

PLUG – IN HYBRIDS

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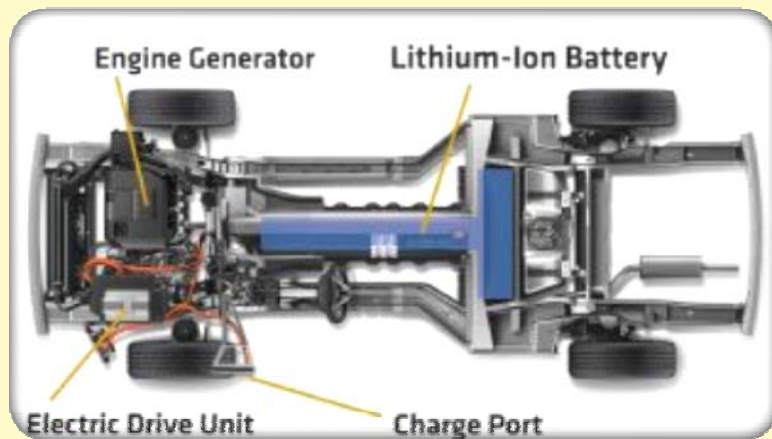
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What is a Plug-In Hybrid?

- ◎ A PHEV is a hybrid vehicle with batteries that can be recharged by connecting a plug to an external power source.
- ◎ Features:
 - > Internal Combustion Engine
 - > Electric Motor
 - > Plug to connect to the electrical grid

How do PHEVs work?

Their batteries can be recharged either by the vehicle's gasoline engine or the electric grid. The plug-in's batteries are usually lithium-ion, which are more powerful than a standard hybrid's nickel-metal-hydride batteries, but need to be plugged in for hours to fully charge. When the electrical charge is depleted, the plug-in runs like a standard gasoline vehicle.



Concept Models

General Motors

Chevrolet Volt



Saturn Vue Green Line



Venture Vehicles: Persu
Mobility



Benefits

◎ Energy Efficient =



◎ Lower GHG emissions =



◎ Energy Independence =



◎ Less Urban Air Pollution =



Challenges

- ⦿ High cost of lithium – ion batteries
- ⦿ High Cost of Warranty voiding kits
- ⦿ High cost to consumers
- ⦿ Increased demand in electricity = increased GHG

Consumer Interest

I could SAVE a lot of money!



Infrastructure: Scenarios

Typical charging infrastructure scenarios include:

- › (1) overnight charging at a home garage
- › (2) overnight charging at an apartment complex, and
- › (3) opportunity charging at a commercial/public facility or multi-vehicle charging units.

TYPES OF CHARGING

Level 1: "Slow" Charging

Requires a standard on board 120 volt, 5 Amp outlet and charges PHEVs overnight. It is the lowest voltage level found in residential and commercial buildings.



Level 2: "Medium" Rate Charging

"Medium Rate" is the preferred or primary method for a battery electric vehicle charger. It requires a 208 to 240 volt, 50 to 80 Amp outlet to charge a variety of EV battery chemistries within a few hours via common on-board EV chargers.



"Conductive" Type



"Inductive" type

Level 3: "Fast" Rate Charging

Requires 480 Amp, specialized off-board charging equipment for high power EV battery packs that can charge up to 80% in approximately 10 minutes.



Electrical Utility Interface

- ◎ Vehicle-to-grid operations (V2G)
 - > Standards for installation and functionality requirements of electric vehicle infrastructure are provided in the NEC Article 625, published by the National Fire Protection Association. Vehicle standards are developed through the society of Automotive Engineers, Inc and may influence the requirements of the NEC.
 - > Minimal Infrastructure Costs

Residential Garage Charging

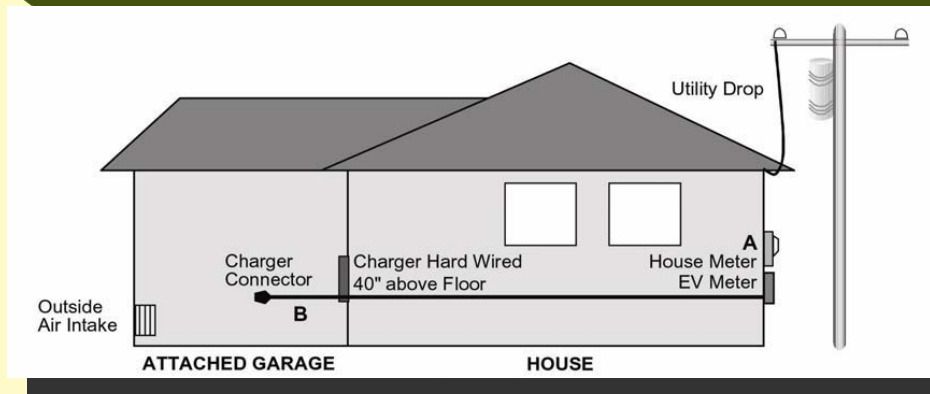
- Installation of electric vehicle charging supply in a residential garage typically consists of installing a dedicated branch circuit from an existing house distribution panel to either a convenience outlet for Level 1 charging or an EVSE for Level 2 charging.



Siting Requirements:

1. Where does the vehicle park
2. Where is the charger inlet on vehicle
3. Length of electric vehicle's cord

Residential Garage Charging: Planning Process



1. Review potential locations in garage to mount EVSE equipment or Level one outlet

2. Determine if adequate power is available in existing supply panel.

3. Develop site plan.

4. Obtain building permit.

5. Hire Contractor.

6. Installation and Final Inspection.

Residential Garage Charging: Cost of Installation



Making an initial
investment with
savings in the
long-term.

Dept. of Energy - Plug in
Hybrid Electric Vehicle
Charging Infrastructure
Review

- Level 1: \$878
- Level 2: \$ 2,146
- Level 3: ???????

Apartment Complex Charging

- Installation of electric vehicle charging supply in an apartment complex typically consists of installing new dedicated branch circuits from the central meter distribution panel to either a convenience outlet with Level 1 charging or an EVSE for Level 2 charging.



Siting Requirements:

1. Generally a parking location in close proximity to where the main apartment distribution points reside.
2. When metered separately, installation location is where all the meters are located.

Apartment Complex Charging: Planning Process

1. Review potential locations with property owner.

2. Determine if there is adequate power available in existing supply panel or if new service is required.

3. Develop site plan.

4. Obtain building permit.

5. Hire Contractor.

6. Installation and Final Inspection.

Apartment Complex Charging: Cost of Installation

Dept. of Energy - Plug in Hybrid Electric
Vehicle Charging Infrastructure Review

Level 1:

Total Per Charger Cost: \$833

Total Cost: \$4,165

Level 2:

Total Per Charger Cost: \$1,520

Total Cost: \$7,597



Commercial Charging Units

- Installation of the electric vehicle charging supply in a commercial facility typically consists of installing new dedicated branch circuits from the central meter distribution of an EVSE for Level 2 charging.
- Two types of commercial charging units:
 - › Commercial Facilities and
 - › Commercial Charging Banks

Types of Commercial Charging Units

Commercial Facilities

- Will typically have a single utility service entrance, with power distributed to several subpanels throughout the building. The simplest installation occurs when the charger location (parking lot) is adjacent to the main distribution panel or a subdistribution panel.



Commercial Charging Banks

- Establish a new meter service and account with the power company. The disadvantage of this approach is that the local utility will require the customer to contribute to the cost of connecting the new meter and to pay a separate bill for the additional meter and account fees.
- Should be placed in heavily visited locations and placed on street lamp poles and parking meters because you could utilize existing conduit to route new wires and mount new outlets, hence, reducing the costs.



Commercial Charging Unit Costs

Dept. of Energy - Plug in Hybrid Electric Vehicle Charging Infrastructure Review



Level 2:

Total Per Charger Cost: \$1,852

Total Level 2 Cost: \$18,519

Multi-Vehicle Charging Units

- Installation of PHEVs consists of installing new dedicated branch circuits from the central meter distribution of a Level 2 & 3 off-board equipment.



- Charging infrastructure deployed in these environments must conform to codes and practices not applicable to residential infrastructure and increase infrastructure costs.

Multi-Vehicle Charging Stations: Additional Recommendations

- Lighting and shelter
- Adequate Lighting
- Signage
- Customer Support
- Access Support



Multi-Vehicle Charging Units: Costs of Installation

- ◉ Plug-in hybrid electric vehicle charging infrastructure – DOE

- > Level 2:

- Total Per Charger Cost: \$1,852
- Total Level 2 Cost: \$18,519

- > Level 3:



Consumer Interest – Paying for Costs of Infrastructure



Pike Research Report:

- Consumers indicated that the availability of workplace, private and public vehicle charging stations in their local area would be very important.
- 79% of consumers would be interested in investing in a fast-charging outlet for their home; however, willingness to pay is out of line with industry expectations.

Government Initiatives

Obama – Biden Plan:



- 1 million plug-in cars on the road by 2015
- \$14.4 Billion in Stimulus Money for PHEVs
 - > \$2 billion - grants for battery manufacturing
 - > 2 Billion: Plug-in vehicle tax credit
 - > 400 million: development of plug-in infrastructure

**Are PHEVs the future of the
American automobile industry?**

