GFCA Neighbor Talks

Electric Vehicles and Charging Stations
January 25, 2023

Topical Agenda

- EVs and Plug-In Hybrids
- Battery and Charging Basics
- Range and Time-To-Charge
- Types of Chargers
- Where to Install Your Charger
- Practical and Cost Considerations

* Key Points in this presentation are Underlined or Highlighted; the rest is for context and additional detail.

EVs and Plug-In Hybrids

Electric Vehicles (EVs): fully electrically powered vehicles propelled by an electric motor(s) powered by an on-board battery. Power for all accessories and ”climate controls” are also provided from the main battery. Typical EV range with fully charged battery: 100 miles to 300+ miles, depending on Make / Model, driving style, speed, terrain, load, use of heating and air conditioner, and ambient temperature. No battery power ➔NO GO.

Plug-In Hybrid Vehicles (PHEVs): vehicle propulsion provided by an electric motor(s) powered by on-board battery AND a complementary gasoline engine after battery energy exhausted. Typically having two propulsion mechanisms, often integrated through a complex planetary gear & continuously-variable transmission (CVT). Pure Electric Range: 10-70 miles, depending on Make / Model, driving style, speed, terrain, load, use of heating and air conditioner, and ambient temperature. No battery power ➔ Use gasoline engine as with a conventional vehicle.*

*Some PHEVs, e.g. Chevrolet VOLT, use a gasoline engine to turn a generator to generate electricity to power the electric motor(s) and charge the battery. Propulsion is done solely by the electric motor, w/o direct engine mechanical propulsion.

Batteries and Charging Basics

Battery Basics:

- Batteries used in EVs and PHEVs operate using DIRECT CURRENT;
- Batteries are typically of Litihum-Ion composition, but actual battery chemistry varies by Manufacturer, as does cost / capacity / rate of charge;
- Batteries are HEAVY; hauling them around consumes energy that isn't reduced as the battery energy is consumed – unlike a gasoline vehicle as gas is used;
- Battery effectiveness is affected significantly by the ambient temperature, both as to charging and RANGE available after charging. The Goldilocks temperature for charging and use is typically in the 60-80 degree (F) range.
- Batteries are usually placed low in a vehicle in order to lower the center of gravity and improve handling, as well as to protect them from damage in the event of a crash.
- Batteries are charged by connecting the vehicle to an electrical power source via a special cable and interconnector that plugs into the vehicle's charging port.
- Effective Battery Capacity is Lower than Rated Capacity (on the order of 20%).

Charging Basics

Charging Basics:

- Charging a vehicle is done by connecting the vehicle to an approved charging station (EV Charger) via a special electric interface and cable that the vehicle and charging station use to “communicate” and to send / accept power into the vehicles on-board charging system;
- Charging Power is delivered to a vehicle using one of two “standard” connector styles, one style for Teslas and one style for “everyone else”;
- Tesla offers a connector adapter that supports use of the “everyone else” connector so that Teslas can be charged at non-Tesla charging stations;
- Tesla supports proprietary vehicle chargers that can deliver large quantities of energy (range) at very high rates of charge (DC / Superchargers);
- New non-Tesla vehicles are expected to able to be equipped with battery systems that also allow use of Direct Current chargers (DC Chargers).
- See: https://www.transportation.gov/rural/ev/toolkit/ev-basics/charging-speeds

How Long Does It Take To Recharge an EV?

That's like your third-grade teacher asking you how long it takes to travel 200 miles if your car travels at an average speed of 35 mph?"

It's all about the effective rate of charge limit: the LOWER of how many kW of energy your charger infrastructure can deliver (1-17 kW) vs how many kW of energy your vehicle's on-board charging system can accept (2-14 kW).

Residential EV chargers deliver power derived from either 110/120-volt or 220/240-volt sources. 220v input is roughly 2x faster.

If the battery capacity is 72 kw and the charger can deliver 40 amps at 240 volts (9,600 watts) but the vehicle can only accept 6kw (the acceptance rate limit) it would require on the order of 12 hours to fully charge the battery because the powerful charger couldn't deliver at its full capacity, limited by the vehicle acceptance limit. If the vehicle could accept 9kw it would require on the order of 8 hours. If the vehicle could accept 14kW (more than the charger could deliver) it would take on the order of 7.5 hours.

Charge Time roughly = Vehicle Battery Watt Hours / LEAST(Vehicle Acceptance Rate Limit, [Charger Amp Limit X Charger Voltage])

Types of Chargers

Level One – Most Basic, Delivered with virtually all new EVs and PHEVs Plugs into standard 110V household outlet via a pig-tail plug to connect to the adapter and then via a standard EV cord / connector to the vehicle charge port, probably around 20-25 ft in length. Charge anywhere, but slowest rate of charge (typically around 1400 watts (12 amp x 120v). Think overnight for full charging of almost any EV / PHEV, longer if battery capacity is large.

Level Two* – Best for at-home charging. Uses same style of connector to the vehicle charge port as a Level One charger, but is powered at 220V/240V, on a double-pole circuit breaker with a dedicated circuit wired directly to the location where the charger is mounted. MANY styles and capacities are widely available. Amperage from approx 5 to 80, making a Level Two charger a great choice for current and near-future EVs, +some "future-proofing", and SMART connectivity.

Level Three** – Commercial-only, very high voltage, fastest charging capacity, not available for residential installation.

*Level Two and ** Level Three chargers installation require electrical permit.

See https://www.transportation.gov/rural/ev/toolkit/ev-basics/charging-speeds

Level-Two Chargers

Level-Two Chargers are available from MANY manufacturers. Here are some suppliers and examples of Level-Two Chargers. Search for “reviews of EV Chargers” or see
https://www.forbes.com/wheels/accessories/best-home-ev-chargers/ or
https://www.caranddriver.com/shopping-advice/a39917614/best-home-ev-chargers-tested/

https://evcharging.enelx.com/products/juicebox

https://store.clippercreek.com
https://store.clippercreek.com/hcs-60-48-amp-ev-charging-station

https://www.chargepoint.com/resources/chargepoint-home-flex-cph50-brochur

Tesla Wall Adapter https://shop.tesla.com/product/wall-connector

https://ev-lectron.com/collections/
lectron-tesla-to-j1772-adapter/products/lectron-tesla-to-j1772-adapter-white

https://grizzl-e.com/home-products/

Some Factors to Consider When Choosing A Level-Two Charger

Cost to Acquire

Charger Delivery Capacity vs Maximum Vehicle Rate of Acceptance (Time to Charge)

Condition / Age, Capacity / Rating, and Space Avail in Your Current Circuit Panel

Capacity / Rating of Current Pepco Meter

Location of Charger when Installed (Accessibility – Easily reach car's charging port?)

Length of Charging Cable (Usability – Can it reach more than 1 vehicle?)

Single- vs Double-Headed Charger (Expect to add 2nd EV or PHEV? Plan ahead.)

Hard-Wired vs Plug-In (a Plug-In if you expect to move; > 50 amp must be hardwired)

See https://insideevs.com/reviews/344001/compare-evs/ for good comparisons of EV and PHEV requirements and capacities.

Costs to Consider

- Acquisition of Charger Device – low hundreds of $ to $3K+
- Circuit Panel Status / Upgrade / Replace? - $0 to $2.5K+ Electrician can advise.
- Pepco Service Upgrade? – Electrician can advise.
- Material to Install Charger at Desired Location – Breaker, cable, etc…low $100s
- Electrician – Permit + Labor – LOCATION / INSTALLATION DEPENDENT
- (MoCo reports an average cost of around $1,500.)

Cost Offsets to Consider

- Federal Tax Incentive – 30% of cost for qualified installations & taxpayers, max $1,000 credit (https://news.yahoo.com/federal-tax-credit-electric-vehicle-093006009.html)
- Maryland Tax Incentive – 40% of cost up to $2,000 (One per residence) (https://marylandev.org/maryland-ev-tax-credit)
- Pepco EV Charger Incentive - $300 with conditions + MoCo Incentive $250 (https://www.pepco.com/SiteCollectionDocuments/MD%20Pepco%20Current%20Rate%20Schedule%20Electric%20Vehicle%20Charging%20Program%20effective%20042022.pdf#search=Electric%20vehicle%20charging)

Net Cost After Credits and Rebates

Assuming a total cost of $2,000 for purchase and installation of a fully-qualifying Level-2 charger the after credit and rebate cost COULD POTENTIALLY be reduced by 70% or more (Pepco*).

Total Cost:	$2,000
Less Federal 30% Credit	- 600
Less Maryland 40% Rebate	- 800**
Less MoCo Rebate/Credit	- 250***

Potential Net Cost:	$ 350

* Pepco offers a discount / rebate program for purchase and installation of an APPROVED Level2 Charger AND a recurring $50 annual credit based on conditions they require (limited control by Pepco, data sharing, etc). See: https://www.pepco.com/SmartEnergy/InnovationTechnology/Pages/ResidentialChargerRebate.aspx

** Funding for Maryland Credit budgeted for the FY23 was exhausted in November, 2022; you can still apply for next FY and get a deferred rebate. See https://energy.maryland.gov/transportation/Pages/incentives_evserebate.aspx

*** See https://www.montgomerycountymd.gov/green/zev/ev-charging.html for requirements

Finding Public Charging Locations and Subscriptions

marylandev.org
chargehub.com (and App)
evgo.com
plugshare.com
libertyplugins.com

and many, many more…

Apps often provided along with new EV or PHEV

Brief Q&A If Time Permits