of time with a vehicle drawing power from charging unit	6%	0%	2%	0%	6%

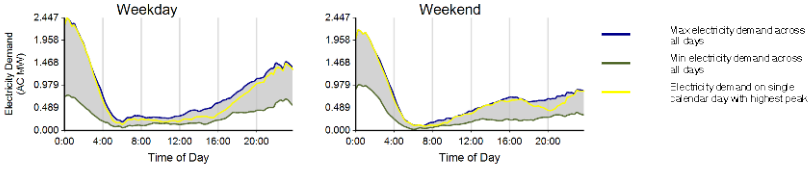




Charging Availability: Range of Percent of Charging Units with a Vehicle Connected versus Time of Day [3]



Charging Demand: Range of Aggregate Electricity Demand versus Time of Day [4]



[1] Includes all charging units that were in use by the end of the reporting period

[2] A charging event is defined as the period when a vehicle is connected to a charging unit, during which period some power is transferred

[3] Considers the connection status of all charging units every minute

[4] Based on 15 minute rolling average power output from all charging units

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VEHICLE DATA Q4-2011

LEAF

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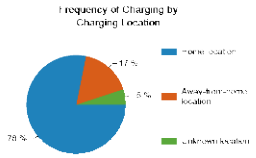
EV Project Nissan Leaf Vehicle Summary Report

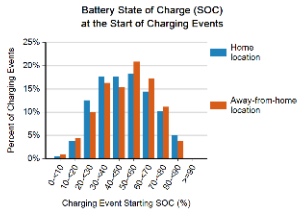
Region: ALL
Number of vehicles: 2645
Reporting period: October 2011 through December 2011

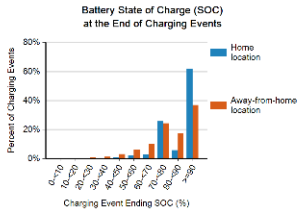
Vehicle Usage

Number of trips	707,330
Total distance traveled (mi)	4,878,735
Avg trip distance (mi)	6.9
Avg distance traveled per day when the vehicle was driven (mi)	30.0
Avg number of trips between charging events	4.0
Avg distance traveled between charging events (mi)	27.7
Avg number of charging events per day when the vehicle was driven	1.1



Charging Location and Type	Home charging location	Away-from-home charging locations	Unknown charging locations
Number of charging events	137,664	29,543	8,955
Percent of all charging events	78%	17%	5%





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VOLT

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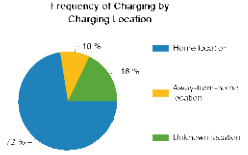
EV Project Chevrolet Volt Vehicle Summary Report

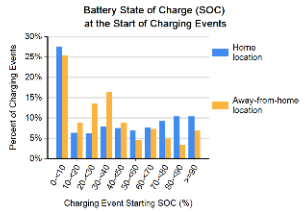
Region: ALL
Number of vehicles: 45
Reporting period: October 2011 through December 2011

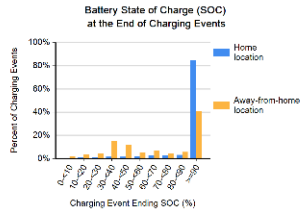
Vehicle Usage

Overall fuel economy (mpg)	131
Overall electrical energy consumption (AC Wh/mi)	271
Number of trips	13,619
Total distance traveled (mi)	108,115
Avg trip distance (mi)	7.8
Avg distance traveled per day when the vehicle was driven (mi)	38.0
Avg number of trips between charging events	3.5
Avg distance traveled between charging events (mi)	27.1
Avg number of charging events per day when the vehicle was driven	1.4



Charging Location and Type	Home charging location	Away-from-home charging locations	Unknown charging locations
Number of charging events	2,695	386	713
Percent of all charging events	72%	10%	18%





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