

EV Charger Facts and Government Incentives Handbook



Charger levels



Level 1 charging

The slowest, Level 1, provides charging through a common residential 120-volt (120V) AC outlet. Level 1 chargers can take 40-50 hours to charge a battery electric vehicle (BEV) from empty and 5-6 hours to charge a plug-in hybrid electric vehicle (PHEV) from empty.

Level 2 charging

Level 2 equipment offers charging through 240V in residential applications, or 208V in commercial applications electrical service and is common for home, workplace, and public charging. Level 2 chargers can charge a BEV from empty in 4-10 hours and a PHEV from empty in 1-2 hours.

Level 3 can be AC or DC

The fastest speed, direct current fast charging (DCFC) equipment, enables rapid charging along heavy-traffic corridors at installed stations. DCFC equipment can charge a BEV to 80% in just 20-60 minutes. Most PHEVs currently on the market do not work with fast chargers.

Detailed comparison of PEV charging levels

Charge Level	Voltage	Current	Power	Similar Power Use	Time to Fully Charge an AEV †
Level 1 - Slow AC	120 V	8 - 1 amps	3 kW	Toaster	8 - 24 hours
Level 2 - Fast AC	240 V	15 - 100 amps	7 - 22 kW	Clothes dryer	4 - 10 hours
DC Fast Charger	480 - 600 V	80 - 120 amps	50 kW	5 - 10 Central air conditioners	80% 10 - 30 minutes*
Ultra-Rapid DC	1000 V		100kW+		20 - 40 minutes

+ AEV refers to a vehicle with a usable battery capacity of approximately 24 kWh.

* 10-15 minutes with Liquid Cooled Cables

When to use a Level 3 charger

It is best only to use Level 3 chargers when you do not have access to a Level 2 charger or need to charge in a short amount of time. This is why you will see many Level 3 chargers on popular long-distance routes - allowing electric cars to travel interstate without the need for overnight charging.

It is advised not to use Level 3 chargers as the only charging method, as regular fast-charging may shorten battery life.



Charge speeds

- Level 1 charges from a standard 120 V outlet, providing about 4-5 miles of range per hour. It takes under eight hours to fully charge from empty a typical electric car (60kWh battery) with a 7kW charger.
- Level 2 charges from a supply of over 200 V, providing 12-60 miles of range per hour. This is dependent on how much power the charger can supply, and how much power the EV battery can accept.
- Level 3 or DC provides up to 1000 V and can charge vehicles to 80% in 35-40 minutes for 60-200 miles of range. With Liquid Cooled Cables, charge speeds are reduced to as little as 10-15 minutes.



Miles of range per kW hour of charging

3 kW slow	7kW fast	22kW fast	43-50kW rapid	180kW rapid	360kW rapid
Up to 15 miles	Up to 30 miles	Up to 90 miles	Up to 90 miles in 30 minutes	Up to 200 miles in 30 minutes	Up to 200 miles in 15 minutes



Cut-away vein of an electric vehicle battery

Efficiency comparison

Per Alternative Fuels Data Center



Factors that affect charge speed

There are five main factors that can affect the time it takes to charge an electric vehicle.

- 1. **Battery size:** The larger a vehicle's battery capacity (measured in kWh), the longer it will take to charge.
- 2. **Battery level:** Charging an empty battery will take longer than topping off from 50%. Above 80% the rate slows down to protect the battery.
- 3. Vehicle's max charge rate: A vehicle's battery can only be charged the maximum charge rate the vehicle can accept.
- 4. **Max charge speed:** The time it takes to charge is limited by the max charging rate of the charger being used. If the vehicle can charge at 11kW, it will only charge at 7kW on a 7kW charger.
- 5. **Environmental:** Extreme hot or cold battery temperatures can slow down charge speed, especially with rapid chargers.
 - Full battery electric vehicles are usually more efficient than plug-in hybrids.
 - The range per hour will vary depending on the efficiency of the car. Small full-battery electric vehicles are the most efficient and will get about 30 miles of range per hour of charge at 7kW.
 - The biggest full-battery electric cars will get about 20 miles of range per hour at 7kW.
 - The efficiency of the car also depends on the environment. Electric vehicles are more efficient in warm temperatures and get a slightly better range per hour than in winter temperatures.

Industry terminology

AC Alternating Current

An electric current that reverses direction at regular intervals.

AEV

Alternative energy vehicle.

AMP

Unit of electric current.

DC Direct Current

An electric current of constant direction.

EREV - Extended-Range

Although the electric motor of a PHEV always drives the wheels, EREVs feature an auxiliary power unit, an internal combustion engine to recharge the battery if it runs out.

KWH - Kilowatt-Hour

A unit of energy equivalent to the energy transferred or expended in one hour by one kilowatt of power. Electric car battery size is measured in kilowatt-hours, the electric car's equivalent of gallons of fuel in a gas tank.

NEVI Compliant

The U.S. DOT Federal Highway Administration NEVI Formula Program provides funding to states to strategically deploy EV charging stations and to establish an interconnected network to facilitate data collection, access, and reliability. Government funding is available for up to 80% of eligible project costs.

OCPP

Open Charge Point Protocol is an application protocol for communication between EV charging stations and a central management system.

PEV / BEV

Plug-in battery electric vehicle.

PHEV

Plug-in hybrid electric vehicle.

Range Anxiety

The anxious feeling of operating an electric vehicle with the fear of running out of battery charge while driving.

RPH

The estimated miles of range per hour an EV charging station delivers. The range depends on but is not limited to the cars state of charge, the on-board charger, and the battery temperature.

TOU - Time of Use

Utility rates can vary according to high peak and low peak usage hours. The rate charged is based on the total electricity used, as well as the time of day for usage.

ZEV - Zero Emission Vehicle

Zero emission vehicle never emits harmful pollutants from the on-board source of power.



AC SAE J1772 charge port Level 1 2 - 5 miles of range per 1 hour of charging Level 2 10 - 20 miles of range per 1 hour of charging



DC Fast CCS1 charge port Level 1 or 2 10 - 20 miles of range per 1 hour of charging



DC Fast CHAdeMO charge port (most common) Type 4 - Level 3 180 - 240 miles of range per 1 hour of charging



DC Fast - Tesla Tesla sells a CHAdeMO adapter 180 - 240 miles of range per 1 hour of charging

Connector types

SAE-J1772 - Type 1 - Level 1

North American standard for electrical connectors for electric vehicles maintained by the SAE (Society of Automotive Engineers).

Mennekes - Type 2 - Level 2

Triple-phase connector. In private spaces, charging power Levels of up to 22 kW are common, while charging power Levels of up to 43 kW (400 V, 63 A, AC) can be used at public charging stations. Most public charging stations are equipped with a Type 2 socket. All mode 3 charging cables can be used with this, and electric cars can be charged with both Type 1 and Type 2 connectors. All mode 3 cables on the sides of charging stations have Mennekes connectors.

CHAdeMO - Type 4

Also referred to as Type 4, CHAdeMO is a DC charging connector, capable of up to 125 A. Bulky and needing a separate socket, it is in competition with the three-phase AC Mennekes and CCS DC systems.

Helpful links

Alternative Fuels Data Center - US Dept of Energy

This page contains content gathered from various US DOT and local Government websites for a helpful consolidated information source.



Download this brochure from the SimplyFuel Solutions website and click the links to access the most current and up-to-date government incentives and information.

Electricity

Basics, Benefits, Laws and Incentives, Vehicles, Considerations, etc.

Alternative Fuel Tax Exemption

Alternative fuels used in a manner that the IRS deems as nontaxable are exempt from federal fuel taxes.

State Laws and Incentives

State Energy Program (SEP) Funding

Some plug-in hybrid and all-electric vehicles qualify for a federal tax credit. Many states also offer additional incentives for purchasing new PEVs. To view a state's laws and incentives related to alternative fuels and advanced vehicles, select a state from the map from the link.

Local Laws and Incentives

Featured laws and incentives created by local governments.

About the Laws and Incentives Data

Most recent updates

For a list of the of state laws and incentives.

How Do All-Electric Cars Work?

Both heavy-duty and light-duty all-electric vehicles are commercially available.

Workplace Charging for Plug-In Electric Vehicles Workplace Charging Employer Workshop Toolkit Resources for EV Infrastructure Planning EV Infrastructure Planning for Rural Areas

1 The Alternative Fuels Data Center recommends that users verify with the appropriate state or federal authority that the specific law or incentive is still applicable before making a purchase or tax-related decision.

US Infrastructure

Progress Toward EV Readiness

Developing Infrastructure to Charge Plug-In Electric Vehicles

Consumers and fleets considering PEVs – which include PHEVs and EVs – need access to charging stations, also known as EVSE.

National Electric Vehicle Infrastructure (NEVI) Program

The \$5 billion NEVI Formula program will provide dedicated funding to States to strategically deploy EV charging infrastructure and establish an interconnected network to facilitate data collection, access, and reliability. Funding is available for up to 80% of eligible project costs.

Developing Infrastructure to Charge Electric Vehicles

Charging the growing number of EVs in use requires a robust network of stations for both consumers and fleets.

Charging Infrastructure Procurement and Installation

Increasing available public and private charging equipment requires infrastructure procurement. Learn about how to successfully plan for, procure, and install charging infrastructure.

Charging Infrastructure Operation and Maintenance

Once charging infrastructure has been procured and installed, it must be properly operated and maintained. Learn about charging infrastructure operation and maintenance considerations.

US Federal Highway Administration Alternative Fuel Corridors (source)



— EV corridor ready — — EV corridor pending



Find your solution

SimplyFuel Solutions offers a complete selection of EV chargers and options that will fulfill any requirement for charge speed, payment options, location, and installation specifications.



Level 4 DC Fast Charger

1

Options: Liquid Cooled cables for fastest charging

ROI message generating 32"screen



Level 3 Split System DC Fast Charger

Options: Liquid Cooled cables for fastest charging

Customizable back-

lit acrylic topper

l cables Dynamic Power rging Allocation

180; 240; or 360 kW

Power Cabinet

Options:



Level 2 - 30-40 Amp Dual Charger

Options: Wall mount or pedestal

Retractable cables

Level 2 - 30-70 Amp Single Charger

Options: Wall mount or pedestal

Retractable cables



Integrate Power Management

Turn OCPP v1.6 or newer enabled EV chargers into Smart chargers and manage your entire infrastructure from one platform.

Upgrade kits are available.



NOTE: All data was collected from public sources. Sources may vary in detail and content changes frequently as technology advances. Please use this guide strictly as a reference tool and not as a definitive source.

