



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

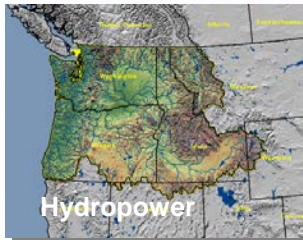
EV Project Data Collection and Reporting Update @ EVS-26

Jim Francfort – Idaho National Laboratory

**EVS-26
Los Angeles, California
May 2012**

Idaho National Laboratory (INL)

- Eastern Idaho based U.S. Department of Energy (DOE) Federal 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
 - Energy Critical Infrastructure Protection
 - Homeland Security and Cyber Security



AVTA Participants and Goals

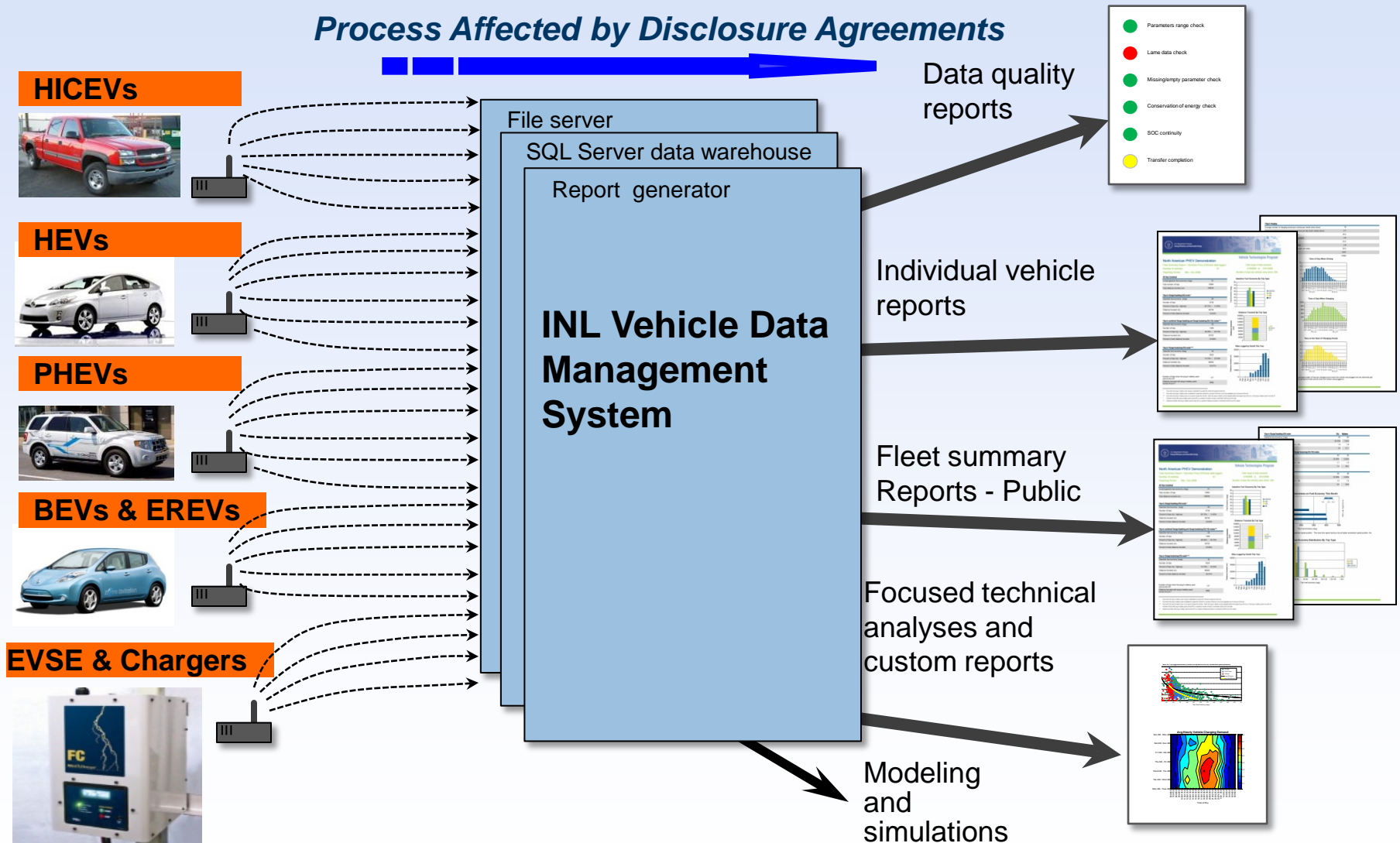
- The INL portion of this work is performed in support of DOE's Advanced Vehicle Testing Activity (AVTA)
 - The AVTA is part of DOE's Vehicle Technologies Program within EERE
 - ECOtality is the EV Project lead, with Nissan and GM/OnStar as significant partners
 - Other EV Project partners include electric utilities, Federal, state and local government agencies, and other stake holders
- The AVTA goal - Petroleum reduction and energy security
 - Provide benchmark data to technology modelers, research and development programs, vehicle manufacturers (via VSATT), and target and goal setters
 - Assist fleet managers in making informed vehicle and infrastructure purchase, deployment and operating decisions

AVTA Testing Experience

- **41.4 million documented test miles accumulated on 8,000 electric drive vehicles representing 100+ models**
- **EV Project: 4,555 Leafs and Volts, 24.4 million test miles (mid April 2012)**
- **EV Project is documenting 105,000 miles and 3,800 charging events per day**
- **PHEVs: 14 models, 430 PHEVs, 4 million test miles**
- **EREVs: 1 model, 135 EREVs, 520,000 test miles**
- **HEVs: 19 models, 50 HEVs, 6 million test miles**
- **Micro hybrid (stop/start) vehicles: 3 models, 7 MHVs, 300,000 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**
- **7,000 EVSE with data loggers (5,562 EV Project and 1,432 ChargePoint America)**

INL Vehicle/EVSE Data Management Process

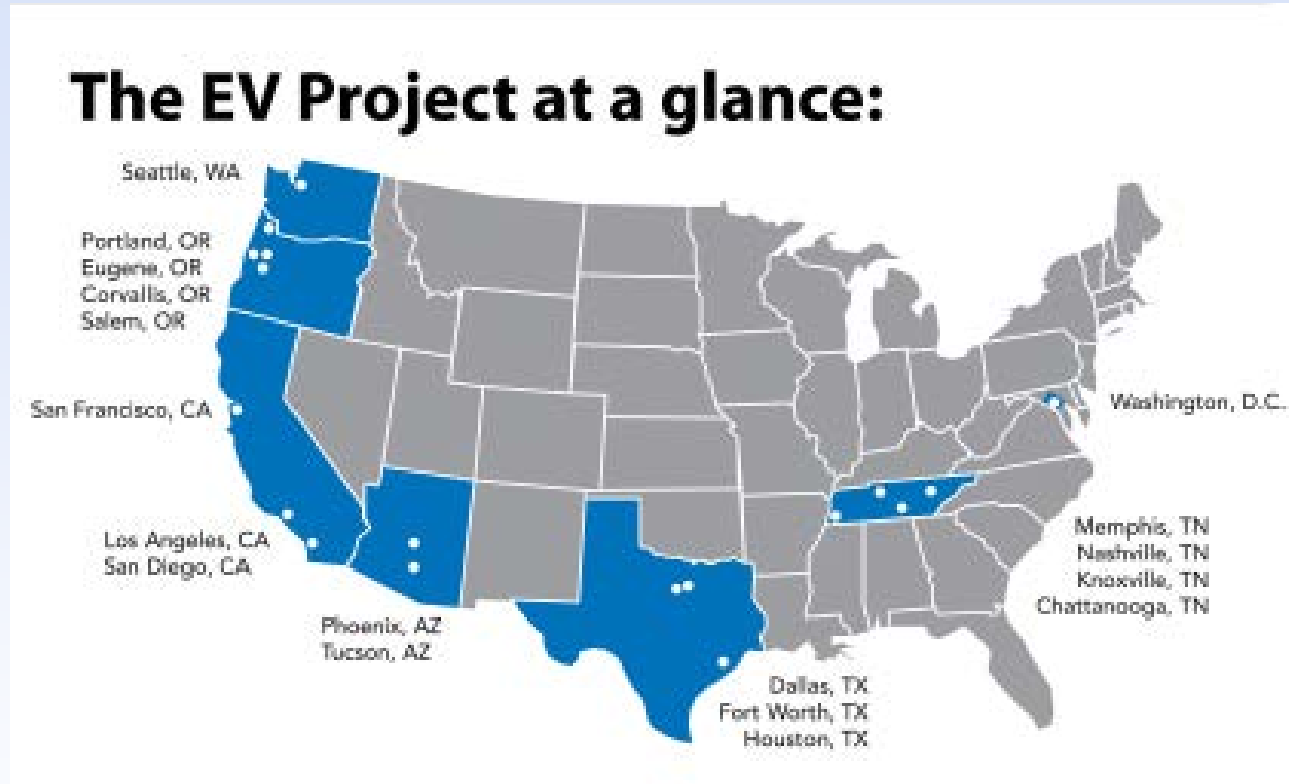
Process Affected by Disclosure Agreements



Data Security, Protection and Use

- All raw vehicle and EVSE data, and personal information protected by NDAs (Non Disclosure Agreements), resulting in:
 - Limitations on how proprietary data can be distributed, stored, and used
 - No raw data can or will be distributed by INL
 - Raw data, in both electronic and printed formats, is not shared with DOE in order to avoid exposure to FOIA
- EV Project reporting requires INL to blend three distinct data streams based on GPS and time/date stamps, and provide independent reports to DOE, ECOTality, project participants, industry, and the general public
- Vehicle and EVSE data collection would not occur unless the above limitations are strictly adhered by INL
- INL has been using data loggers on vehicles and EVSE since 1994 to document user and equipment profiles

EV Project Locations (Largest in the World Vehicle and EVSE Data Collection Activity)



- **Purpose: Build and study mature charging infrastructures and take the lessons learned to support the future streamlined deployment of grid-connected electric drive vehicles**

EV Project – EVSE Data Parameters Collected per Charge Event

- Unique ID for Charging Event
- Unique ID Identifying the EVSE
- **Date/Time Stamp**
- **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**
- **And other non-dynamic EVSE information (GPS, ID, type, contact info, etc.)**



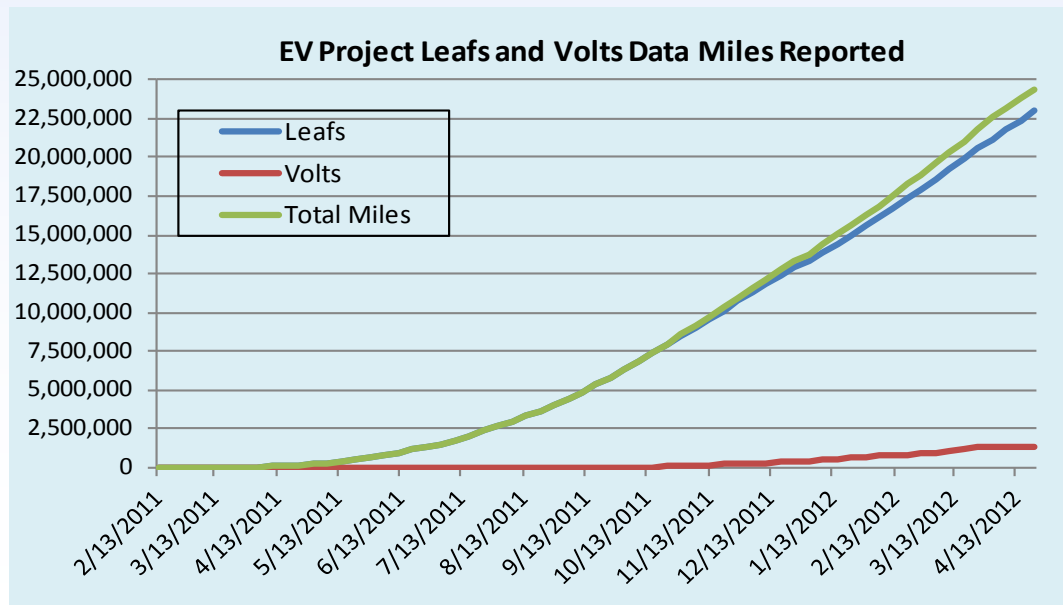
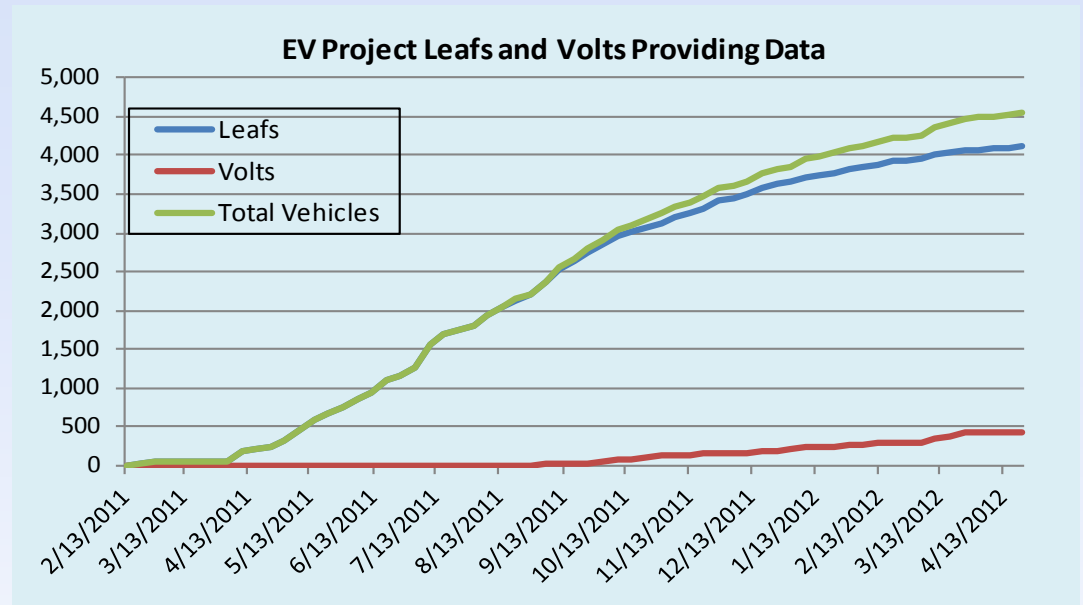
EV Project – Vehicle Data Parameters Collected per Start/Stop Event

- Vehicle ID
- Event type (key on / key off)
- Odometer
- Battery state of charge
- Date/Time Stamp
- GPS (longitude and latitude)
- Recorded for each key-on and key-off event



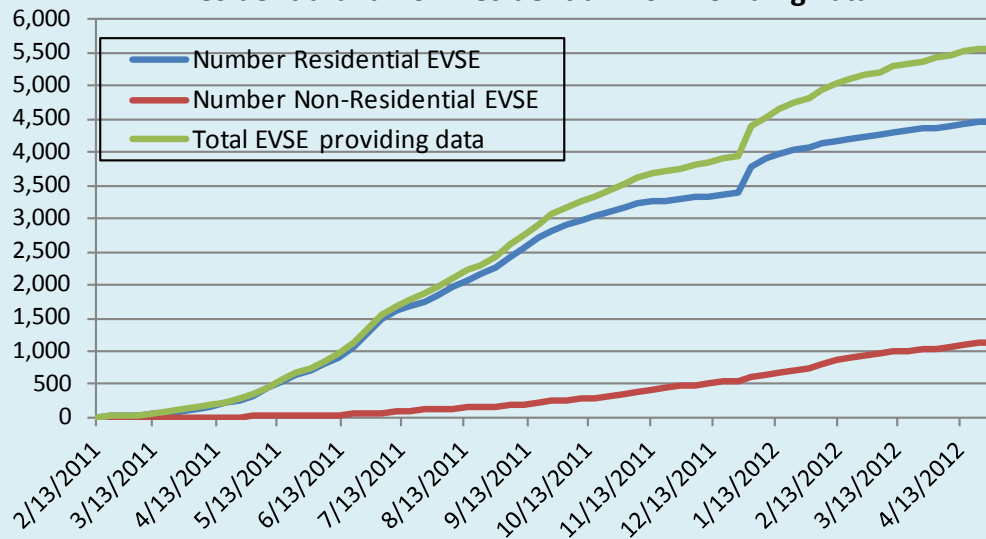
EV Project – Vehicle Deployments / Miles

- Leaf data 4/22/12
- Volt data 4/01/12
- 4,555 total vehicles reporting data
- 24.4 million total data miles



EV Project – EVSE Deployment and Use

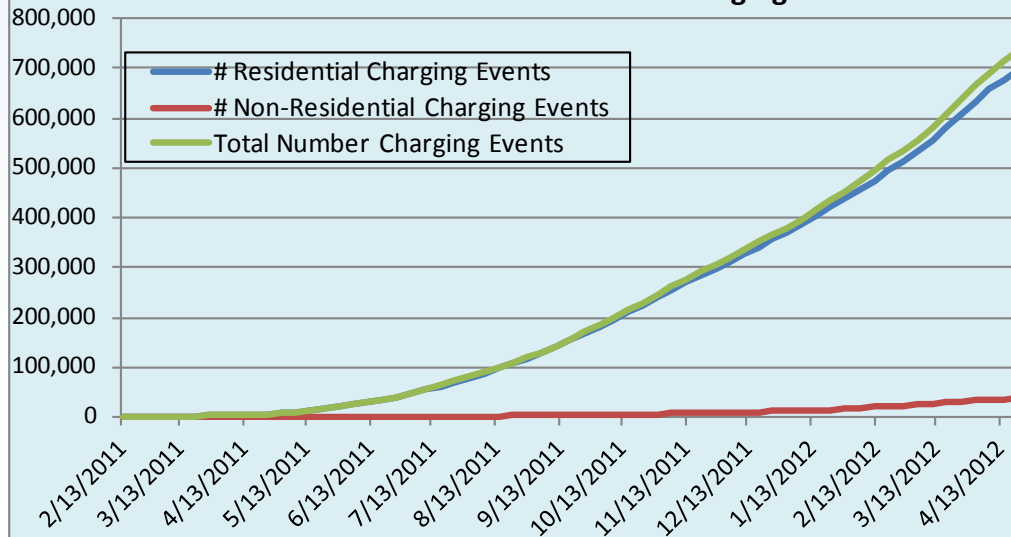
Residential and Non-Residential EVSE Providing Data



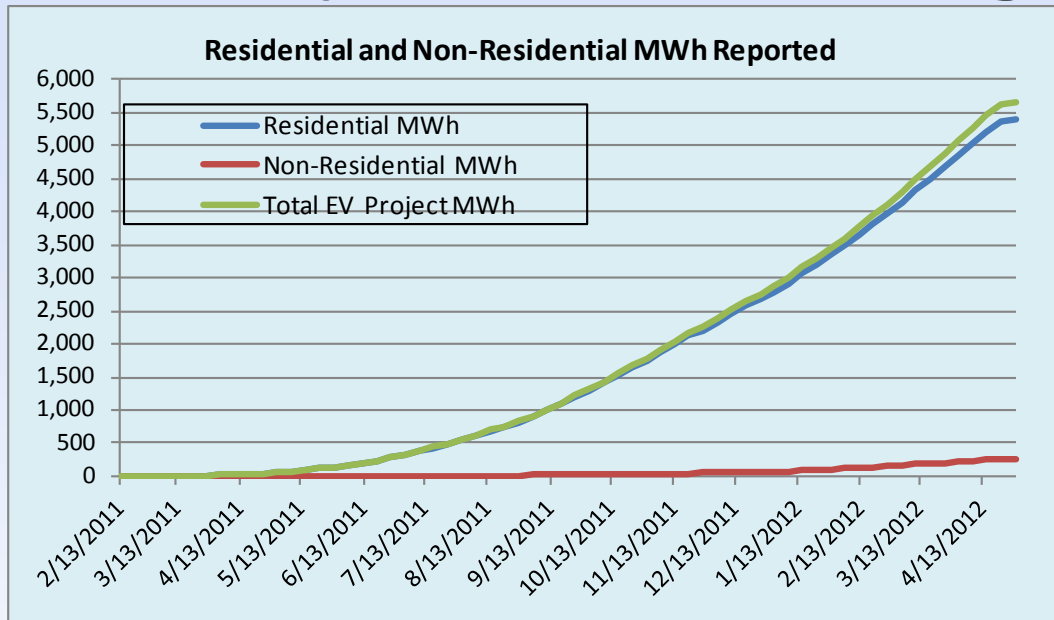
- 5,563 EVSE (4/29/12)
- 736,652 charge events
- Non-Residential includes DCFC

- INL reports vehicle and EVSE data differently than ECOtality as INL is required to report processed data counts, not deployment counts

Residential and Non-Residential Charging Events



EV Project – Total Charge Energy (MWh)

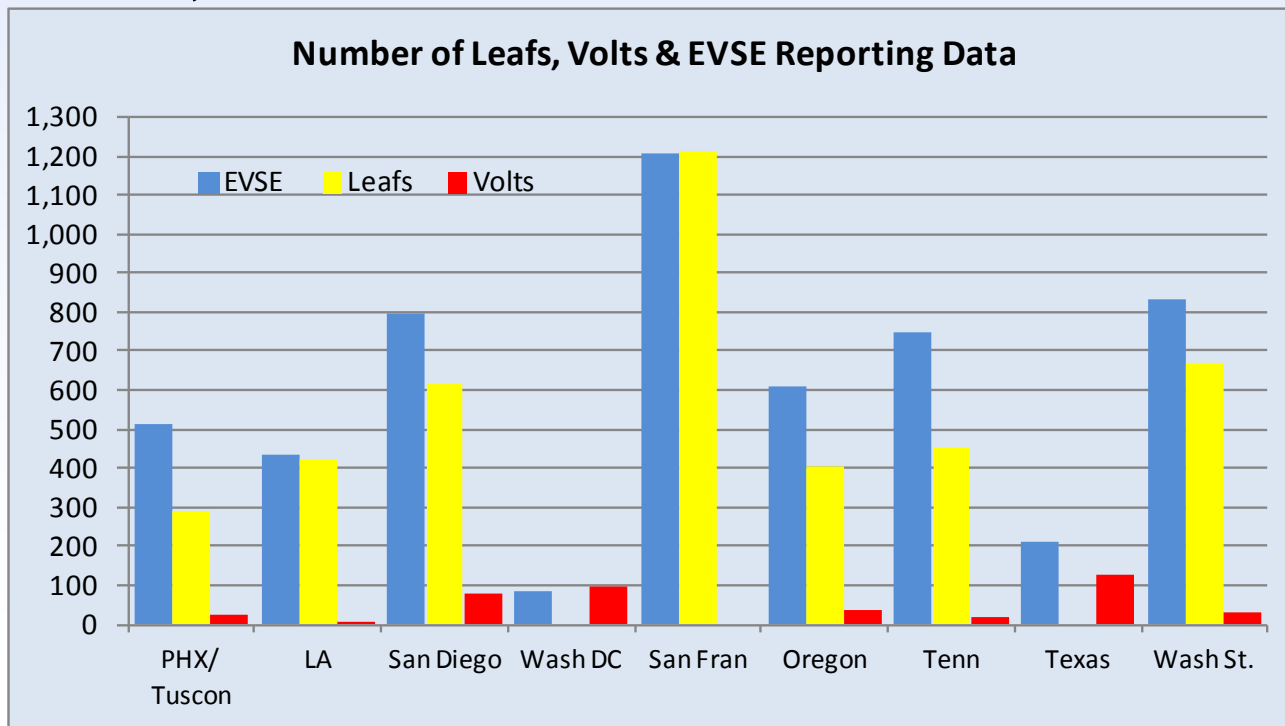


- 5,640 total MWh charged via EV Project EVSE and DCFC (4/29/12)

- **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 non-EV Project locations or at other 240V non-EV Project EVSE**

EV Project – Overview Report 1st Quarter

- Vehicles and charging infrastructure deployed to date 1st quarter 2012 and data received by INL
- Charging infrastructure
 - 5,432 units installed
 - 665,968 charging events
 - 5,069 AC MWh
- Vehicles
 - 4,066 Leafs
 - 427 Volts
 - 22.6 million miles



EV Project – Vehicle Usage Report

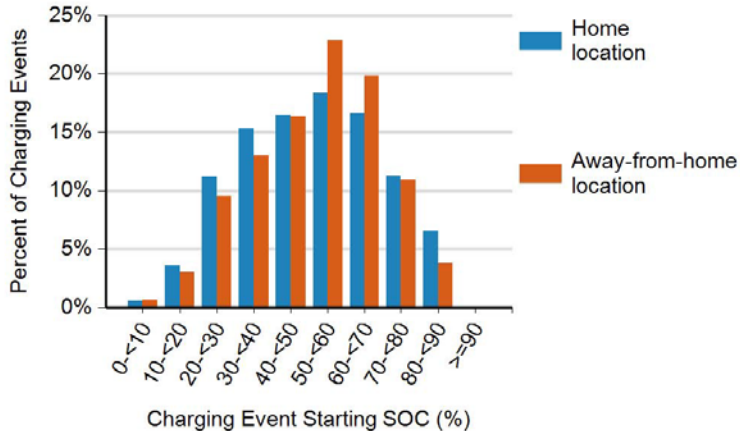
Vehicle Usage – 1st quarter 2012

	<u>Leafs</u>	<u>Volts</u>
• Number of vehicles	2,987	317
• Number of Trips	773,602	76,425
• Quarter distance (millions)	5.6 mi	0.6 mi
• Ave trip distance	7.2 mi	8.0 mi
• Ave distance per day	30.2 mi	36.4 mi
• Ave # trips between charging events	3.8	3.0
• Ave distance between charging events	27.4 mi	24.1 mi
• Ave # charging events per day	1.1	1.5

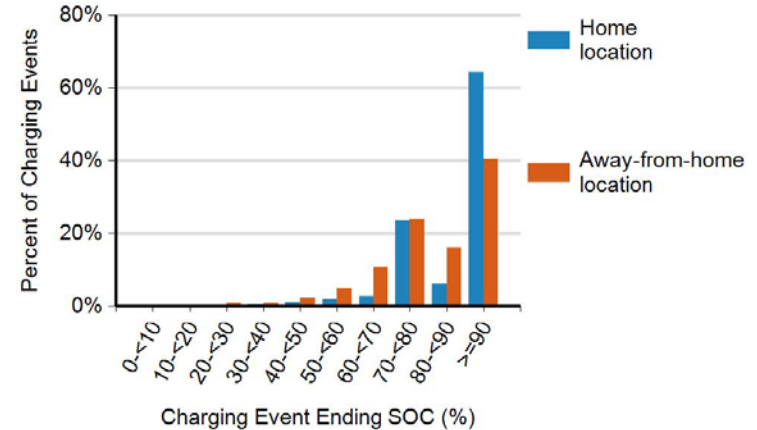
Note that per day data is for days a vehicle is driven

EV Project – Leaf Usage Report

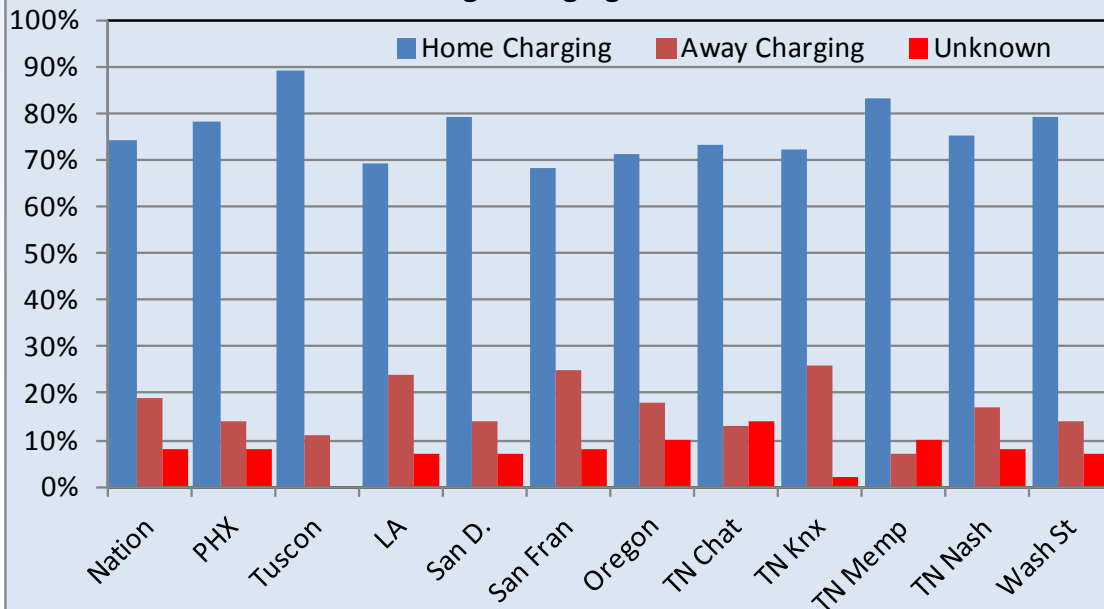
Battery State of Charge (SOC)
at the Start of Charging Events



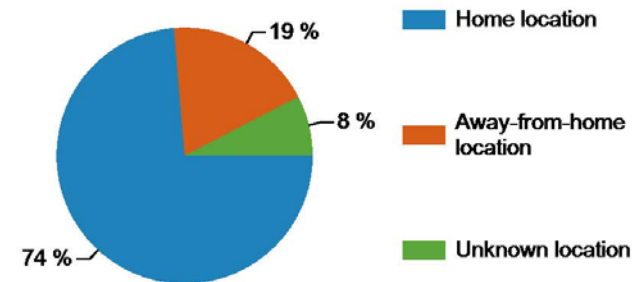
Battery State of Charge (SOC)
at the End of Charging Events



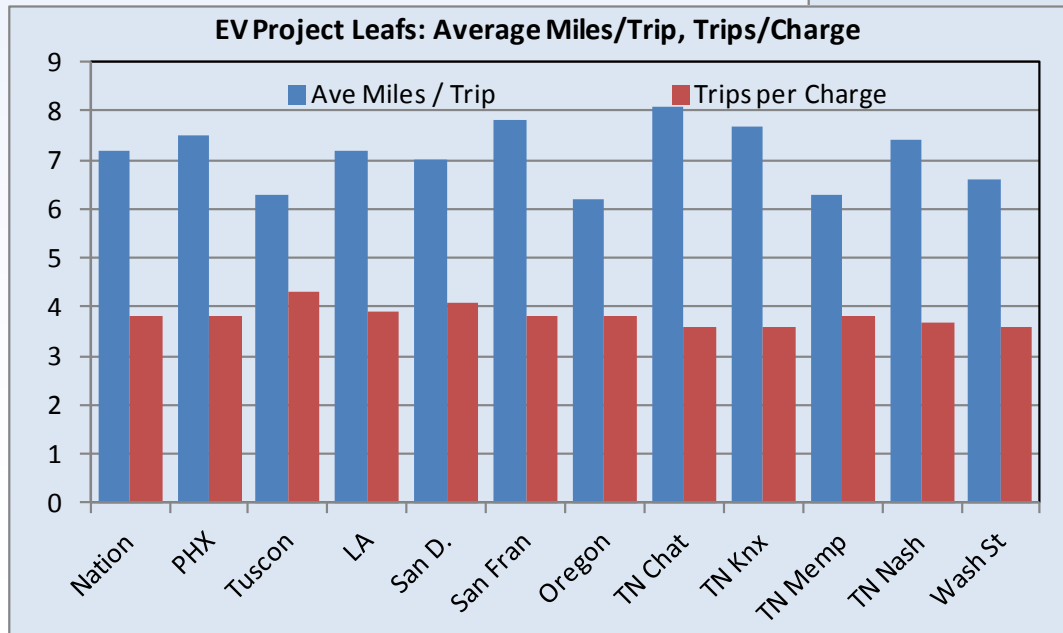
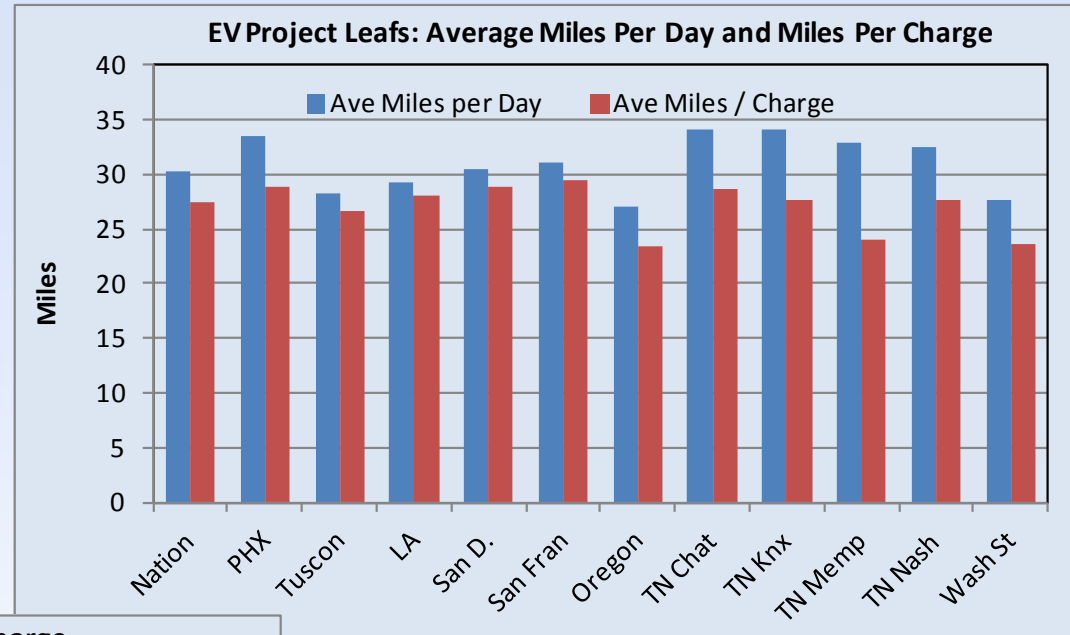
Percentage Charging Locations



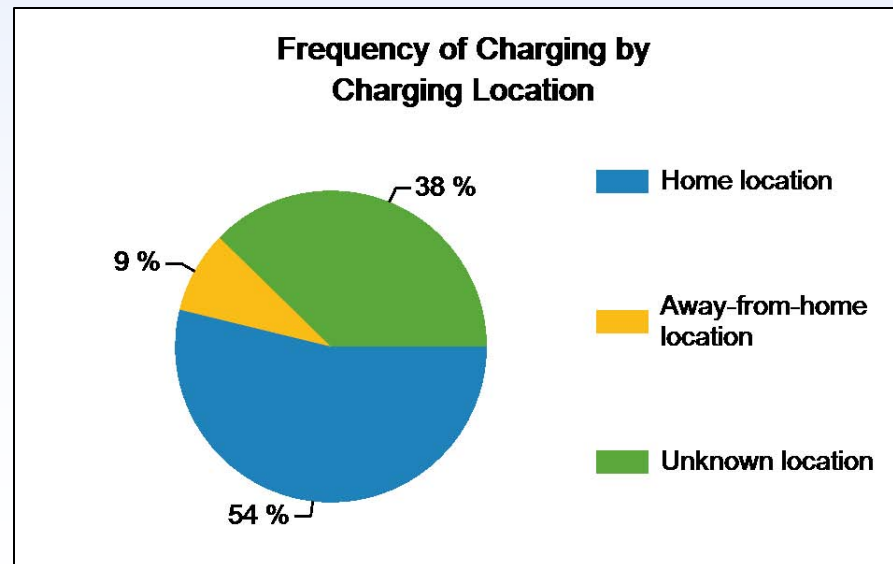
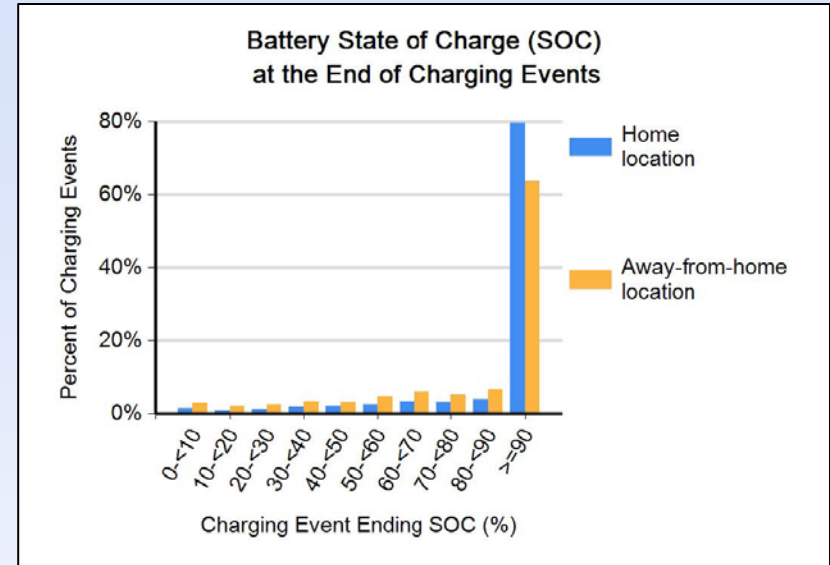
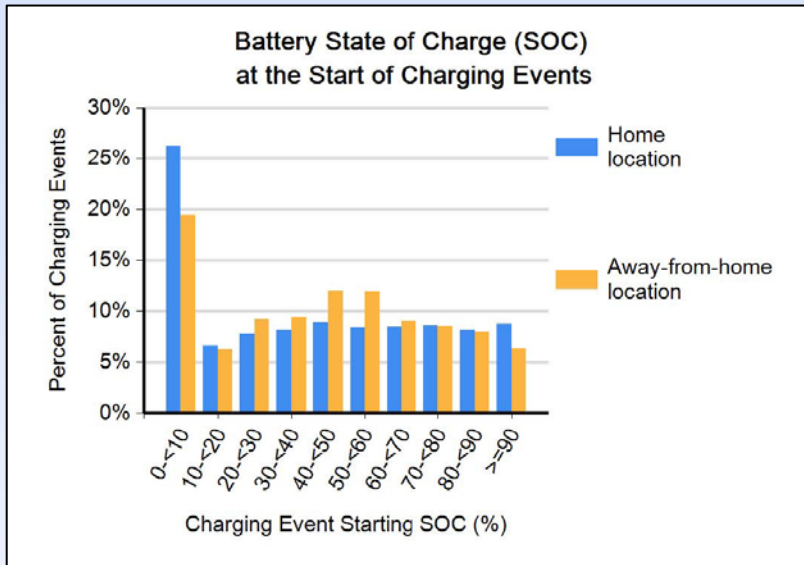
Frequency of Charging by
Charging Location



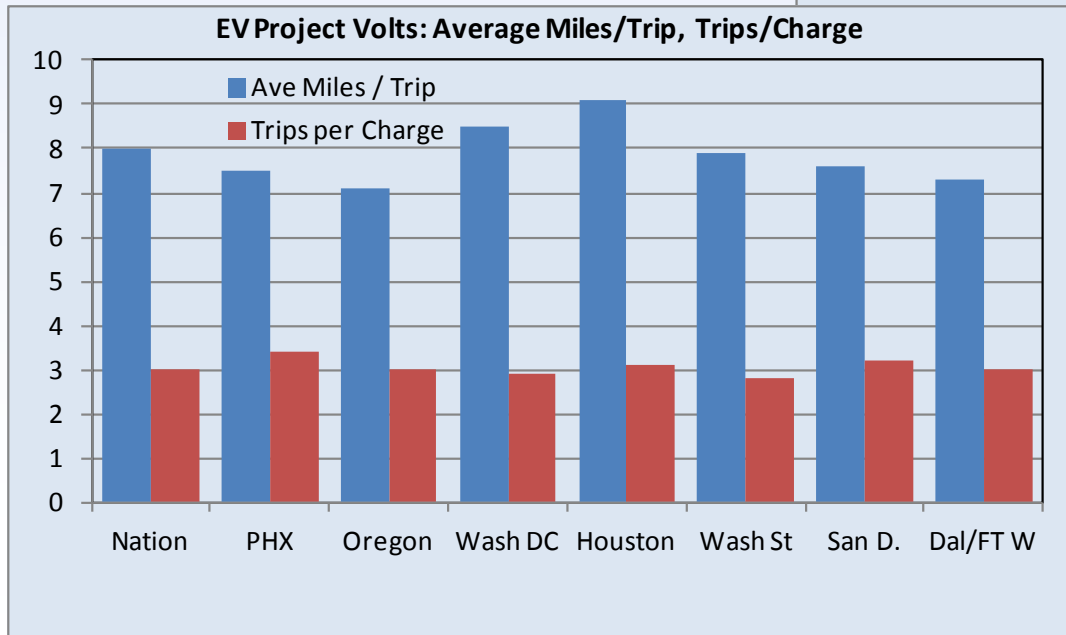
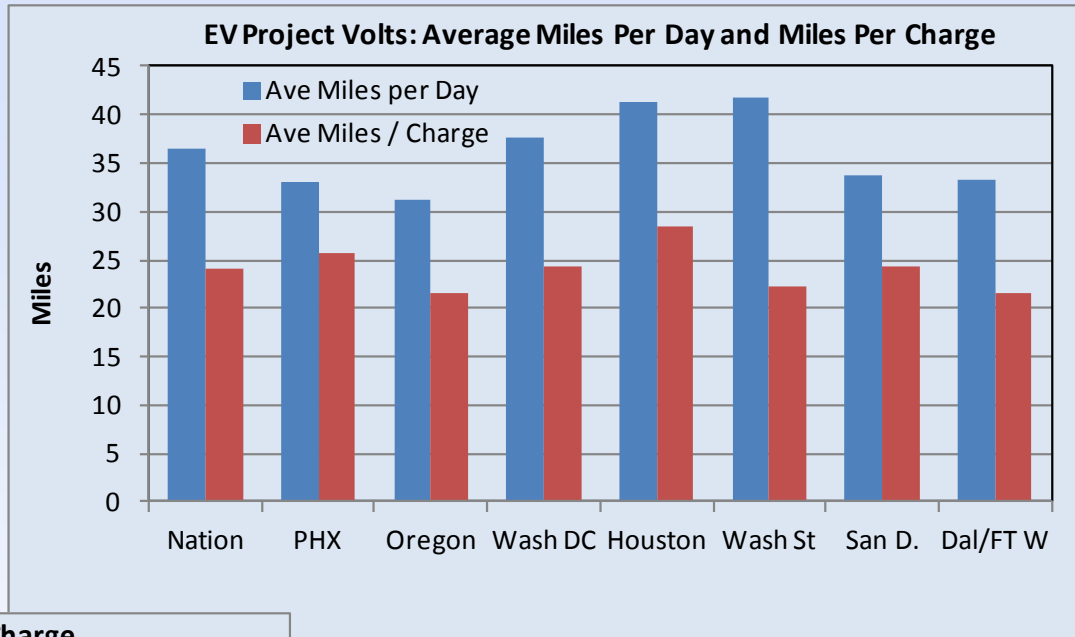
EV Project – Leaf Usage Report



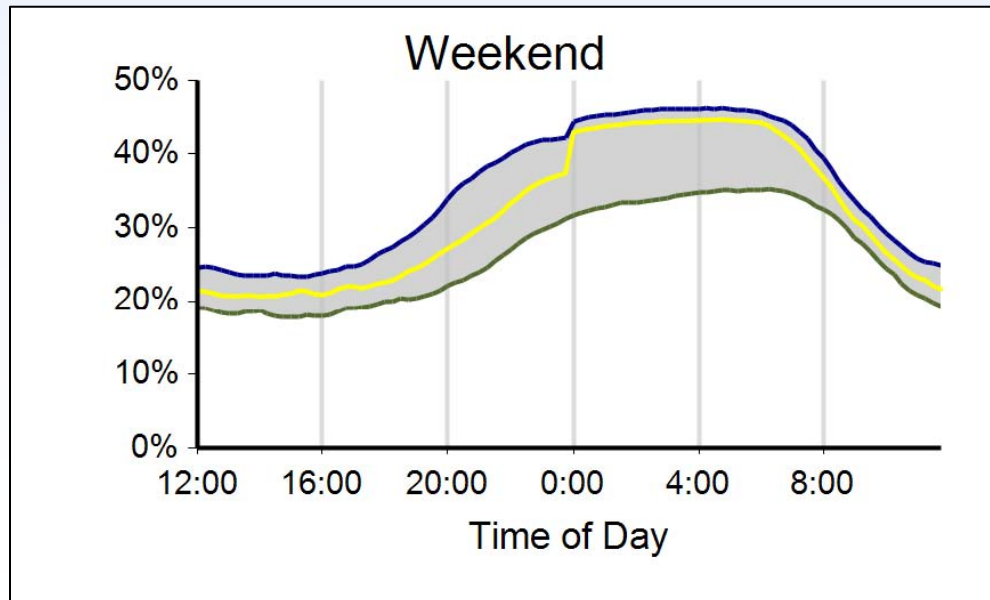
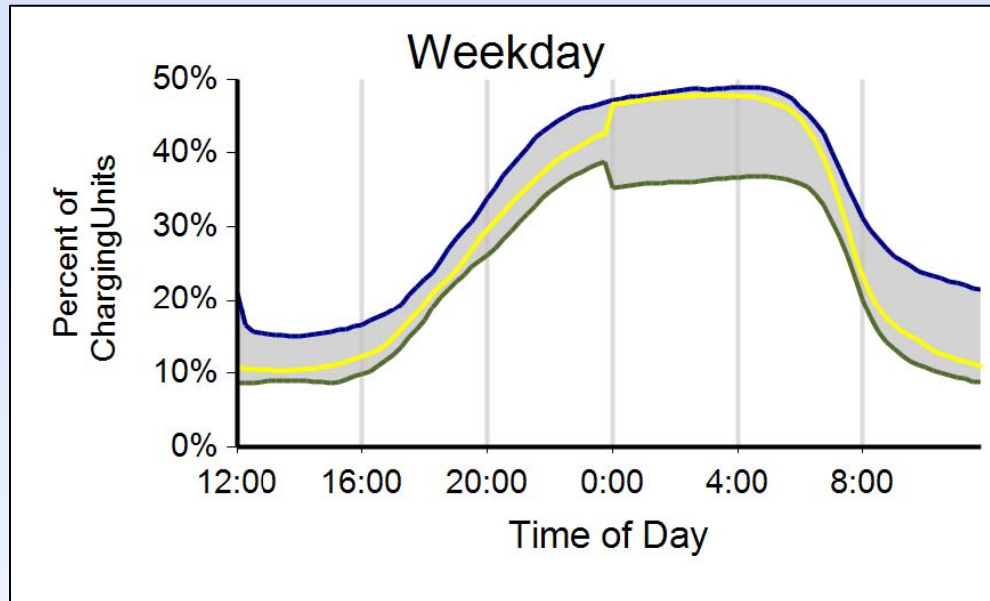
EV Project – Volt Usage Report



EV Project – Volt Usage Report

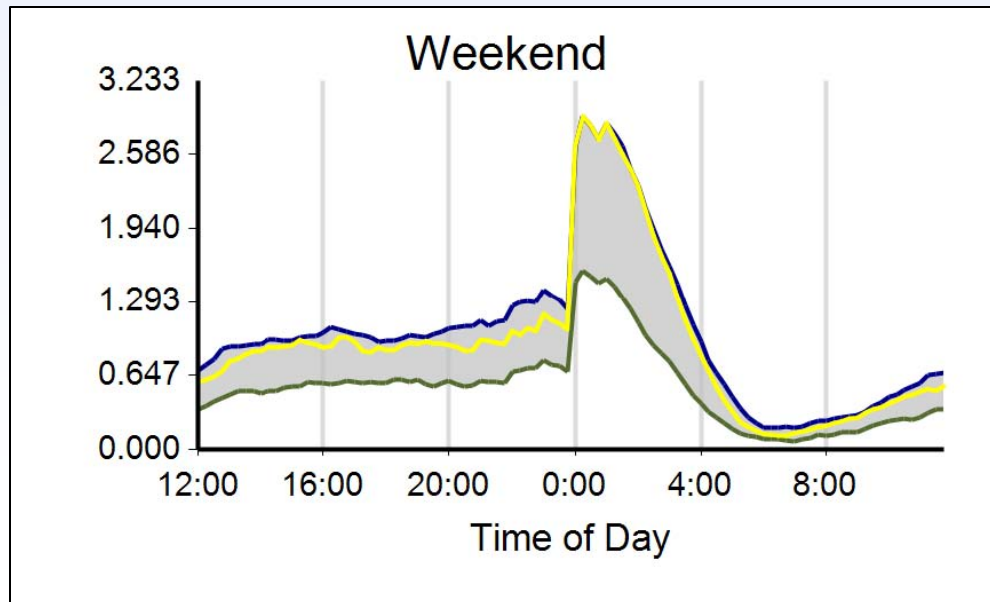
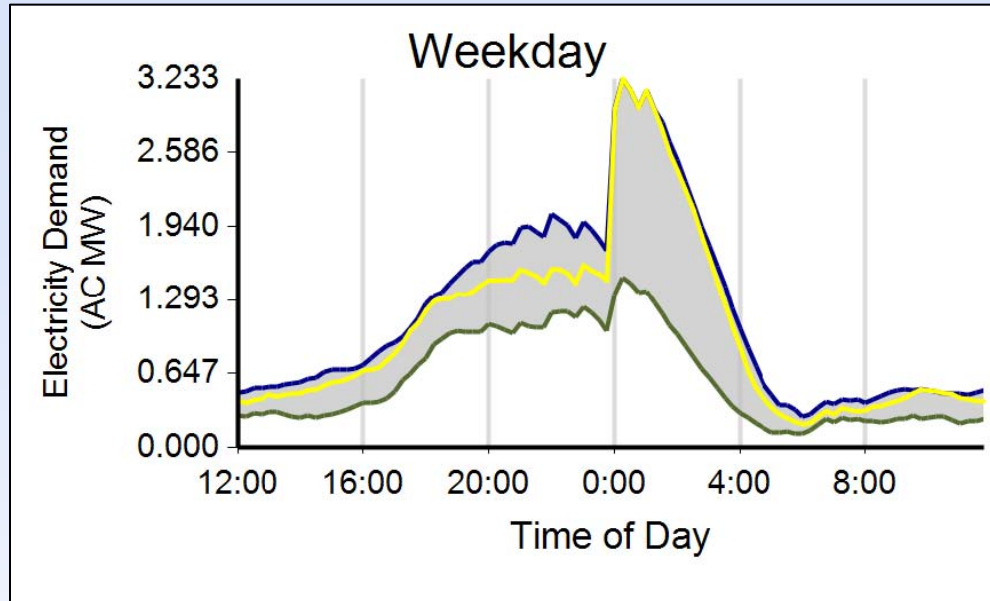


EV Project – EVSE Infra. Summary Report



- Charging Availability
- Range of Percent of Charging Units with a Vehicle Connected vs. Time of Day
- National Data
- 1st quarter 2012
- 3,324 residential and 955 publicly available Level 2 EVSE
- 10 DC fast chargers

EV Project – EVSE Infra. Summary Report

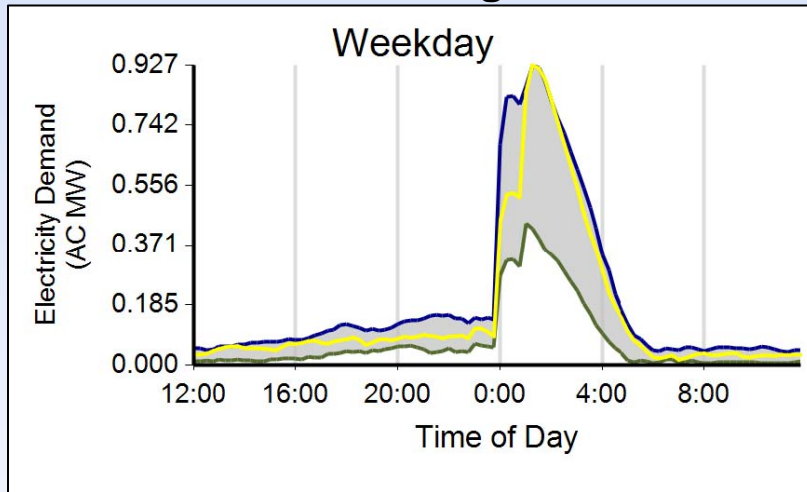


- Charging Demand
- Range of Aggregate Electricity Demand vs. Time of Day (AC MW)
- National Data
- 1st quarter 2012
- 3,324 residential and 955 publicly available Level 2 EVSE
- 10 DC fast chargers

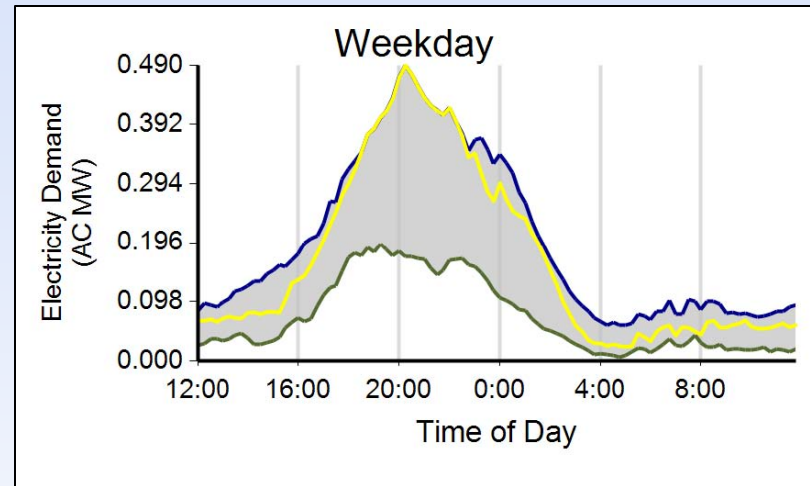
EV Project – EVSE Infra. Summary Report

- Residential Level 2 Weekday EVSE 1st Quarter 2012

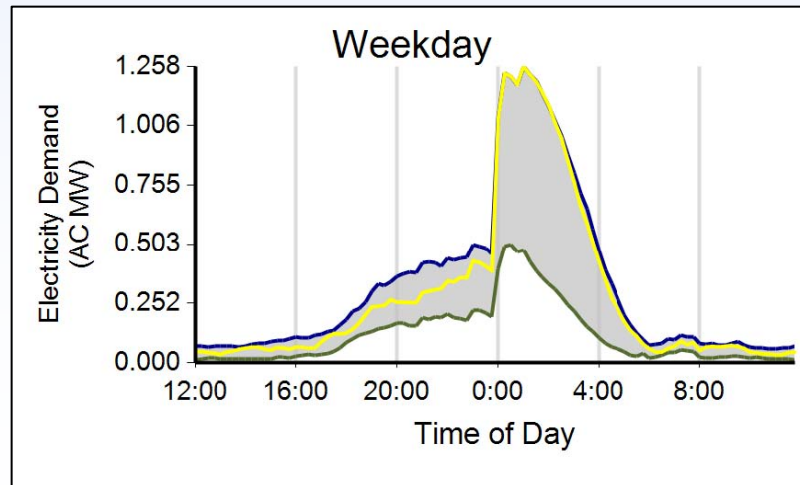
San Diego



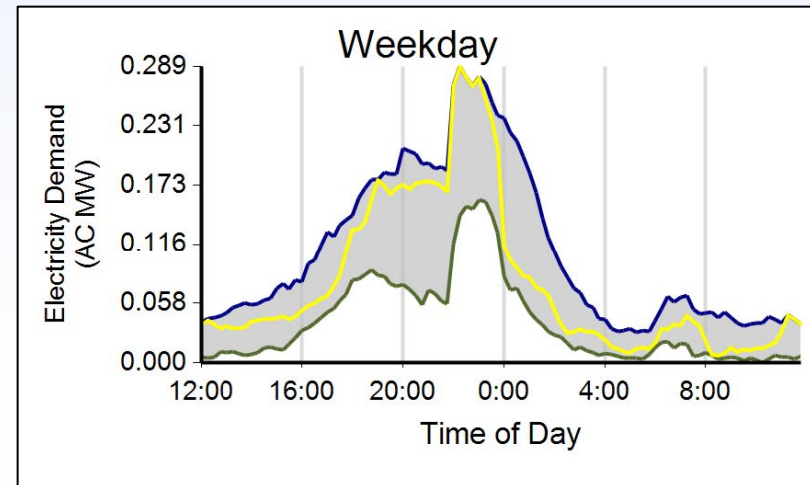
Washington State



San Francisco



Oregon



EV Project – EVSE Infra. Summary Report

- **National Data – 1st quarter 2012**
 - Ave time vehicle connected R2 WD 11.4 hours
 - Ave time vehicle connected R2 WE 11.8 hours
 - Ave time vehicle drawing power R2 WD 2.4 hours
 - Ave time vehicle drawing power R2 WE 2.0 hours
 - Ave energy per charge event R2 WD 8.7 AC kWh
 - Ave energy per charge event R2 WE 7.3 AC kWh
 - Ave time vehicle connected P2 WD 6.3 hours
 - Ave time vehicle connected P2 WE 4.1 hours
 - Ave time vehicle drawing power P2 WD 2.1 hours
 - Ave time vehicle drawing power P2 WE 1.9 hours
 - Ave energy per charge event P2 WD 7.3 AC kWh
 - Ave energy per charge event P2 WE 6.6 AC kWh
- **R: residential, P: public, WD: weekday, WE: weekend,
All: weekday/end combined**

Summary Data – Based on 1st Quarter 2012

- There appears to be a quarterly trend of more frequent Leaf charges per day
- Regional Leaf differences of up to 21% for at-home charging and 19% for public charging
- Up to 31% Leaf regional difference in average trip distances
- Up to 25% Leaf regional difference in miles per day
- Nationally, 65% Leaf home location charging results in $\geq 90\%$ SOC at charge completion
- Nationally, 40% Leaf away-from-home location charging results in $\geq 90\%$ SOC at charge completion
- 74% Leaf charge events occur at home location, 19% public charging
- Volts are driven farther per day, charged more often, and travel less miles per charge event than Leafs

Summary – Based on Early Data

- Majority of residential Level 2 charging occurs off-peak with significant charge-starts occurring at start of off-peak kWh rates
- EV Project vehicles connected significantly longer than needed to recharge - opportunities to shift “smart” charging times
- EV Project is accumulating 105,000 miles of data per day
- Opportunity to start understanding how the public uses public versus non-public infrastructure
- Only 20 to 25% of EV Project data has been collected to date
- “Normal” research project process requires
 - Project and data collection completed, analyzed, and reports issued at completion of experiment
- The EV Project needs to complete a rich data set before reporting final trends and behaviors

Future Data Analysis Subjects

- Pricing elasticity – TOU rate influences
- Power versus time charging profiles for Leaf and Volt in varying circumstances – battery conditioning, cabin conditioning, hot and cold ambient
- Regional and seasonal demographics and charging behaviors
- Density of residential and non-residential EVSE as input to local distribution studies
- Charge control preferences - vehicle and Blink based, and scheduled versus random
- Rich public versus non-rich EVSE charging behaviors
- L2 EVSE versus DCFC behaviors
- Travel corridor versus convenience charging
- 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

More Information

<http://avt.inl.gov>

or

<http://avt.inel.gov/evproject.shtml>

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