

PEV Standards and Codes, Thought Starter Materials

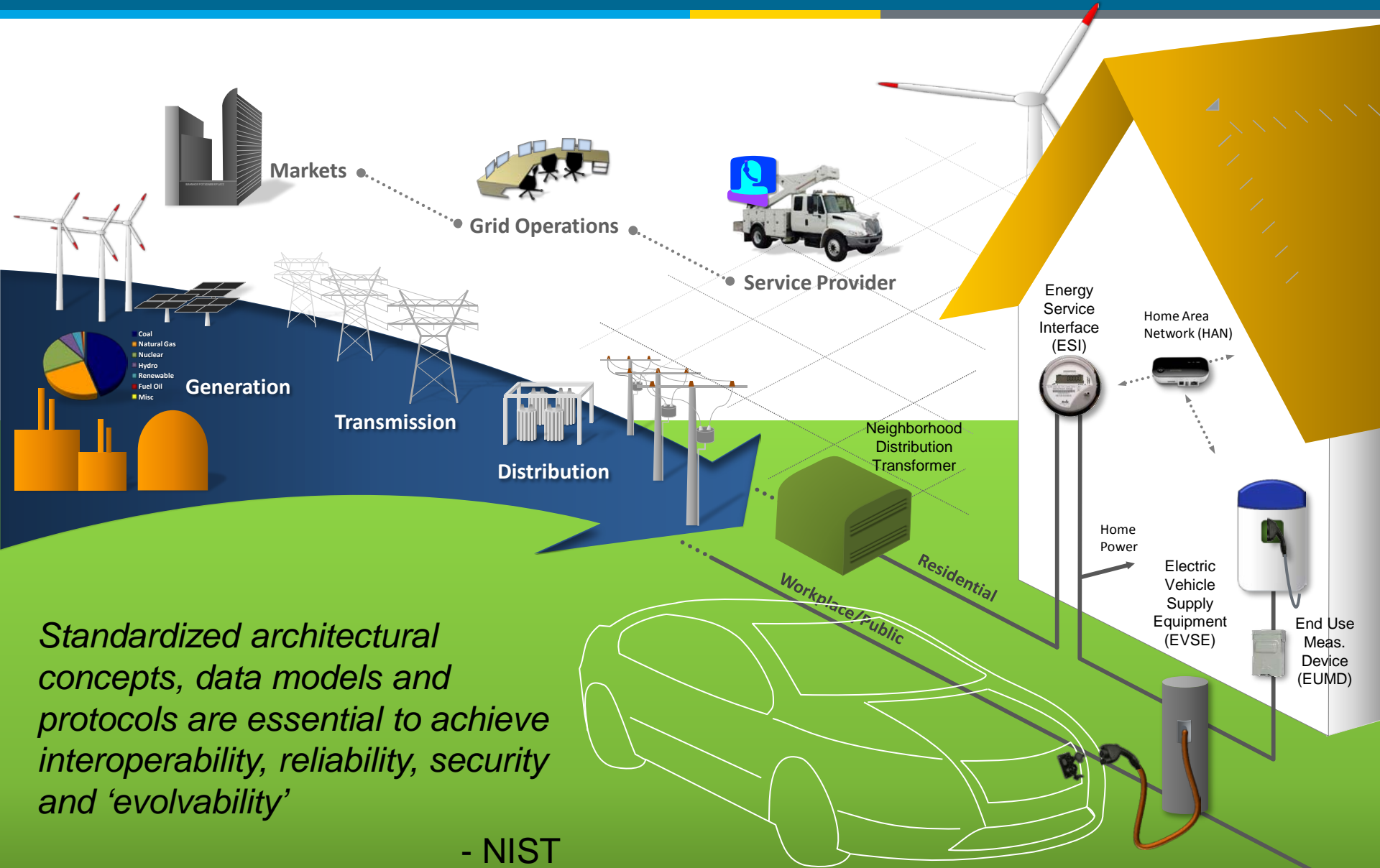


NUTC Workshop:
The Electrification of Transportation
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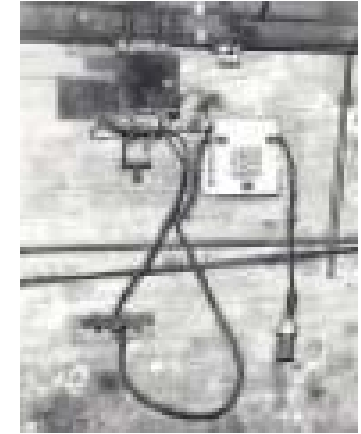
The Big (Infrastructure) Picture



Detroit was the first American city to use electric taxi cabs, in 1914.

Detroit's first electric taxi accumulated >46,000 miles first two years of operation.

Are Indoor/Outdoor Charge Ports New?



Outdoor Curb-Side Charging Port

Indoor charging stations



Unique Charging Needed for Each Vehicle Type



– Plug in Hybrid Electric Vehicle (PHEV)

- Very limited electric range – small battery 5-10 kWhr
- Charge power 1-3 kW



– Extended Range Electric Vehicle (EREV)

- Increased electric range – medium battery 10-20 kWhr
- Charge power up to 6 kW



– Battery Electric Vehicle (BEV)

- All electric range – large battery >20kWhr
- Charge power > 6 kW

Relative Annual PEV Energy Usage {~2500kWhr/year or \$275/year; ~\$23/month}

Annual Energy Usage – Electrical Appliances

Home Heating System 3,524 kWh

Central Air Conditioning 2,796 kWh

Refrigerator/Freezer 2,610 kWh

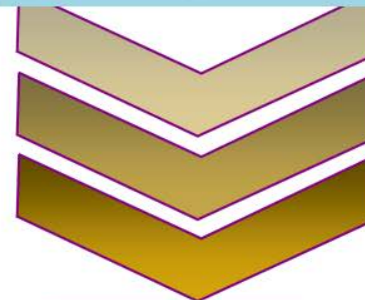
Water Heater 2,552 kWh

  **2,520 kWh**

Clothes Dryer 1,079 kWh

Lighting 940 kWh

1 Computer & monitor
operating ALL day



1 **CHEVY**

for annual
energy usage

Historical Perspective on EV Charging Equipment 1900 to Today ...and Tomorrow

1913- 150A/48vdc coupler
(30,000 EVs in 1913)

The electric vehicle - raising the standards



Figure 3.25: 150 A charging plug with handle¹⁰¹

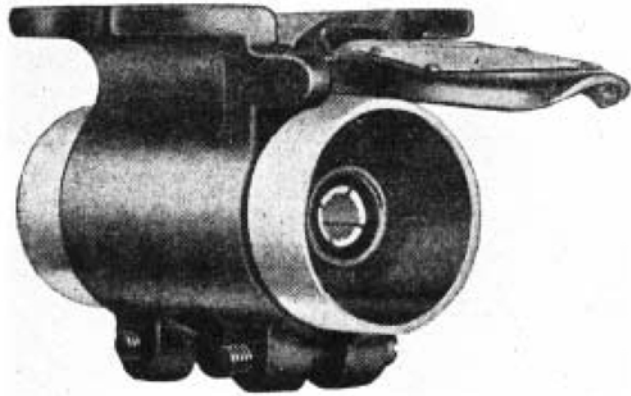
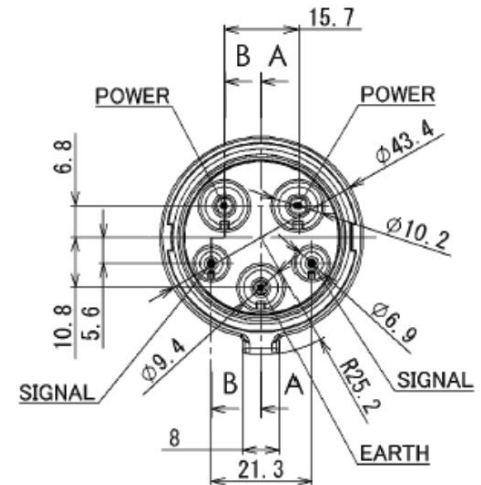


Figure 3.26: 150 ampere-hour (sic) charging receptacle¹⁰²

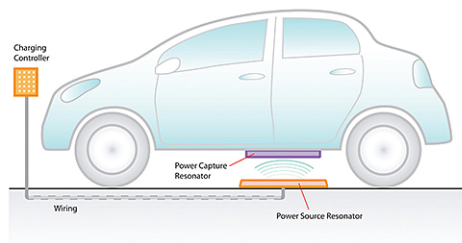
1990's J1772 Conductive
SAE J1773 Inductive



2010 SAE J1772 Level 2
240vac/<80A (32A typ.)

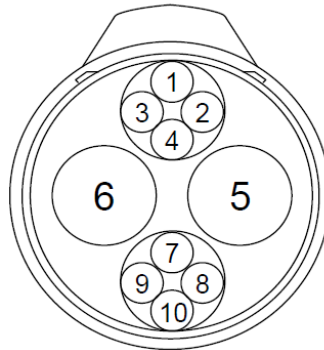
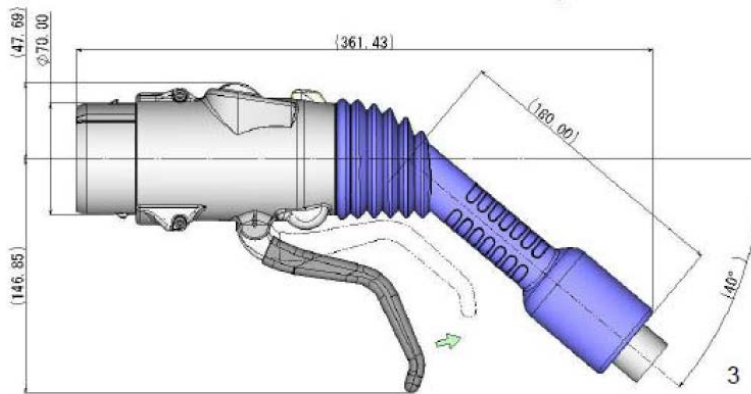


2011 SAE J2954
Wireless Charging



DC Fast Charging Couplers: JARI-ChAdEMO->SAE J1772-Hybrid

*Look mom, no lever!
Due to fewer Comm Pins*

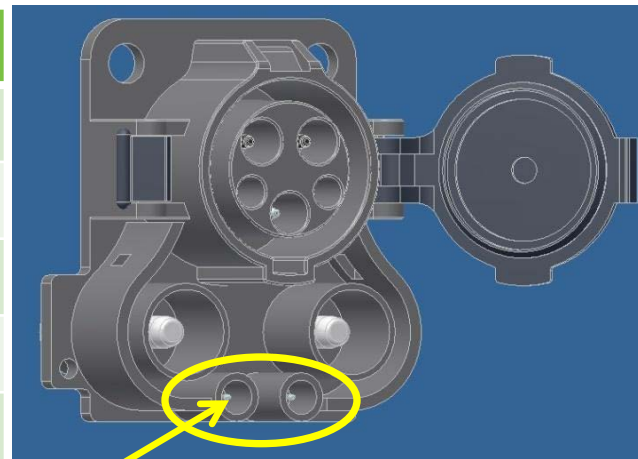


The J1772 coupler standard is being revised to address dc fast charging (enabled by the two pins at bottom) in addition to ac charging, the



Nissan Leaf uses two connectors (DC-JARI and AC-J1772)

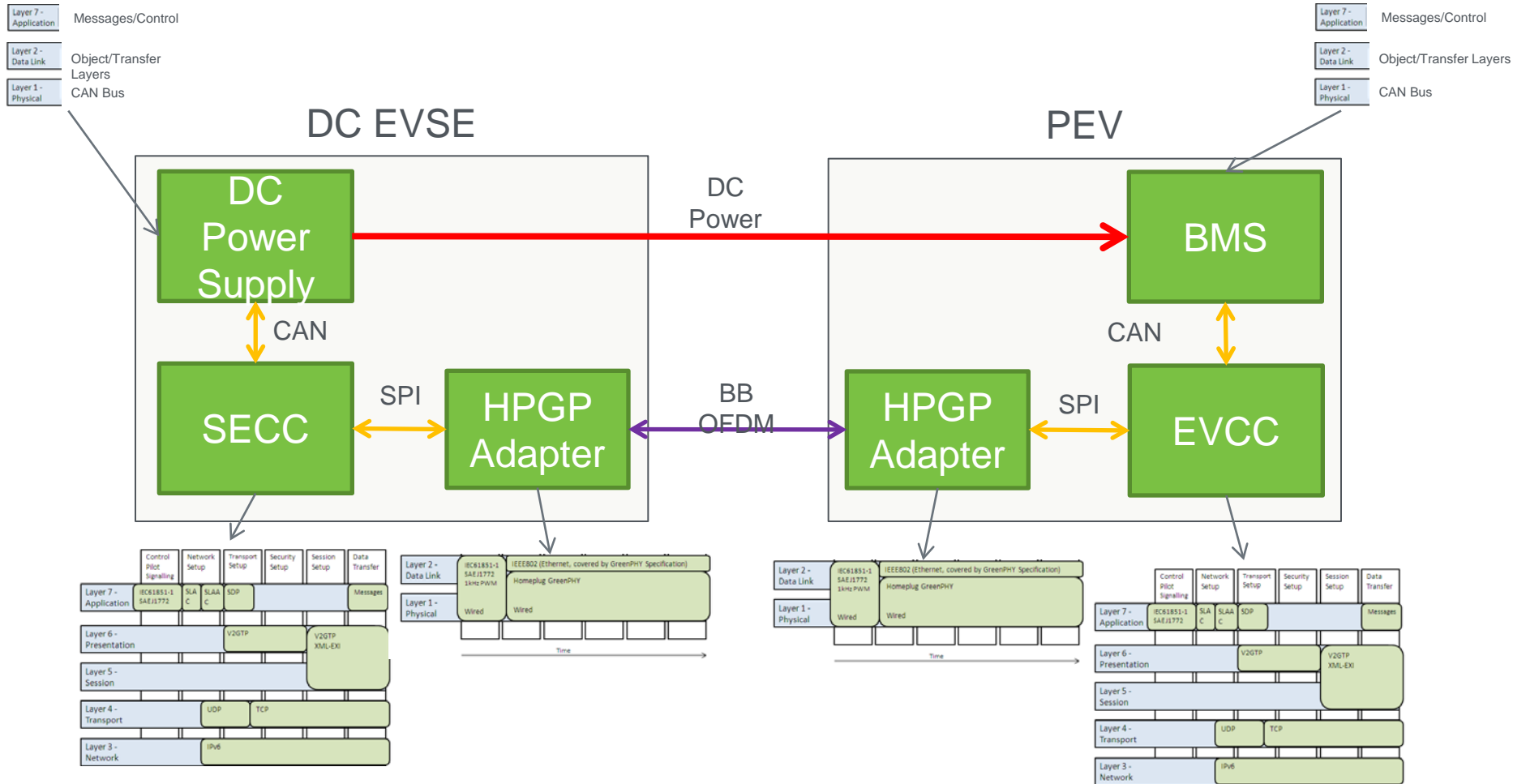
Level	Volts	Amps
AC-1	120	20
AC-2	240	<80
DC-1	<450	<80
DC-2	<450	<200
DC-3	<600	<400



SAE/ISO AC+DC Combo J1772)

CAN Pins avoided via J2931 PLC over Pilot

DC Fast Charging and Utility Programs Communication is the Key (Enabled by New Standards)



DC Charging Stations

- Currently only Nissan Leaf and Mitsubishi iMIEV have DC charging inlets (50kW)- (previously ~\$900 option, now std.)
- SAE/IEC combination DC-AC charging standards are coming in 2012- vehicles 2014?

- $50\text{kW} = 50/3 = 12.6\text{kWhr} \rightarrow \1.26 of electricity at $\$0.10/\text{kWhr}$;
- Including service fee $\$20/12.6\text{kWhr} = \$1.59/\text{kWhr}$



Blink



Coulomb-
Acker Wade



Nissan



Epyon- Holland,



Aerovironment

All of the above use the JEVS105-1993 (JARI) DC coupler

Others include Eaton, Efacec, Delta Products, Fuji Electronics, DBT, etc

SAE J2953-PEV-EVSE Compatibility EVSE-PEV-EUMD-Utility Test Fixture/Tools

Many Combinations of EVs, EVSE and Utility Region Installations

Occasional use cable

EVSE

DC off board charger



Utilities



? Interoperability ?



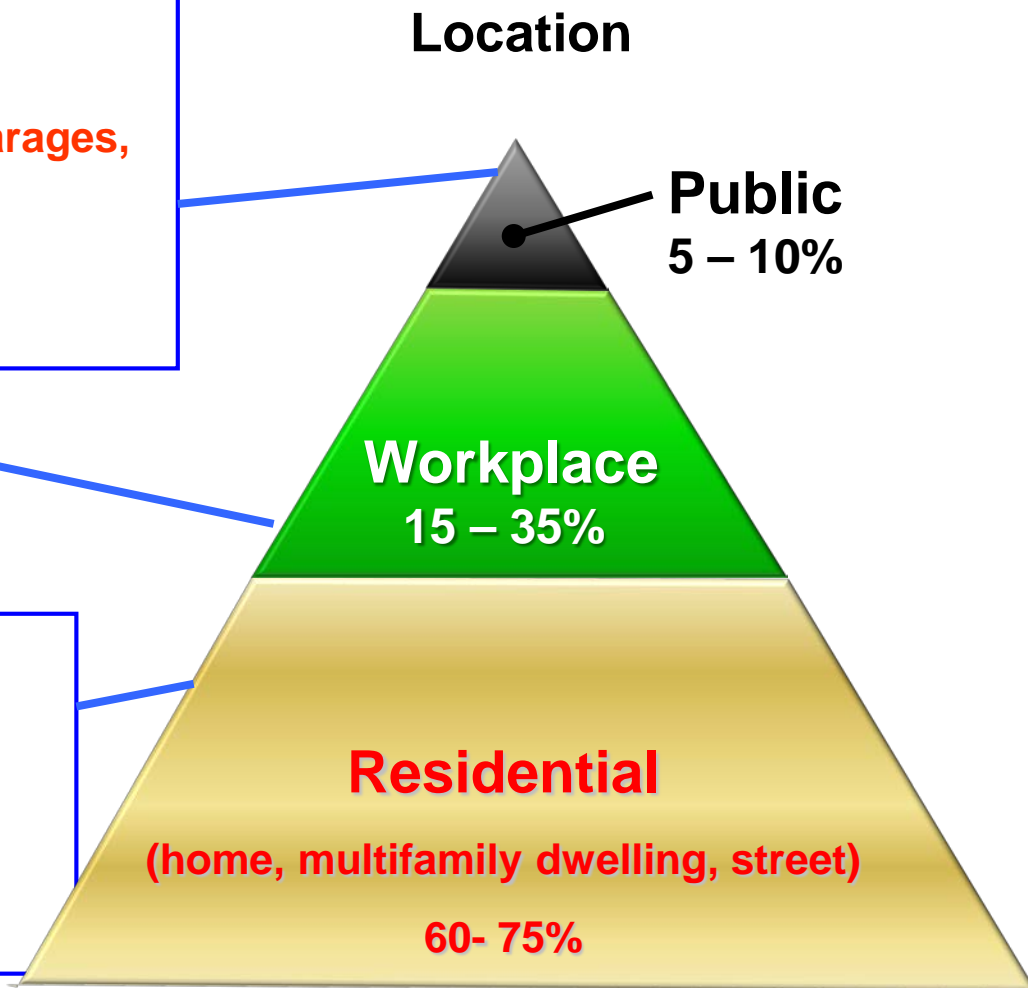
Charge location & power levels

Power Level Summary

- AC L1 (1.4 kW)
 - Street parking, parking garages, businesses
- AC L2 (7 kW)
 - Parking lots, parking garages, businesses
- DC L1 (35-45 kW)
- DC L2 (50-100 kW)
- DC L3 (150 kW)

- AC L1 (1.4 kW)
- AC L2
 - 7 kW
- DC L1

- AC L1 (1.4 kW)
- AC L2
 - 7 kW – most installations
 - 20 kW – allowed by J1772™
- DC L1 (10-20 kW)

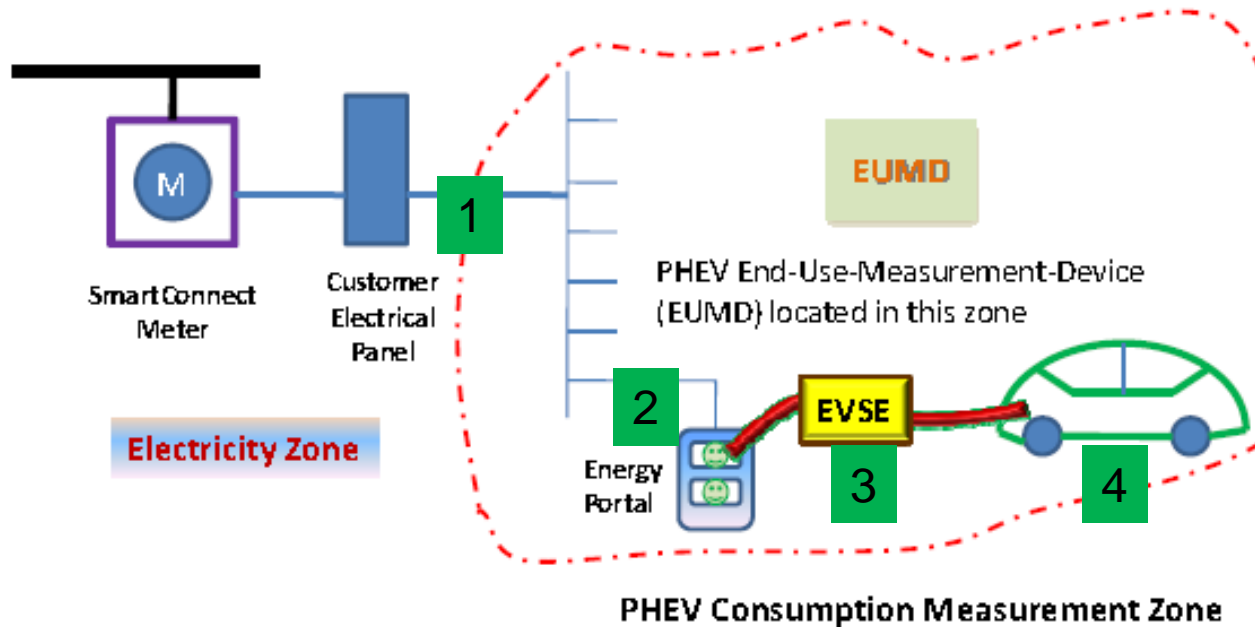


Source: R. Scholer VPPC , 2011- Smart Grid Charging and V2G

Where Does the EUMD/Sub-meter Reside? (Depends on your segment of the EV industry)

The UEMD measures just the branch circuit power flow to the EV, but may be located in different segments of that branch.

- 1) **Utilities** tend to favor locating it in an outdoor, technician accessible area, such as next to the main meter; possibly as a fused sub-panel with dedicated run to EVSE.
- 2) **Home Owners** may want it next to their service panel or in garage near the EVSE.
- 3) **EVSE manufacturers** want to build it into the EVSE, or in a socket in the EVSE.
- 4) **Auto manufacturers** may want the EUMD on-board the vehicle to simplify access to EUMD consumption information and eliminating association problems.



**ANL \$20 (Material cost)
Sub-meter Module**

