ENERGETICS
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# EVSE Considerations

Bryan Roy
Senior Engineer

# Terminology

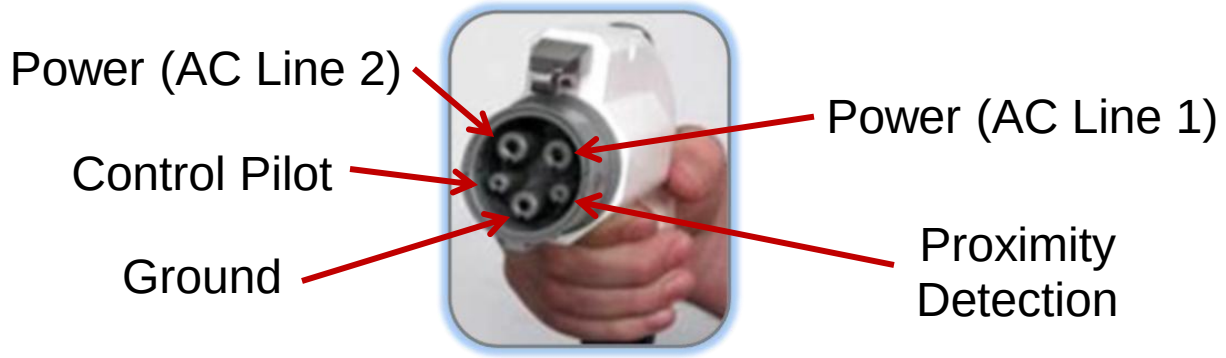
- **Plug-in Electric Vehicle (PEV):** Any electric vehicle (EV) that plugs-in; battery electric vehicle (BEV), plug-in hybrid-electric vehicle (PHEV), and extended range electric vehicles (EREV).


- **PEV Inlet:** The device on the PEV into which the PEV connector is inserted for energy transfer and information exchange.

# Terminology

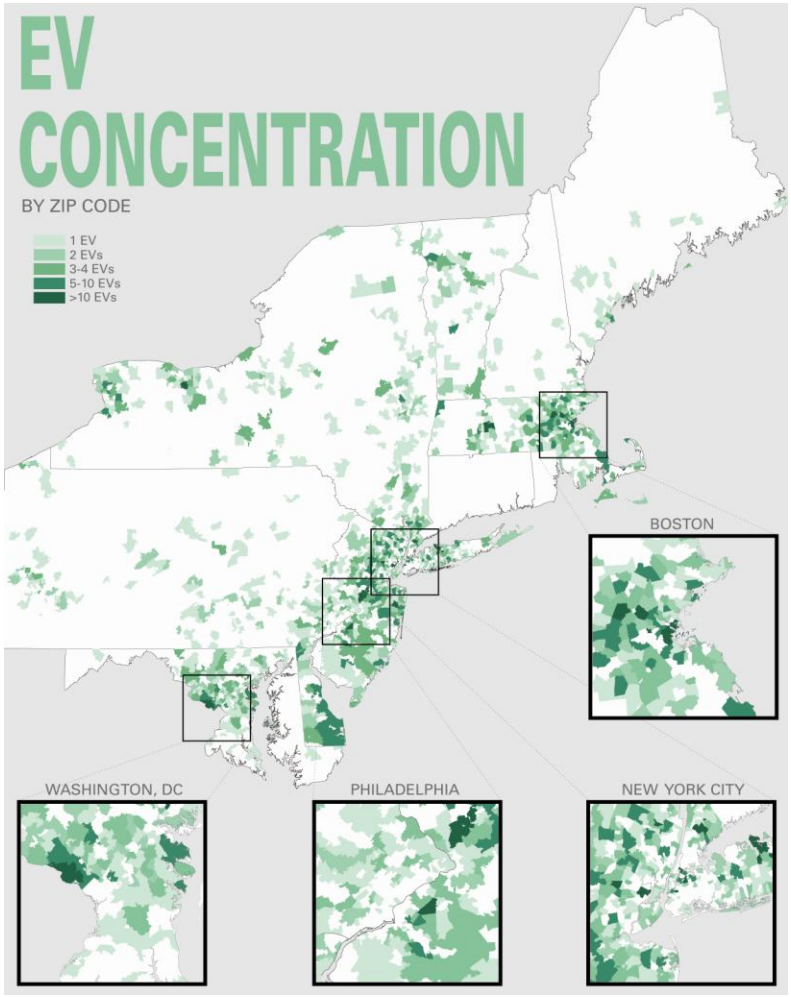
- **Electric Vehicle Supply Equipment (EVSE):** conductors, PEV connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of delivering energy from the premises wiring to the PEV.
- **PEV Connector:** A device that, by insertion into an PEV inlet, establishes an electrical connection to the PEV for the purpose of energy transfer and information exchange.

# SAE J1772 Connector




- **Power:** 2 pins (AC Line 1 & AC Line 2/neutral)
- **Ground:** First to engage, last to disengage and break (for safety)
- **Proximity Detection:** Prevents the car from moving while charging (for safety)
- **Control Pilot:** Last to engage, first to disengage and break, communicates charge rate available to determine amount of current allowed for the vehicle being charged.

# EV Owners




## DEMOGRAPHICS*

The typical EV community is YOUNGER, more EDUCATED, WEALTHIER, PROFESSIONAL and low-density EXURBAN & SUBURBAN

All the above characteristics are greater in communities with THREE OR MORE EVs

- **YOUNGER,** tech-savvy and eco-conscious

**6%** larger under 45 population

**1.5 Years** younger median age

- **WEALTHIER** and desiring to show off the latest eco-purchase

**38%** higher median household incomes

**47%** more households with income greater than or equal to $200,000

- **Highly EDUCATED** and more concerned with energy security

**31%** more bachelor's degrees

**47%** more graduate degrees

- **SUBURBAN & EXURBAN DWELLERS** living in stable households

**40%** higher home values

**38%** more homes with four or more bedrooms

- Diverse occupation base with high percent in **MANAGERIAL** positions

**21%** more management, business, science and arts roles

**23%** more in professional and scientific industries

*For ZIP codes and census tracts, based on 2010 Census and American Community Survey data

# EVSE Rating Levels

**AC level 1**
(SAE J1772™)

PEV includes on-board charger
120V, 1.4 kW @ 12 amp
120V, 1.9 kW @ 16 amp
Est. charge time:
PHEV: 7hrs (SOC* - 0% to full)
BEV: 17hrs (SOC – 20% to full)

**AC level 2**
(SAE J1772™)

PEV includes on-board charger (see below for different types)
240 V, up to 19.2 kW (80 A)
Est. charge time for 3.3 kW on-board charger
PEV: 3 hrs (SOC* - 0% to full)
BEV: 7 hrs (SOC – 20% to full)
Est. charge time for 7 kW on-board charger
PEV: 1.5 hrs (SOC* - 0% to full)
BEV: 3.5 hrs (SOC – 20% to full)
Est. charge time for 20 kW on-board charger
PEV: 22 min. (SOC* - 0% to full)
BEV: 1.2 hrs (SOC – 20% to full)

**DC Level 1**
(SAE J1772™)

EVSE includes an off-board charger
200-500 V DC, up to 40 kW (80 A)
Est. charge time (20 kW off-board charger):
PHEV: 22 min. (SOC* - 0% to 80%)
BEV: 1.2 hrs. (SOC – 20% to 100%)

**DC Level 2**
(SAE J1772™)

EVSE includes an off-board charger
200-500 V DC, up to 100 kW (200 A)
Est. charge time (45 kW off-board charger):
PHEV: 10 min. (SOC - 0% to 80%)
BEV: 20 min. (SOC – 20% to 80%)

Voltages are nominal configuration voltages, not coupler ratings
Rated Power is at nominal configuration operating voltage and coupler rated current
Ideal charge times assume 90% efficient chargers, 150W to 12V loads and no balancing of Traction Battery Pack

Notes:
1) BEV (25 kWh usable pack size) charging always starts at 20% SOC, faster than a 1C rate (total capacity charged in one hour) will also stop at 80% SOC instead of 100%
2) PHEV can start from 0% SOC since the hybrid mode is available.

*ver. 100312*

# EVSE Charging Units

- AC Level 1 cord-and-plug connected (portable)
  - Single-phase 120 V, up to 16 A (1.9 kW)
  - Typically 8 to 16 hours for a complete charge

- AC Level 2 wired to individual branch circuit
  - Single-phase 208 V or 240 V, up to 80 A (19.2 kW)
  - 3.3 kW PEV charger will have a charge time about 42% of the 120-volt charge time
  - Typically 4 to 6 hours for a complete charge
  - Similar to an electric cloths dryer or electric range/stove

- DC Fast Charge Level 1
  - 200-500 V DC, up to 80 A  (40 kW)
  - Complete charge typically takes less than one hour
  - Similar to a commercial HVAC system

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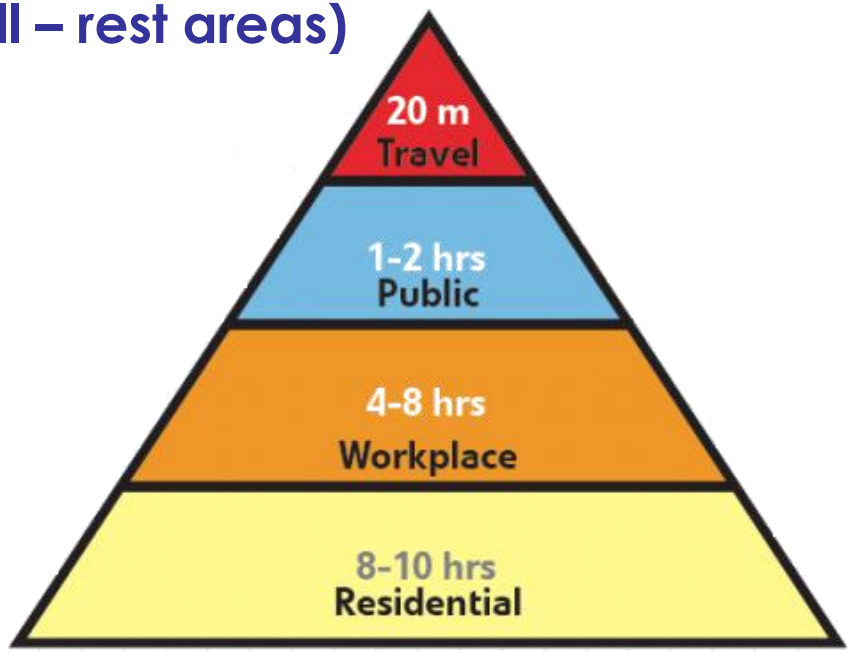
# The Right EVSE?

- DC Fast Charging
  - Public Stations (15 minute dwell – rest areas)
  - SAE Combo vs. CHAdeMo
- AC Level 2
  - Residential
  - Workplace (BEVs)
  - Public Stations (1-2 hour dwell)
- AC Level 1
  - Residential overnight charging
  - Workplace (PHEVs, EREVs)
- Wireless Charging
- Battery Swapping
- eTRU Charging




# Charging for charging

- Free is nice, but not sustainable
- DC fast charging demand charges can be significant
  - $25/kW in some territories
  - 20 kW to 50 kW thresholds

| 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 |

- Pay per kWh or/and hour
  - Several states (CA, CO, FL, MD, VA) have passed laws specifically excluding EVSE service providers from public utility regulations if the electricity is used as a transportation fuel
  - A vehicle with 3.3 kW charger and $4.00/gallon of gas;
    $2.00/hr or $0.61/kWh = 22 mpg gas equivalent car
    $1.32/hr or $0.40/kWh = 33 mpg gas equivalent car
    $1.00/hr or $0.30/kWh = 44 mpg gas equivalent car
    $0.43/hr or $0.13/kWh = 103 mpg gas equivalent car
- Decline in use of public EVSE

# EV Charging Rates

## Typical U.S. Utility Rate Options

Electric Vehicle Infrastructure Training Program

| PLAN | Residential Plan (Schedule D) One meter | Home & Electric Vehicle Plan (TOU-D-TEV) One meter | Electric Vehicle Plan (TOU-EV-1) Two meters |
|---|---|---|---|
| DESCRIPTION | "The more you use, the more you pay" | "Lower rate at night, higher rate during the day, measures home and EV together" | "Lowest rate, separate meter for EV, requires more initial set-up cost, time and coordination" |
| RATE RANGE | 12¢ – 31¢ per kWh* | 10¢ – 55¢ per kWh* | 11¢ – 27¢ per kWh* |
| APPROXIMATE ELECTRICITY COST | 6¢ per mile** | 4¢ per mile** | 2.5¢ per mile** |

GASOLINE COST = 12¢ per mile**



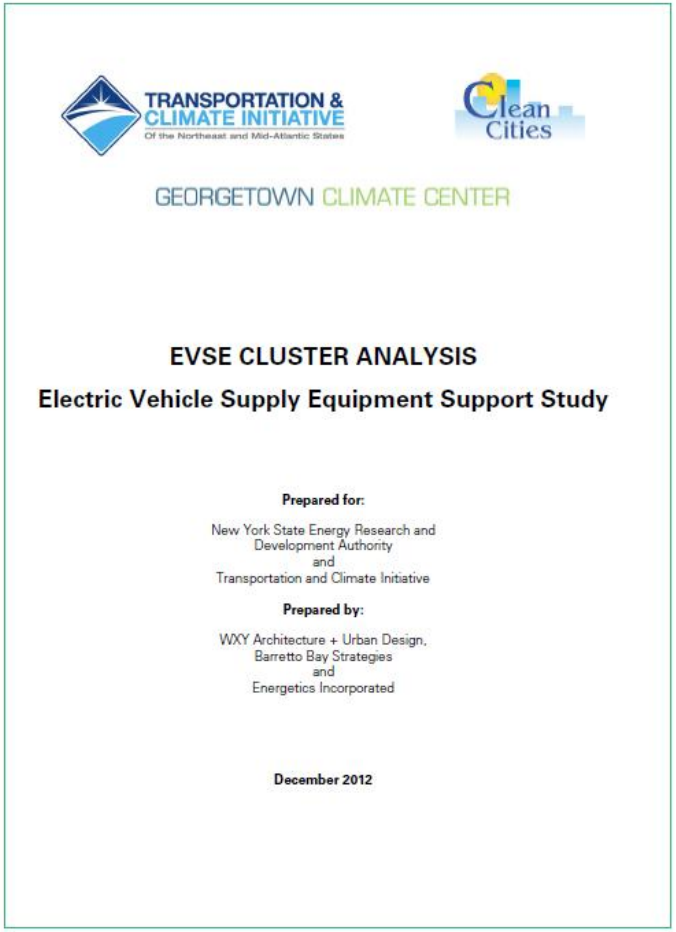
- Notification of EVSE installations is important

# EVSE Locations

## Sites with the greatest benefit for PEV drivers

- Home (single family and multi-family)
- Work
  - Employees
  - Higher education
  - Medical campus
  - Regional transit
  - Company vehicles
- Retail and leisure destinations
- Dealerships

Different considerations for residential, commercial, and public installations


TRANSPORTATION & CLIMATE INITIATIVE
Of the Northeast and Mid-Atlantic States

Clean Cities

GEORGETOWN CLIMATE CENTER

EVSE CLUSTER ANALYSIS

Electric Vehicle Supply Equipment Support Study

Prepared for:

New York State Energy Research and Development Authority
and
Transportation and Climate Initiative

Prepared by:

WXY Architecture + Urban Design,
Barretto Bay Strategies
and
Energetics Incorporated

December 2012

# Installation Factors

## Where should the EVSE unit be placed?

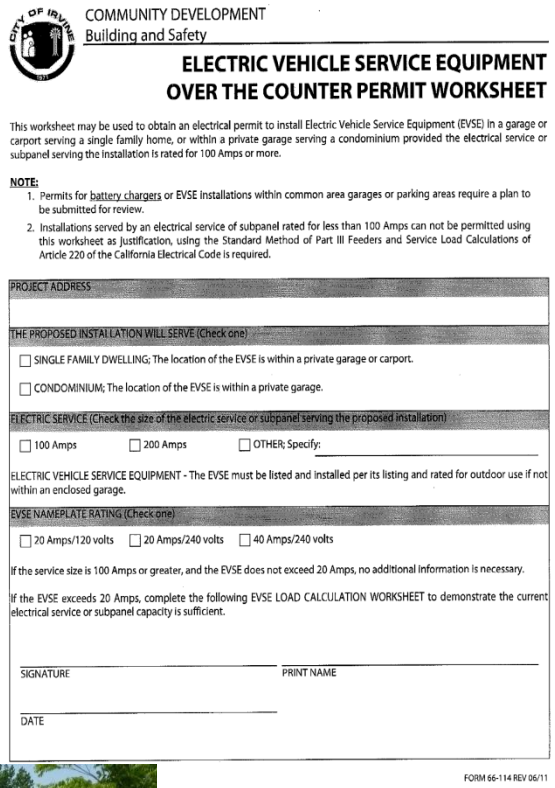
- Cost
  - Length of cable run from electrical panel
  - Pavement
- Convenience for PEV drivers
- Green branding
- Signage
- Empty parking spaces





# Community Support

- Codes
  - Mandating percentage of parking spaces to be EV-ready
- Permitting
  - Streamlining: minor work label, online forms, self-inspections
- ADA EVSE
- Parking space enforcement
  - Getting "ICE'd"
- Grant funding
  - Is EVSE deployment a social responsibility?



COMMUNITY DEVELOPMENT
Building and Safety

**ELECTRIC VEHICLE SERVICE EQUIPMENT OVER THE COUNTER PERMIT WORKSHEET**

This worksheet may be used to obtain an electrical permit to install Electric Vehicle Service Equipment (EVSE) in a garage or carport serving a single family home, or within a private garage serving a condominium provided the electrical service or subpanel serving the installation is rated for 100 Amps or more.

**NOTE:**
1. Permits for battery chargers or EVSE installations within common area garages or parking areas require a plan to be submitted for review.
2. Installations served by an electrical service of subpanel rated for less than 100 Amps can not be permitted using this worksheet as justification, using the Standard Method of Part III Feeders and Service Load Calculations of Article 220 of the California Electrical Code is required.

PROJECT ADDRESS

THE PROPOSED INSTALLATION WILL SERVE (Check one)

☐ SINGLE FAMILY DWELLING; The location of the EVSE is within a private garage or carport.

☐ CONDOMINIUM; The location of the EVSE is within a private garage.

ELECTRIC SERVICE (Check the size of the electric service or subpanel serving the proposed installation)

☐ 100 Amps ☐ 200 Amps ☐ OTHER; Specify: _____

ELECTRIC VEHICLE SERVICE EQUIPMENT - The EVSE must be listed and installed per its listing and rated for outdoor use if not within an enclosed garage.

EVSE NAMEPLATE RATING (Check one)

☐ 20 Amps/120 volts ☐ 20 Amps/240 volts ☐ 40 Amps/240 volts

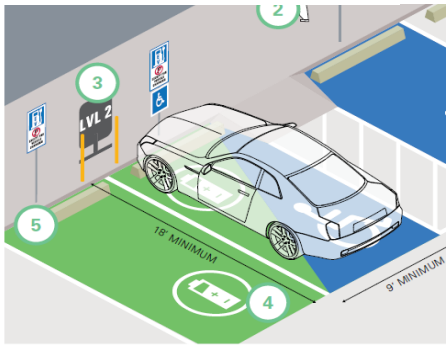
If the service size is 100 Amps or greater, and the EVSE does not exceed 20 Amps, no additional information is necessary.

If the EVSE exceeds 20 Amps, complete the following EVSE LOAD CALCULATION WORKSHEET to demonstrate the current electrical service or subpanel capacity is sufficient.

SIGNATURE _____ PRINT NAME _____

DATE _____

FORM 66-114 REV 06/11



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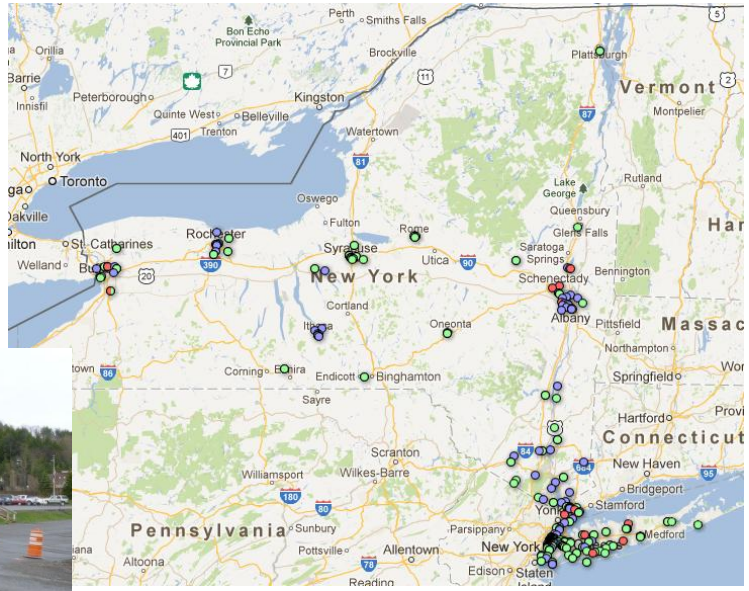
# EVSE Incentives

- **Federal Alternative Fuel Infrastructure Tax Credit**
  - EVSE installed by December 31, 2013, is eligible for a tax credit of 30% of the cost, not to exceed $30,000. Permitting and inspection fees are not included in covered expenses.
  - Residential fueling equipment purchased prior to December 31, 2013, receive a tax credit of up to $1,000.
- **New York State Tax Credit**
  - 50% up to $5,000 per installation (for businesses) from January 1, 2013 to December 31, 2013
  - Cannot be used if you get grant money from NYSERDA
- **NYSERDA EVSE Grants (PON 2301)**

# NYSERDA EVSE

- $8M for 582 EVSE serving 900 charging spots
  - ChargePoint – statewide deployment
  - Leviton – statewide deployment
  - NYPA – near NYC
  - Car Charging/Beam Charging – NYC garages
  - Frito-Lay – delivery trucks
  - EV Connect – Marriot Hotels, Hertz
  - Access Technology – Albany, Schenectady
  - EVPass – malls
  - Golub – Price Chopper
  - City of Rochester
  - Greater Long Island Clean Cities – Multi-dwelling units

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# INL AVTA

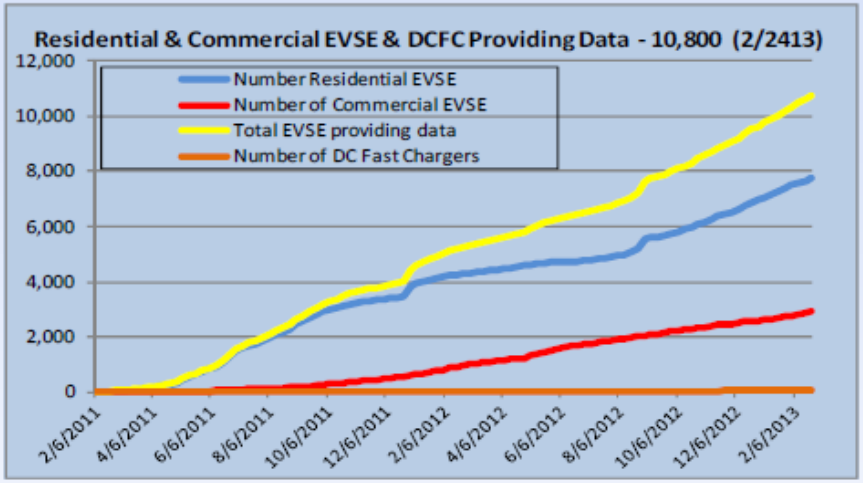
## Idaho National Laboratory

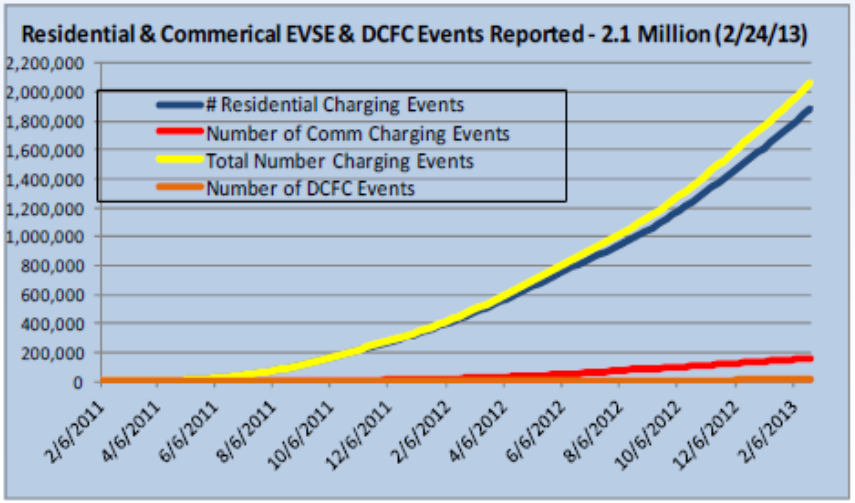
- U.S. Department of Energy (DOE) laboratory
- Supports DOE's strategic goal to increase U.S. energy security and reduce dependence on foreign oil

## Advanced Vehicle Testing Activity (AVTA)

- DOE Vehicle Technologies Program's singular field, tract, and laboratory based source of testing light-duty whole vehicle systems and subsystems
- EV Project
  - Build and study mature charging infrastructure
  - ECOtality is the lead, with INL, Nissan and Onstar/GM as the prime partners, and 40+ other partners (electric utilities)
- ChargePoint America ARRA Project
  - Deployment and monitoring of Coulomb EVSE

# EV Project EVSE Deployed / Use, 2/24/13




- 10,757 total EVSE
  - 7,762 (72%) Residential EVSE 2,923 (27%) non-residential EVSE
  - 72 (1%) DCFC
- 2.1 million charge events
  - 1,884,508 (91%) Residential EVSE
  - 161,183 (8%) non-residential EVSE
  - 16,820 (1%) DCFC

# EV Project – National Data

## 4rd quarter 2012 Data Only

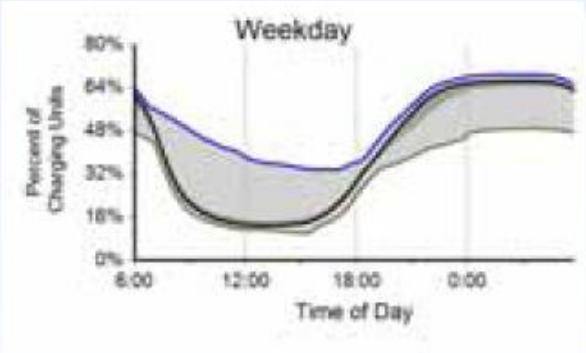
| | Leafs | Volts |
|---|---|---|
| • Number of vehicles | 3,762 | 1,021 |
| • Number of Trips | 969,853 | 369,118 |
| • Distance (million miles) | 6.7 | 3.0 |
| • Average (Ave) trip distance | 6.9 mi | 8.1 mi |
| • Ave distance per day | 29.2 mi | 40.5 mi |
| • Ave number (#) trips between charging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

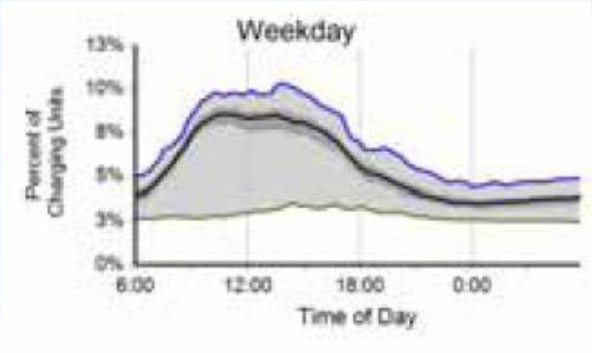
# EV Project – EVSE Infra. Summary Report

- 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

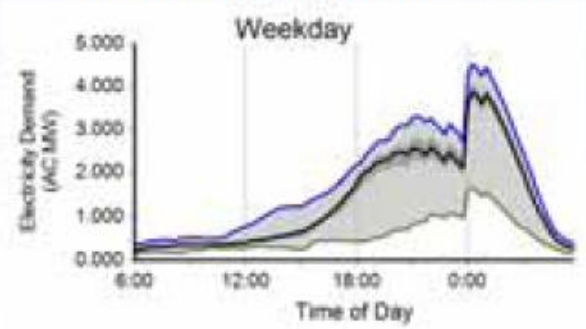
National Residential Connect Time



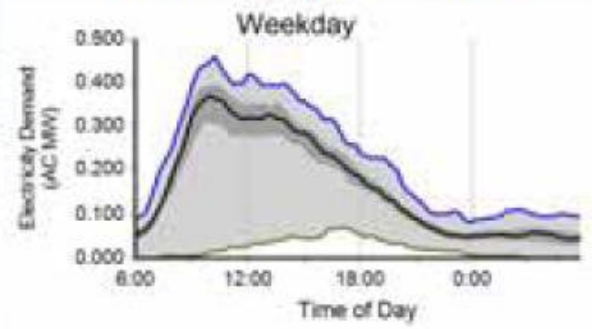

National Public Connect Time




National Residential Demand




National Public Demand



# Residential Lessons Learned

- 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 |

# Commercial Lessons Learned

- 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 |

# Breakout Sessions

- Municipal Planners and Building Code Officials
- Installers and Inspectors

- Useful resources
- Lessons learned
- Best practices
- Local experiences