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

DOT/FHA – DOE's EV Project Update

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Federal Highway Administration EV Forum
Washington, D.C.
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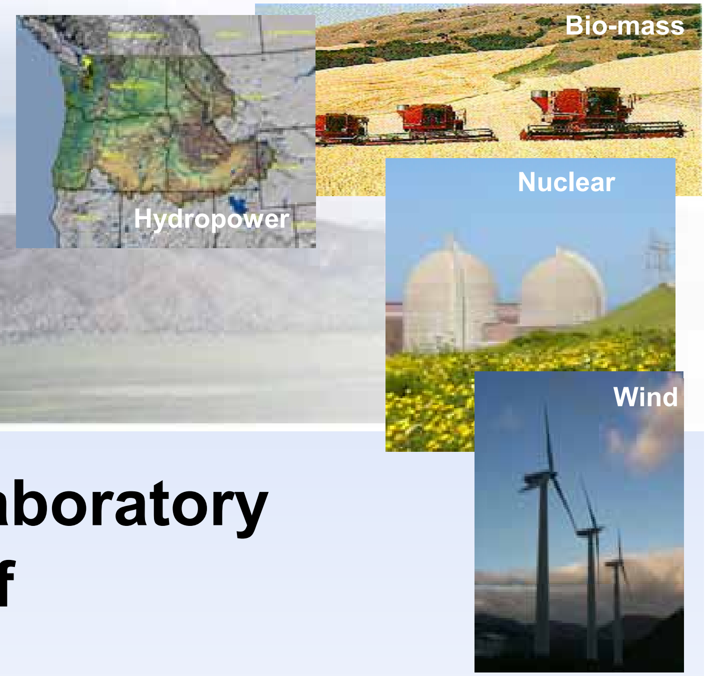
This presentation does not contain any proprietary or sensitive information

Presentation Outline

- INL and Vehicle Technology Experience and General Data Collection Methods
- EV Project results to date (majority of presentation)
- Corridor charging (briefly)
- Other Testing Activities (briefly)
- Summary
- Where you can find this presentation

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

- DOE's Advanced Vehicle Testing Activity (AVTA), part of the Vehicle Technologies Program (VTP) conducts field-, test track-, and laboratory-based testing of light-duty vehicle systems and subsystems
  - Idaho National Laboratory provides technical direction and oversight of 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

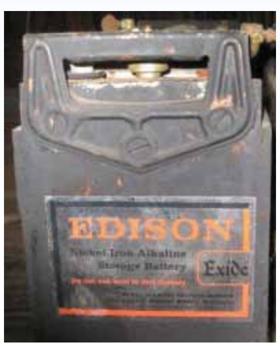
- The AVTA goals
  - Petroleum reduction and energy security
  - Benchmark technologies that are developed via DOE research investments
- Provide benchmark data to DOE, National Laboratories (ANL, NREL, ORNL, PNNL), Federal Agencies (DOD, DOI, DOT, EPA, USPS), technology modelers, R&D programs, vehicle 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

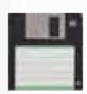
Vehicle / Infrastructure Testing Experience

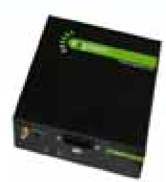
- 93 million test miles accumulated on 12,200 electric drive vehicles representing 119 models. 1 million miles / week
- EV Project: 8,715 Leafs, Volts and Smart EVs, 11,208 EVSE and DC Fast Chargers (DCFC), 74 million test miles
- ChargePoint: 3,908 EVSE reporting 761,000 charge events
- PHEVs: 15 models, 434 PHEVs, 4 million test miles
- EREVs: 2 model, 156 EREVs, 2 million test miles
- HEVs: 24 models, 58 HEVs, 6.4 million test miles
- Micro hybrid (stop/start) vehicles: 3 models, 7 MHVs, 608,000 test miles
- NEVs: 24 models, 372 NEVs, 200,000 test miles
- BEVs: 48 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

Data Collection and Security History

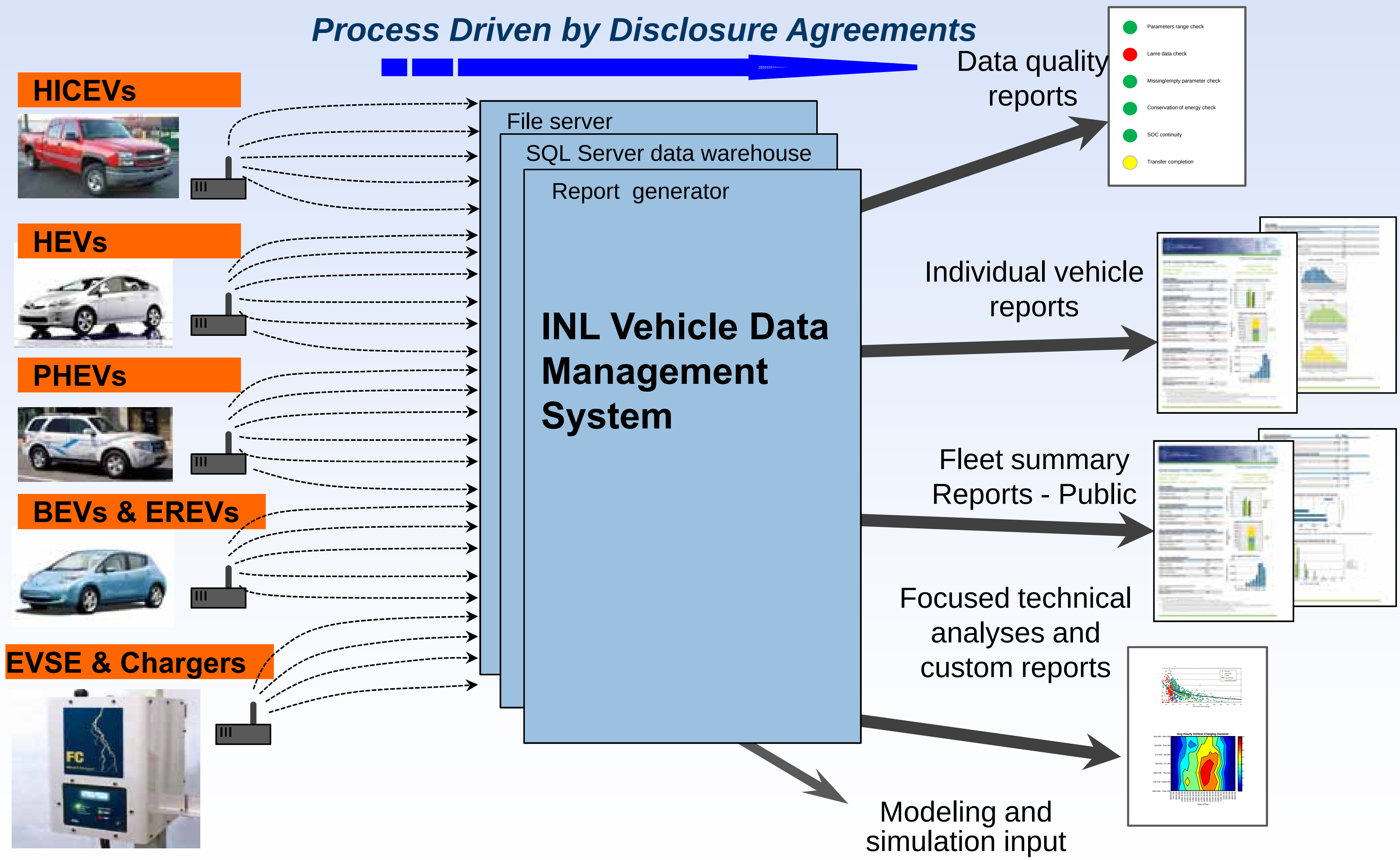
- 1993 state-of-art 386 PCs and floppy drives that were mailed via the USPS from 300 PEVs. Initial PEV database
- 1994 hand-held, optical readers connected to laptops, read ABB meters on vehicles and EVSE
- 2007 started data collection via the www for 44 PEVs when data could be uploaded from thumb drives
- 2008 stared data collection with integrated vehicle data loggers and cellular from 200 PEVs in 28 states
- Twenty year history of data security and NDAs protecting and limiting the distribution of PII and raw data



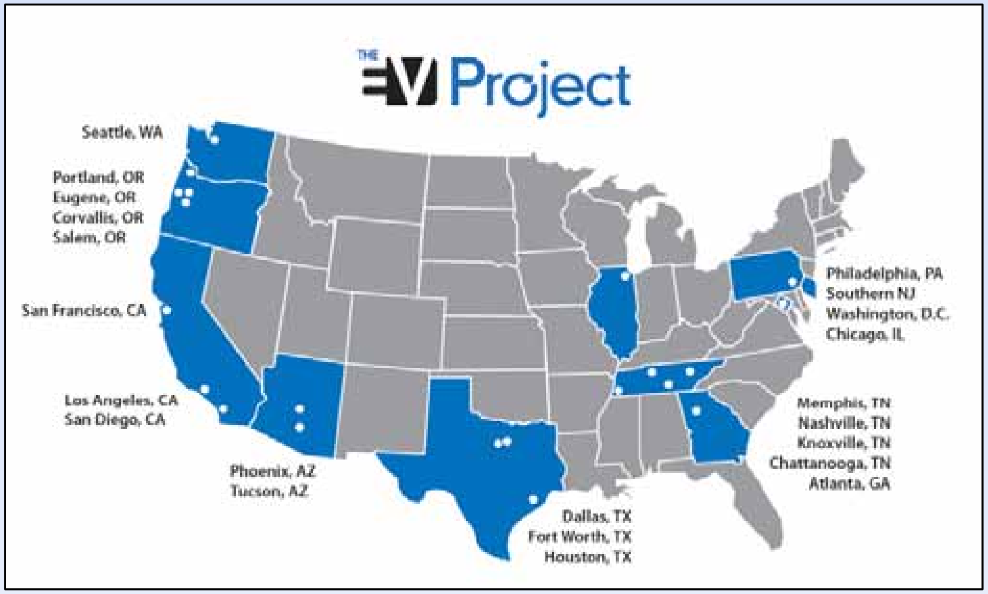

INL Vehicle/EVSE Data Management Process



Today - Data Collection, Security & 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 the 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
- 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 & other EVSE networks
- 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.)

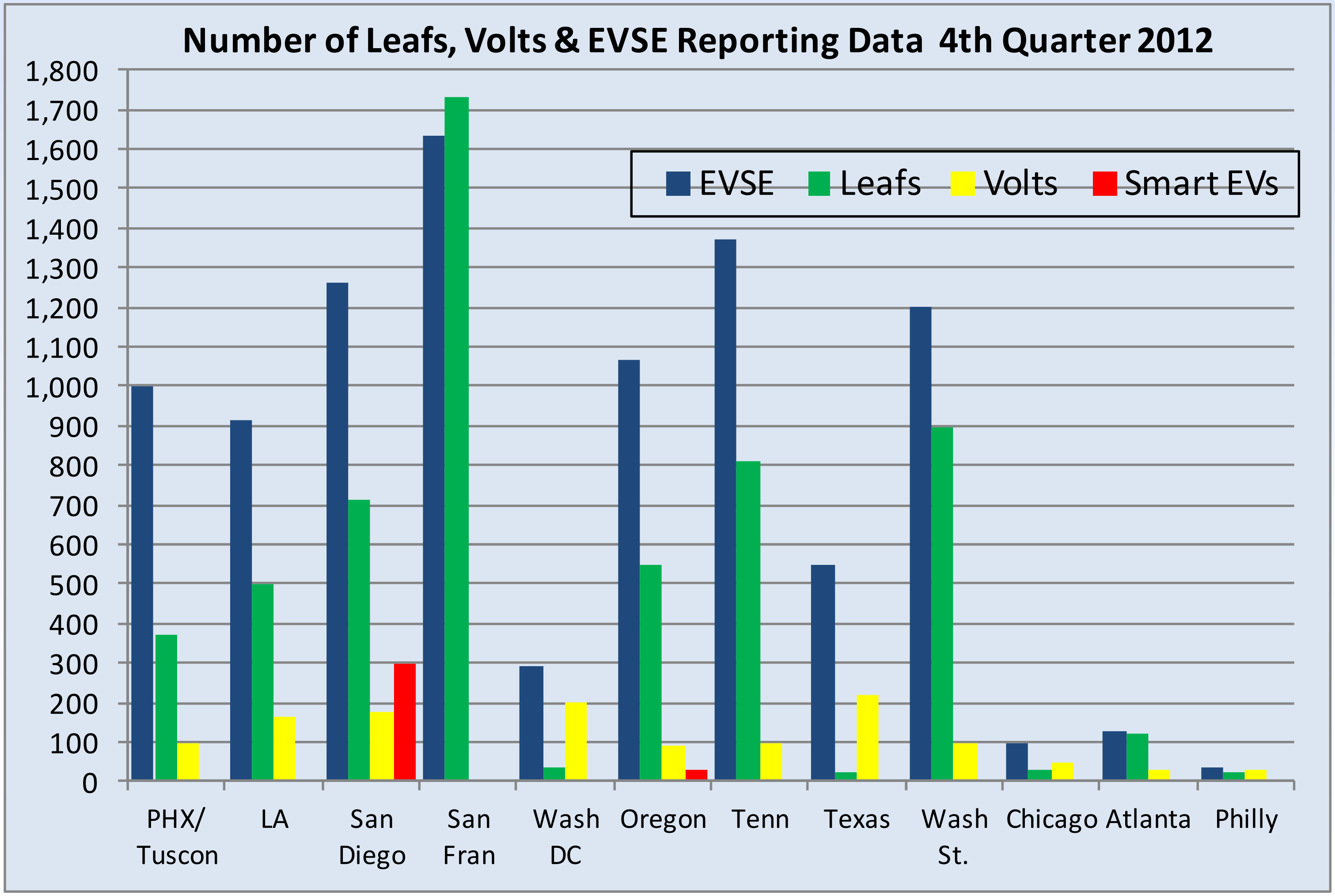
EV Project – Vehicle Data Parameters Collected per Key On/Off Events

- 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 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**

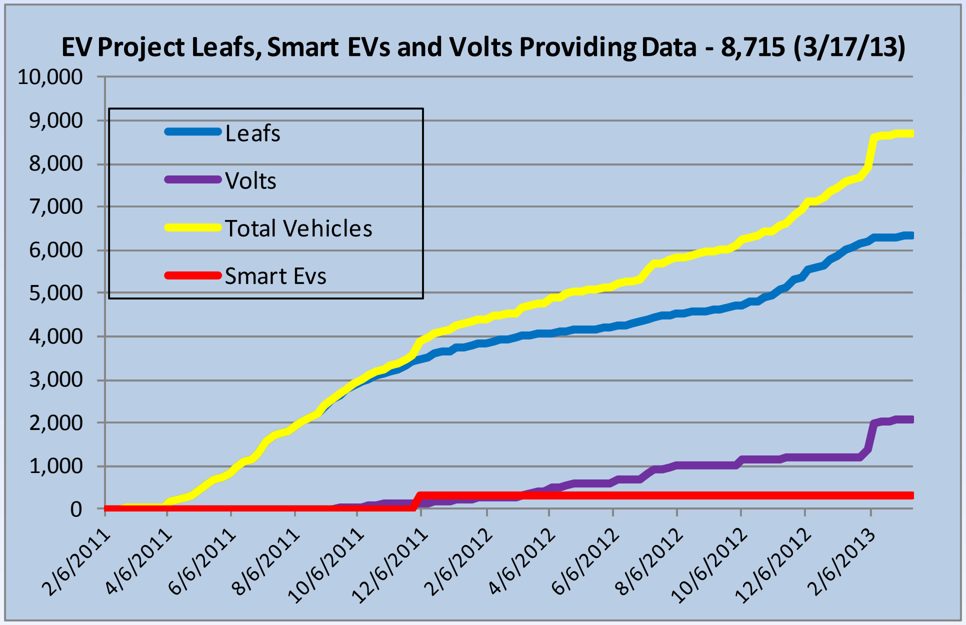


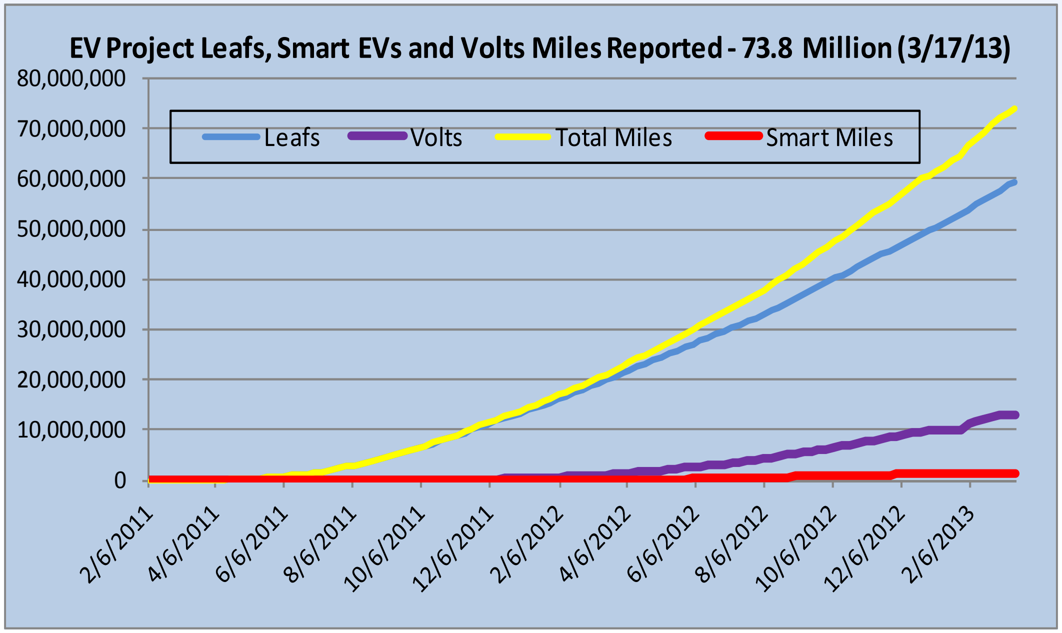
EV Project Data Complexity

- The EV Project has 44 Databases (DB)
  - Nissan Leaf & GM/OnStar Volt
  - ECOtality Blink, Aerovironment & EPRI EVSE
  - Admin (look up tables, territories, zips codes, QA parameters, etc.)
    - Each of the above six DBs has three versions (process, stage & production) = 18 DBs
  - Four GIS DBs for the Leafs, Volts, Blink EVSEs, and Base (streets, utility service territory areas, etc.)
  - Above 22 (18 + 4) DBs exist on two systems = 44 DBs
- Hundreds of algorithms and thousands of lines of code are required to generate 56,000 data parameters for populating 132 pages of public quarterly reports
- INL must blend multiple data streams, from multiple sources, all on different delivery schedules
- This is no flat file. This is NOT a simple Excel Spreadsheet task

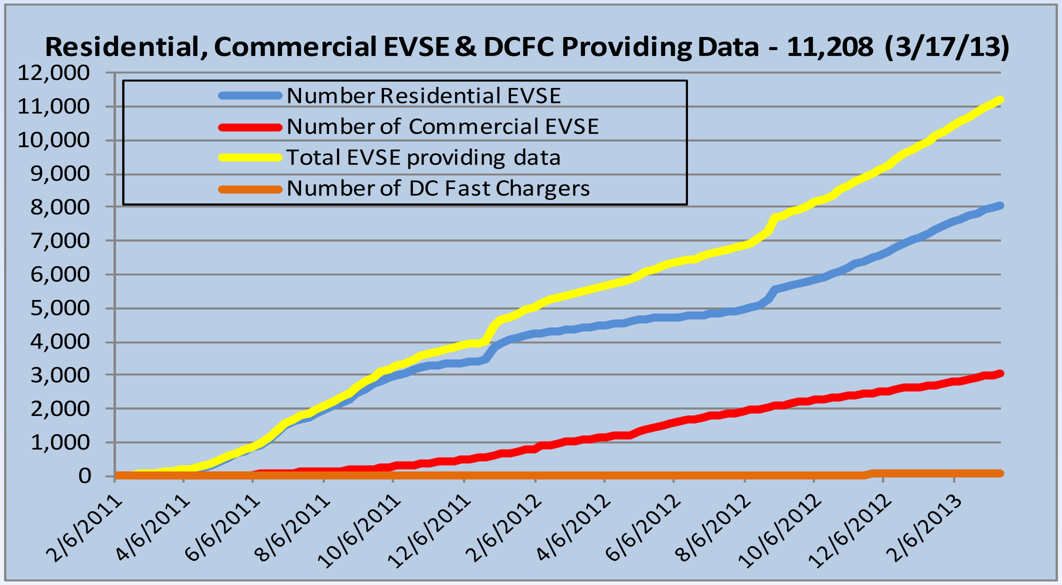
EV Project Vehicles / Miles, 3/17/13

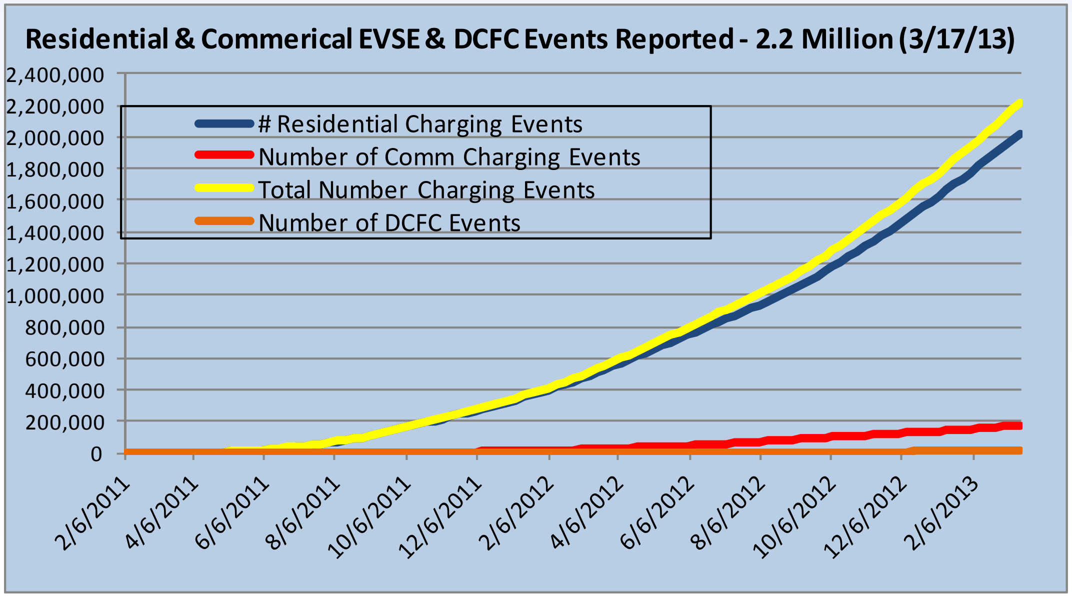
- **8,715 vehicles reporting data**
  - **6,329 Leafs. 73%**
  - **1,255 Volts. 24%**
  - **330 Smart EVs. 4%**
- **73.8 million total miles**
  - **Leafs 81%**
  - **Volts 18%**
  - **Smart EVs 2%**
- **173,000 test miles per day = 1 million miles every 5.8 days**





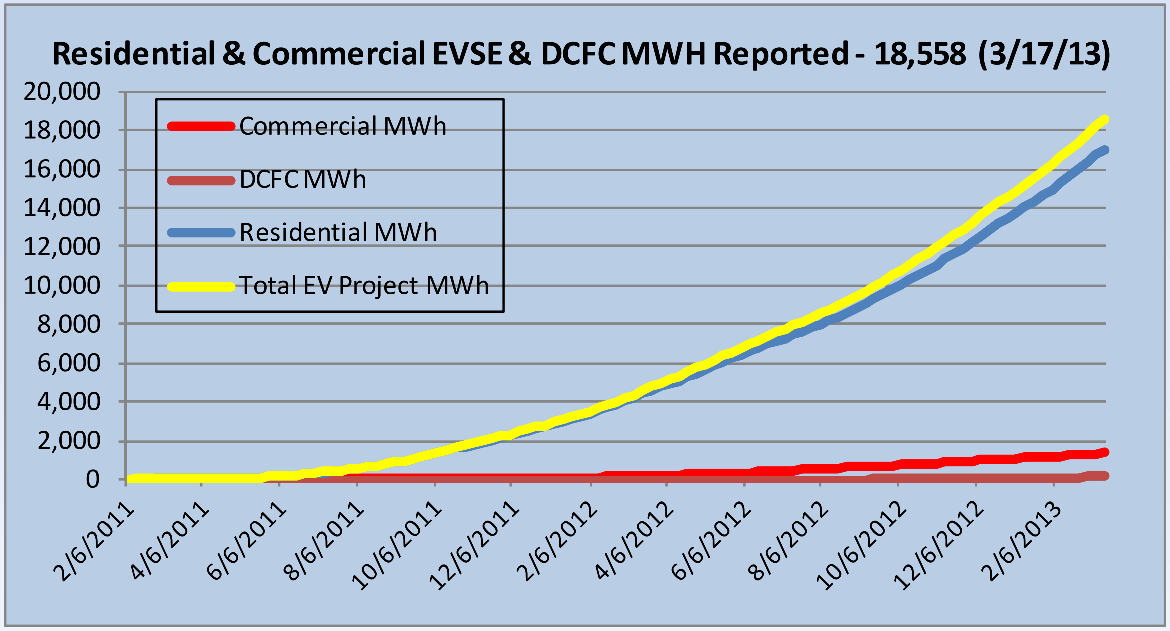
EV Project EVSE Deployed / Use, 3/17/13





- **11,208 total EVSE**
  - **8,083 (72%) Residential EVSE**
  - **3,049 (27%) non-residential EVSE**
  - **76 (1%) DCFC**
- **2.2 million charge events**
  - **2,025,000 (91%) Residential EVSE**
  - **173,000 (8%) non-residential EVSE**
  - **20,000 (1%) DCFC**

EV Project Charge Energy (MWh), 3/17/13



- **18,559 AC MWh total electricity charged**
  - **17,042 MWh (92%) residential**
  - **1,370 MWh (7%) non-residential**
  - **147 MWh (1%) 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 – National Data

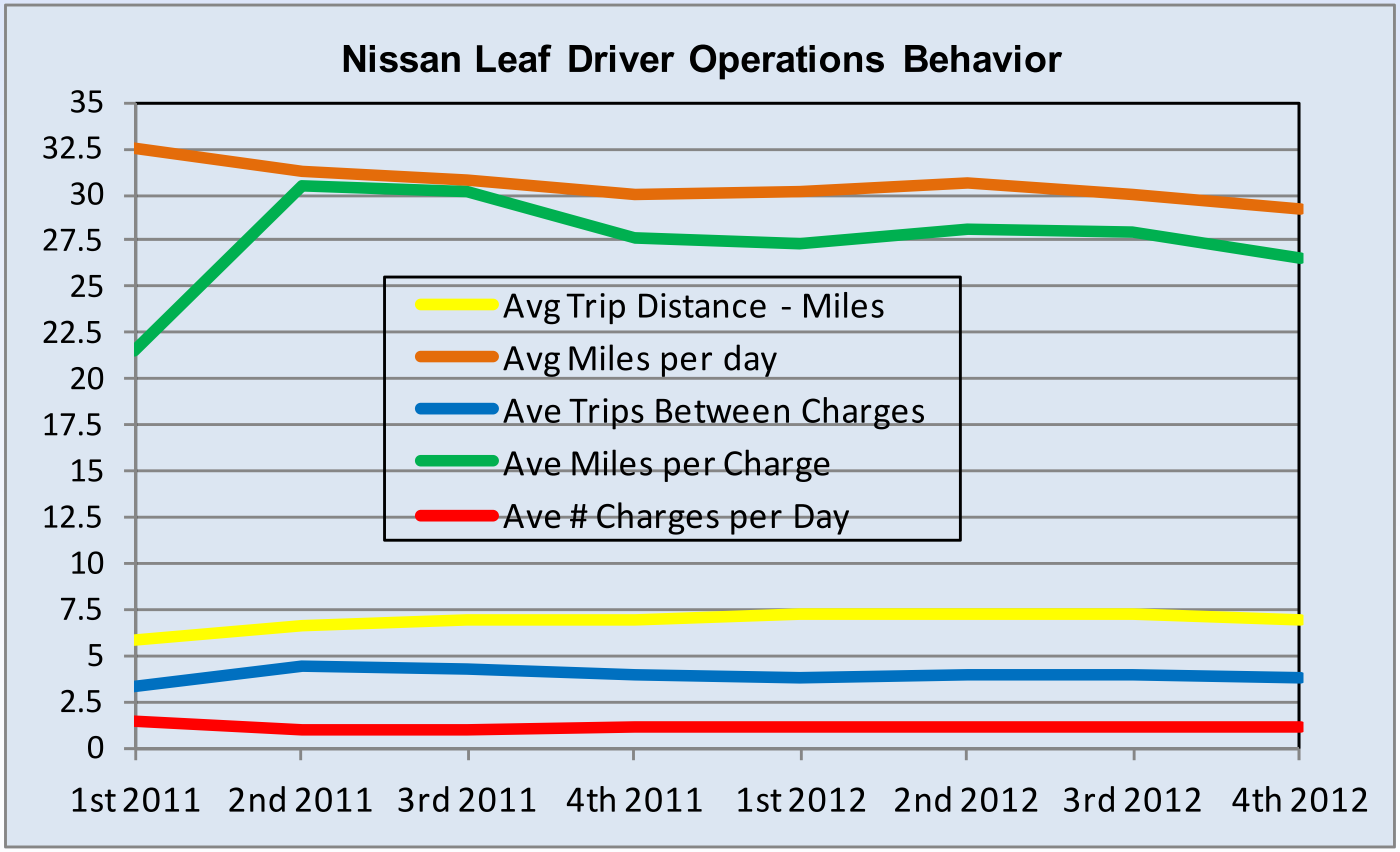
4th quarter 2012 Data Only

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

* Note that per day data is only for days a vehicle is driven

EV Project – Leaf Operations Trends

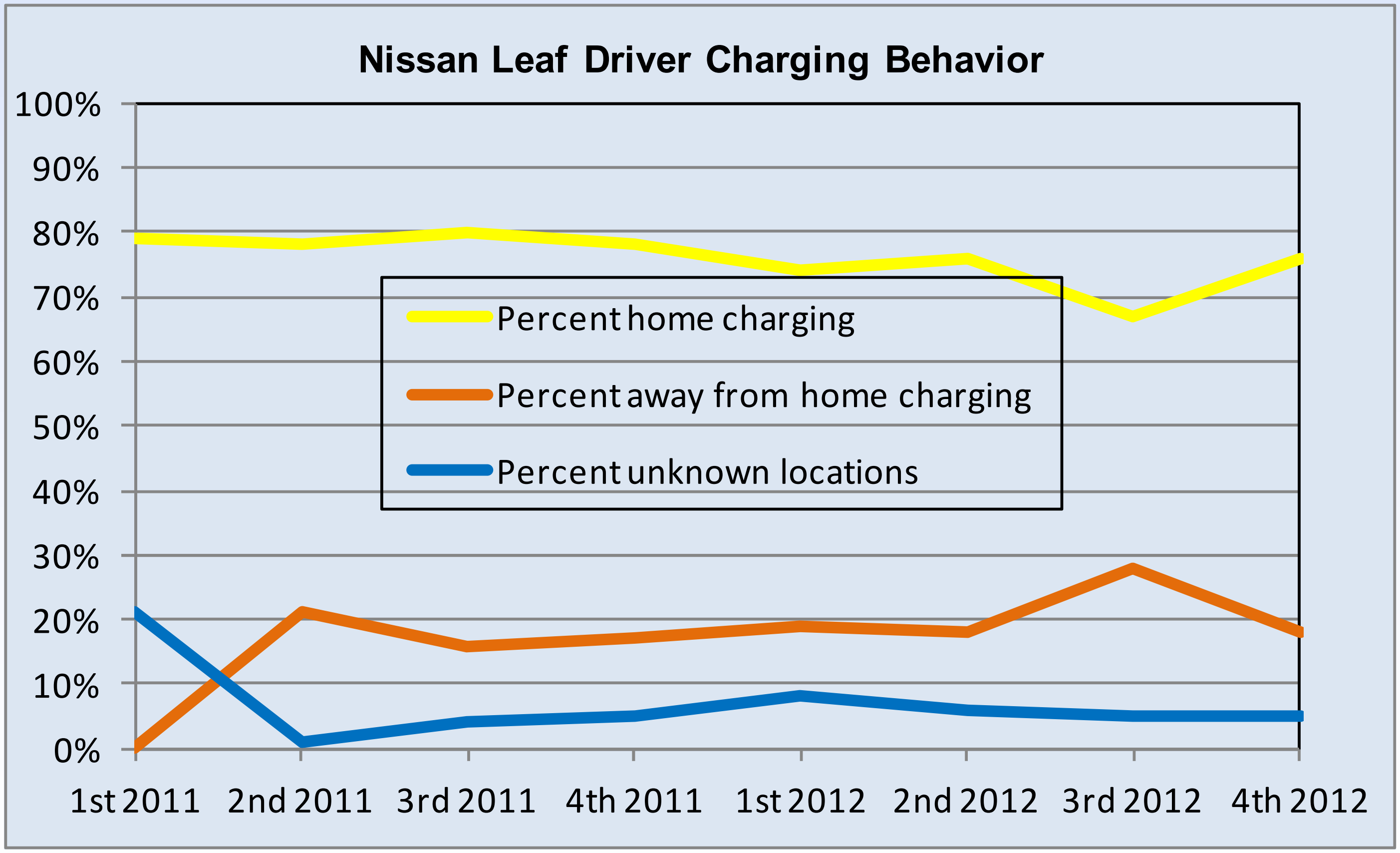
- **Slight decreases in average miles per day and average miles per charge**



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

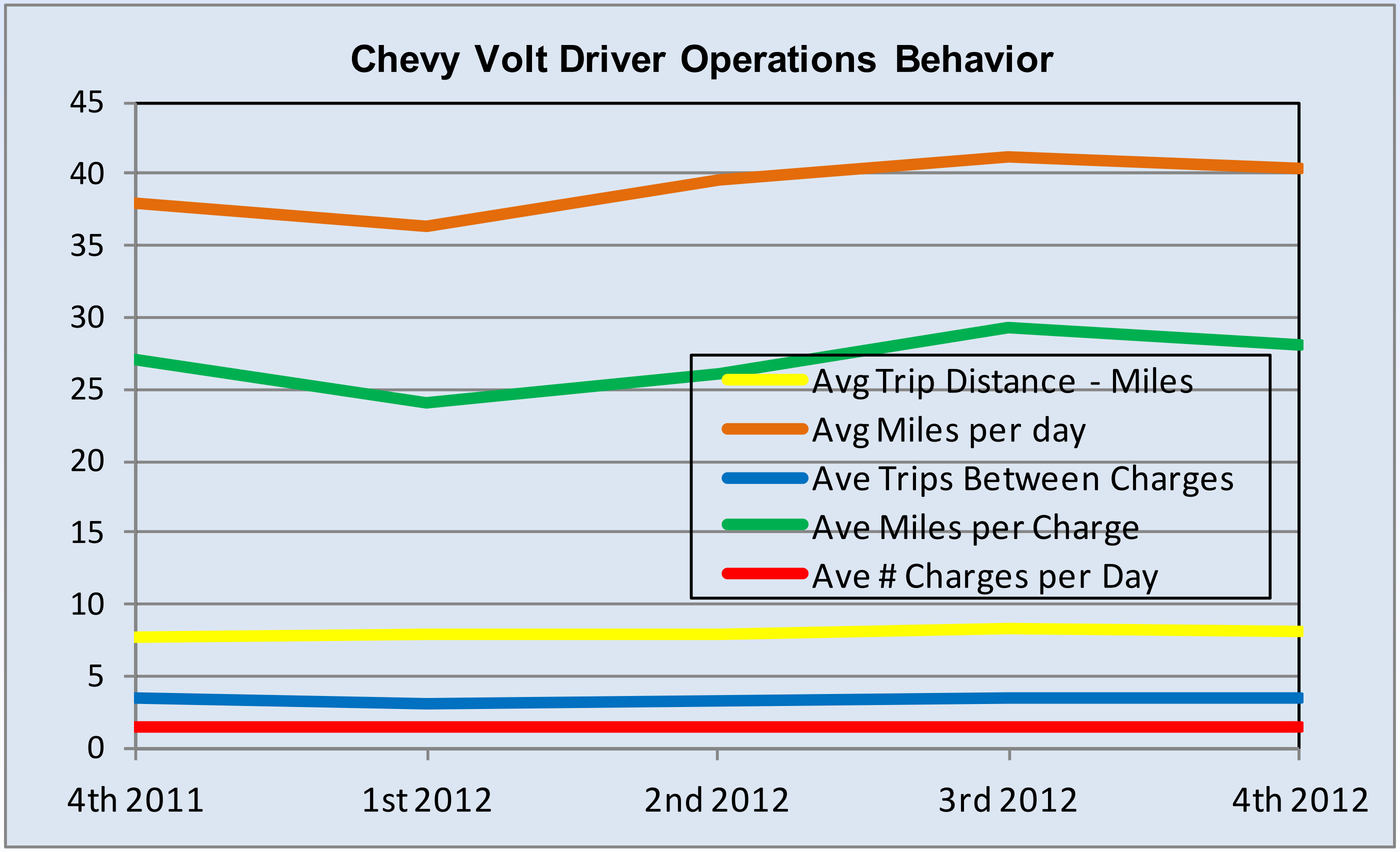
- 13.4% increase in home charging and 36% decrease in non-home charging as a revenue model is introduced
  - HOWEVER, one data point does not make a trend…..



Number of Leafs reporting each quarter with matched EVSE data							
35	956	2,394	2645	2987	2911	3200	3762

EV Project – Volt Operations Trends

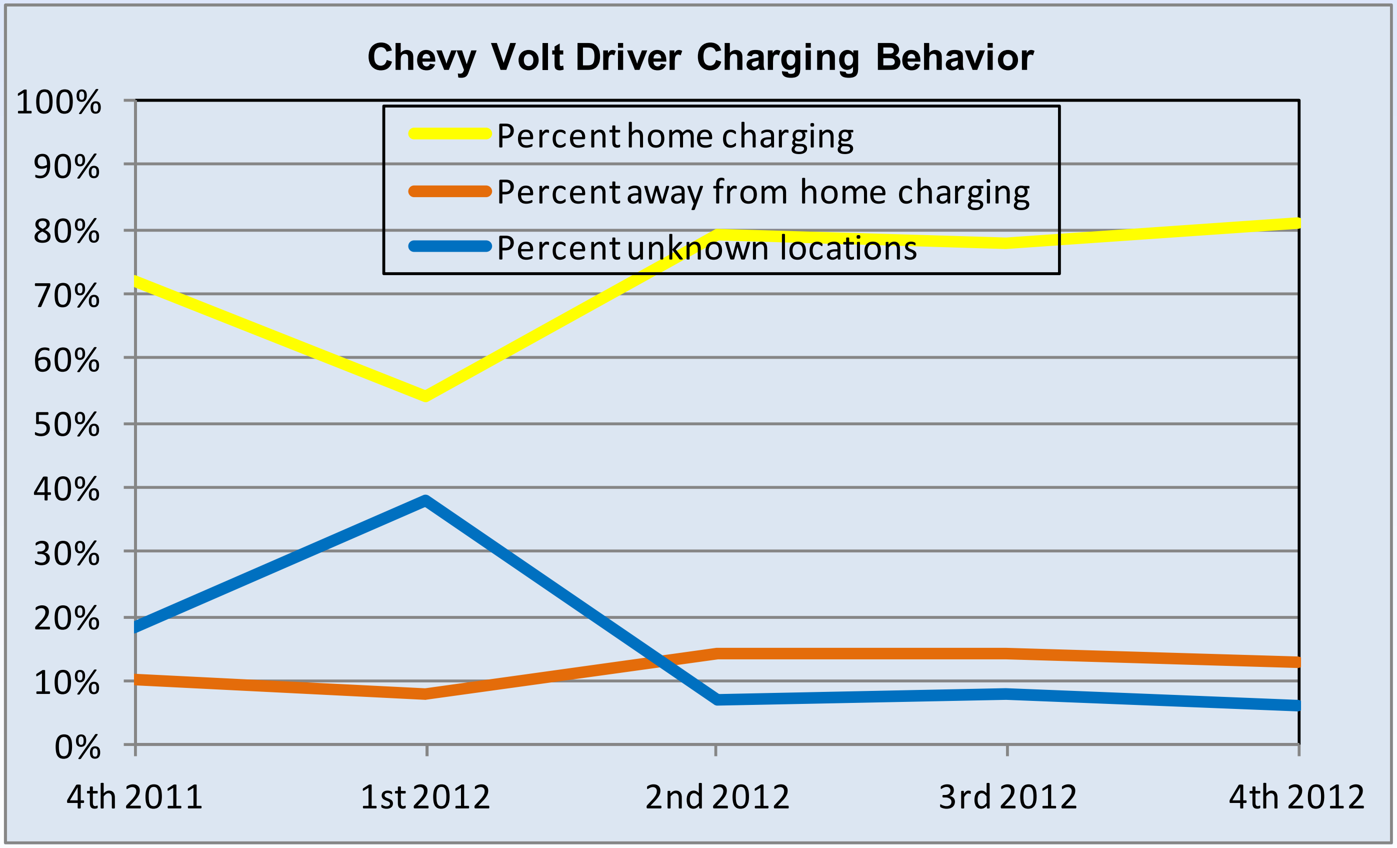
- **Mostly upwards trends in miles per day and miles per charge reversed last quarter**



Number of Volts reporting each quarter with matched EVSE data				
45	317	408	809	1021

EV Project – Volt Charging Location Trends

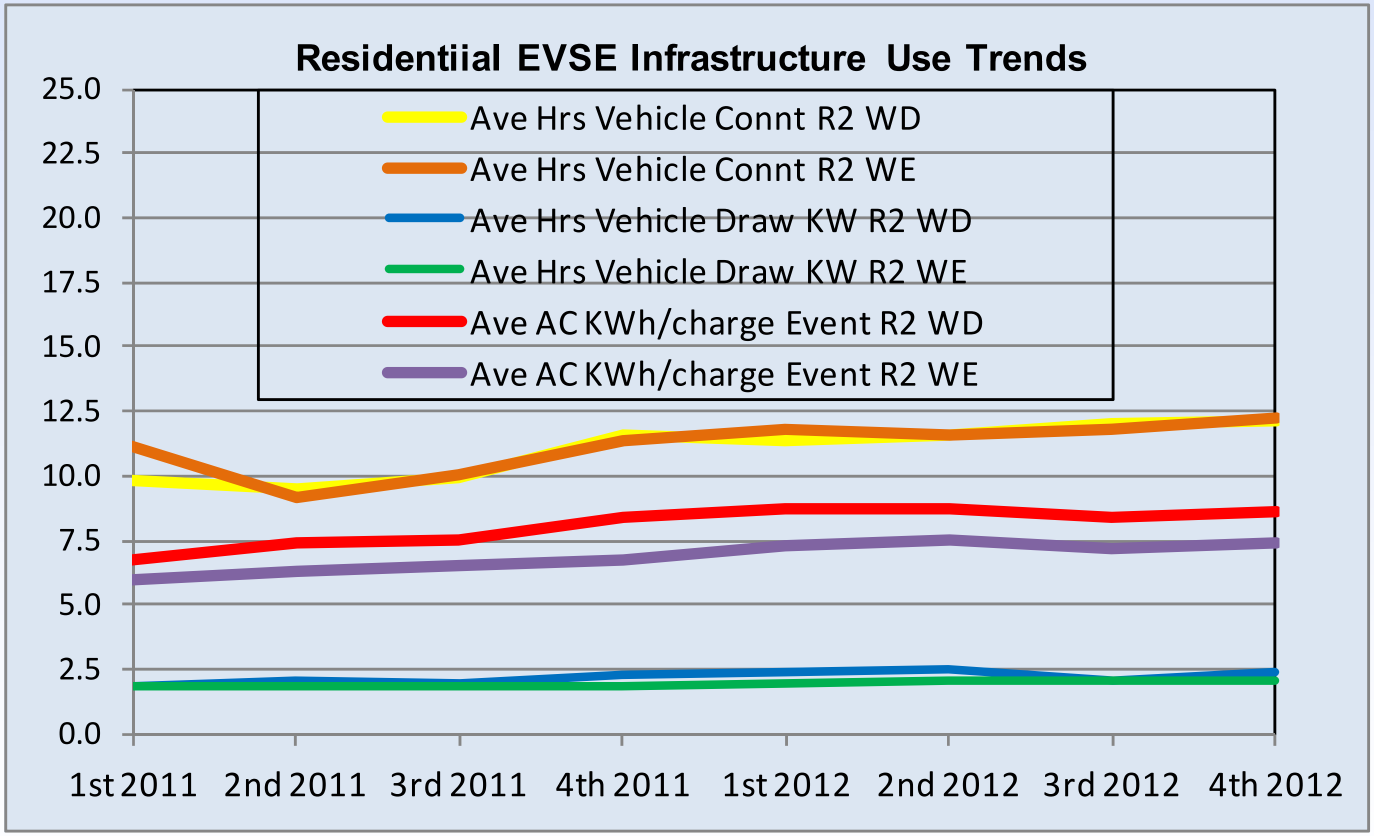
- **4% increase in home charging and 7% decrease in non-home charging as a revenue model is introduced**
  - **AGAIN, one data point does not make a trend…..**



Number of Volts reporting each quarter with matched EVSE data				
45	317	408	809	1021

EV Project – Residential EVSE L2 Use Trends

- Slight increases in times vehicles connected and drawing power, and increase in AC KWh transferred per charge event

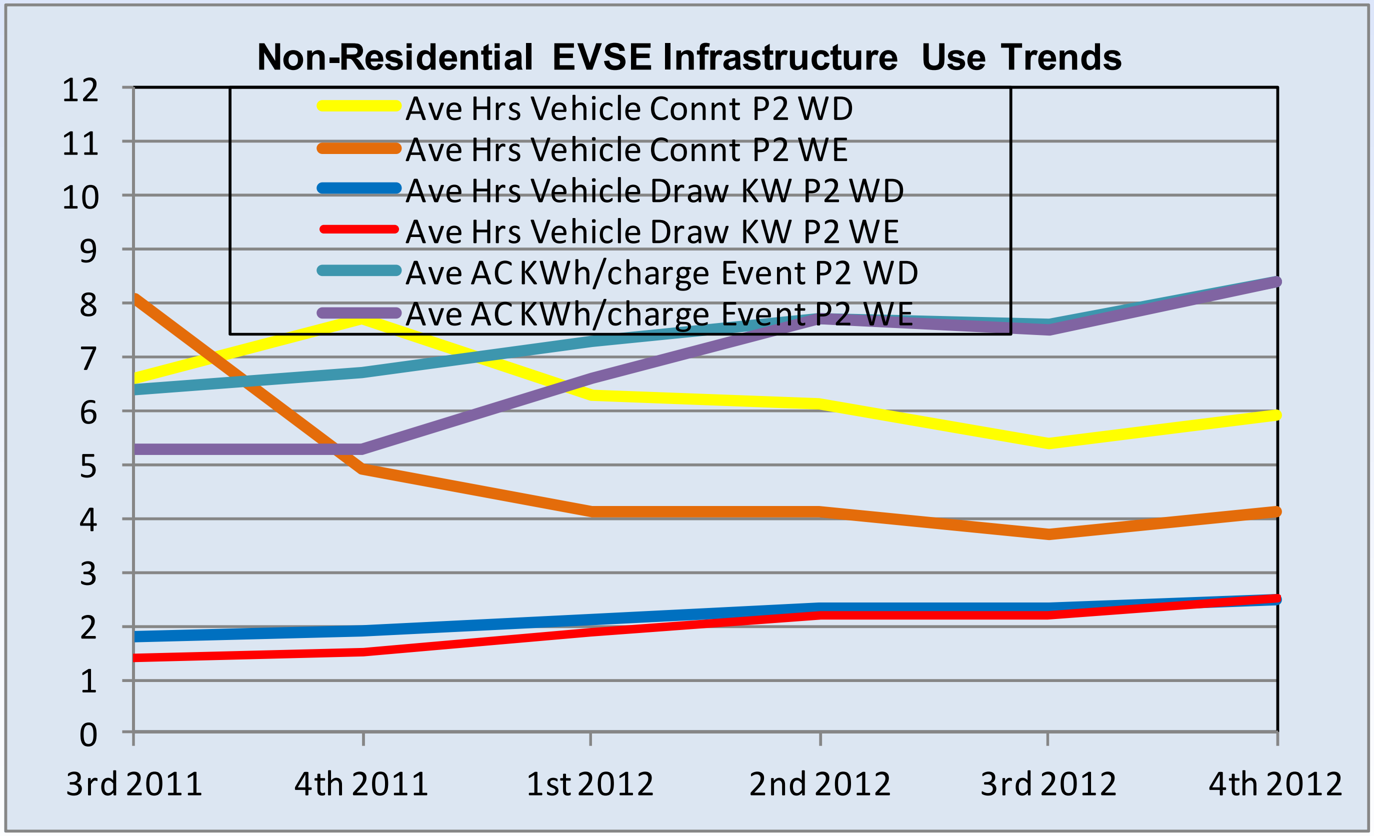


Number of Residential EVSE Level reporting each quarter							
35	955	2413	2704	3324	3338	4020	4819

Residential EVSE Level 2 = R2, Weekend = WE, Weekday = WD

EV Project – Public EVSE L2 Use Trends

- Increases in kWh per charge, time energy is drawn and time connected

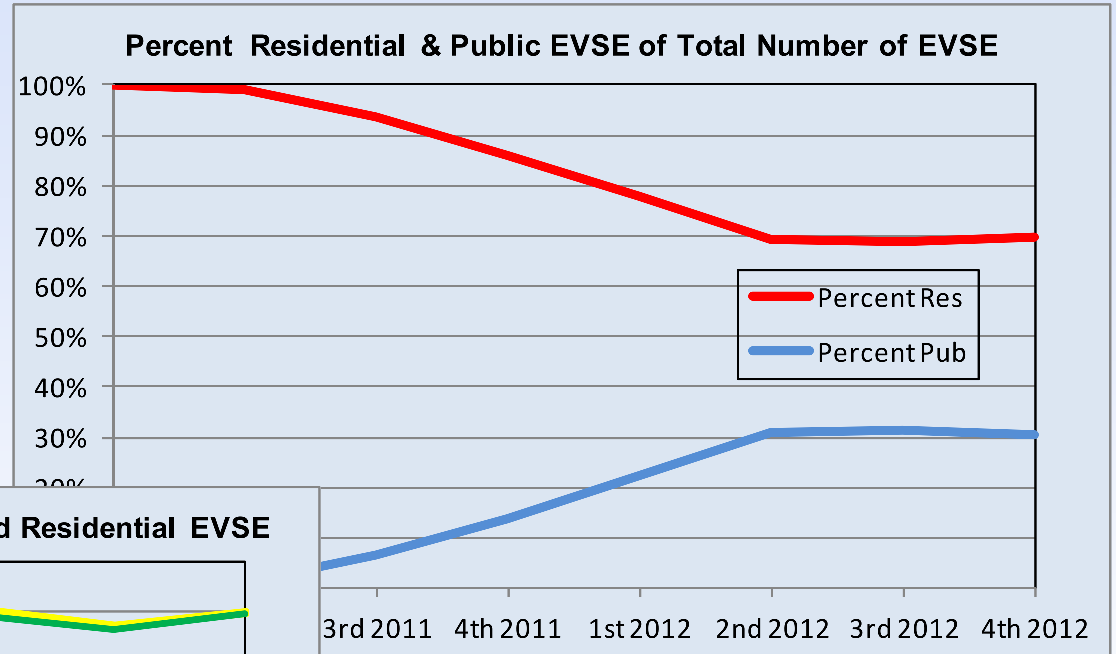


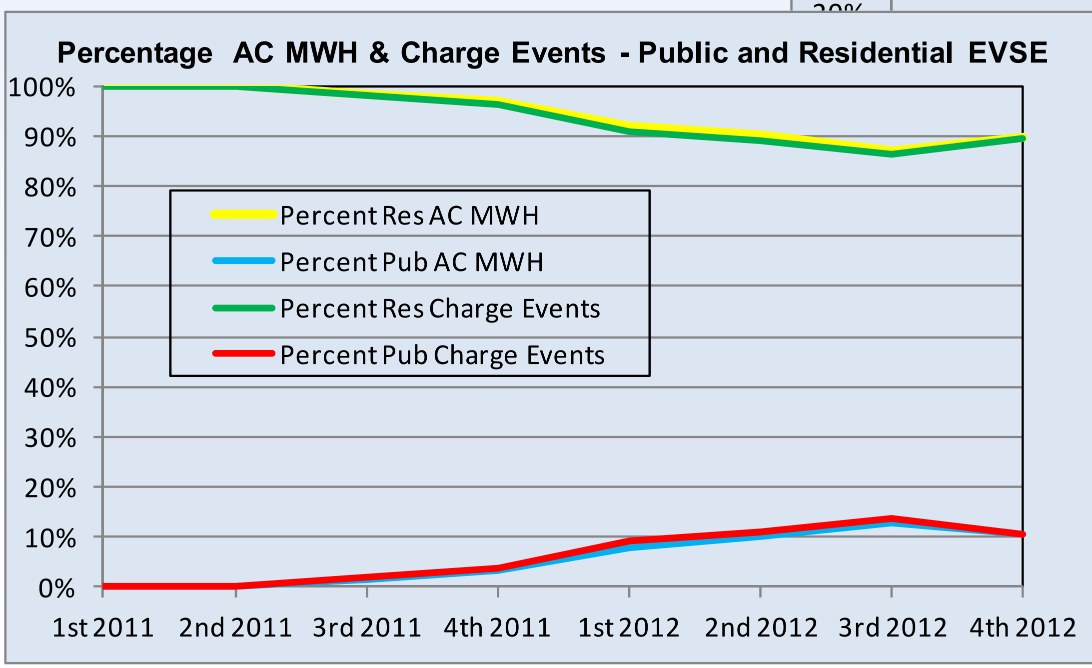
Number of Public EVSE Level reporting each quarter					
170	438	955	1483	1818	1988

Public EVSE Level 2 = P2, Weekend = WE, Weekday = WD

EV Project – EVSE Infra. Summary Report

- Percent of public L2 EVSE deployed was about 30% of all L2 EVSE 4th quarter 2012





- As measured by kWh use and number of charge events, revenue model may be decreasing known public L2 EVSE use

EV Project Public L2 EVSE Usage 4th ¼ 2012

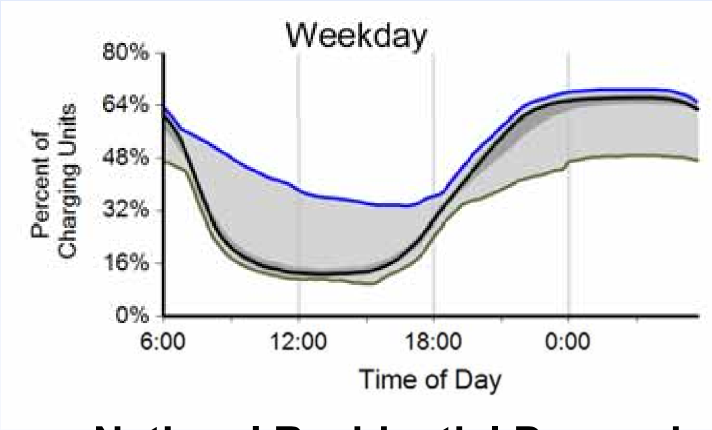
- **Public charging contribution of Car Sharing Fleet is significant in San Diego**

All territories				
Vehicles Charged	Car sharing fleet	Nissan Leaf	Chevrolet Volt	Unknown
Percent of charging events	25%	21%	5%	49%
Percent of kWh consumed	38%	17%	3%	41%
San Diego				
Vehicles Charged	**300 Car2Go fleet**	Nissan Leaf	Chevrolet Volt	Unknown
Percent of charging events	**59%**	16%	2%	23%
Percent of kWh consumed	**72%**	11%	1%	16%
Oregon (Car2Go in Portland)				
Vehicles Charged	30 Car2Go fleet	Nissan Leaf	Chevrolet Volt	Unknown
Percent of charging events	5%	29%	4%	61%
Percent of kWh consumed	11%	27%	4%	58%

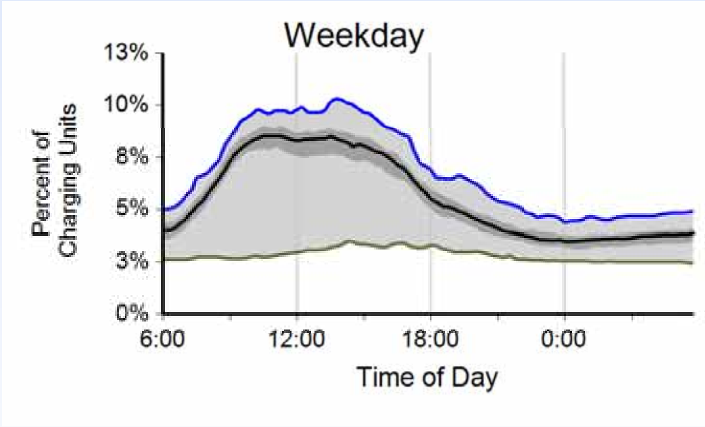
EV Project – EVSE Infra. Summary Report

- 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

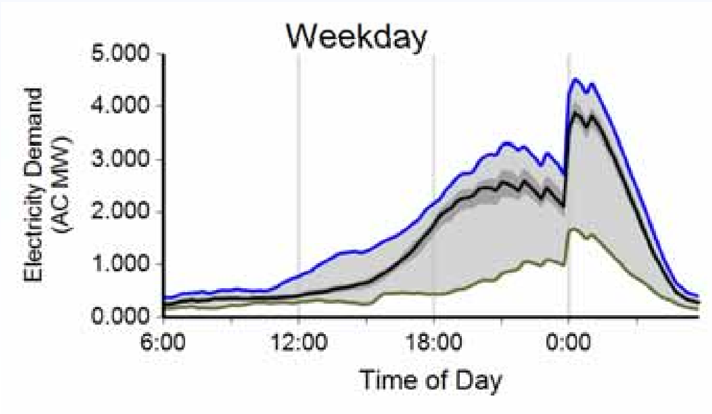
National Residential Connect Time



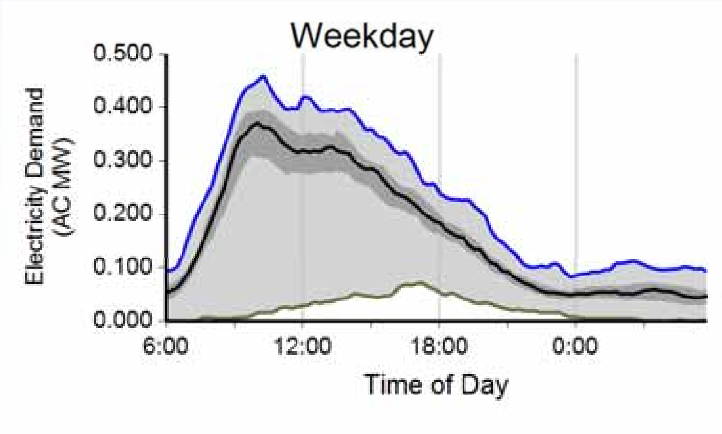
National Public Connect Time



National Residential Demand



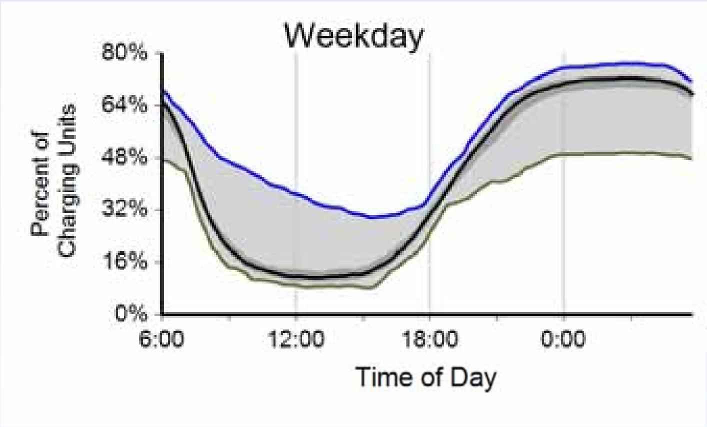
National Public Demand



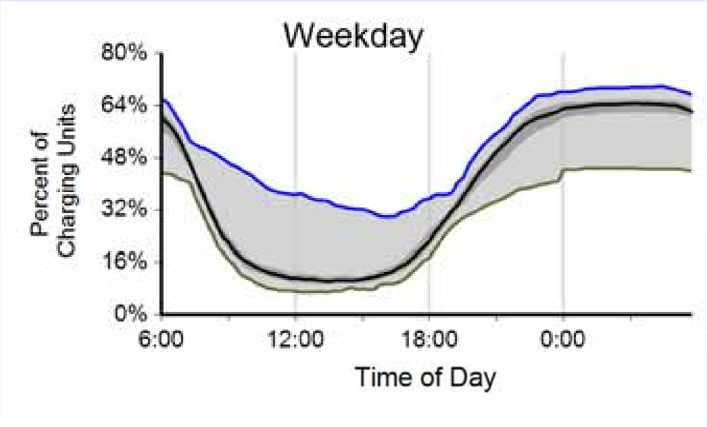
EV Project – EVSE Infra. Summary Report

- **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**

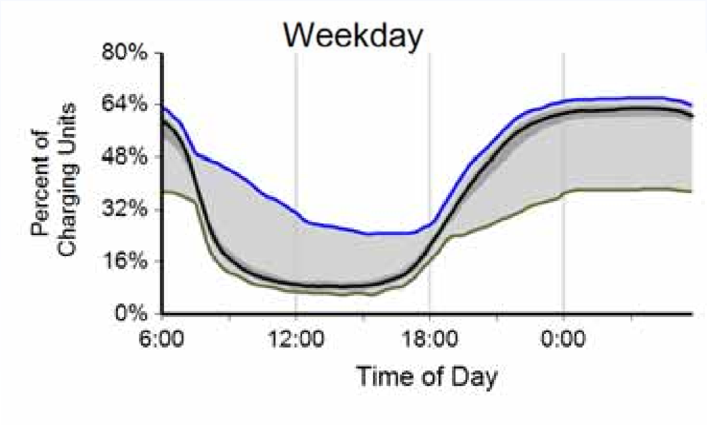
San Diego



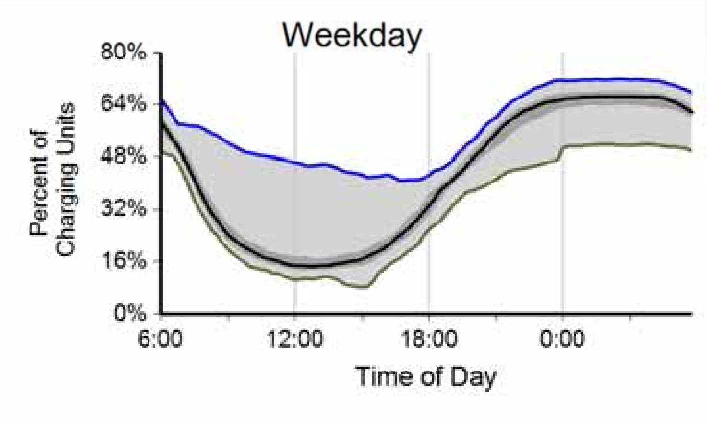
Los Angeles



San Francisco



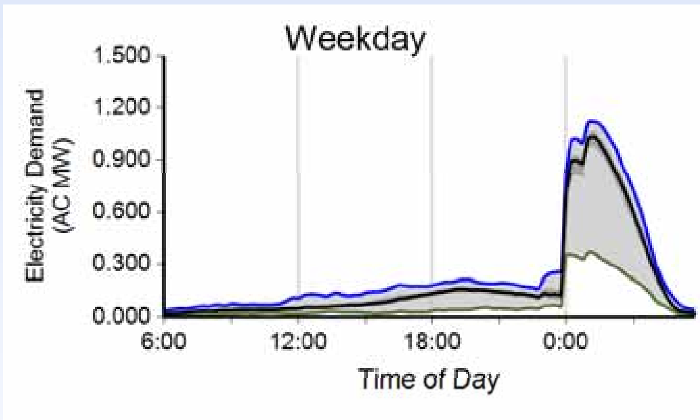
Washington State



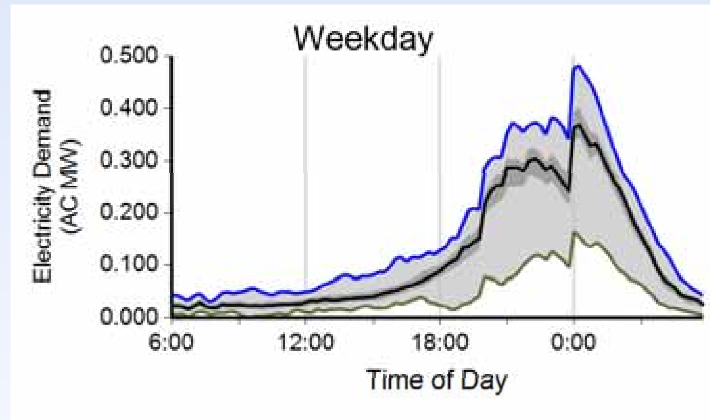
EV Project – EVSE Infra. Summary Report

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

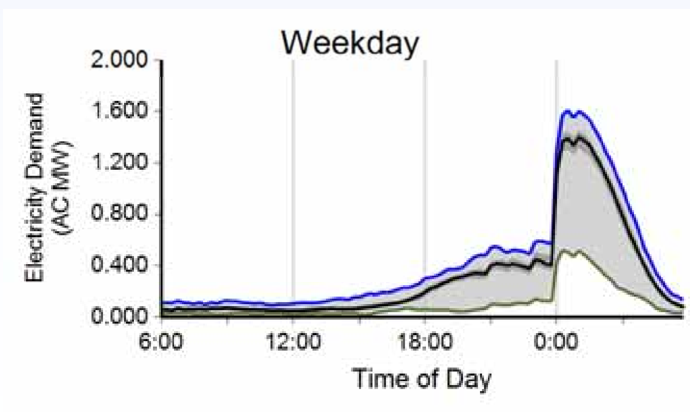
San Diego



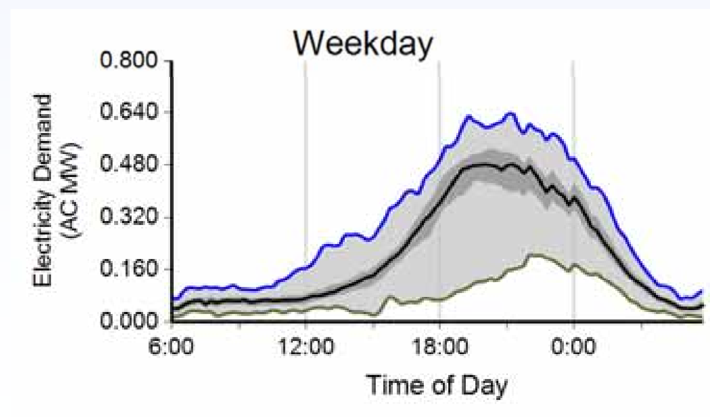
Los Angeles



San Francisco



Washington State



EV Project – EVSE Infra. Summary Report

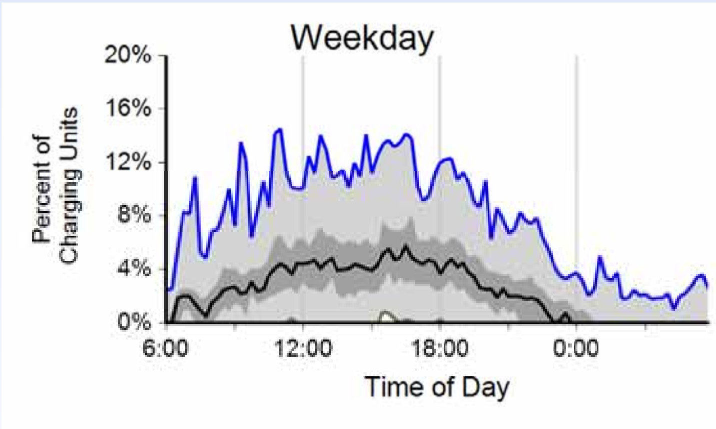
4th quarter 2012	National.
• Ave hours V connected R2 WD	12.1 hours
• Ave hours V connected R2 WE	12.2 hours
• Ave hours V drawing power R2 WD	2.4 hours
• Ave hours V drawing power R2 WE	2.1 hours
• Ave AC kWh/charge event R2 WD	8.6 AC kWh
• Ave AC kWh/charge event R2 WE	7.4 AC kWh
• Ave hours V connected P2 WD	5.9 hours
• Ave hours V connected P2 WE	4.1 hours
• Ave hours V drawing power P2 WD	2.5 hours
• Ave hours V drawing power P2 WE	2.5 hours
• Ave AC kWh/charge event P2 WD	8.4 AC kWh
• Ave AC kWh/charge event P2 WE	6.4 AC kWh

- R: residential, P: public, WD: weekday, WE: weekend, 2: Level 2 EVSE, and V: vehicle

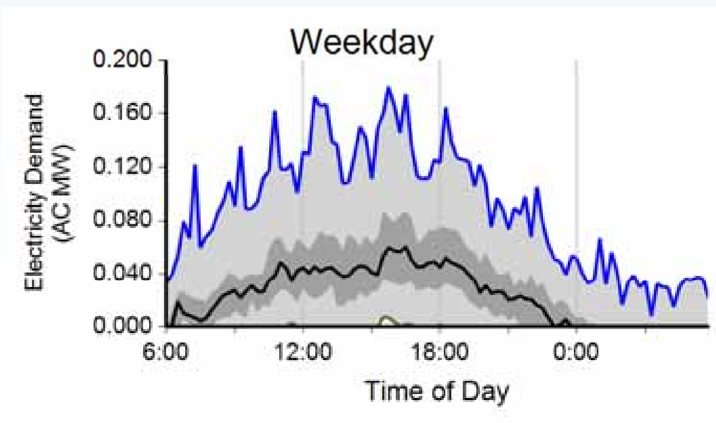
EV Project – EVSE Infra. Summary Report

- **DC Fast Chargers Weekday 4th Quarter 2012**
- **54 DCFC, 6,089 charge events and 58 AC MWh**

Weekday Connected Profile



Weekday Demand Profile



- **1.9 average charge events per day per DCFC**
- **Leafs 43% charge events and 45% energy**
- **Unknowns are other charge events and energy**
- **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 feel 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 Permit Costs / Issues

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

Region	Count of Permits	Average Permit Fee	Minimum Permit Fee	Maximum Permit Fee
Arizona	66	$96.11	$26.25	$280.80
Los Angeles	109	$83.99	$45.70	$218.76
San Diego	496	$213.30	$12.00	$409.23
San Francisco	401	$147.57	$29.00	$500.00
Tennessee	322	$47.15	$7.50	$108.00
Oregon	316	$40.98	$12.84	$355.04
Washington	497	$78.27	$27.70	$317.25

Residential Installation Costs

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

Marlets In Ascending Order Of Residential Installation Cost	Number of Installations	Average Installation Cost	Variation From Project Average
Tennessee (entire State)	542	$ 1,113.07	-19.0%
Arizona (Phoenix & Tucson)	357	$ 1,148.88	-16.4%
Washington DC	3	$ 1,197.44	-12.9%
Oregon (Portland, Eugene, Coralvls & Salem)	465	$ 1,229.06	-10.6%
Washington (Seattle & Olympia)	730	$ 1,289.56	-6.2%
Maryland	39	$ 1,311.75	-4.5%
Washington	80	$ 1,321.36	-3.8%
Virginia	38	$ 1,341.01	-2.4%
San Fransisco	1254	$ 1,386.13	0.9%
Texas (metro Houston & Dallas)	128	$ 1,422.77	3.5%
San Diego	726	$ 1,593.91	16.0%
Los Angeles	415	$ 1,794.64	30.6%

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 Level 2 Permits Cost

- **Commercial permits range $14 to $821**

Region	Count of Permits	Average Permit Fee	Minimum Permit Fee	Maximum Permit Fee
Arizona	72	$228	$35	$542
Los Angeles	17	$195	$67	$650
San Diego	17	$361	$44	$821
Texas	47	$150	$37	$775
Tennessee	159	$71	$19	$216
Oregon	102	$112	$14	$291
Washington	33	$189	$57	$590

Commercial DC Fast Charger Installation Costs / Issues

- Current installations range from $6,090 to $48,000 (70+)
- Average installation cost to date is about $22,600·
- Host has obvious commitment for the parking and ground space - not included in above costs
- Above does not include any costs that electric utility may have incurred in evaluating or upgrading service

- These are the preliminary costs to date. When all 200 DC Fast Chargers are installed, installation costs may be different
  - All the best (lower-cost) sites are installed first, so final costs may be higher
  - Lessons learned may help lower future costs and site selections, so final costs may be lower

Commercial DC Fast Charger Installation Costs / Issues

- Items of concern associated with installation that drive costs
  - Power upgrades needed for site
  - Impact on local transformer
  - Ground surface material and cost to "put back" (e.g. concrete, asphalt, landscaping)
  - Other underground services that may affect method of trenching power to DCFC
  - Gatekeeper or decision-maker for the property is not always apparent
  - Magnitude of operating costs and revenue opportunities are still largely unknown
  - Time associated with permissions
    - Permits, load studies, and pre-, post-, and interim inspections

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

No Demand Charges - Nissan Leaf	
CA	Pacific Gas & Electric
	City of Palo Alto
	Alameda Municipal Power
	Silicon Valley Power
AZ	Tucson Electric Power
OR	Eugene Water & Electric Board
	Lane Electric Co-op
TN	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

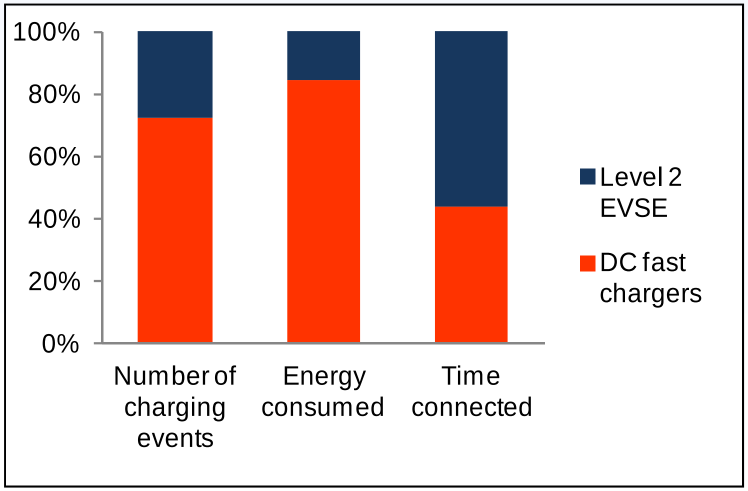
Commercial Lessons Learned

- **Especially in California, recurring Nissan Leaf DC fast charge demand charges are significant in many utility service territories**

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

Corridor Charging – 1st Look 4th Quarter 2012

- Ten Level 2 EVSE and two DCFCs in CA, WA and OR travel corridors outside of major cities
- 55 distinct vehicle owners charged 92 times at Level 2 EVSE for an average of 1.6 hours and 4.1 kWh
- 64 distinct vehicles owners charged 151 times at DCFCs for an average of 19 minutes and 7.9 kWh
- Two locations had one DCFC and one Level 2 EVSE. One immediate I-5 access and one on state highway
  - I-5 DCFC had 2 times the charging events as state highway DCFC
  - DCFC 5 times energy used as Level 2 at ¾ connect time
  - DCFC 2.5 times number charges as Level 2
  - Some vehicles may not be DCFC capable
  - Very small sample



ChargePoint results to date

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

VEHICLE TECHNOLOGIES PROGRAM

ChargePoint ®America Vehicle Charging Infrastructure Summary Report

Project Status to Date through: June 2012

Charging Unit - By State	Residential	Private Commercial	Public	Not Specified	Charging Units Installed to Date[1]	Number of Charging Events Performed[2]	Electricity Consumed (AC MWh)
California	791	39	518	3	1,351	213,758	1,487.7
Connecticut	11	-	-	-	11	2,569	15.1
District of Columbia	-	16	16	-	32	718	5.4
Florida	43	10	228	2	283	9,323	55.2
Maryland	18	7	46	-	71	5,956	37.9
Massachusetts	23	7	74	-	104	4,133	35.5
Michigan	252	14	172	-	438	60,436	407.1
New Jersey	51	2	17	-	70	15,397	95.7
New York	23	88	102	-	213	17,401	139.6
Texas	51	9	227	-	287	17,759	114.4
Virginia	23	17	43	-	83	10,061	65.0
Washington	12	7	123	-	142	8,153	50.0
Total	1,298	216	1,566	5	3,085	365,664	2,508.7

ChargePoint America Charging Unit Distribution

Project to Date

[1] Includes all charging units that were in use by the end of the repo...

[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

ChargePoint Network | INL Idaho National Laboratory

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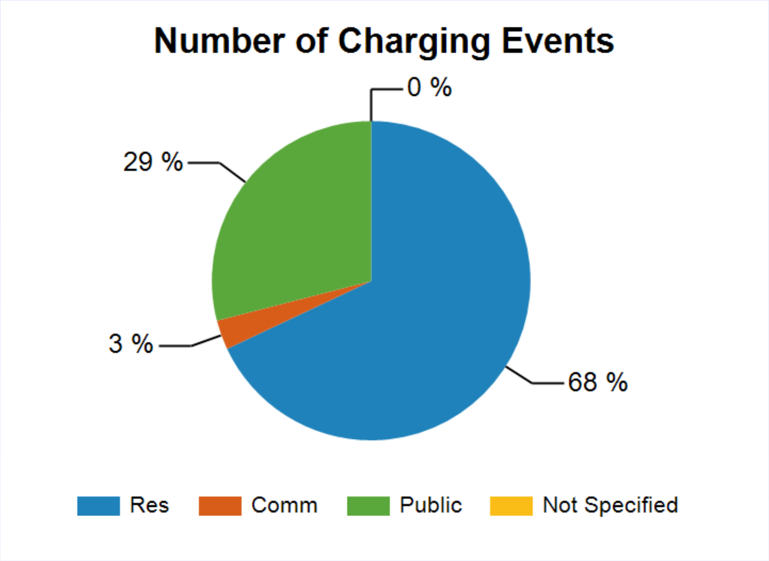
Page 1 of 8

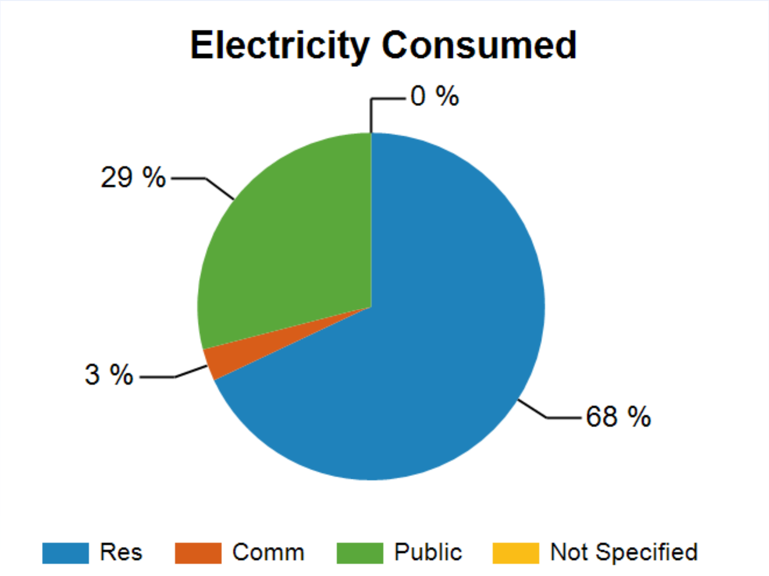
ChargePoint America ARRA Project

- 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 ARRA Project

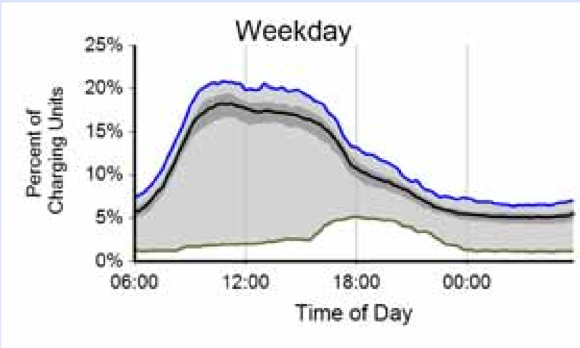
- Oct - Dec 2012 data
- 3,541 units
- Percent time vehicle connected
  - Residential 47%
  - Private/com 24%
  - Public 9%
- Percent time drawing power
  - Residential 9%
  - Private/com 5%
  - Public 4%
- EVSE data only



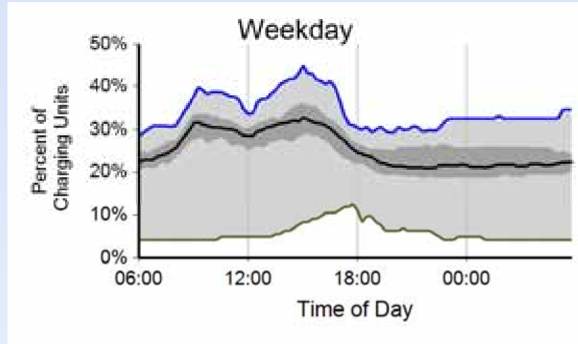


ChargePoint America: Oct – Dec. 2012

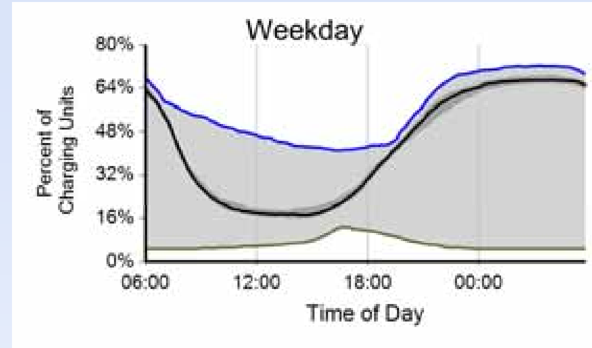
Public Connect Time



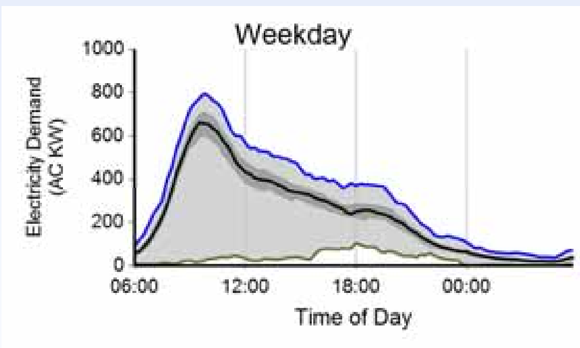
Commercial Connect Time



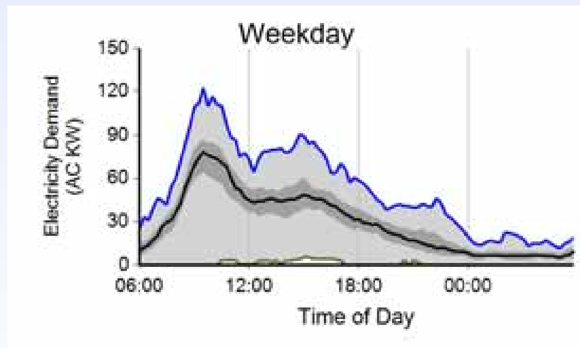
Residential Connect Time



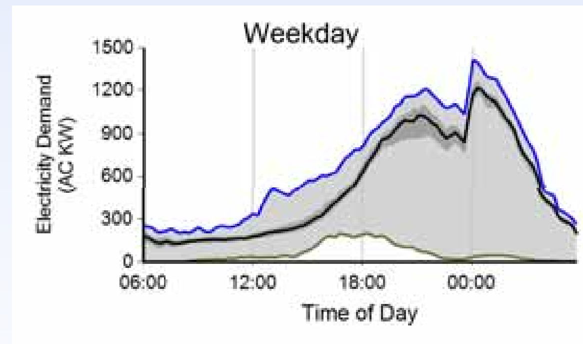
Public Demand



Commercial Demand



Residential Demand



- **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**

Other Testing Activities

Summary

Where you can find this presentation

Additional Testing

- Initiated field and lab DC Fast Charge and Level 2 charging study of impacts on battery life in 6 Nissan Leafs
  - At 20k miles each vehicle similar minimal capacity fade
- INL, with DOE, DOT and NFPA support, conducting PEV traction battery fire demonstration and suppression project
- INL initiated ~500 New York EVSE data collection with NYSERDA, NYPA, Port Authority of NY/NJ, and Energetics
- 30 EVSE and 10 vehicle conductive interoperability testing conducted with SAE
- Initiated data collection project for six Nissan Leafs in New York City taxi fleet. Data from 6 Level 2 EVSE & 3 DCFCs, vehicles and NYC Taxi & Limousine Commission
- Initiated wireless charging test program – first two systems this month
- Cyber security testing of smart EVSE and thus the Smart Grid

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 charges starting at midnight. TOU rates indicate 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 and this creates electric utility policy decisions
- Tested 13 EVSE and DC Fast Charges to date
- How, where, when we measure EVSE and vehicle system charging efficiencies results in significantly different results
- First independent testing of wireless systems will validate SAE testing procedures
- If I only had another 20 minutes I could have 100 slides……

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 is posted in the publications section of the above website, alphabetically as "DOT/FHA – DOE's EV Project Update"

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