EV CHARGERS EXPLAINED

Actemium e-mobility consultant Giles Benbow gives us the lowdown on the various types of EV charging available – their peak output, the time they take, the range they provide and the connectors they use.

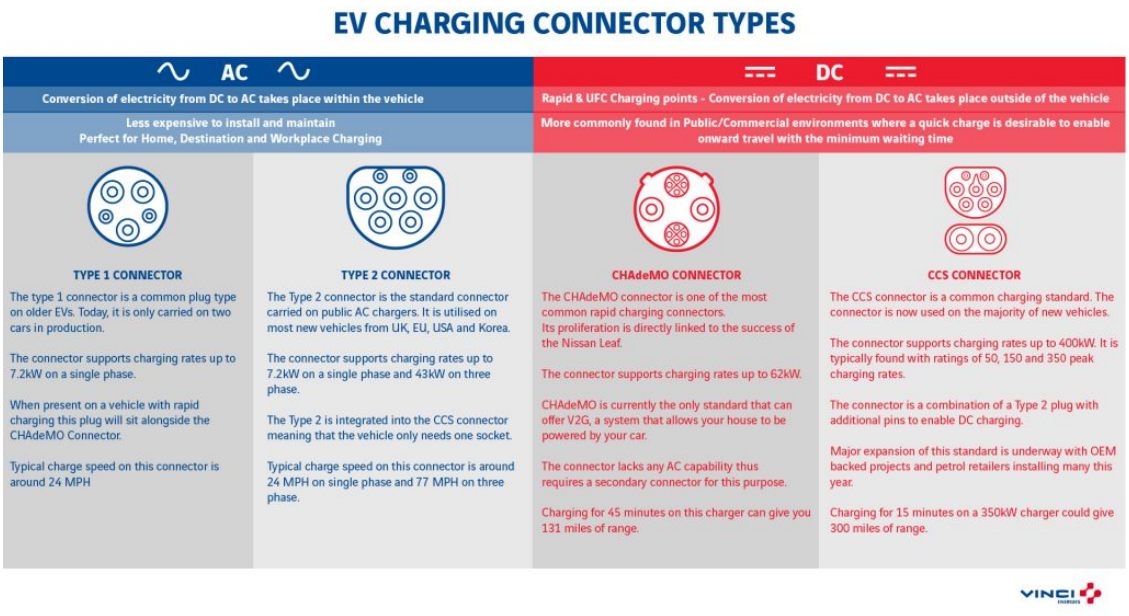
It's not a case of 'one size fits all' when it comes to electric vehicle (EV) charging. There are a number of different types out there and it can get pretty confusing pretty quickly. So we've put together this simple guide to help you get to grips with the most common terminology and how it works in practice.

Term	Description
AC (alternating current)	A format of electricity, as it is transmitted on the grid.
DC (direct current)	A format of electricity, as it is stored in a battery.
Type 1	An AC connector type found on Japanese and early EU/US electric vehicles circa 2010-2015.
Type 2	An AC connector type found on European electric vehicles.
CCS (Combined Charging Standard)	A DC connector type found on European electric vehicles.
CHAdeMO	A DC connector type found on Japanese electric vehicles.
KW (kilowatt)	The peak rate of a charger.
KWh (kilowatt-hour)	The unit of electricity.
Volts	The voltage output of the charger.
Slow charger	A charger with a peak output of less than 7kW.
Fast charger	A charger with a peak output of 7-50kW.
Rapid charger	A charger with a peak output of 50-150kW.
Ultra-rapid charger	A charger with a peak output of more than 150kW.

So what does it mean?

It is actually rather straightforward when you break it down. The electricity supplied to our homes is transmitted around the grid in AC form. The energy from the grid (AC) needs to be converted into DC electricity, as this is the form that the batteries need.

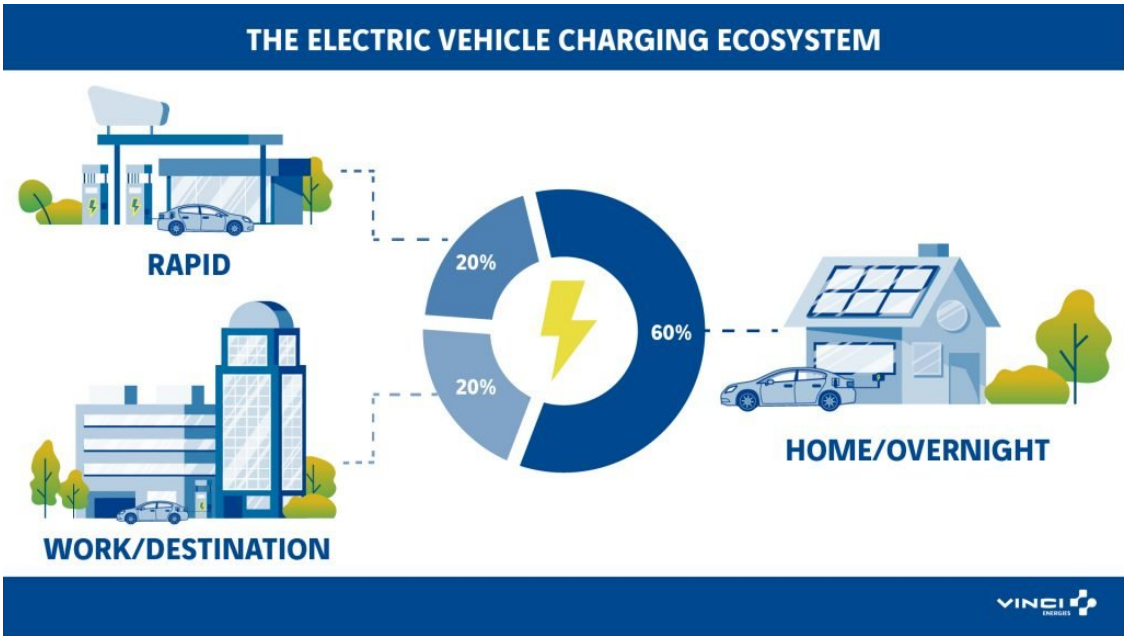
The conversion of electricity from AC to DC can take place either inside or outside of the vehicle. So when talking about a charger, an AC charger (with a Type 1 or 2 connector) relies on the vehicle handling the conversion, where as a DC charger (with a CCS or CHAdeMO connectors) provides already-converted energy to the car.



Why the difference?

Flexibility and cost are the primary drivers. Powerful, costly and heavy power electronics are needed to convert electricity from AC to DC. Within the confines of the vehicle, only so much energy can be dealt with without impacting the cost, range and safety. The on-board charger is designed to meet the demands of charging at home or at a destination where outright speed isn't beneficial.

An AC charger is less expensive to install and maintain. It is perfect for the Home, Destination and Workplace charging locations.



DC chargers are more commonly seen in public/commercial locations. As the conversion of electricity takes place outside of the vehicle, the same compromises with AC charging do not apply. In the Rapid/Ultra-fast charging space, a quick charge is desirable to enable onward to travel with the minimum waiting time.

kW and kWh - energy output and energy consumption

A kW (kilowatt) is a measure of power. In charging terms, this is the highest power output of a charger. The speed of the charge correlates to the kW. Sometimes the car can be the limiting factor as not every car charges at the same rate.

A kWh is a unit of electricity – like a litre of fuel. For example, if you used 50kW for one hour, the consumption would be 50kWh. When paying for the use of an EV charger, you will likely pay based on the kWh that you use.

Vehicle compatibility

AC Type 1 and AC type 2 are compatible with the correct adaptors. At home, you will typically have a charger with a cable attached which matches your vehicle. In the public space, you will see a Type 2 socket.

This socket can be considered similar to a standard USB port – when you wish to charge your phone you use your own cable. An iPhone will use a different cable to an Android device, but as the source plug is the same, the two devices can plug into the same port. The same is entirely true of an EV – for public charging you will have a cable in the boot.

The Type 2 socket can be considered more flexible as it can accommodate faster three-phase charging where the vehicle allows.

And what about DC?

There are two major DC standards. CHAdeMO and Combined Charging Standard,

CHadeMo is the first DC rapid charging standard, founded in Japan. The name is derived from a Japanese phrase, translating to English as 'How about a cup of tea?'. This standard is highly prevalent in the UK due to the popularity of the Nissan Leaf. However, it is only carried on two cars on sale today – the Nissan Leaf and the Mitsubishi Outlander PHEV. A vehicle with a CHAdeMO fast-charge port will have a secondary socket for AC charging as the plug isn't combined.

First implemented in 2014, CCS (Combined Charging Standard) is carried on most Korean, European and American EVs today. The standard, as its name suggests, combines both AC and DC charging into one port. Some CCS chargers are rated to deliver 400kW as opposed to the 62kW offered by the CHAdeMO.

Beyond the two mentioned above, 43kW AC charging and Tesla Superchargers also exist alongside CCS and CHAdeMO.

This needn't be of concern to the driver, however. Most chargers that are not brand specific carry more than one of the connectors. It's a little like a petrol pump with four nozzles, but unlike the petrol pump, you can't plug the wrong one into your car.

Charging speed

Using an average efficiency value, you can calculate the estimated range added by a period of charging. It is crucial to point out here that charging is not linear and is affected by other factors. The main ones are the state of charge and temperature. When a battery is cold or has a high state of charge (more than 50%), the car will reduce the charging rate to protect the battery.

It is still useful to estimate how much range you will add in a time window, however. At home, it can be reasonably expected that you will charge overnight. At work, you might spend 4-8 hours charging and when on the move, less than 30 minutes.

Location	Peak power kW	Time	Time unit	Miles added
Home	7	10	Hours	245
Work	11	7.5	Hours	289
Destination	22	2	Hours	154
Rapid	50	45	Minutes	131
HPC	150	30	Minutes	263
UFC	350	15	Minutes	306

These are just a few of the basics but if you have any questions about EV charging, please don't hesitate to get in touch. Actemium is the UK's most experienced turnkey deployment teams for workplace, destination and rapid charging and can help you find the right solutions for your needs at the right cost.

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