



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

## **China/US EV and Battery Technology Workshop VI @ UMass - Update on US and Los Angeles EV and PHEV Demonstrations –**

**Jim Francfort**

**UMass Campus Center  
Boston, MA  
August 23-24, 2012**

# Outline

- **Participants**
- **Goals**
- **Testing experience**
- **Data processes and data security**
- **EV Project (Majority of presentation)**
  - **Description and data parameters**
  - **Project status**
  - **Leaf, Volt, and EVSE benchmarking results**
- **Other electric drive vehicle research activities**
- **Summary**
- **Future work**



# Idaho National Laboratory (INL)

- **Eastern Idaho based U.S. Department of Energy (DOE) Federal research laboratory**
- **890 square mile site with 4,000 staff**
- **INL supports DOE's strategic goal**
  - **Increase U.S. energy security and reduce the nation's dependence on foreign oil**
- **Multi-program DOE laboratory**
  - **Nuclear Energy**
  - **Energy Critical Infrastructure Protection**
  - **Homeland Security and Cyber Security**
  - **Advanced Vehicles and Battery Development**
  - **Fossil, Biomass, Wind, Geothermal and Hydropower Energy**



# AVTA Participants

- **INL manages the Advanced Vehicle Testing Activity's (AVTA) field testing of advanced technology light-duty vehicles for DOE's Vehicle Technologies Program**
- **ECOtality provides testing support via a competitively bid NETL (National Energy Testing Laboratory) contract**
- **Test partners include electric utilities, Federal, state and local government agencies, private companies, and individual vehicle owners**
- **AVTA benchmarking supports DOE's international petroleum reduction goals with**
  - **Canada**
  - **China**
  - **European Union**



# AVTA Goals

- **The AVTA goals**
  - **Petroleum reduction and energy security**
  - **Benchmark technologies that are developed via DOE research investments**
- **Confuse people with facts via structured benchmark testing**
- **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**

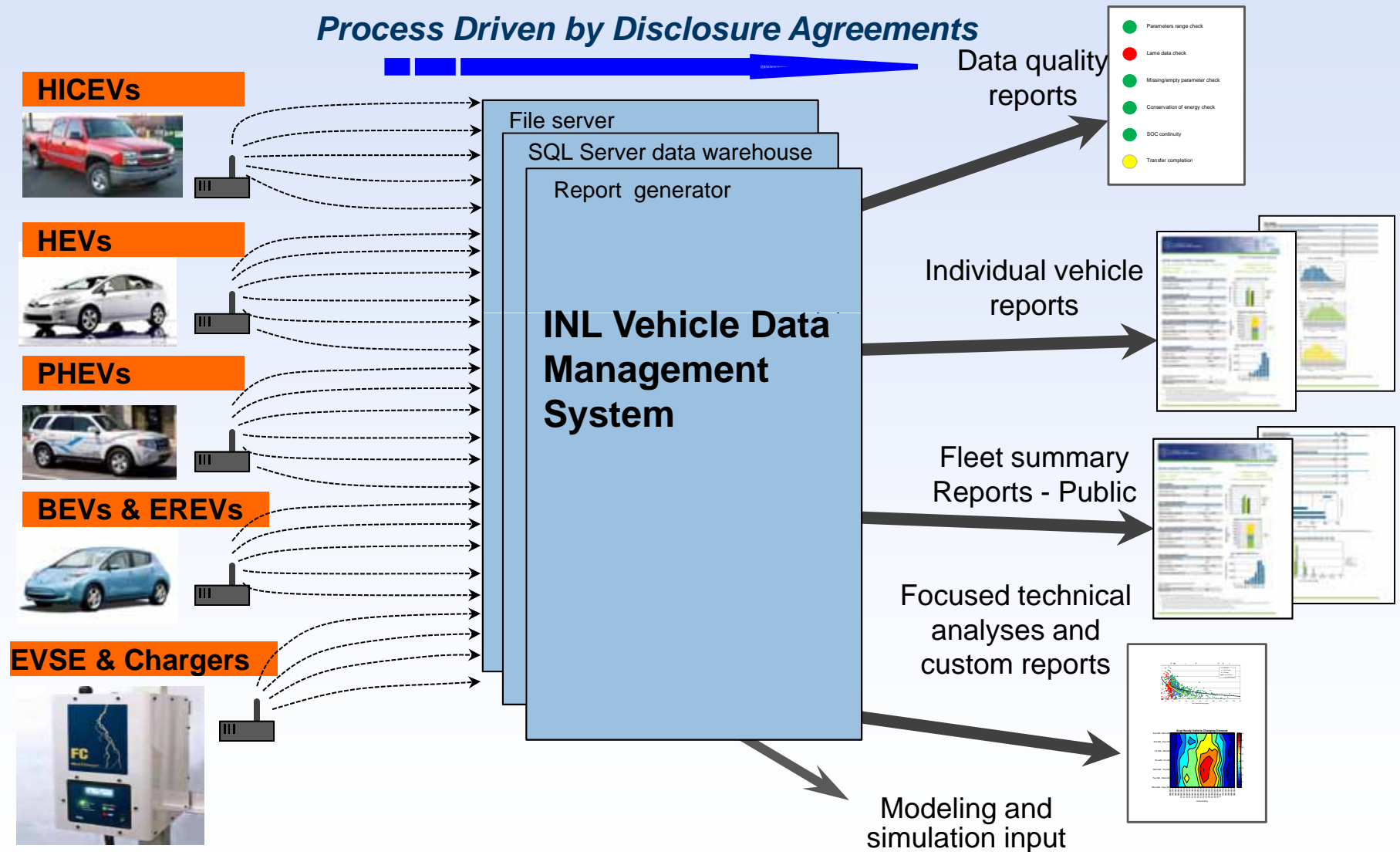


# Vehicle / Infrastructure Testing Experience

- **54 million test miles accumulated on 9,000 electric drive vehicles representing 115 models**
- **EV Project: 5,500 Leafs, Volts and Smart EVs, 6,500 EVSE (electric vehicle supply equipment), 36 million test miles**
  - **EV Project LA: 488 Leafs and Volts, 528 EVSE, 2.9 million test miles**
- **PHEVs: 14 models, 430 PHEVs, 4 million test miles**
- **EREVs: 1 model, 150 EREVs, 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**



# INL Vehicle/EVSE Data Management Process



# Data Collection, Security and Protection

- The AVTA has used data loggers on vehicles and EVSE (electric vehicle supply equipment) since 1993 to benchmark vehicle and charging equipment profiles
- All vehicle, EVSE, and personal 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

## The EV Project at a glance:



- **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.)



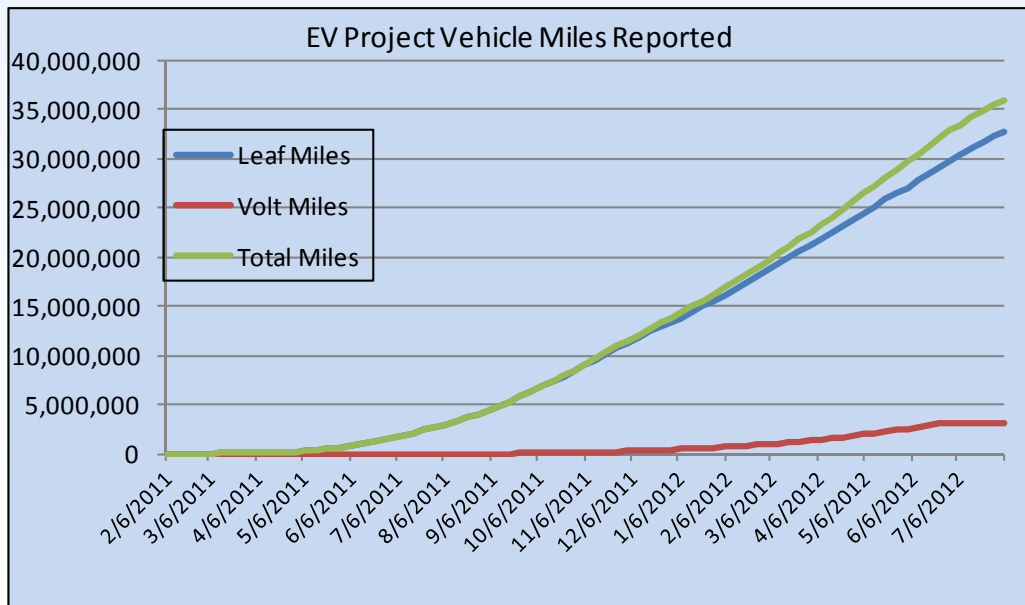
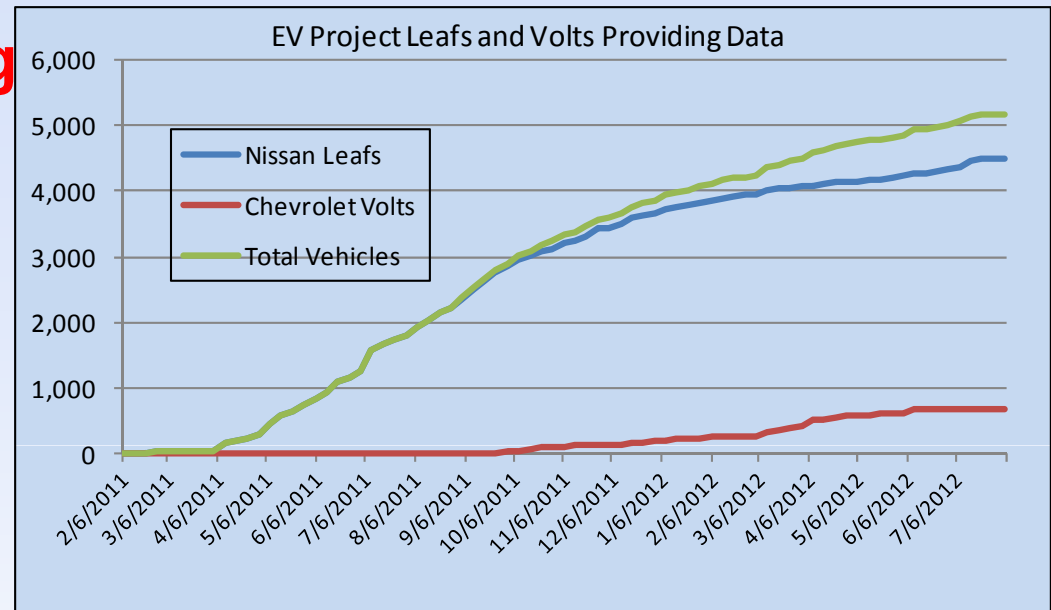
# EV Project – Vehicle Data Parameters Collected per Start/Stop Event

- 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



# EV Project – Vehicle Deployments / Miles

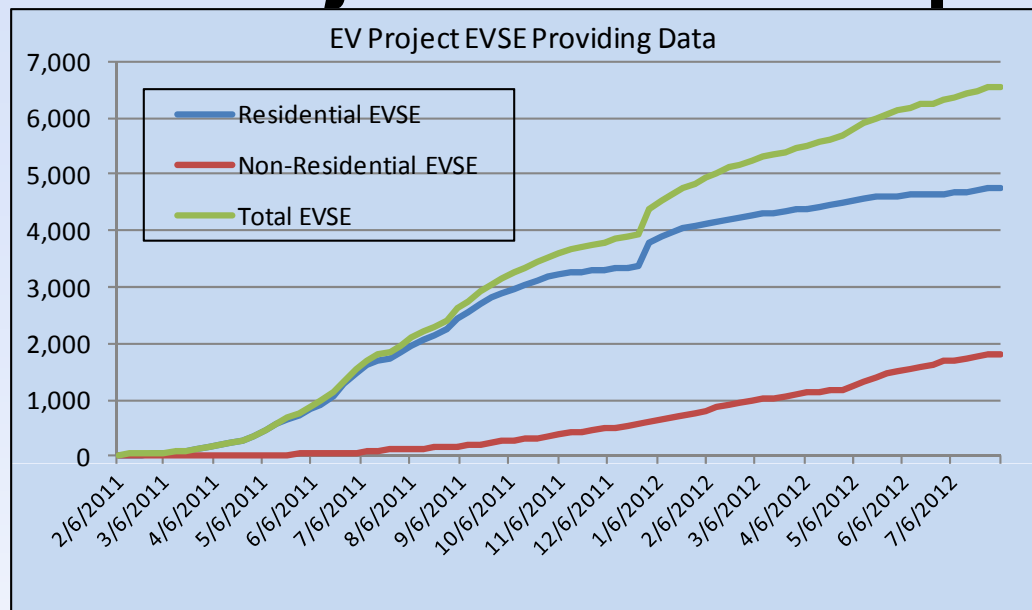
- **5,177 vehicles reporting data and growing**
- **4,500 Leafs (7/29) and 677 Volts (6/24) reporting data**
- **36 million total miles**
- **112,000 test miles per day**



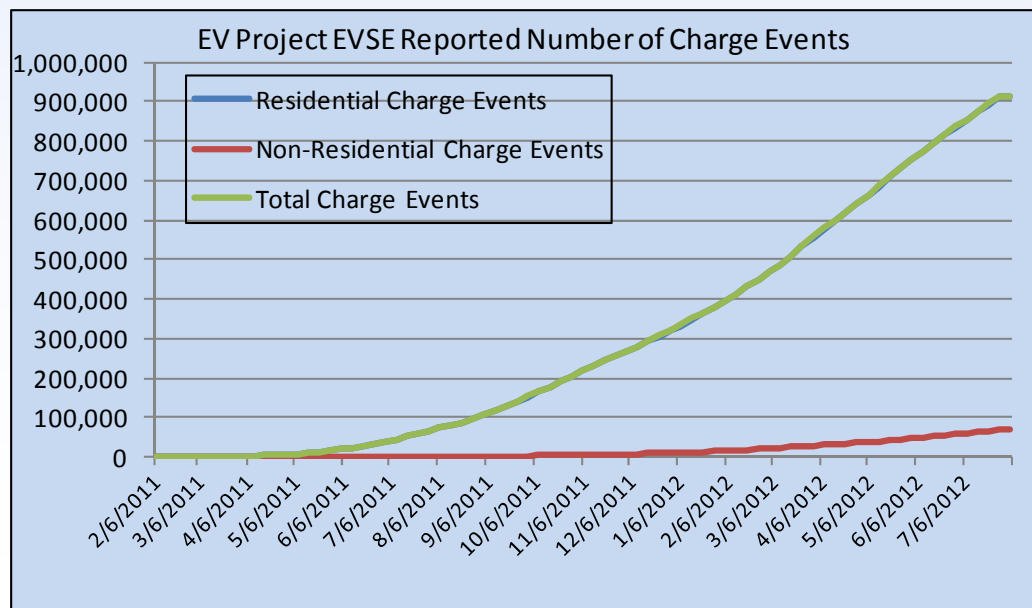
- **First data set just received for ~300 Daimler Smart EVs**



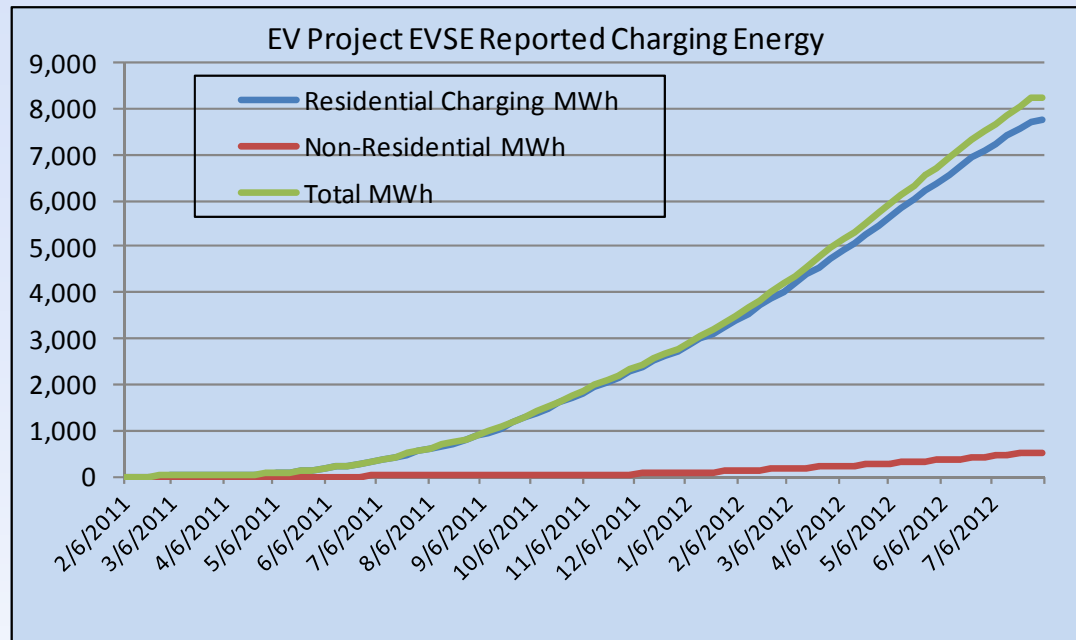
# EV Project – EVSE Deployment and Use



- **As of 08/05/12, 6,535 total EVSE**
  - 4,736 Residential EVSE
  - 1,799 non-Residential EVSE, includes DCFC
- 914,000 charge events
- **3,150 charge events per day**
- Data is continuously back-filled



# EV Project – Total Charge Energy (MWh)

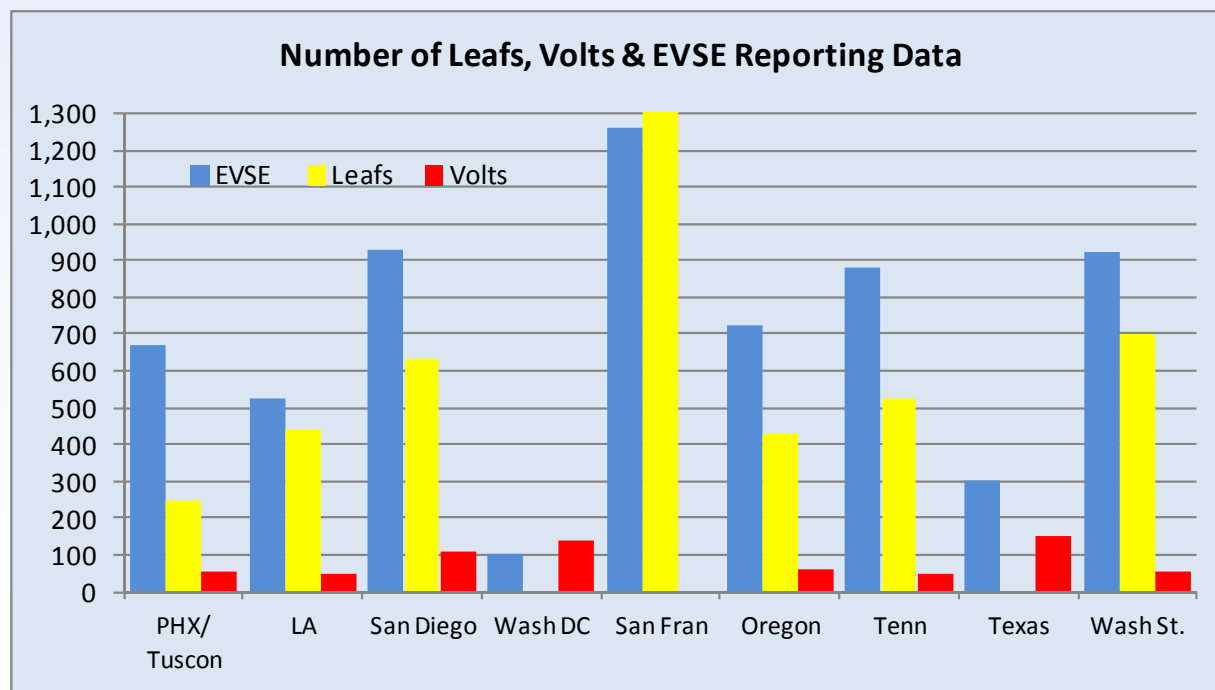


- **8,239 MWh total electricity charged**
  - 7,728 MWh residential
  - 510 MWh non-residential
- **29 MWh used for charging per day**

- **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 2nd Quarter

- **Vehicles and charging infrastructure deployed 2<sup>nd</sup> quarter 2012 and data received by INL**
- **Charging infrastructure**
  - 6,319 units installed
  - 881,06 charging events
  - 7,513 AC MWh
- **Vehicles**
  - 4,322 Leafs
  - 676 Volts
  - 33 million miles
- **Regional analyses are conducted and reported each quarter**
- **2<sup>nd</sup> quarter 2012: 94 pages and 53,000 data values calculated for 4 public reports**





# EV Project – Leaf Usage Report

## Leaf Usage – 2<sup>nd</sup> quarter 2012 Data

	<u>National</u>	<u>L.A.</u>
• Number of vehicles	2,911	274
• Number of Trips	788,000	66,581
• Distance (million miles)	5.7	0.48
• Average (Ave) trip distance	7.2 mi	7.1 mi
• Ave distance per day	30.6 mi	28.7 mi
• Ave number (#) trips between charging events	3.9	3.9
• Ave distance between charging events	28.1 mi	27.8 mi
• Ave # charging events per day	1.1	1.0

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





# EV Project – Volt Usage Report

## Volts Usage – 2<sup>nd</sup> quarter 2012 Data

### National

• Number of vehicles	408
• Number of Trips	148,000
• Distance (million miles)	1.2
• Average (Ave) trip distance	8.0 mi
• Ave distance per day	39.6 mi
• Ave number (#) trips between charge events	3.2
• Ave distance between charging events	26.0 mi
• Ave # charging events per day	1.5
• Overall mpg	155
• Overall AC Wh/mi	242

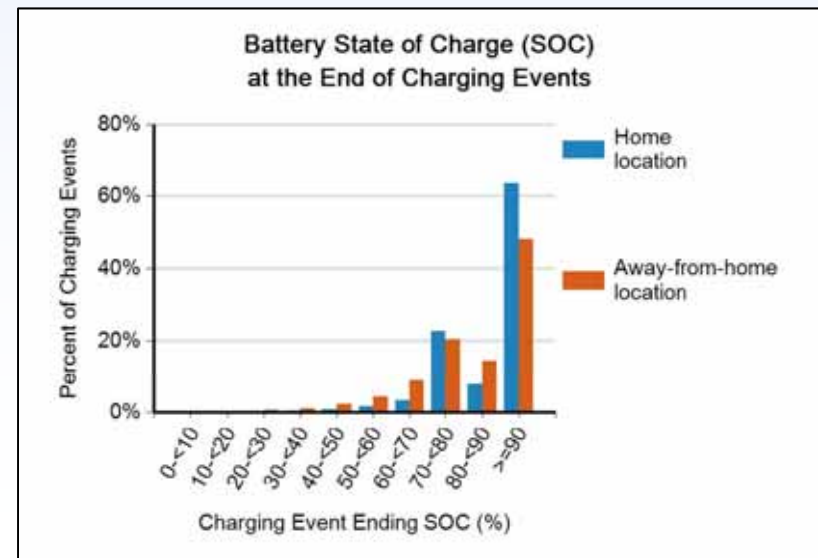
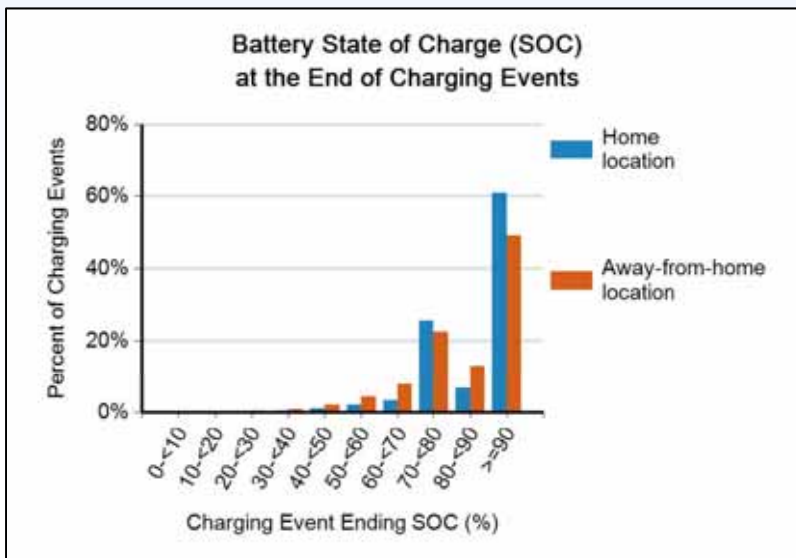
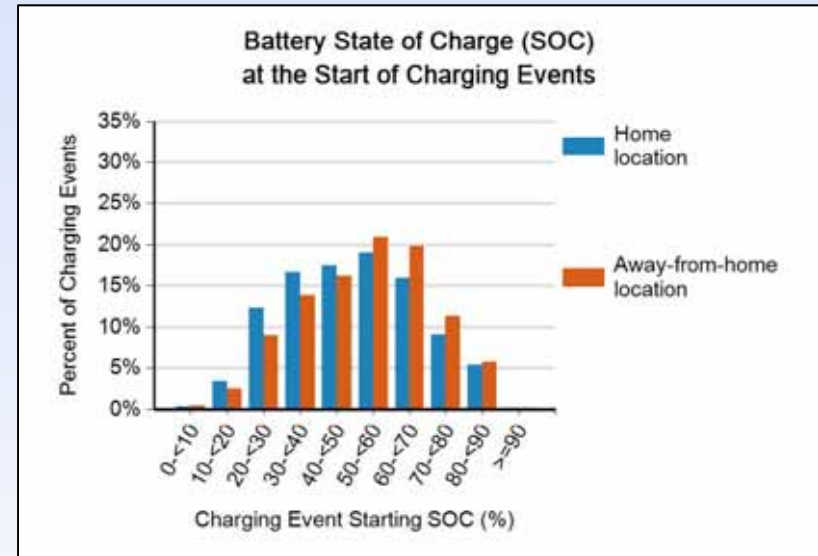
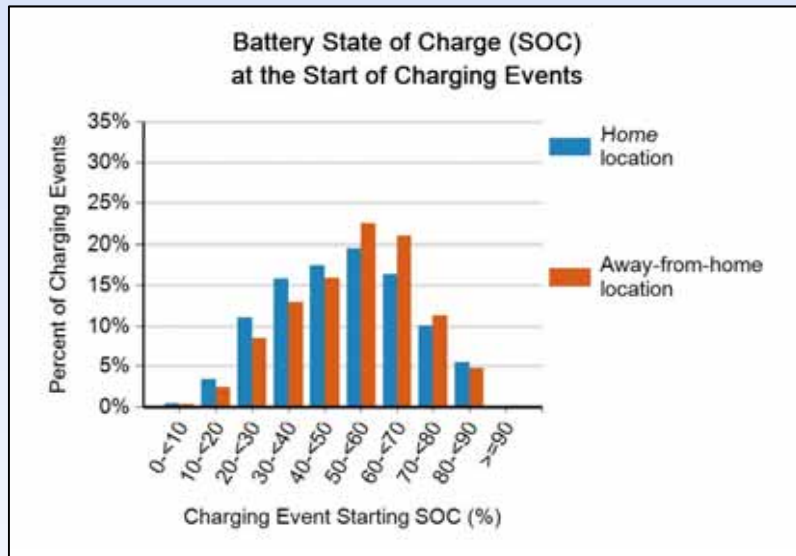
\* There are insufficient numbers of matched EVSE and Volts to report L.A. data

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



# EV Project – Leaf Usage Report (2<sup>nd</sup> ¼ 2012)

- Leaf battery SOC before and after charge events by home and non-home locations

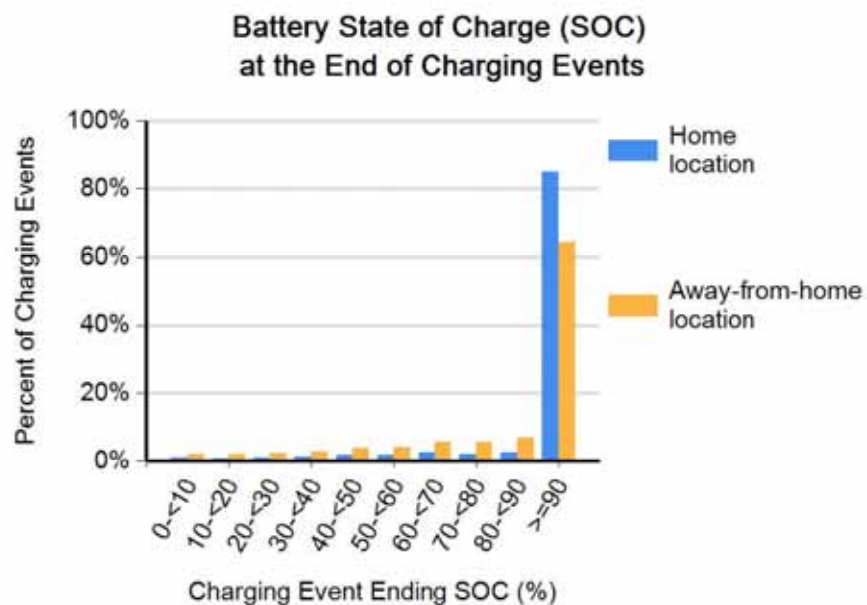
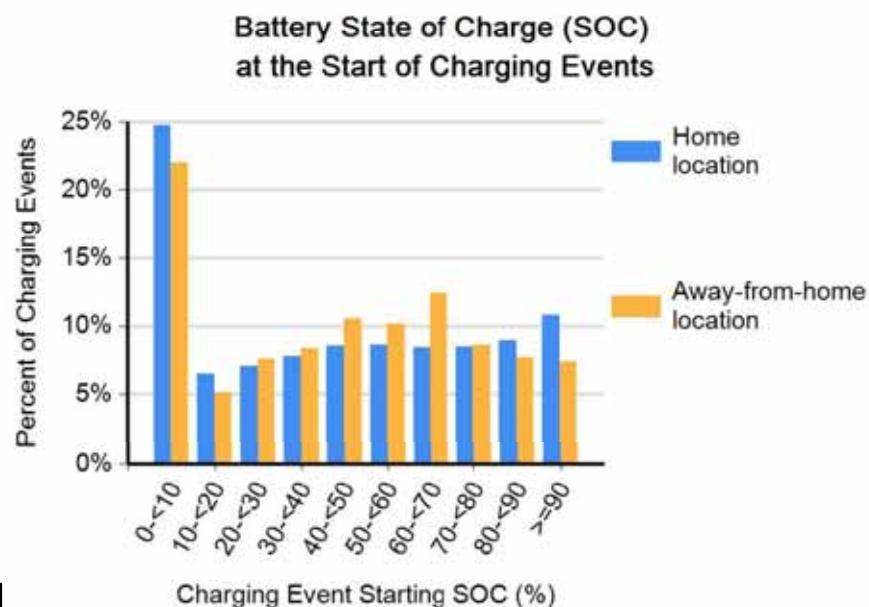


National Data

L.A. Data

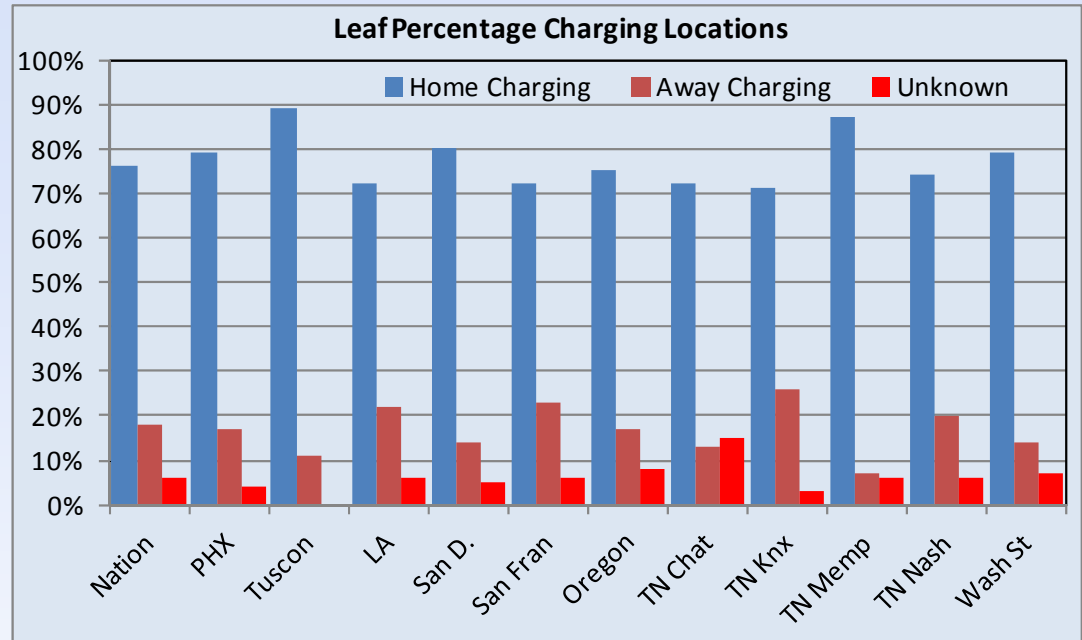
# EV Project – Volt Usage Report (2<sup>nd</sup> 1/4 2012)

- Volt battery SOC before and after charge events by home and non-home locations

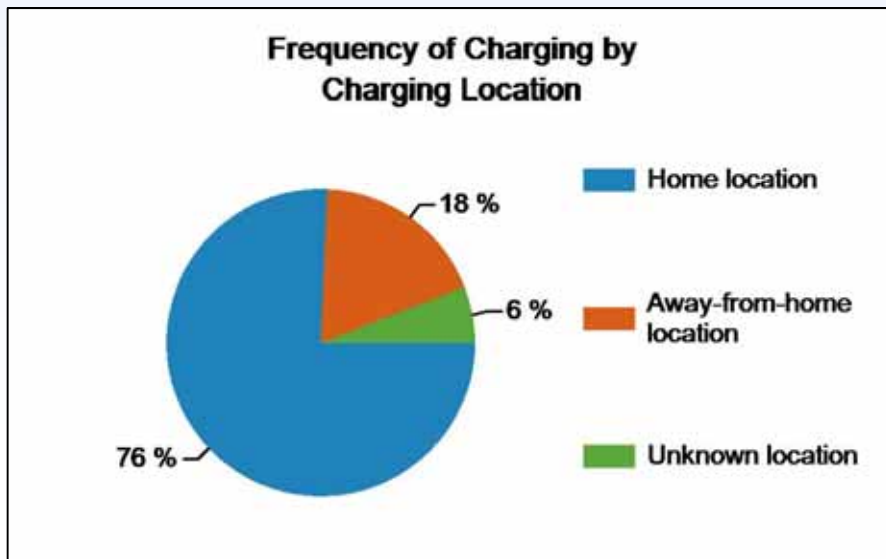


# EV Project – Leaf Usage Report (2<sup>st</sup> ¼ 2012)

- Regional variations in charging behavior
- LA has lower percent of at home charging frequency and higher away from home charging frequency



## National Data

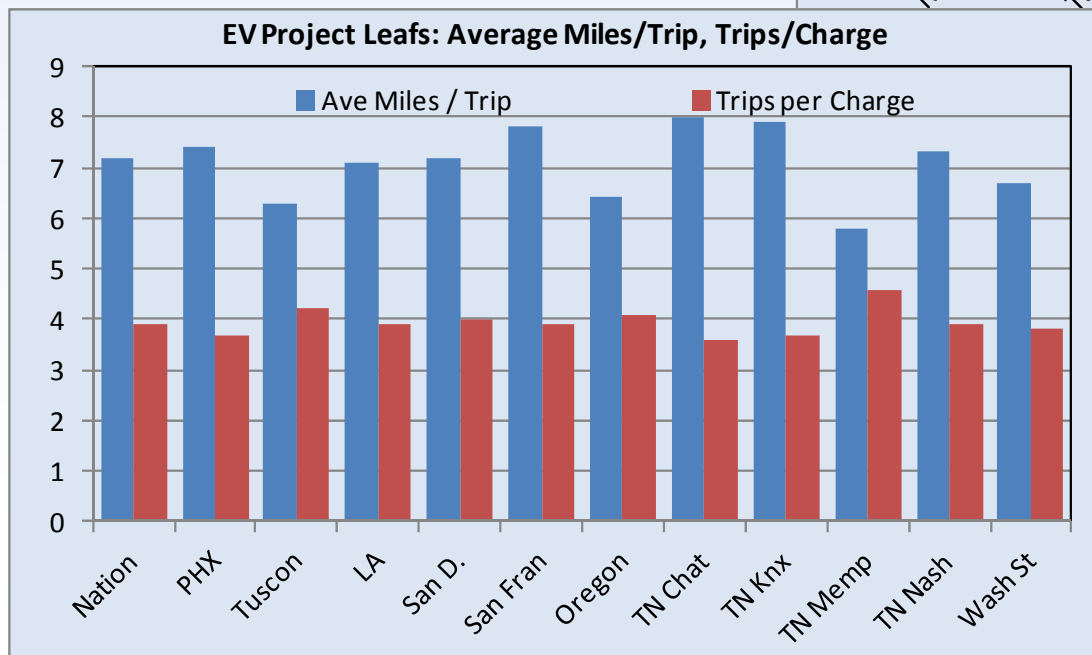
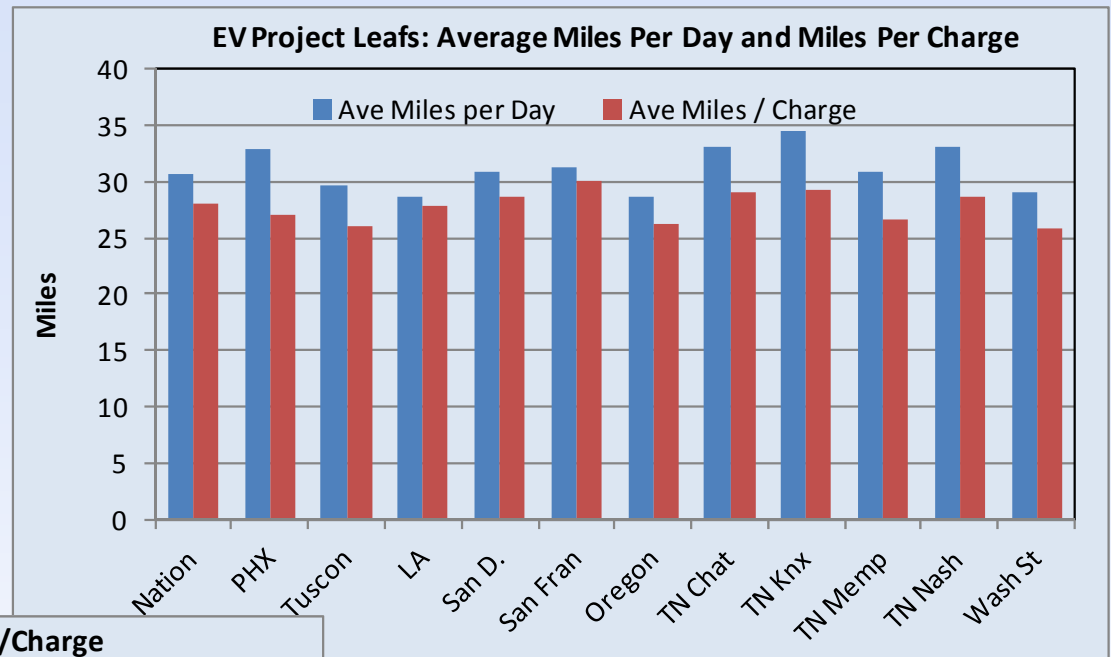


- Data is also available for Volts



# EV Project – Leaf Usage Report (2<sup>nd</sup> ¼ 2012)

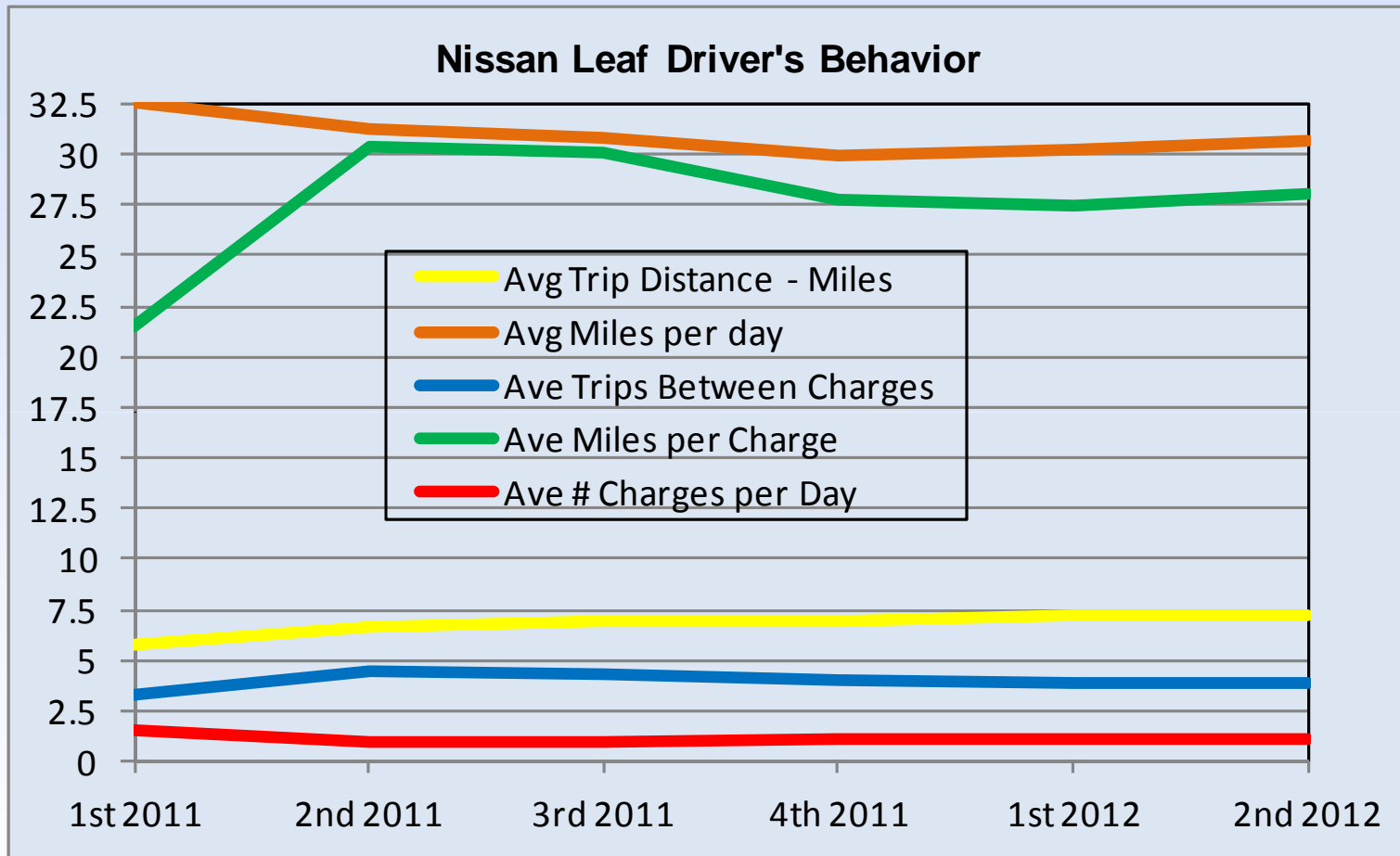
- Some regional variations in driving and charging profiles
- LA has low miles per day and per charge
- LA miles per trip and charge are average



- Data is also available for Volts



# EV Project – Leaf Usage Report 5 Quarters

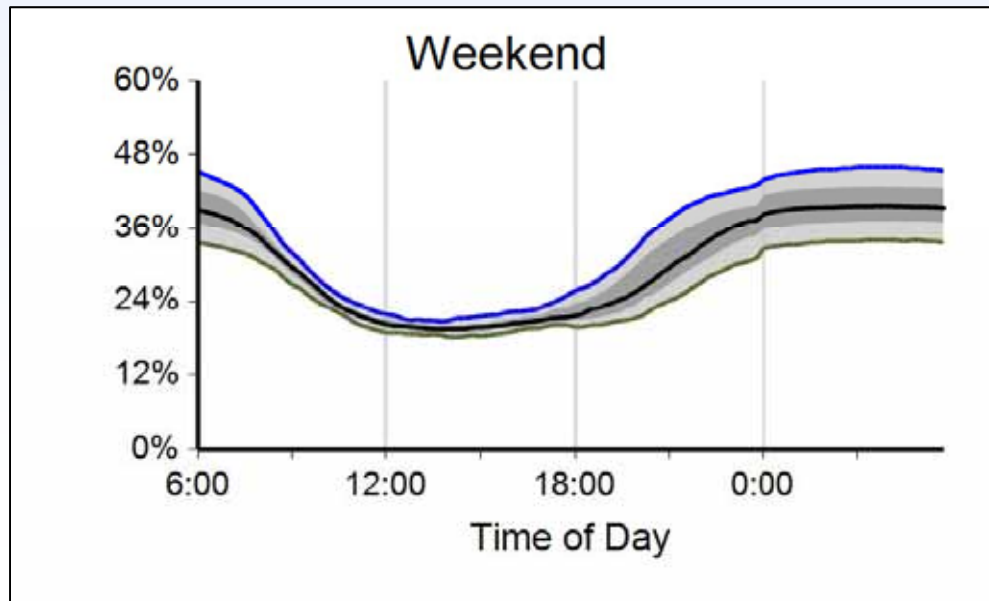
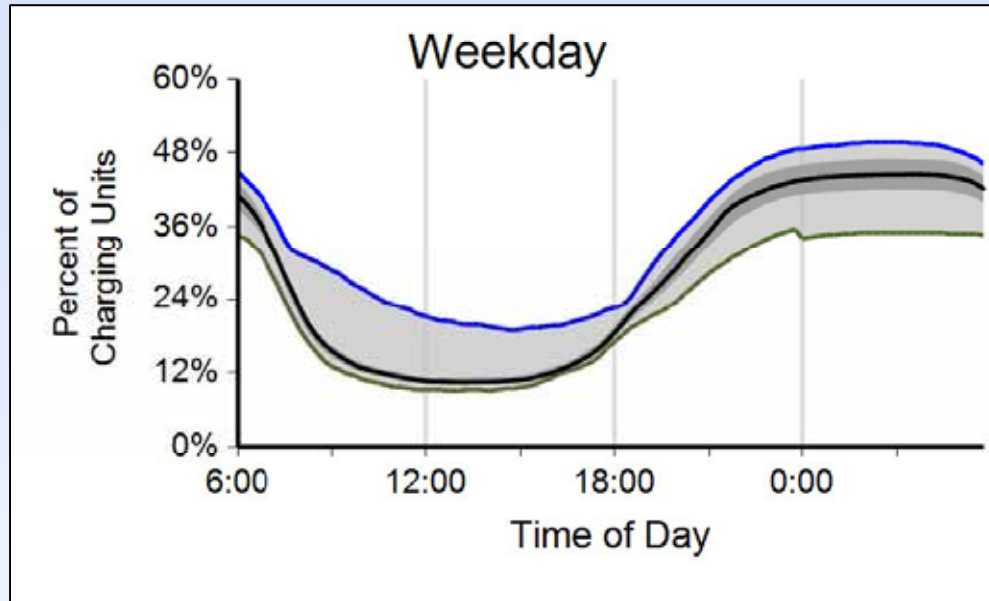


## Number of Leafs reporting each quarter

35	956	2,394	2645	2987	2911
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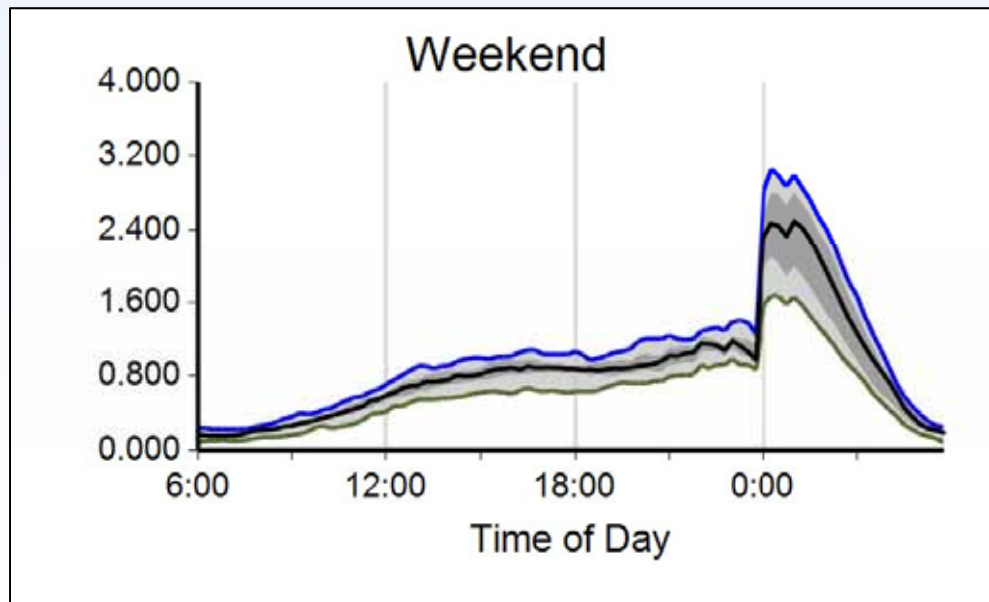
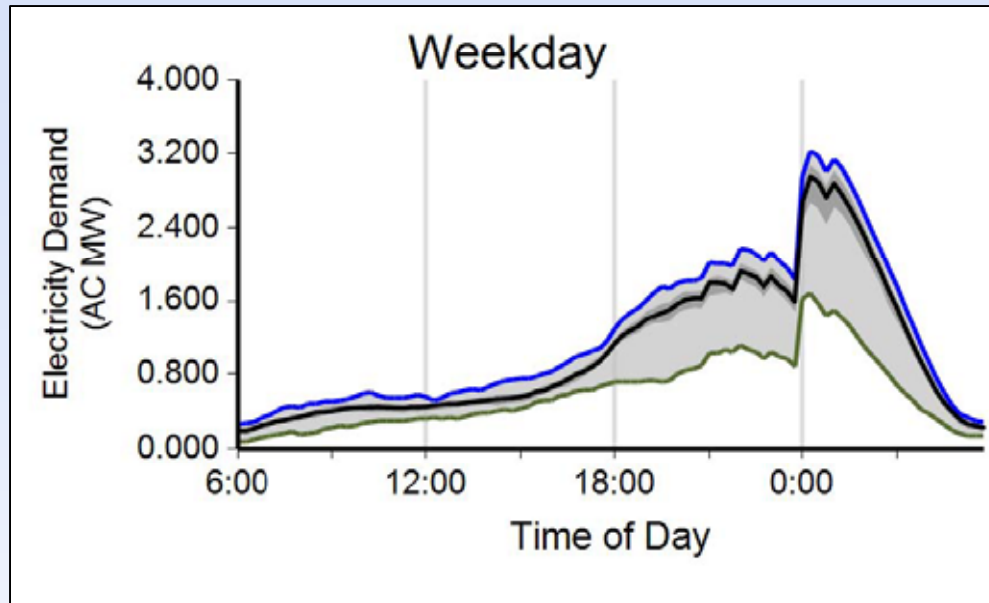
# EV Project – EVSE Infra. Summary Report



- **Graphs document when EVSE have a vehicle connected during the 2<sup>nd</sup> quarter 2012**
- **National Data**
- **Range of Percent of Charging Units with a Vehicle Connected vs. Time of Day**
- **4,821 total EVSE**
- **3,338 residential and 1,483 publicly available Level 2 EVSE**



# EV Project – EVSE Infra. Summary Report



- **Charging demand in AC MW during the 2<sup>nd</sup> quarter 2012**
- **National data, all EVSE**
- Time of day kWh rates are influencing charging start times as measured by AC MW demand
- **Range of Aggregate Electricity Demand vs. Time of Day (AC MW)**
- **4,821 total EVSE**
- **3,338 residential and 1,483 publicly available Level 2 EVSE**

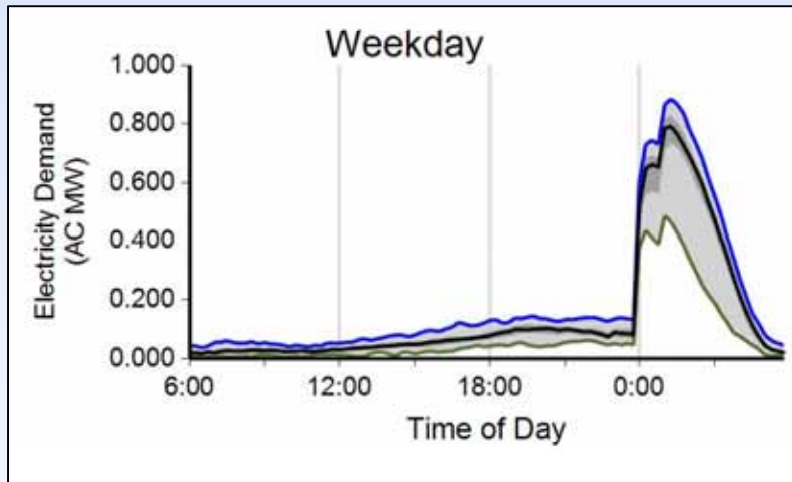




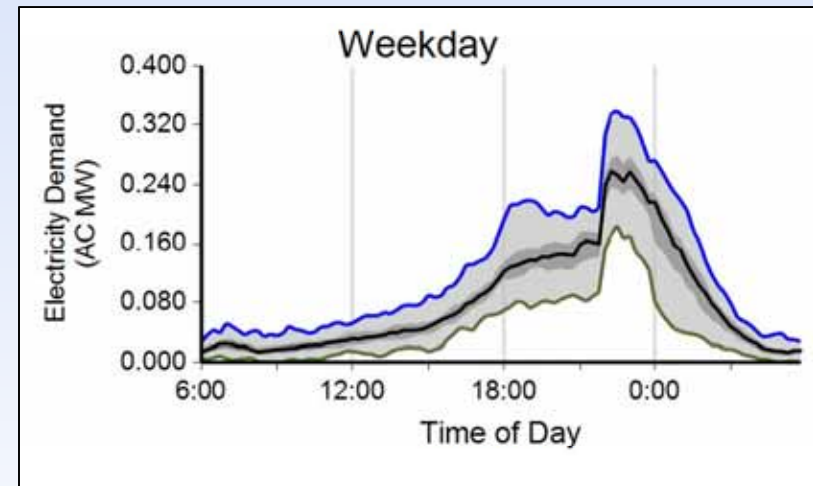
# EV Project – EVSE Infra. Summary Report

- Residential Level 2 Weekday EVSE 2<sup>nd</sup> Quarter 2012
- Time of day kWh rates clearly influence charge patterns

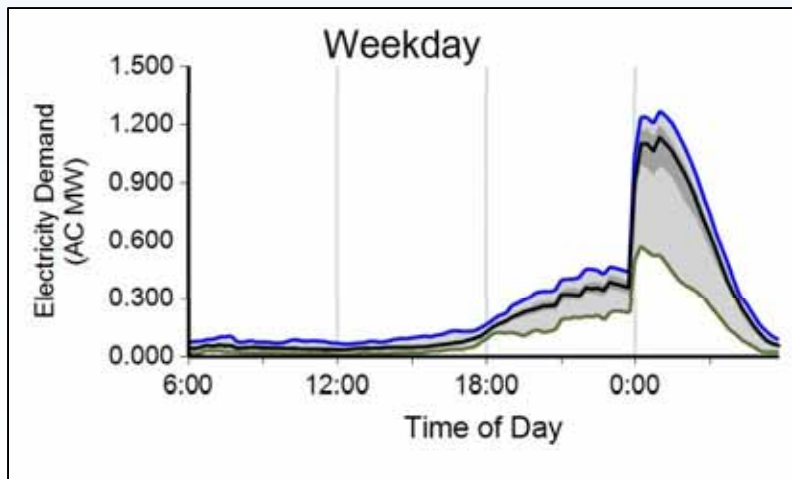
San Diego



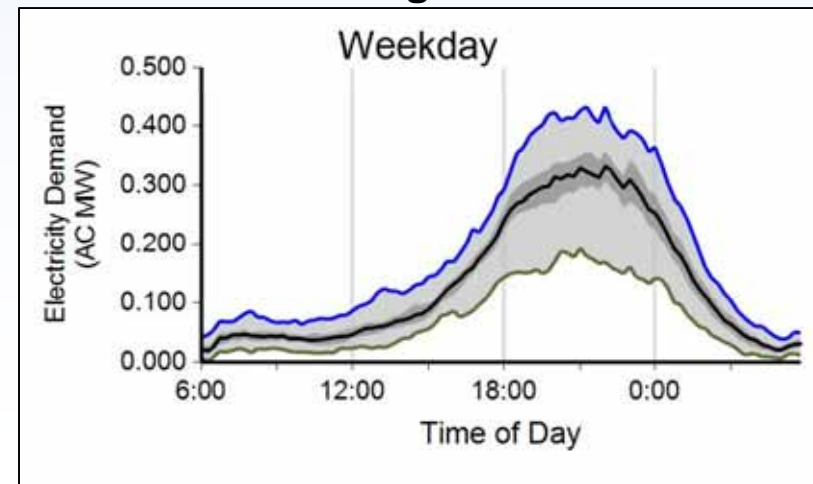
Oregon



San Francisco



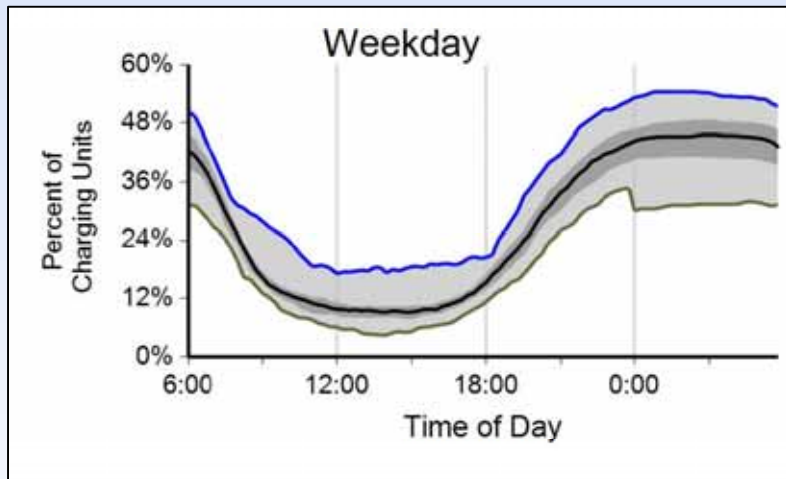
Washington State



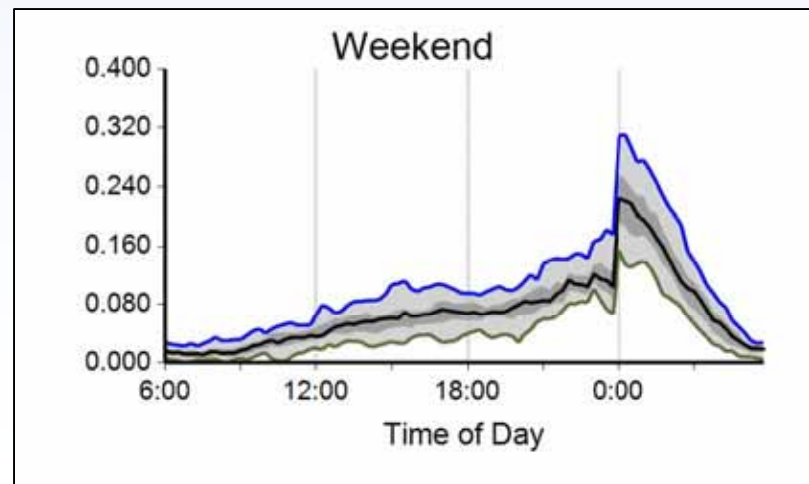
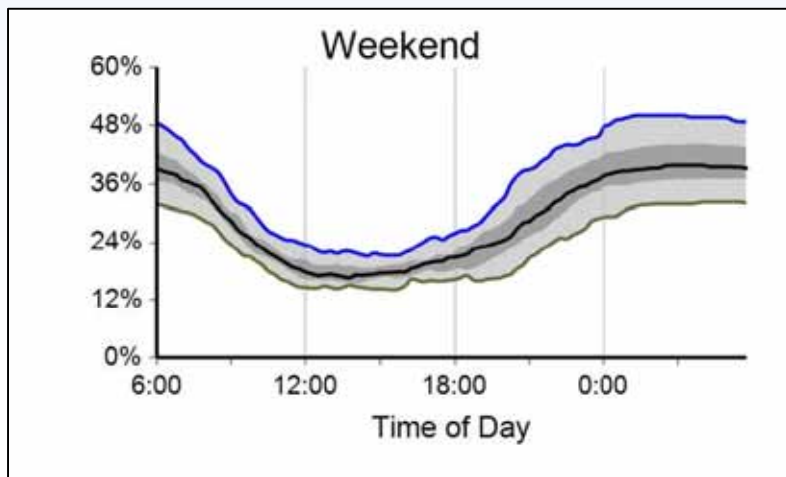
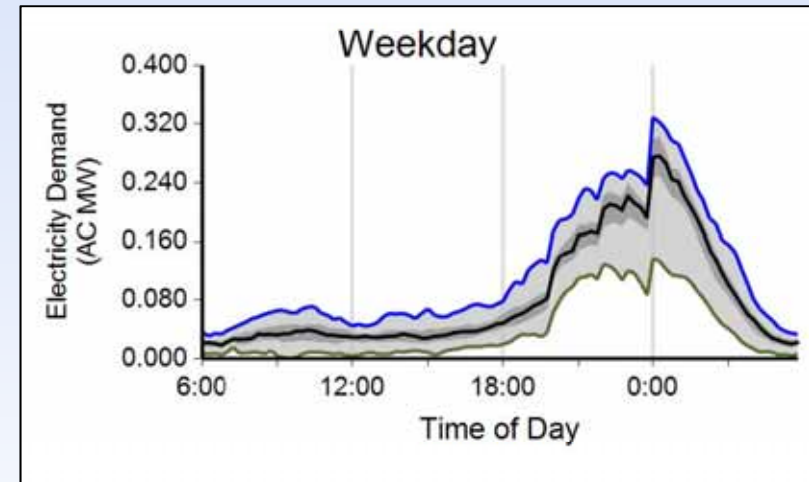
# EV Project – EVSE Infra. Summary Report

- **L.A. Residential and Non Residential Level 2 Weekday EVSE 2<sup>nd</sup> Quarter 2012**

**LA Vehicle Connected**



**LA Demand – AC MW**



# EV Project – EVSE Infra. Summary Report

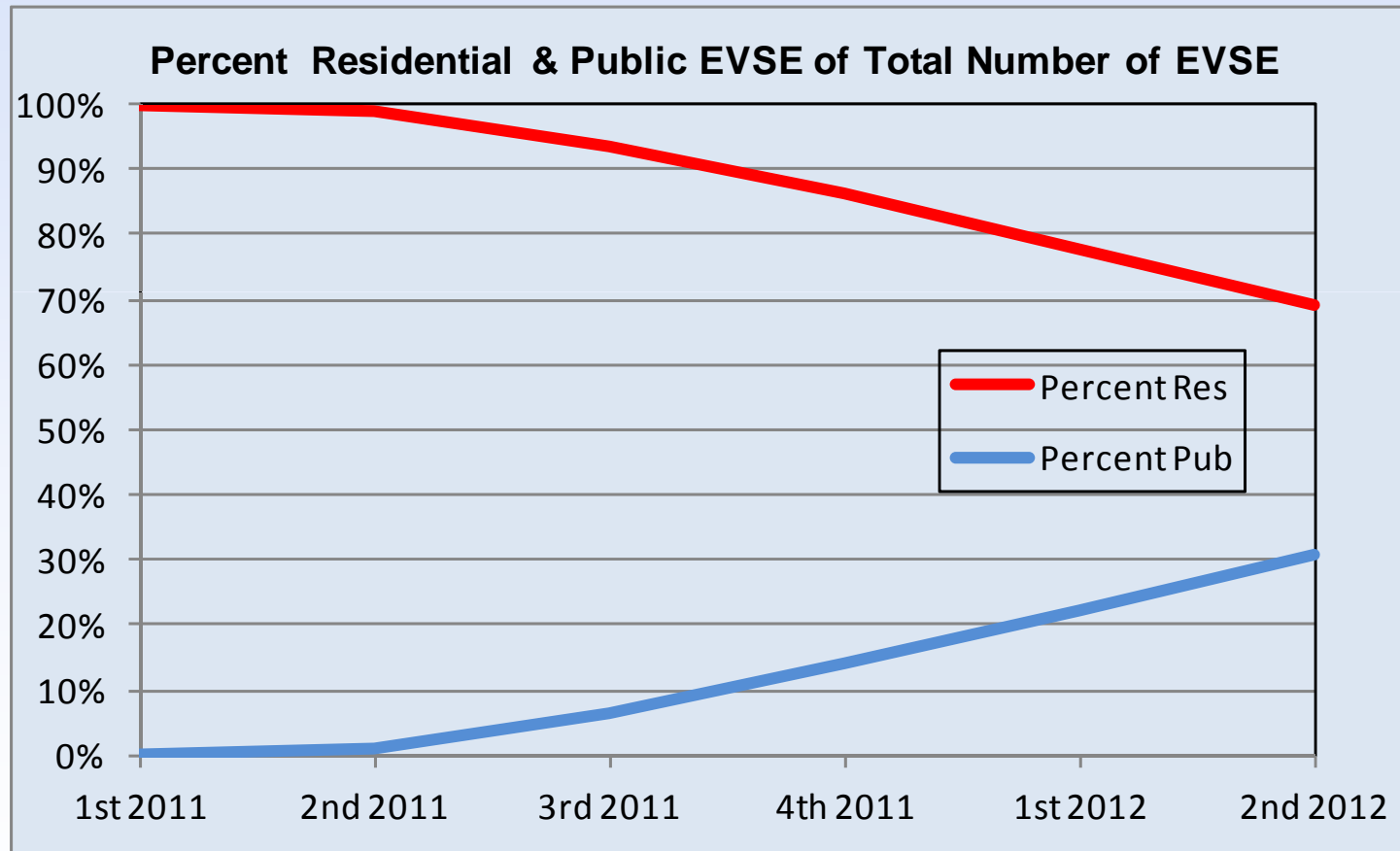
<b>2nd quarter 2012</b>	<b><u>National</u></b>	<b><u>L.A.</u></b>
• Ave hours V connected R2 WD	11.6	11.9 hours
• Ave hours V connected R2 WE	11.6	11.5 hours
• Ave hours V drawing power R2 WD	2.5	2.6 hours
• Ave hours V drawing power R2 WE	2.1	2.3 hours
• Ave AC kWh/charge event R2 WD	8.7	9.6 AC kWh
• Ave AC kWh/charge event R2 WE	7.5	8.2 AC kWh
• Ave hours V connected P2 WD	6.1	4.8 hours
• Ave hours V connected P2 WE	4.1	3.8 hours
• Ave hours V drawing power P2 WD	2.3	2.3 hours
• Ave hours V drawing power P2 WE	2.2	1.6 hours
• Ave AC kWh/charge event P2 WD	7.7	7.9 AC kWh
• Ave AC kWh/charge event P2 WE	7.7	5.6 AC kWh

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



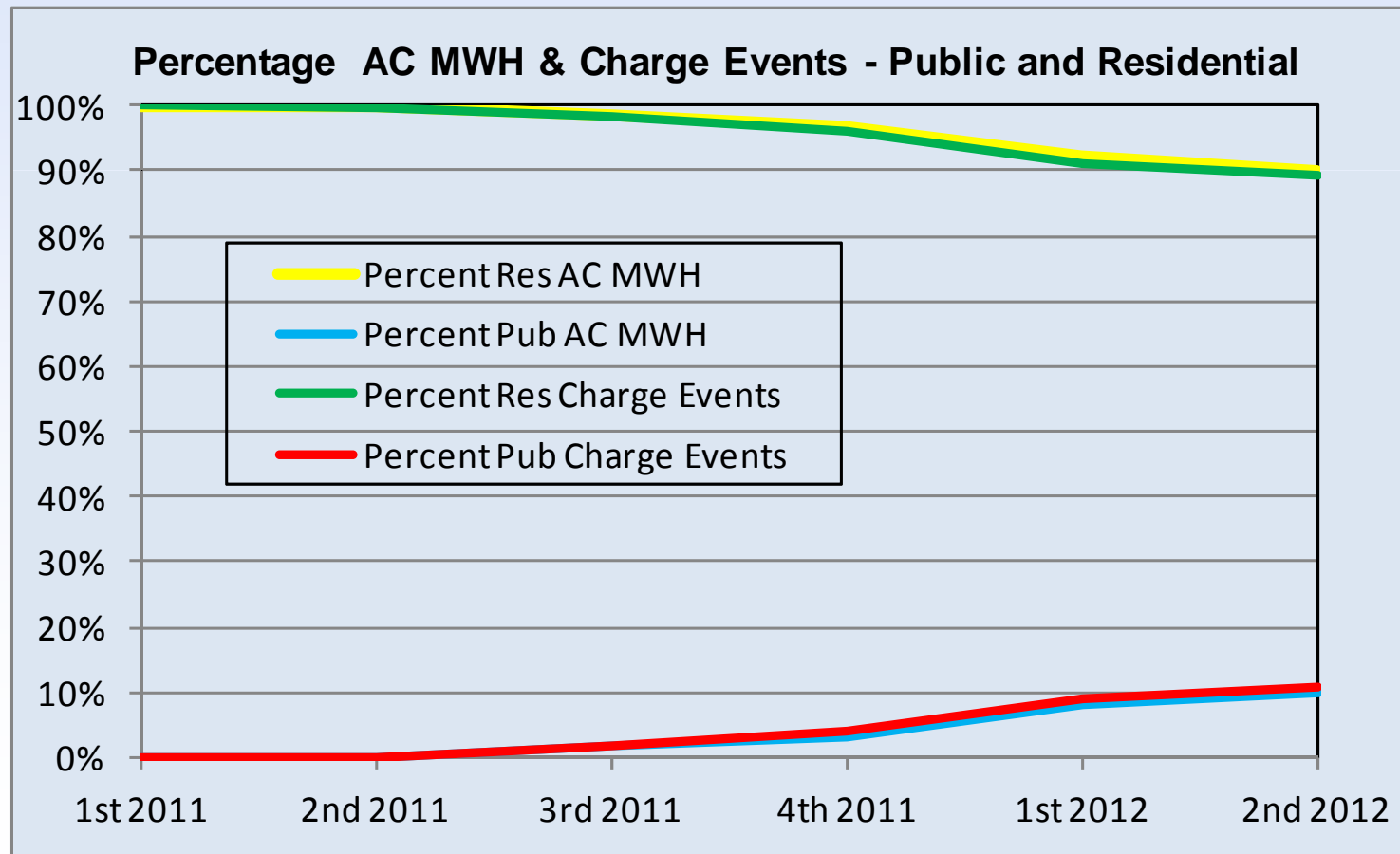
# EV Project – EVSE Infra. Summary Report

- **Percent of public EVSE deployed is increasing, now representing 31% of all EVSE**



# EV Project – EVSE Infra. Summary Report

- Percent charge events and AC MWH use by residential and public EVSE each reporting quarter
- **Public EVSE use (red & blue lines) is increasing**
- **10.8% charge events and 10.0% MWh 2<sup>nd</sup> quarter 2012**



## Chevrolet Volt Vehicle Demonstration

Fleet Summary Report

Reporting period: April 2012 through June 2012

Number of vehicles: 143

Number of vehicle days driven: 6,598

### All operation

Overall gasoline fuel economy (mpg)	73.7
Overall AC electrical energy consumption (AC Wh/mi)	170
Average Trip Distance	12.6
Total distance traveled (mi)	370,987
Average Ambient Temperature (deg F)	71.0

### Electric Vehicle mode operation (EV)

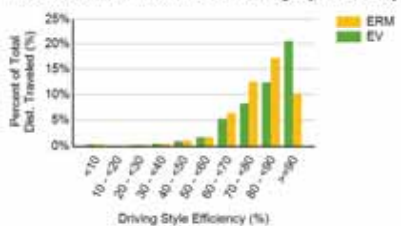
Gasoline fuel economy (mpg)	No Fuel Used
AC electrical energy consumption (AC Wh/mi)	341
Distance traveled (mi)	185,282
Percent of total distance traveled	49.9%
Average driving style efficiency (distance weighted) <sup>1</sup>	83%

### Extended Range mode operation (ERM)

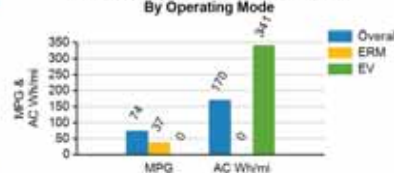
Gasoline fuel economy (mpg)	36.9
AC electrical energy consumption (AC Wh/mi)	No Elec. Used
Distance traveled (mi)	185,705
Percent of total distance traveled	50.1%
Average driving style efficiency (distance weighted) <sup>1</sup>	79%

	City <sup>3</sup>	Highway <sup>3</sup>
Percent of miles in EV operation (%)	68.0%	32.4%
Percent Number of trips	85.4%	14.6%
Average trip distance (mi)	7.3	43.7
Average driving style efficiency (distance weighted) <sup>1</sup>	80%	82%

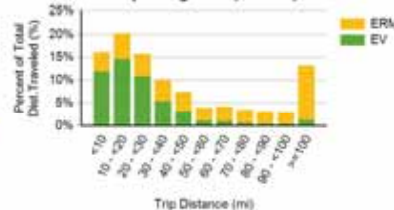
Percent Distance Driven for each Driving Style Efficiency



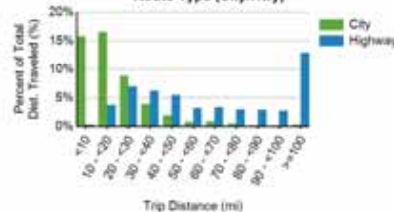
Fuel Economy & Electrical Consumption By Operating Mode



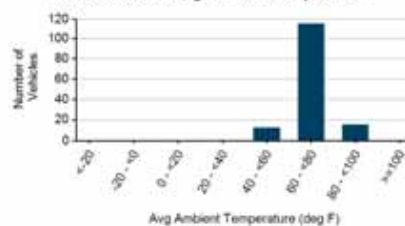
Percent Distance Traveled By Operating Mode (EV/ERM)



Percent Distance Traveled by Route Type (City/Hwy)



Distribution of Average Ambient Temperature<sup>2</sup>



<sup>1</sup> The energy efficiency over the drive cycle is based on driving style. Driving in a more efficient manner results in a higher percentage for driving style.

<sup>2</sup> Plot shows average ambient temperature during all driving in the reporting period for each vehicle.

<sup>3</sup> City / Highway defined per SAE J2841

# Chevrolet Volt DOE ARRA Project

- **Non-public fleet drivers operating 150 Volts**
- **May '11 to June '12**
  - 1.2 million total miles
  - **All trips, 70.0 mpg, 174 AC Wh/mi**
  - **EV mode, 352 AC Wh/mi. 49.5% miles**
  - **Extended range mode, 35.4 mpg**
- **April to June 2012**
  - 371,000 miles
  - **EV mode, 341 AC Wh/mi. 49.9% miles**



# Chevrolet Volt DOE ARRA Project

- **Non-public fleet drivers**

- **150 Volts (May '11 – June '12)**

- Average charging events per month 17
- Average # charging events per vehicle day 1.3
- Average miles per charging event 43 miles
- Average trips between charging events 3.4
- Average time connected per event 3.2 hours
- Average energy per charge event 7.2 AC kWh
- Average charging energy per vehicle 125 AC kWh month
- Average trip distance city driving 7.3 miles
- Average trip distance highway driving 44.0 miles
- Percent of miles in EREV (electric) mode 49.5%



**Ford Escape Advanced Research Fleet**

Number of vehicles: 21

Date range of data received: 11/01/2009 to 06/30/2012

Reporting period: Nov 09 - June 12

Number of vehicle days driven: 9,131

**All Trips Combined**

Overall gasoline fuel economy (mpg)	38
Overall AC electrical energy consumption (AC Wh/mi) <sup>1</sup>	100
Overall DC electrical energy consumption (DC Wh/mi) <sup>2</sup>	68
Total number of trips	44,178
Total distance traveled (mi)	528,632

**Trips in Charge Depleting (CD) mode<sup>3</sup>**

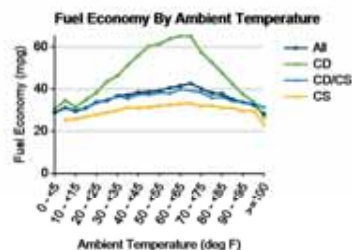
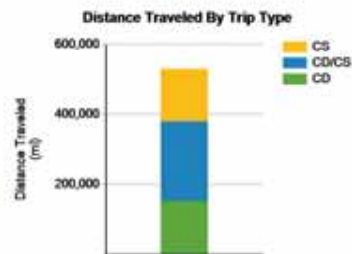
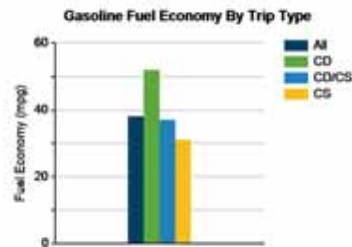
Gasoline fuel economy (mpg)	52
DC electrical energy consumption (DC Wh/mi) <sup>4</sup>	163
Number of trips	25,801
Percent of trips city   highway	83%   17%
Distance traveled (mi)	151,628
Percent of total distance traveled	29%

**Trips in both Charge Depleting & Charge Sustaining (CD/CS) modes<sup>5</sup>**

Gasoline fuel economy (mpg)	37
DC electrical energy consumption (DC Wh/mi) <sup>6</sup>	54
Number of trips	8,261
Percent of trips city   highway	38%   62%
Distance traveled (mi)	227,283
Percent of total distance traveled	43%

**Trips in Charge Sustaining (CS) mode<sup>7</sup>**

Gasoline fuel economy (mpg)	31
Number of trips	10,106
Percent of trips city   highway	66%   34%
Distance traveled (mi)	149,720
Percent of total distance traveled	28%



Notes: 1 - 7. Please see <http://avt.inl.gov/pdf/phev/fordreportnotes.pdf> for an explanation of all PHEV Fleet Testing Report notes.

Since these vehicles are flex-fuel capable, some driving events are conducted with E-85, which may decrease fuel economy results.

\*The Ford Escape Advanced Research Fleet was designed as a demonstration of customer duty cycles related to plug-in electric vehicles. The vehicles used in this demonstration have not been optimized to provide the maximum potential fuel economy.\*

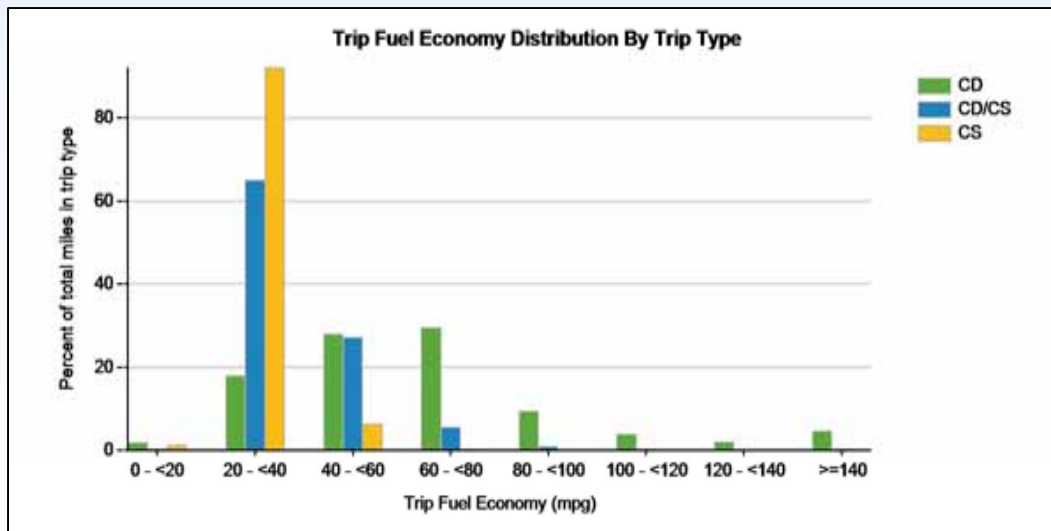
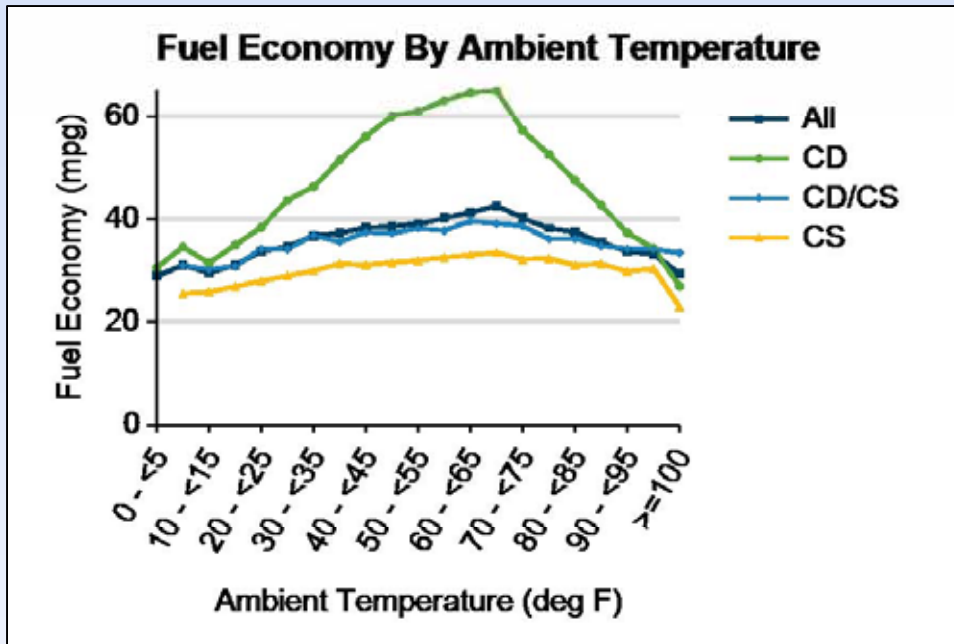
# Ford Escape Adv. Research Vehicle

- **21 Ford Escape PHEVs**
- **Fleet drivers**
- **Nov 09 to July 12**
- **529,000 test miles**
- **All trips, 38 mpg, 100 AC & 68 DC Wh/mi**
- **Charge Depleting (CD), 52 mpg & 163 DC Wh/mi. 29% of all miles**
- **Charge Sustaining (CS), 31 mpg. 28% of all miles**
- **Charging = 68% overall increase in mpg when comparing CD to CS trips**



# Ford Escape Adv. Research Vehicle

- Ambient temperature and increased engine off-times impact mpg
- **Charging = 57% increase in city mpg and 78% increase in highway mpg (compare CD to CS)**
- **City - 36% CD and 23% CS miles engine off**
- **Highway - 11% CD and 4% CS miles engine off**



**Chrysler RAM PHEV Fleet**

Number of vehicles: 109

Reporting period: July 2011 to May 2012

**All Fleets**

Date range of data received: 7/1/2011 to 5/31/2012

Number of vehicle days driven: 14280

**All Trips Combined**

Overall gasoline fuel economy (mpg)	19
Overall AC electrical energy consumption (AC Wh/mi) <sup>1</sup>	100
Overall DC electrical energy consumption (DC Wh/mi) <sup>2</sup>	69
Overall DC electrical energy captured from regenerative braking (DC Wh/mi)	44
Total number of trips	86,891
Total distance traveled (mi)	815,236

**Trips in Charge Depleting (CD) mode<sup>3</sup>**

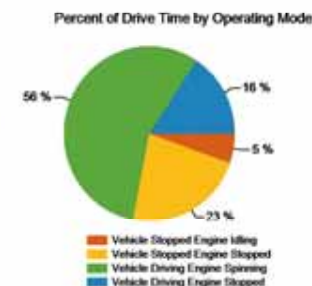
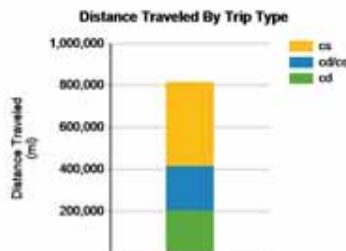
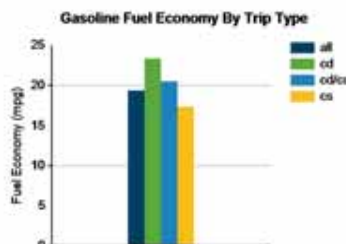
Gasoline fuel economy (mpg)	23
DC electrical energy consumption (DC Wh/mi) <sup>4</sup>	210
Number of trips	37,002
Percent of trips city   highway	94%   6%
Distance traveled (mi)	205,637
Percent of total distance traveled	25%

**Trips in both Charge Depleting & Charge Sustaining (CD/CS) modes<sup>5</sup>**

Gasoline fuel economy (mpg)	21
DC electrical energy consumption (DC Wh/mi) <sup>6</sup>	69
Number of trips	10,253
Percent of trips city   highway	74%   26%
Distance traveled CD   CS (mi)	131,86   2
Percent of total distance traveled CD   CS	10%   16%

**Trips in Charge Sustaining (CS) mode<sup>7</sup>**

Gasoline fuel economy (mpg)	17
Number of trips	41,636
Percent of trips city   highway	90%   10%
Distance traveled (mi)	399,840
Percent of total distance traveled	49%



Notes: 1 - 9. Please see <http://art.tsl.gov/pdf/phev/chryslerreportnotes.pdf> for an explanation of all PHEV Fleet Testing Report notes. This document also includes all report changes to date.

The Chrysler RAM PHEV Fleet was designed as a demonstration program of customer duty cycles related to plug-in electric vehicles and may not necessarily demonstrate optimized fuel economy.

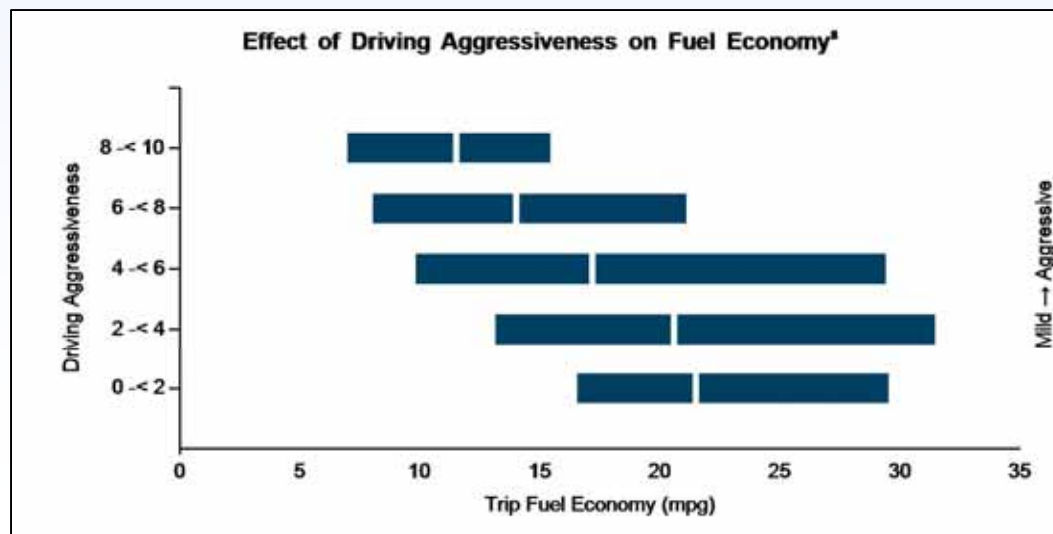
Vehicle fuel economy is based on customer usage and may not be representative of maximum potential fuel economy.

# Chrysler Ram PHEV Project

- **109 Ram PHEVs**
- **Fleet drivers**
- **July 2011 to May 2012**
- **815,000 test miles**
- **All trips, 19 mpg, 100 AC & 69 DC Wh/mi. 44 DC Wh/mi captured by regenerative braking**
- **CD, 23 mpg & 210 DC Wh/mi**
- **CS, 17 mpg**
- **Charging = 35% overall increase in mpg when comparing CD to CS trips**

# Chrysler Ram PHEV Pickups

- Rams in fleet applications
- **Vehicle driving 16% time engine stopped**
- **Vehicle stopped 23% time engine stopped**
- 64.1 miles per charge event
- 7.0 trips per charge event
- 0.89 charge events per vehicle day
- 2.4 average hours per charge event
- 6.4 AC kWh average energy / charge



## ChargePoint® America Vehicle Charging Infrastructure Summary Report

Project Status to Date through: March 2012

Charging Unit - By State	Residential	Private Commercial	Public	Not Specified	Charging Units Installed to Date <sup>1</sup>	Number of Charging Events Performed <sup>2</sup>	Electricity Consumed (AC MWh)
California	578	34	463	3	1,078	128,396	873.3
Connecticut	8	-	-	-	8	1,815	9.7
District of Columbia	-	13	16	-	29	503	3.9
Florida	24	10	204	2	240	3,195	18.1
Maryland	17	7	46	-	70	3,807	24.0
Massachusetts	13	7	64	-	84	1,501	11.5
Michigan	196	12	160	-	368	37,707	260.4
New Jersey	44	2	17	-	63	10,589	63.6
New York	20	88	85	-	193	11,530	91.8
Texas	39	9	182	-	230	11,729	75.3
Virginia	23	6	39	-	68	7,280	47.7
Washington	10	7	95	-	112	5,067	32.5
Total	972	195	1,371	5	2,543	223,119	1,511.8

ChargePoint America Charging Unit Distribution  
Project to Date through March 2012<sup>1</sup> Includes all charging units that were in use by the end of the reporting period.<sup>2</sup> A charging event is defined as the period when a vehicle is connected to a charging station and some power is transferred.

# ChargePoint America ARRA Project

- Conducted by Coulomb
- Project to March 2012
- 2,543 EVSE installed and reporting data
- 972 Residential
- 195 Private/commercial
- 1,371 Public
- 5 unknown
- 223,000 charge events
- 1,500 AC MWh



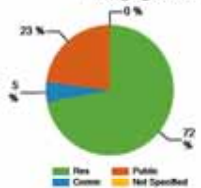
## ChargePoint® America Vehicle Charging Infrastructure Summary Report

Report period: February through March 2012

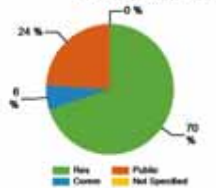
## Charging Unit Usage - By Type

	Residential	Private Commercial	Public	Not Specified	Total
Number of charging units <sup>1</sup>	913	124	981	5	2,023
Number of charging events <sup>2</sup>	48,370	3,075	15,198	162	66,805
Electricity consumed (AC MWh)	322.81	26.99	110.51	1.22	461.54
Percent of time with a vehicle connected	51%	29%	7%	35%	29%
Percent of time with a vehicle drawing power	16%	9%	4%	9%	10%

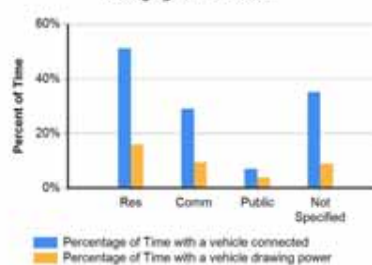
Charging Events



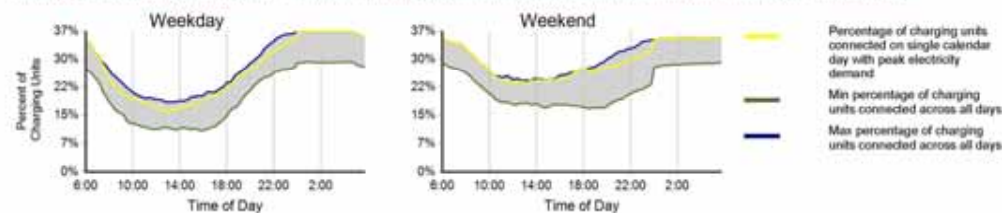
Electricity Consumed



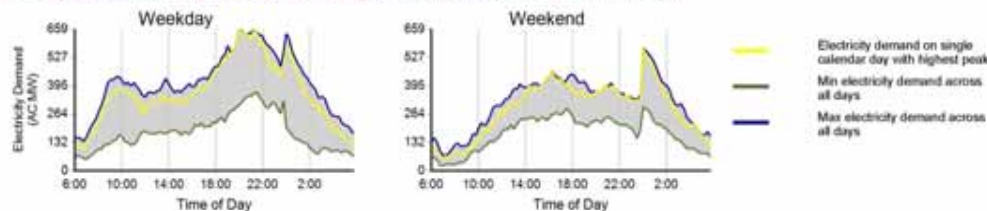
Charging Unit Utilization



## Charging Availability: Range of Percent of Charging Units with a Vehicle Connected versus Time of Day



## Charging Demand: Range of Aggregate Electricity Demand versus Time of Day

<sup>1</sup> Includes all charging units that were in use during the reporting period and have reported data to the INL.<sup>2</sup> A charging event is defined as the period when a vehicle is connected to a charging unit, during which period power is transferred.

# ChargePoint America ARRA Project

- Feb & March 2012 data
- 67,000 charge events
- **Percent time vehicle connected**
  - **Residential 51%**
  - **Private/com 29%**
  - **Public 7%**
- **Percent time drawing power**
  - **Residential 16%**
  - **Private/com 9%**
  - **Public 4%**
- **EVSE data only**

# Additional PEV and Infrastructure Testing

- Conducting testing of “dumb” and “smart” EVSE
- Initiated wireless charging test program
- Initiated field and lab DC Fast and Level 2 charging study of impacts on battery life in 6 vehicles
- Conducting first responders training program with the National Fire Prevention Association and NHTSA
- Battery mule test vehicle provides field testing of traction battery packs at any power and efficiency level
- 20 Quantum PHEV Escape conversions in benchmarking
- Additional EVSE providers are also providing charging data to INL



# EV Project Summary To Date

- 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 occurring at the midnight starts of super off-peak TOU kWh rates
- Significant opportunities to fully understand how the public uses public versus non-public infrastructure
- Revenue models for public charging are currently being introduced – impacts?
- Only about 30% of EV Project data collected to date
- “Normal” research project process requires:
  - Design and execute the project, data collection completed, data analyzed, and finally, reports issued at completion of experiment
- INL/ECOtality needs to completely collect all data before definitively reporting seasonal trends and behaviors



# Future EV Project Data Analysis Subjects

- Pricing elasticity – TOU rate influences?
- Regional and seasonal demographics and charging behaviors?
- Density of residential and non-residential EVSE as input to local micro distribution studies – transformer failures?
- Charge control preferences – vehicle, Blink and web based, and scheduled versus random?
- Rich public versus non-rich public EVSE charging behaviors?
- Level 2 EVSE versus DCFC behaviors?
- Travel corridor versus convenience charging at stores?
- Length of vehicle ownership and miles per day / week / charge?
- Non-residential subcategories (public and work parking)?
- Etc., etc., etc.?





# **Acknowledgement**

**This work is supported by the U.S. Department of Energy's EERE Vehicle Technologies Program**

**This presenter is very grateful for DOE's support and the contributions of all the testing partners**

## **More Information**

**<http://avt.inl.gov>**

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

**INL/MIS-12-26977**

