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

White House, DOE, DOT, SAE - Vehicle Data Jam

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Vehicle Data Jam
Detroit, Michigan
April 18, 2013

This presentation does not contain any proprietary or sensitive information

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 manages 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

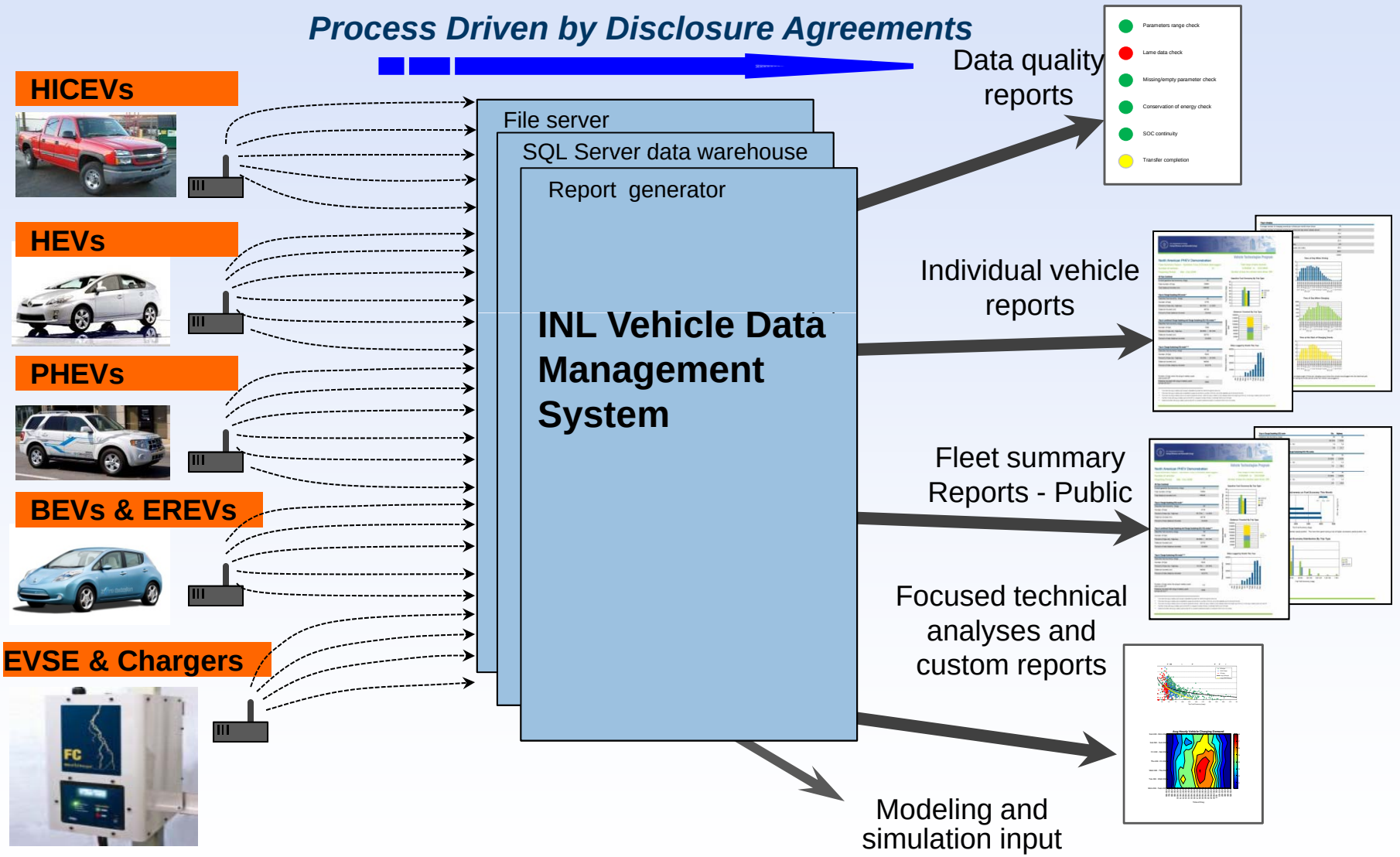
AVTA Goals

- **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 12,202 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**

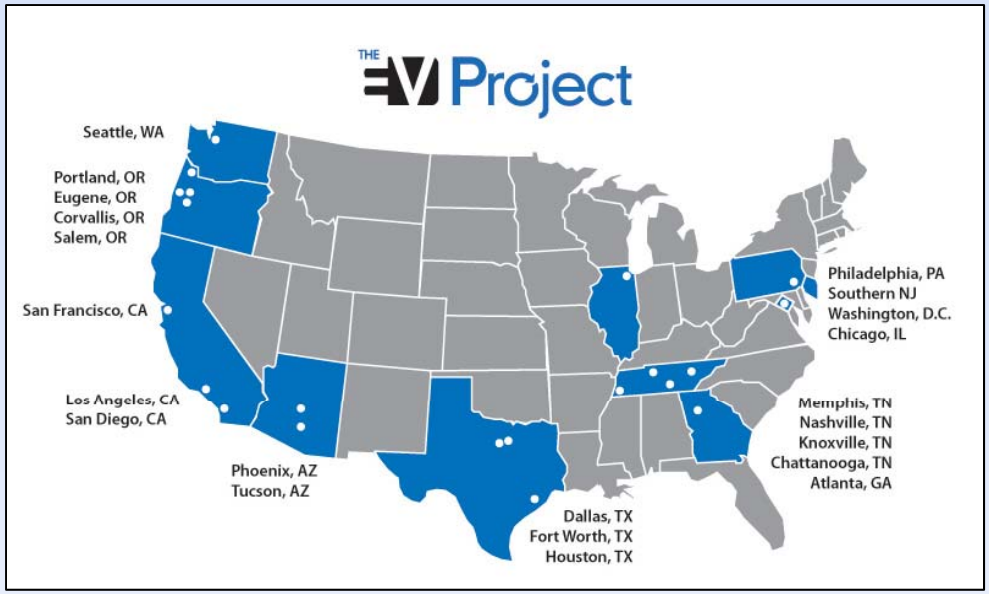
INL Vehicle/EVSE Data Management Process



Data Collection, Security and 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 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**

EVSE Data Parameters Collected per Charge Event – EV Project & ChargePoint

- 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 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

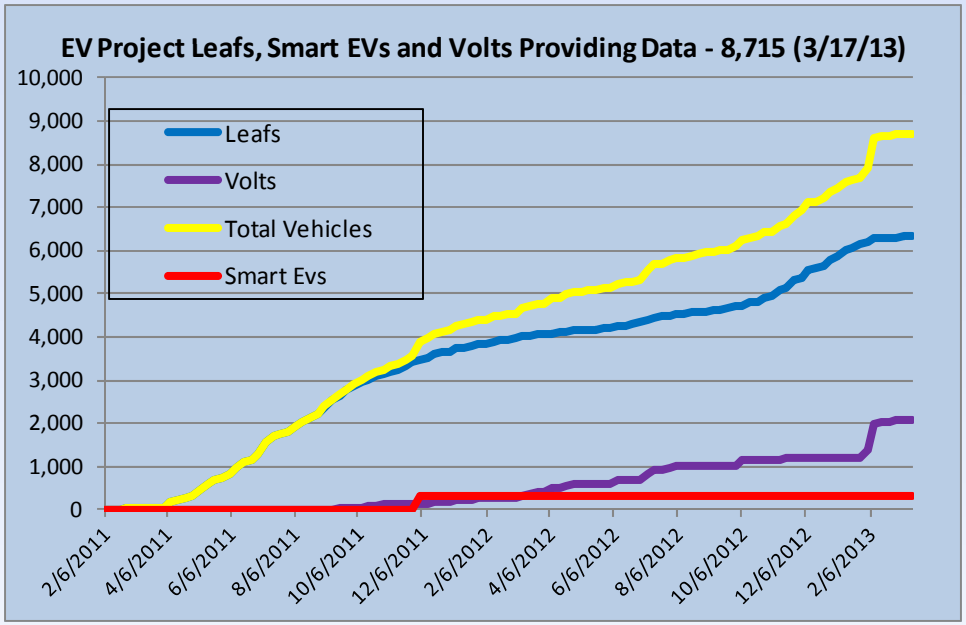
- Additional data is received monthly from Car2go for the Smart EVs

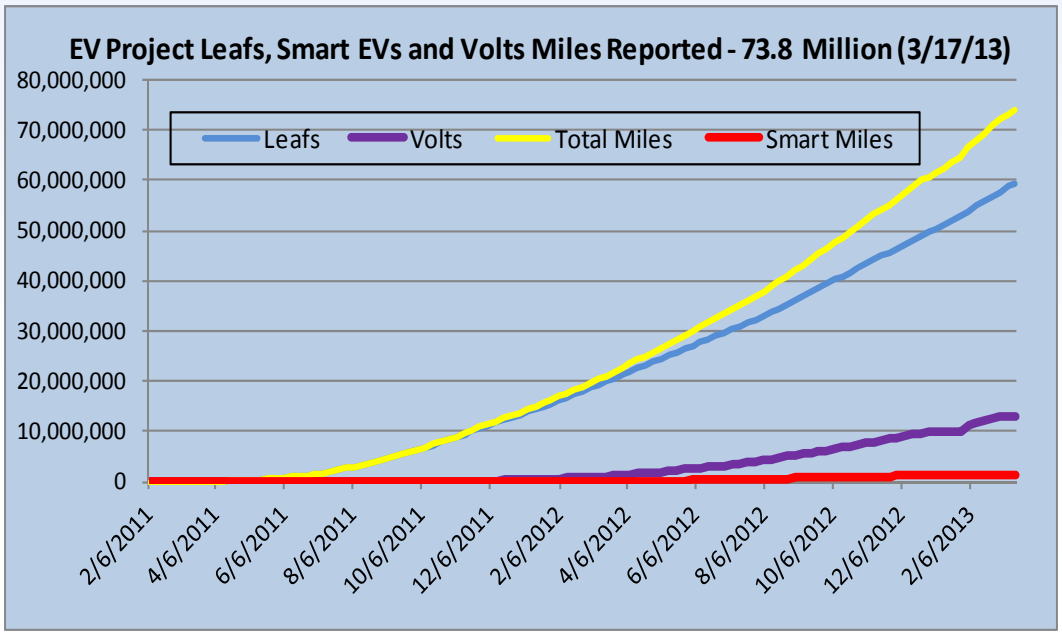
EV Project Data Complexity

- **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 not a flat file, spreadsheet experience and this is NOT a simple task**

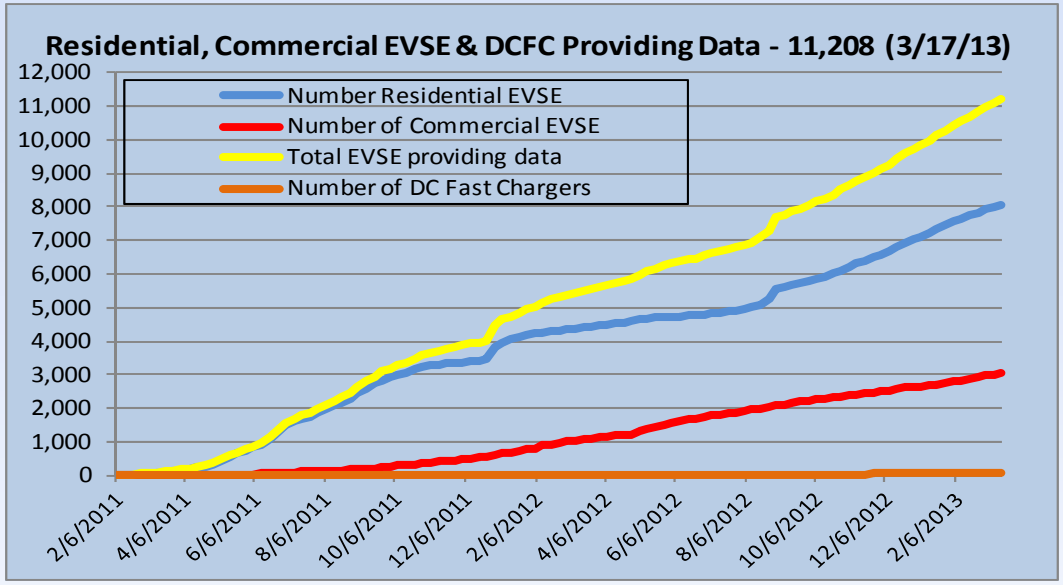
EV Project Vehicles / Miles, 3/17/13

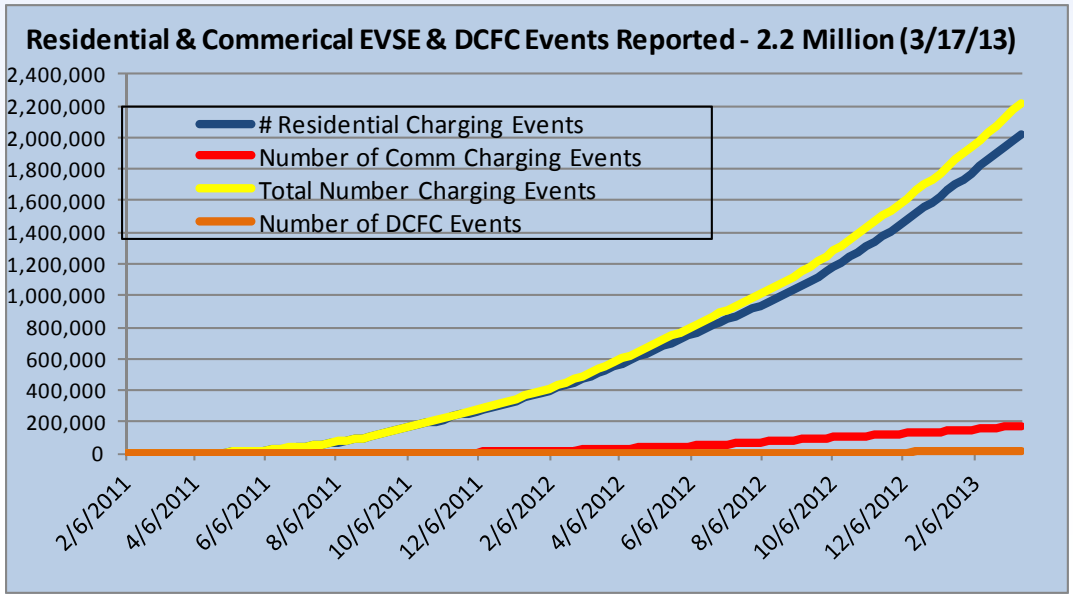
- 8,715 vehicles reporting data
  - 6,329 Leafs. 73%
  - 1,255 Volts. 24%
  - 330 Smart EVs. 4%
- 73.8 million total miles
  - Leafs 81%
  - Volts 18%
  - Smart EVs 2%
- 173,000 test miles per day = 1 million miles every 5.8 days





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 – National Data

4rd 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 – EVSE Infra. Summary Report

4th quarter 2012

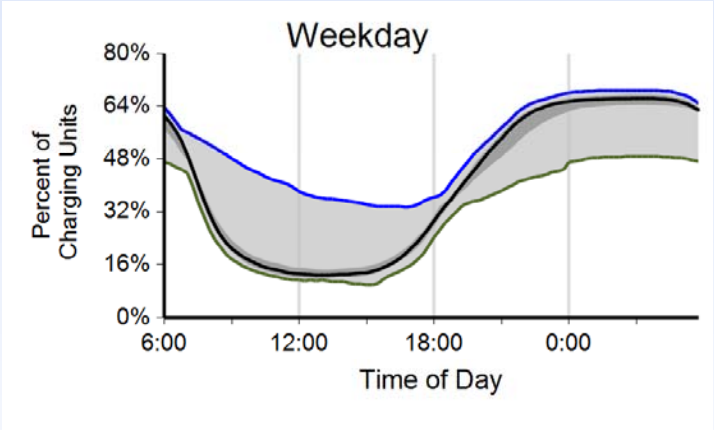
	National.
• Ave hours V connected R2 WD	12.1 hours
• Ave hours V connected R2 WE	12.2 hours
• Ave hours V drawing power R2 WD	2.4 hours
• Ave hours V drawing power R2 WE	2.1 hours
• Ave AC kWh/charge event R2 WD	8.6 AC kWh
• Ave AC kWh/charge event R2 WE	7.4 AC kWh
• Ave hours V connected P2 WD	5.9 hours
• 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

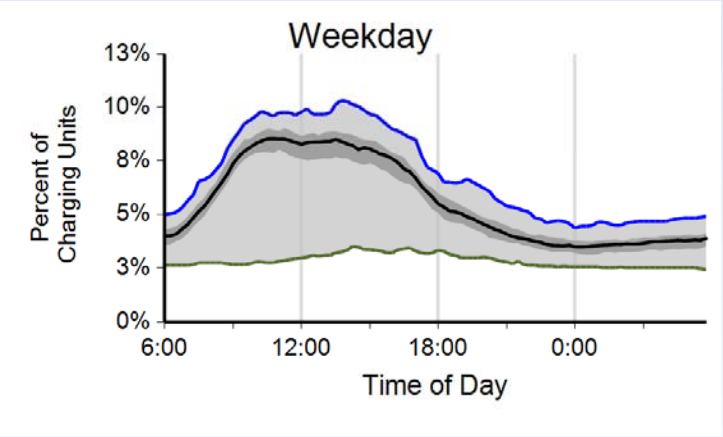
EV Project – EVSE Infra. Summary Report

- **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**

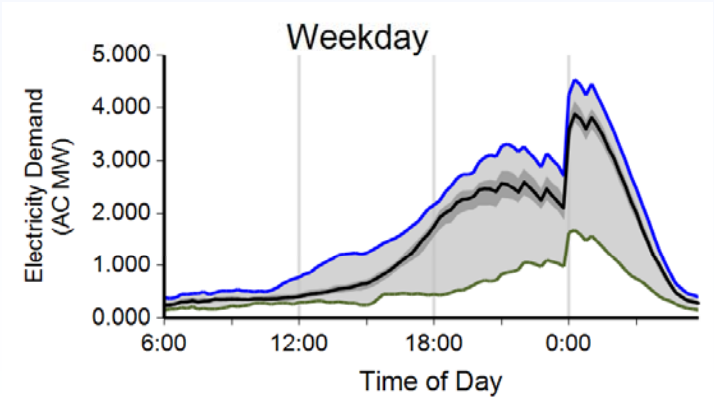
National Residential Connect Time



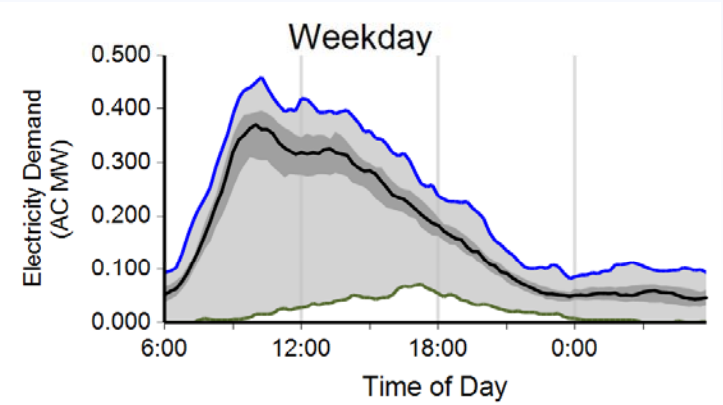
National Public Connect Time



National Residential Demand



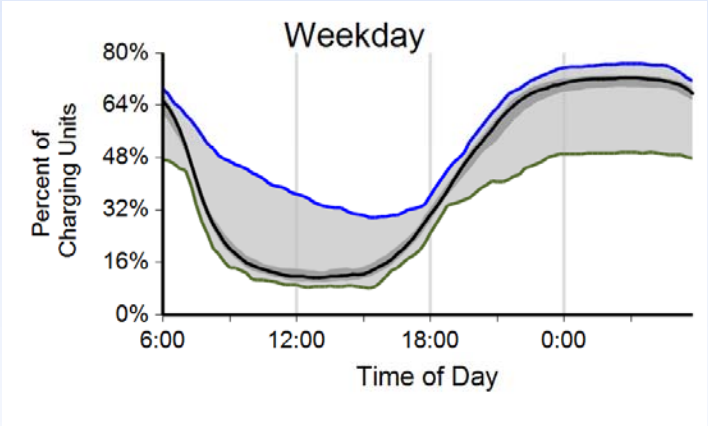
National Public Demand



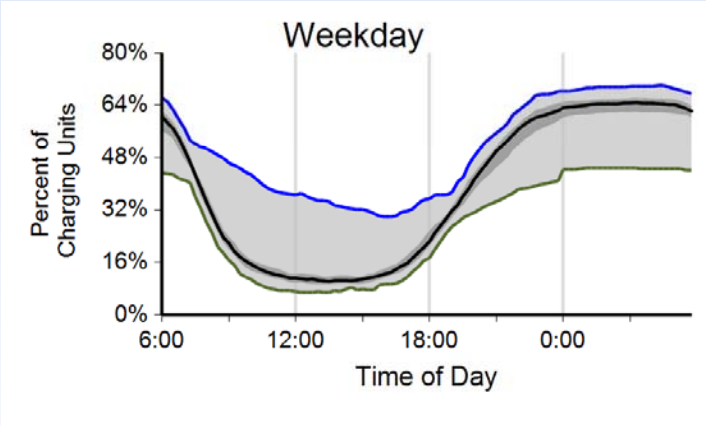
EV Project – EVSE Infra. Summary Report

- **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**

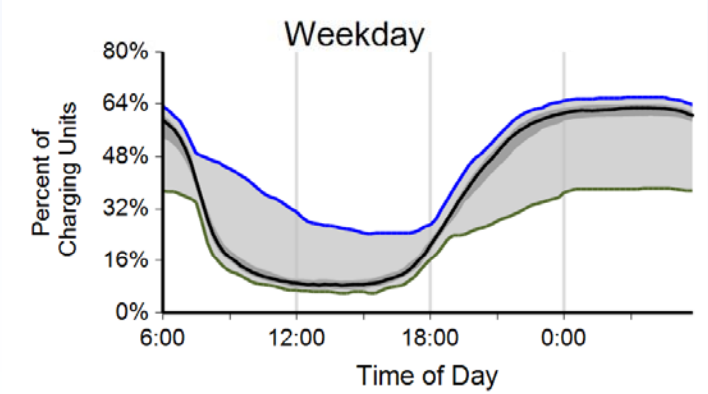
San Diego



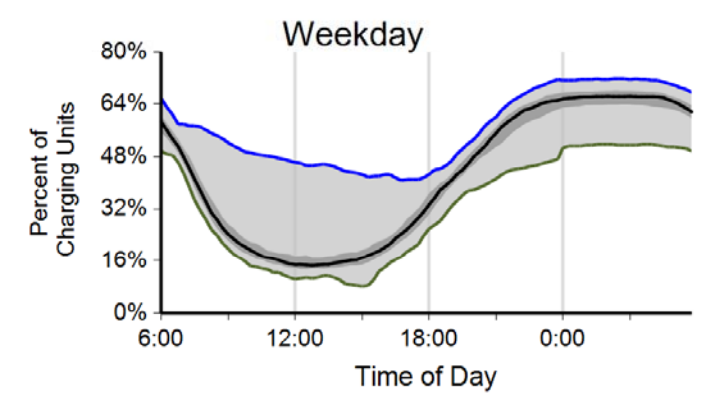
Los Angeles



San Francisco



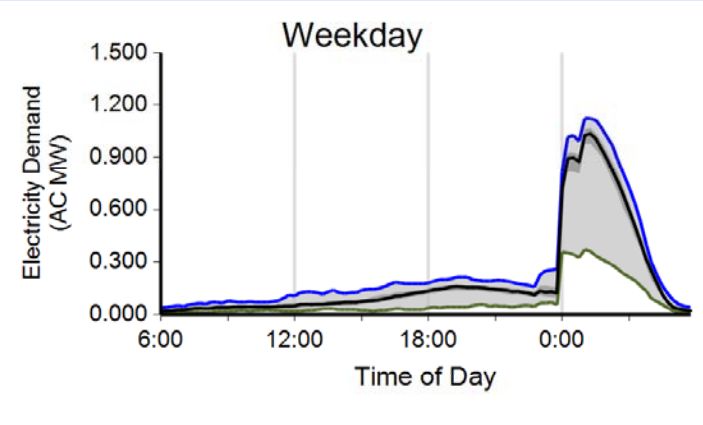
Washington State



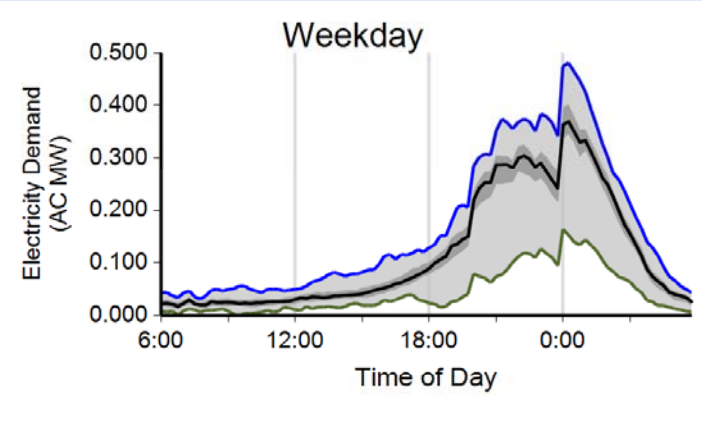
EV Project – EVSE Infra. Summary Report

- **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**

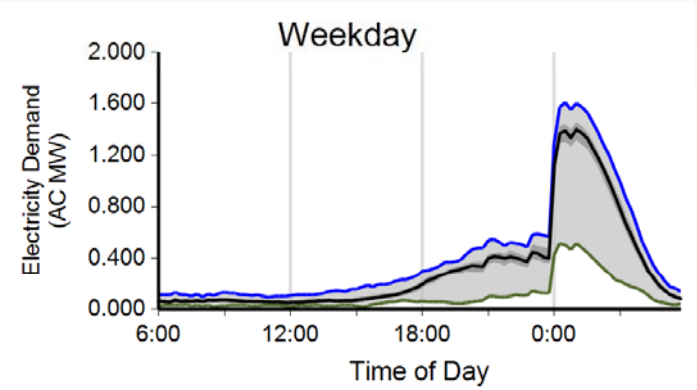
San Diego



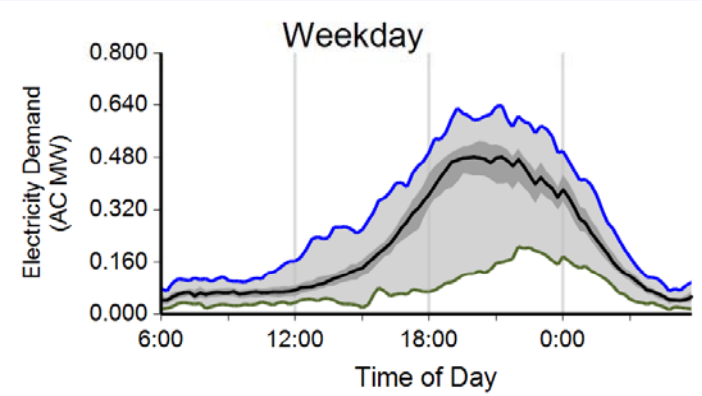
Los Angeles



San Francisco



Washington State



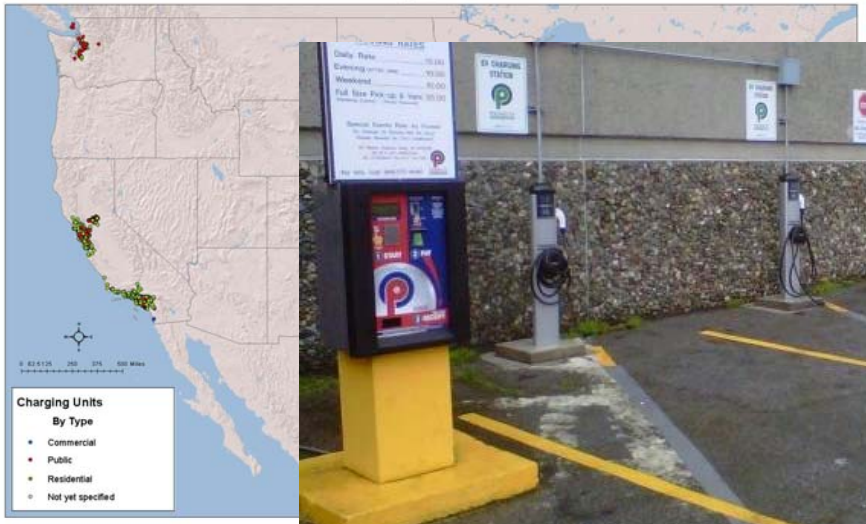
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy | VEHICLE TECHNOLOGIES PROGRAM

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 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

ChargePoint Network | INL Idaho National Laboratory

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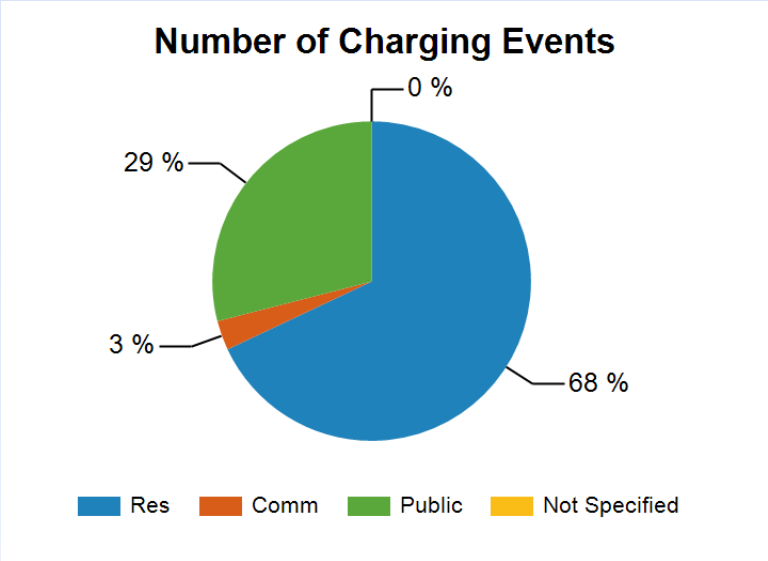
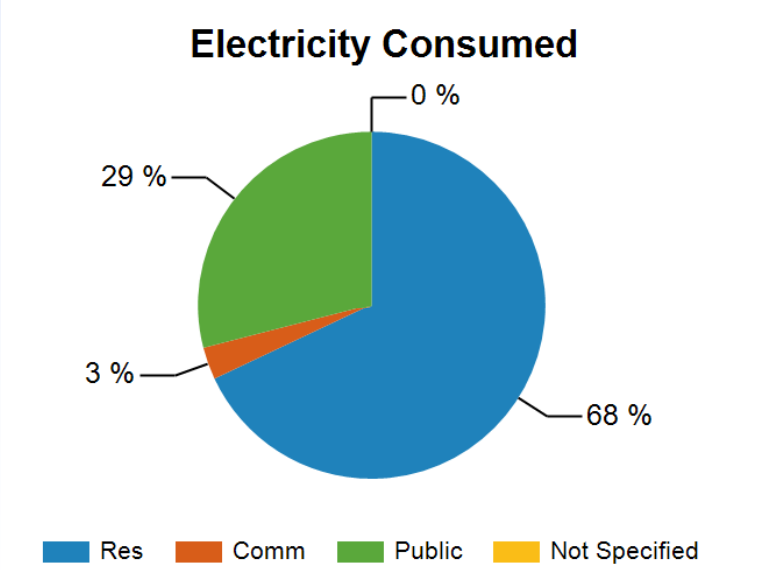
ChargePoint America ARRA Project

- 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

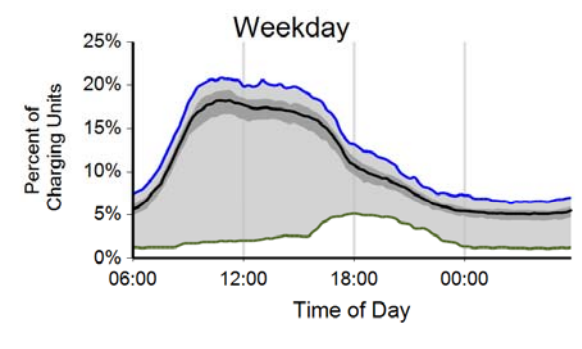
- Oct - Dec 2012 data
- 3,541 units
- Percent time vehicle connected
  - Residential 47%
  - Private/com 24%
  - Public 9%
- Percent time drawing power
  - Residential 9%
  - Private/com 5%
  - Public 4%
- EVSE data only



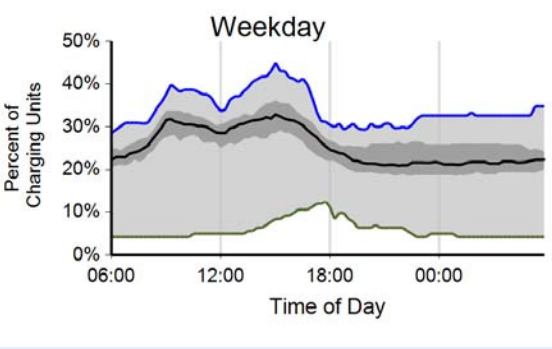


ChargePoint America: Oct – Dec. 2012

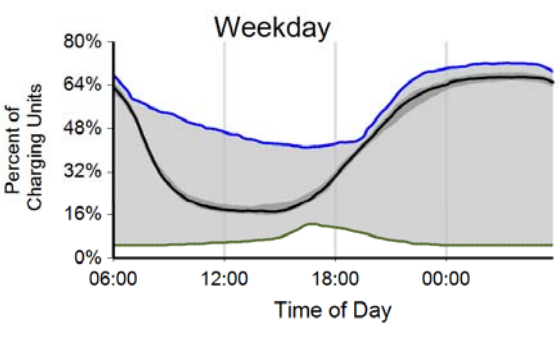
Public Connect Time



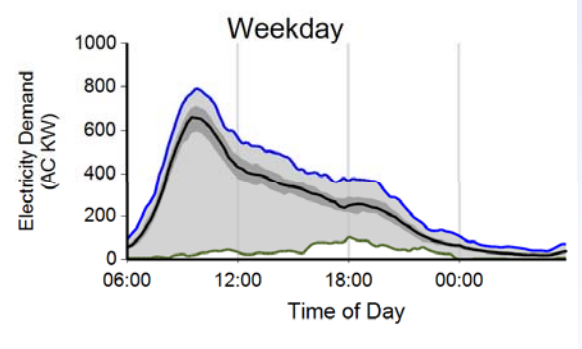
Commercial Connect Time



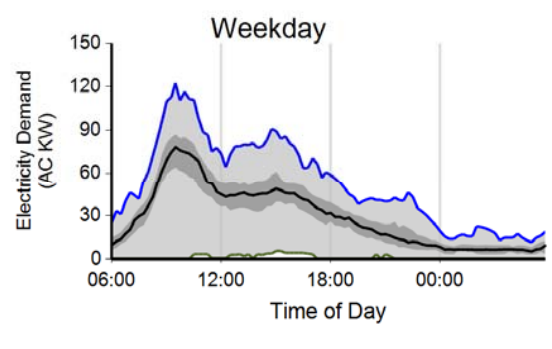
Residential Connect Time



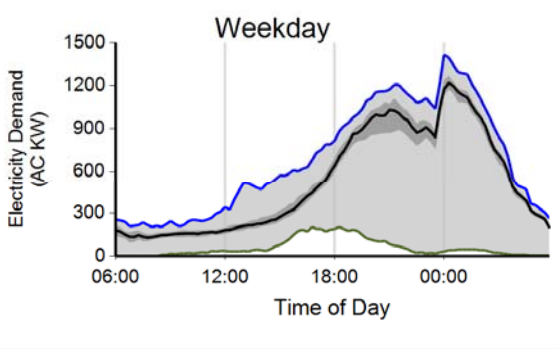
Public Demand



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**

Summary

- **Combined, largest infrastructure and plug-in electric vehicle research in the world with 24,000 data sources**
- **The data allows researchers to understand both how vehicles are operated and charged**
  - **Supports studies to understand where future infrastructure should be placed**
  - **Where infrastructure is and is not used**
  - **How operators drive different technologies**
  - **Impacts from public infrastructure revenue models**
  - **Identify opportunities to incorporate smart charging**
  - **Identify grip impacts and demand costs**
  - **Problems with vehicles and infrastructure that both meet the same SAE standard**
- **There are many legal, PII, proprietary, and investment constraints that restrict the use of vehicle and charging infrastructure data**

ChargePoint, Inc
April 18, 2013

ChargePoint: The Leader

- 70%+ of the public charging station market
- 1,700+ companies providing charging via ChargePoint
- 11,000+ charging spots
- 937+ Megawatt hours (MWh) dispensed each month
- 2,400,000 gallons of gas avoided (annual equivalent)
- 35 million lbs of CO_2 emissions prevented
- 4,500+ times every day drivers plug into a ChargePoint station
- 54,000+ mobile app downloads
- 14 countries

1,700+ ChargePoint Customers

Major Employers

Google, Microsoft, 3M, Adobe, Dell, GM, SAP, Netflix, Johnson & Johnson, MasterCard, eBay, and more

Utilities & EV Service Providers

LA Dept of Water & Power, San Diego Gas & Electric, Austin Energy, Toronto Hydro, Hydro Quebec, and more

Government & Fleet

New York, San Francisco, LA, Boston, Orlando, Washington DC, Connect by Hertz, Google, and more

MDUs/Apartments

Equity Residential, The Keller Group, TGI, The Tower Companies, Alliance Residential, and more

Retail, Hotels & Shopping Centers

Walgreens, Kohl's, Whole Foods, Meijer, Ritz-Carlton, Hyatt, Best Western, Bellevue Square (WA), Fashion Island (CA), and more

Regional & National Parking Services

Edison Properties, Sylvan Parking, Priority Parking, InterPark, and more

Charging Services

- Charging Stations
- Billing Software
- Reservations
- Smartphone Apps
- Advertising
- Authentication
- Asset Management
- Energy Management
- 24/7 Driver Care
- Station Owner Care
- Monitoring & Statistics
- Remote Maintenance

ChargePoint Open Network Solution

Services for Station Owners

ChargePoint Service Plans
Cloud-based solutions for managing EV charging

Services for Drivers

Driver Applications & Services
Web, mobile, in-car apps from ChargePoint & ecosystem providers

ChargePoint and OnRamp Stations

From ChargePoint or other manufacturer

For Drivers

- **Charging Session Info**
- **Usage History**
- **Monthly statement**
- **Notifications**
- **Finding Charging Stations**
- **Reservations**
- **Smartphone Apps**
- **24/7 Driver Care**
- **Monitoring & Statistics**
- **Remote Maintenance**

For Station Owners

- **Charging Stations**
- **Billing Software**
- **Reservations**
- **Smartphone Apps**
- **Advertising**
- **Authentication**
- **Asset Management**
- **Energy Management**
- **24/7 Driver Care**
- **Station Owner Care**
- **Monitoring & Statistics**
- **Remote Maintenance**
- **Charging Session Info**
- **Usage History**
- **Monthly statement**
- **Notifications**

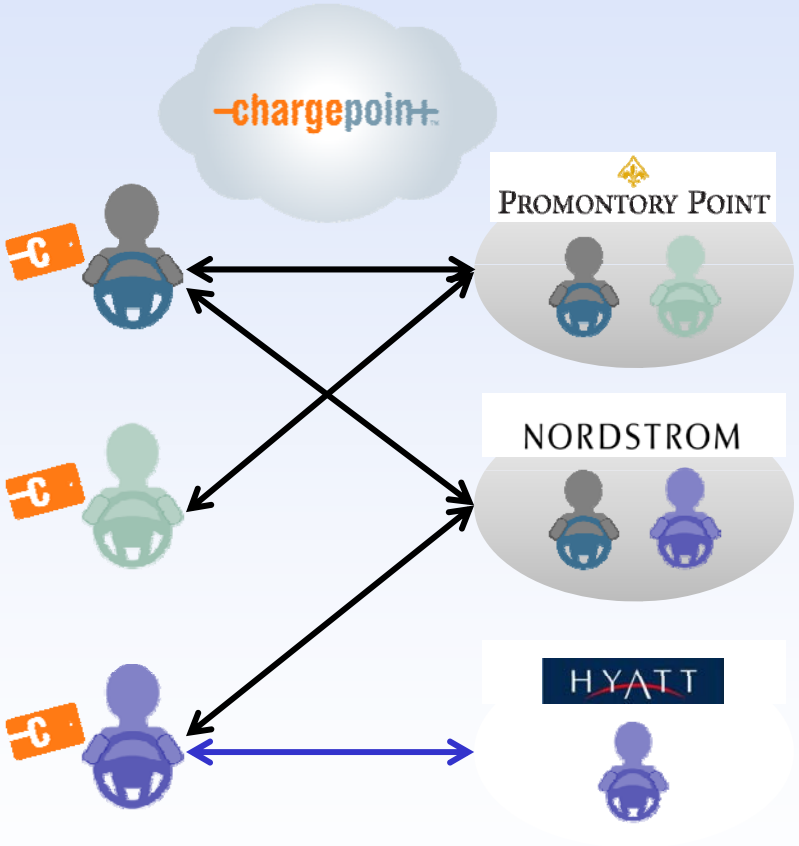
For OEM’s

- **Charging Stations**
- **ChargePoint Software**
- **Database of charging stations**
- **Reservations**
- **Smartphone Apps**
- **24/7 Driver Care**
- **Monitoring & Statistics**
- **Remote Maintenance**

ChargePoint Connections

Connecting Drivers with Retailers, Employers, Utilities, and Others

- **Drivers declare affiliations via their ChargePoint account**
  - **Opt-in for rewards, custom benefits**
  - **Single account for many Connections**
- **Examples**
  - **Connect with Employer to access private stations**
  - **Connect with Retailers for benefits (e.g., charging credits, advertising, discounts, offers)**
  - **Connect with EVSP/Utility for preferred rates**

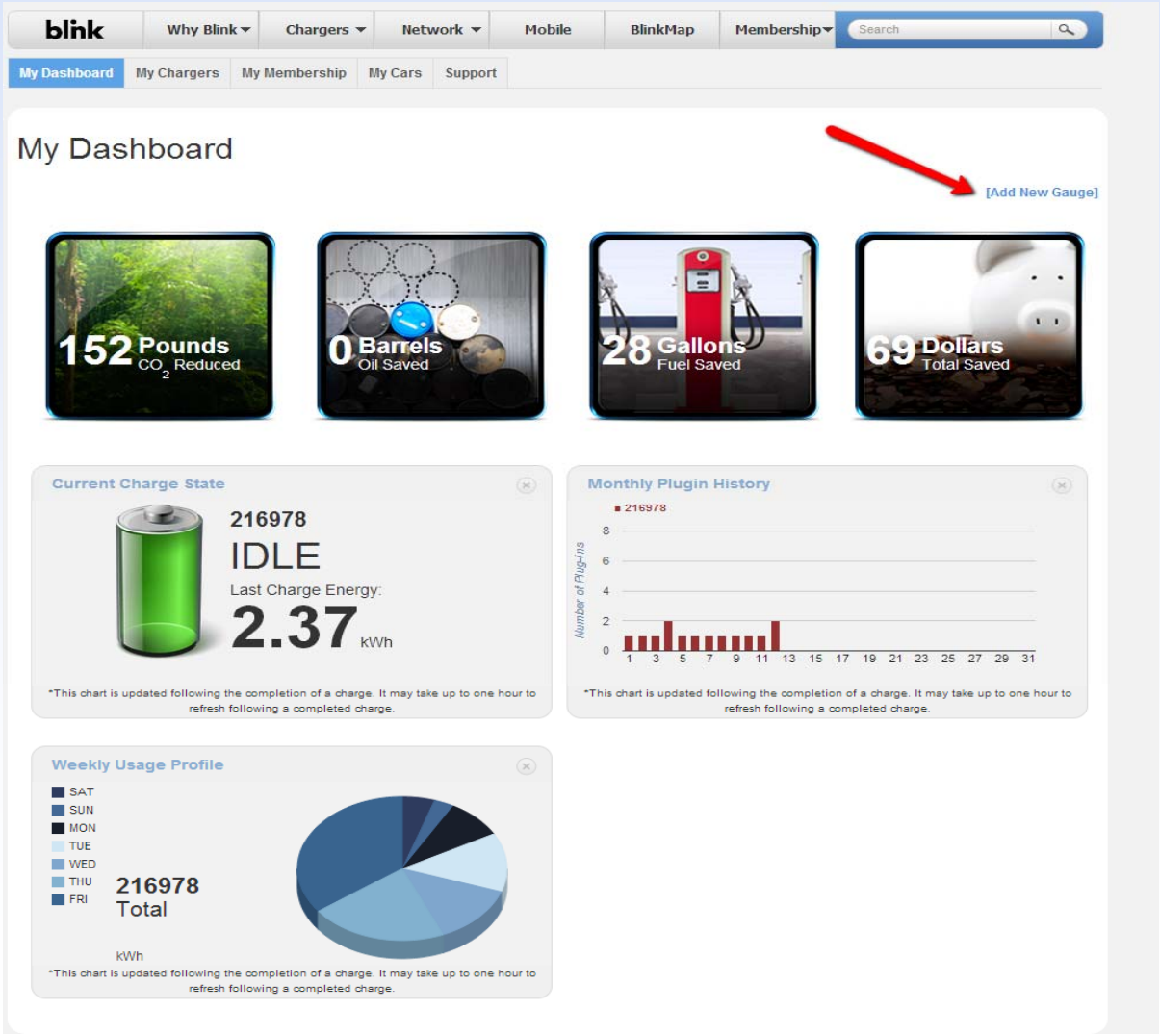


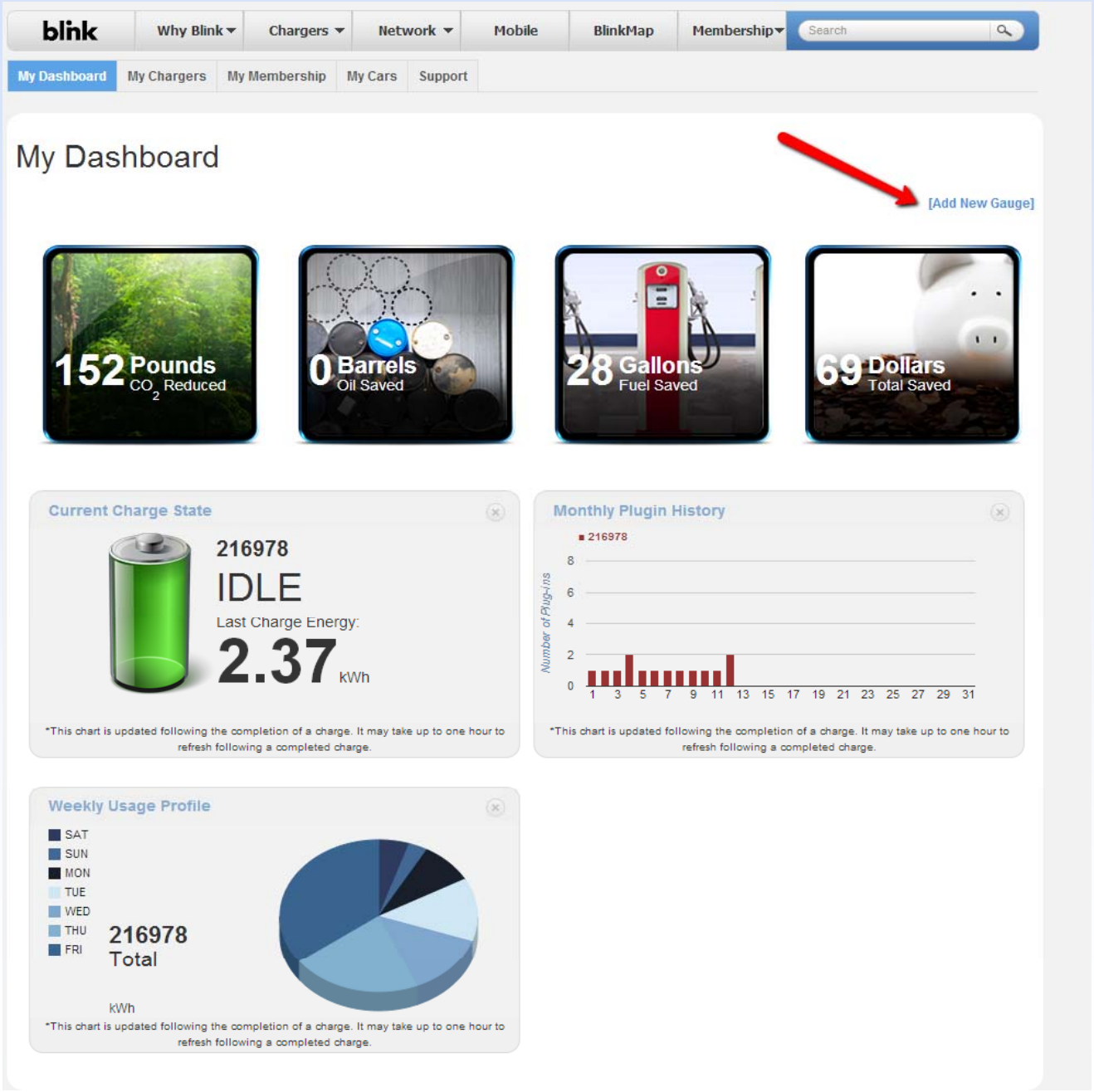
Thank You

www.chargepoint.com

blink

- **Every owner of a blink home-charger that registers with the blink network and agrees to the terms of use, can view their utilization through gauges and dashboards that are available.**




blink
Why Blink
Chargers
Network
Mobile
BlinkMap
Membership
Search
My Dashboard
My Chargers
My Membership
My Cars
Support
My Dashboard
[Add New Gauge]
152 Pounds CO2 Reduced
0 Barrels Oil Saved
28 Gallons Fuel Saved
69 Dollars Total Saved
Current Charge State
216978
IDLE
Last Charge Energy:
2.37 kWh
*This chart is updated following the completion of a charge. It may take up to one hour to refresh following a completed charge.
Monthly Plugin History
216978
Number of Plug-ins
0
2
4
6
8
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
*This chart is updated following the completion of a charge. It may take up to one hour to refresh following a completed charge.
Weekly Usage Profile
SAT
SUN
MON
TUE
WED
THU
FRI
216978
Total
kWh
*This chart is updated following the completion of a charge. It may take up to one hour to refresh following a completed charge.

- **Clicking on the ECOtiles provides additional information about how this data is calculated**

My Dashboard

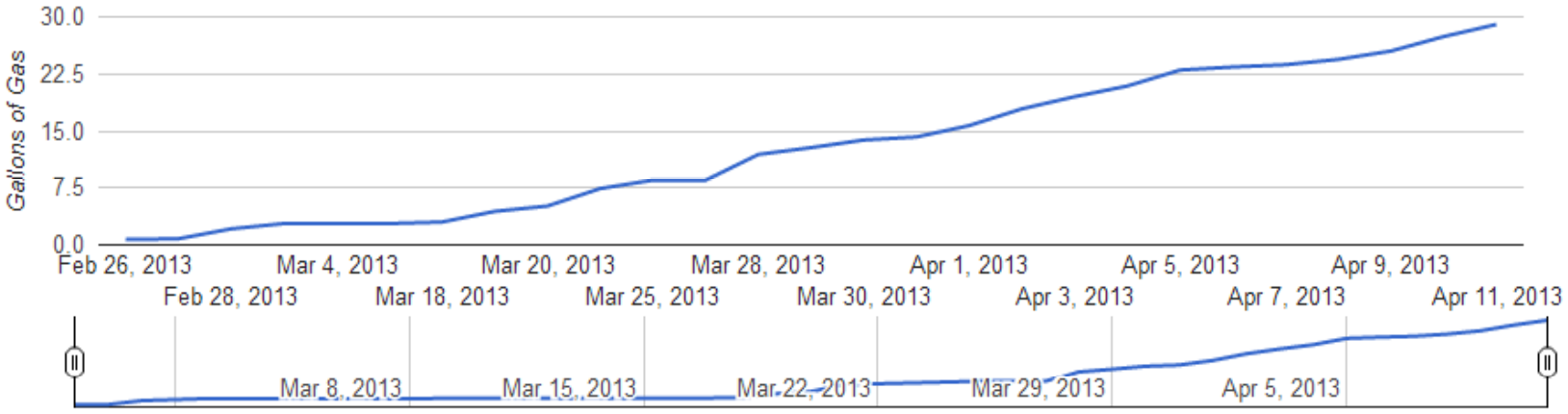
[Add New Gauge]

Gallons of fuel saved assumes that 1% of US electricity generation comes from petroleum and can thus be neglected. The number of kWh used to power the EV, 340 Wh/mile electricity consumption of the EV, and the 28.6 mpg fuel economy of the comparable, conventional vehicle are used in the formula for Gallons of Fuel saved:

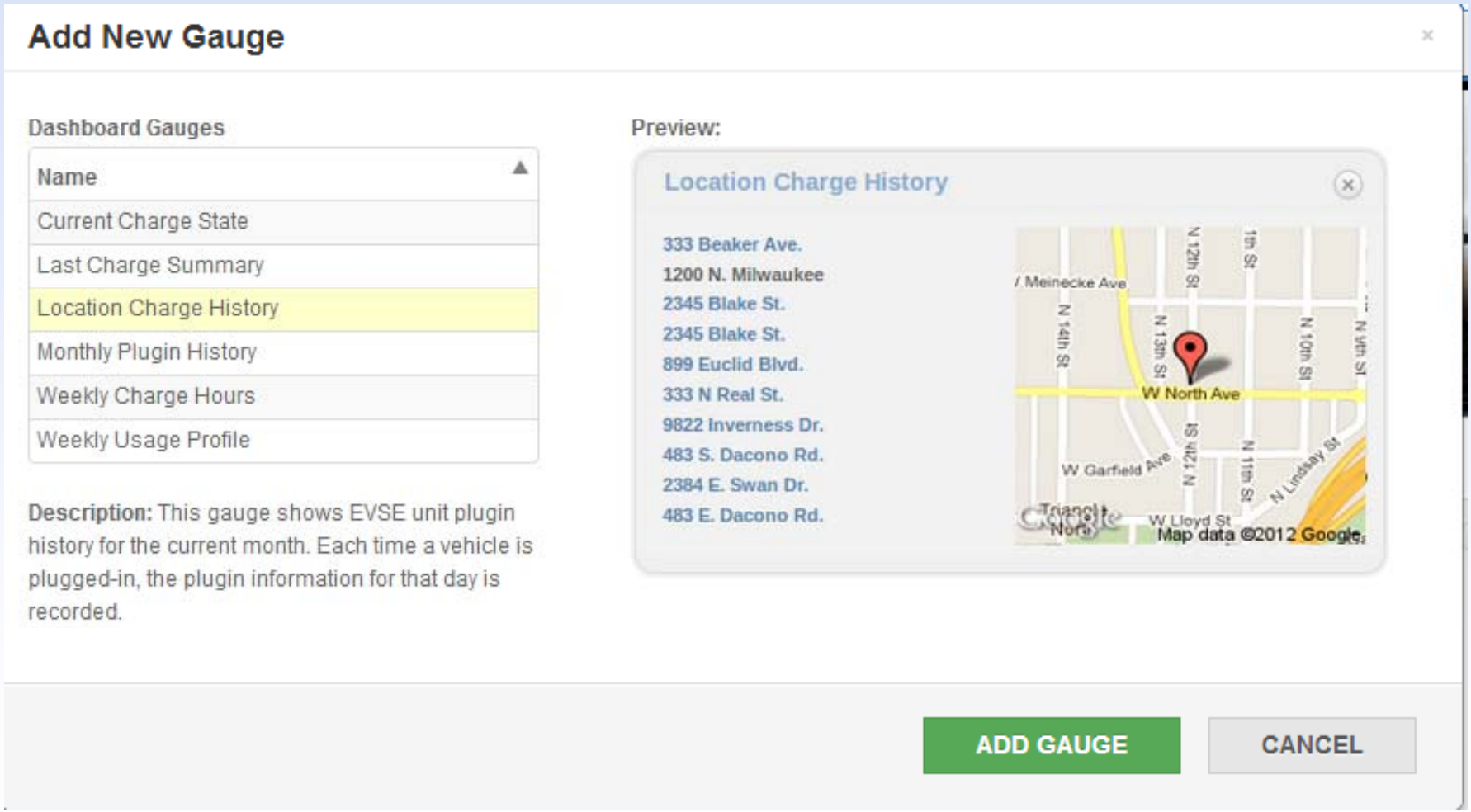
Gallons of Fuel Saved = (Total kWh Used*1000)/340/28.6

Download CSV of Usage Data

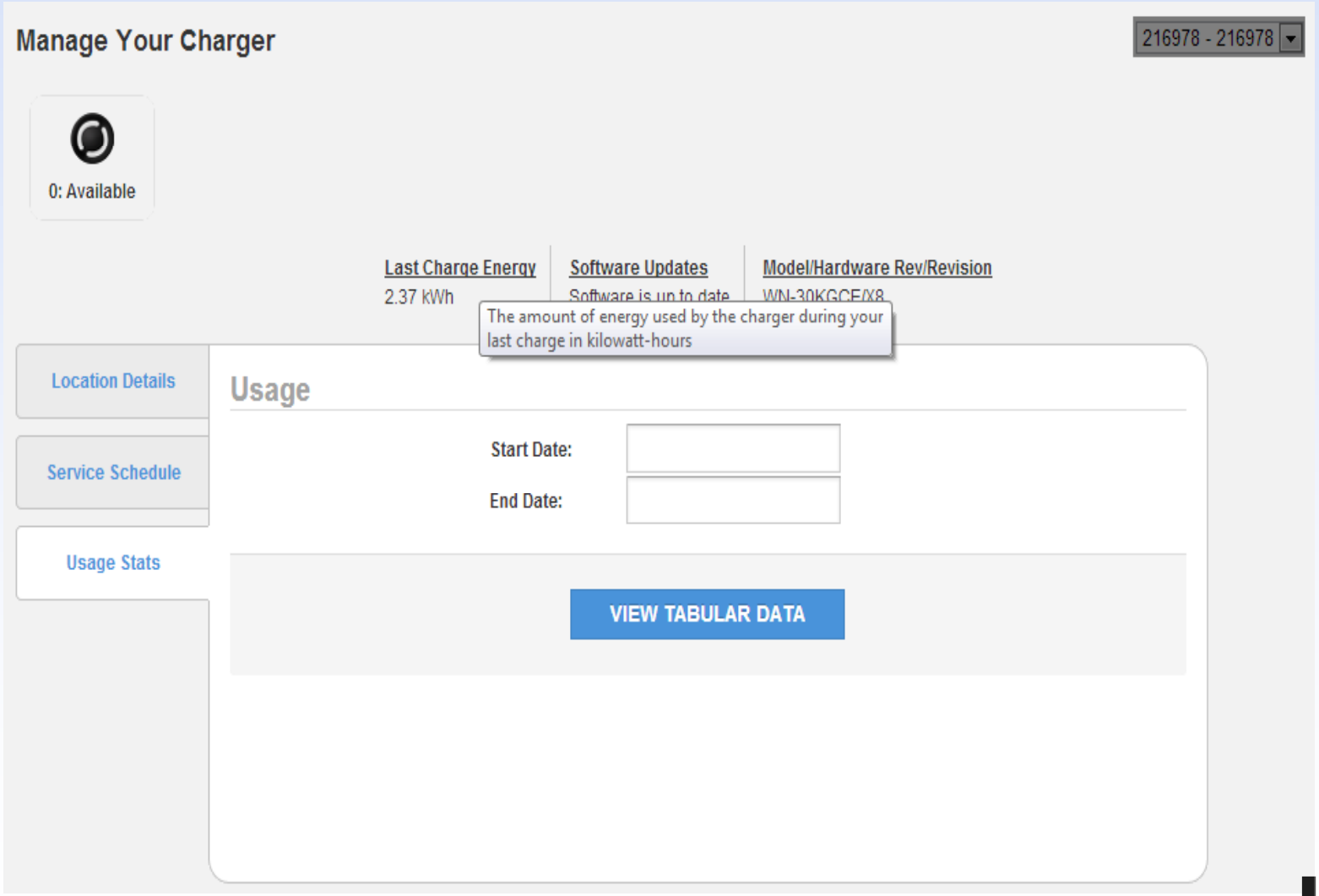
Total Usage



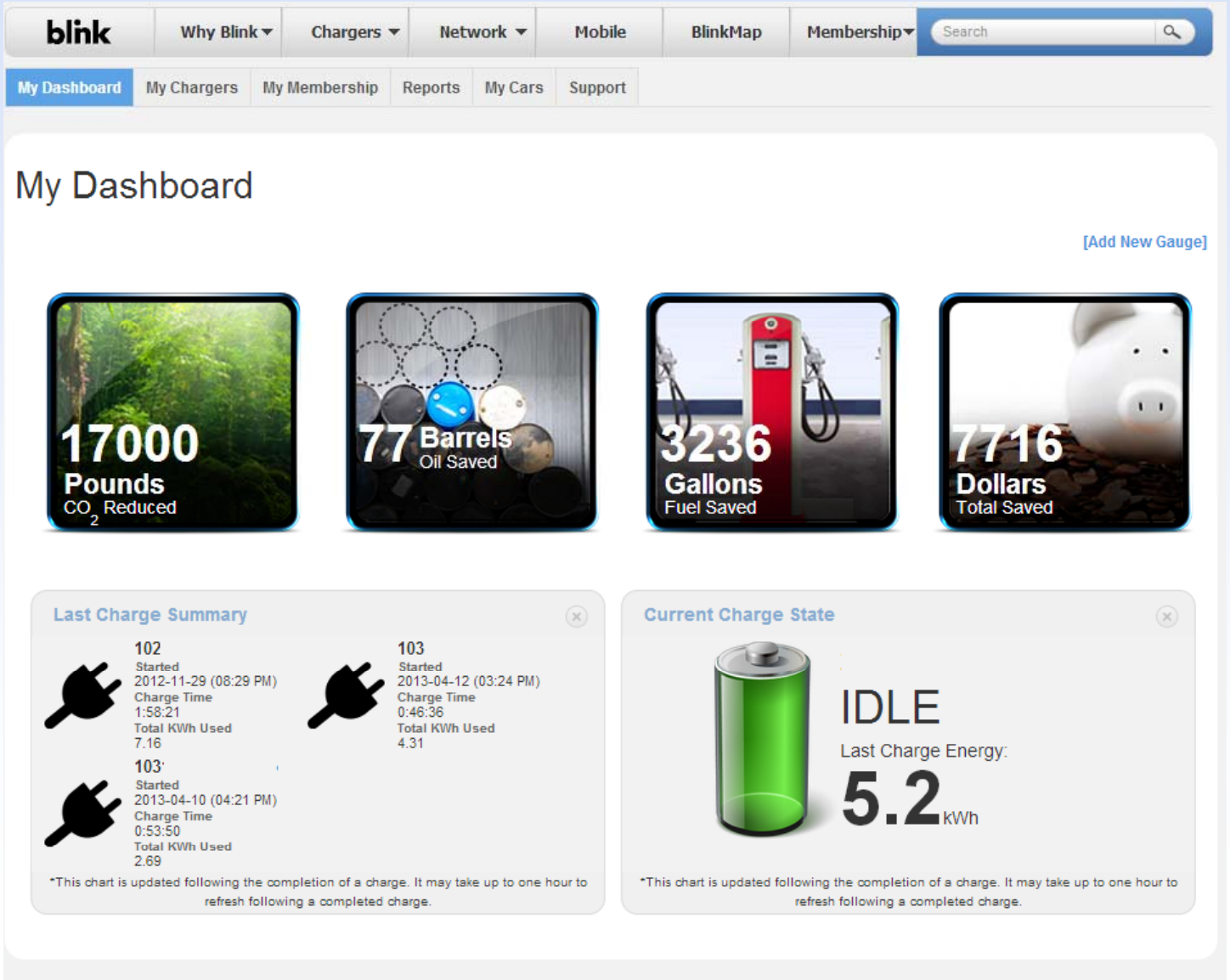
- **There are several pre-generated graphs that can be chosen to add to a residential dashboard.**



- **Exporting charging data can be done through the following:**



- **Commercial blink owners get the same tiles and are allowed to view or pull data from any charger they own.**



Acknowledgement

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More Information

http://avt.inl.gov

This presentation will be posted in the publications section of the above website, alphabetically as "White House, DOE, DOT, SAE - Vehicle Data Jam"

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