A user-friendly guide **to electric mobility**

TotalEnergies

Introduction

Discover our guide to electric mobility!

Whether you own an electric vehicle or are just interested in finding out more about electric mobility, this guide is for you!

You'll find everything you need to know about electric mobility: from how chargers and electric charging work, autonomy, power, and more.

Get ready to explore the fascinating world of electric mobility and dive deeper into how charging works.

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The ABC's of electric mobility

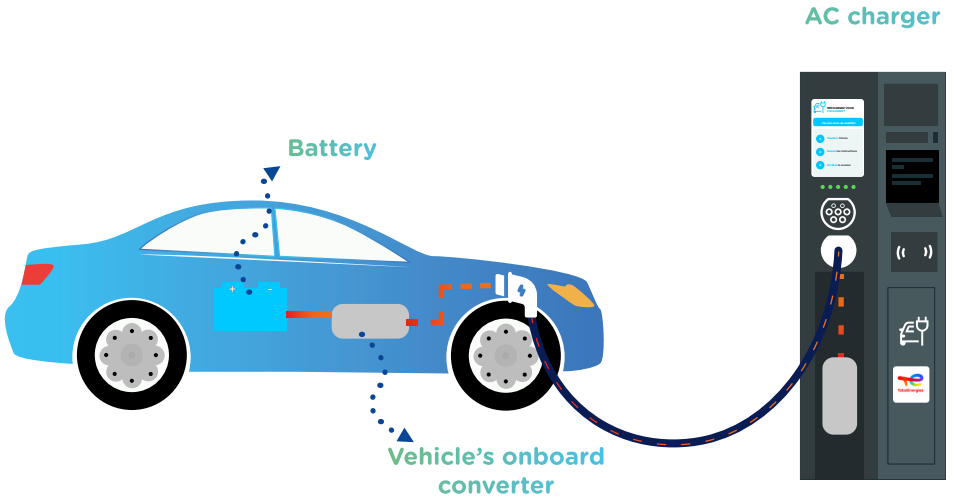
Electric charging

There are two different types of electric current: **alternating** *(AC – Alternating Current)* **and direct** *(DC – Direct Current)*.

Electric vehicles can be charged using either an **alternating current** or **direct current.** All electric vehicles are fitted with **a converter** that works to turn the network's AC current into DC power stored in the vehicle's battery.

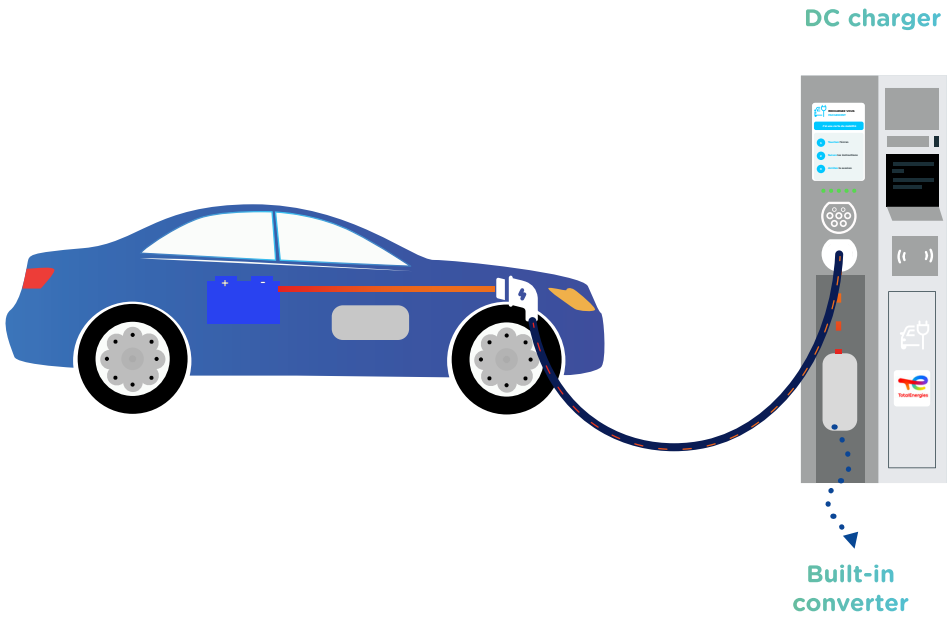
Alternating current (AC) chargers send alternating power directly into the electric vehicle. **This current is then converted into direct current (DC) by the electric vehicle's onboard converter** to store the power in the battery, thereby charging it up.

The operator of the charging service, who runs the charge points, cannot measure the power transmitted from the electric vehicle's charger to the vehicle's battery. The only aspect they have control over is the power delivered by the charger they operate. As a result, we calculate the **estimated power** delivered, drawing on known network data: the apparent, or theoretical, power. **kVA is the unit used to measure this apparent power in AC charge points.**



Direct current (DC) chargers feature a built-in converter that **transforms alternating current into direct current in the charger itself.** This means we know the exact power both delivered by the charger and received by the vehicle, known as **effective power.** This is expressed **in kW and refers to the power delivered by DC chargers.** A DC charger charges a vehicle faster than an AC charger.

However, the difference between effective power and apparent power is very small, we usually talk in terms of kW, even for AC charging, and although theoretically it is not exact.

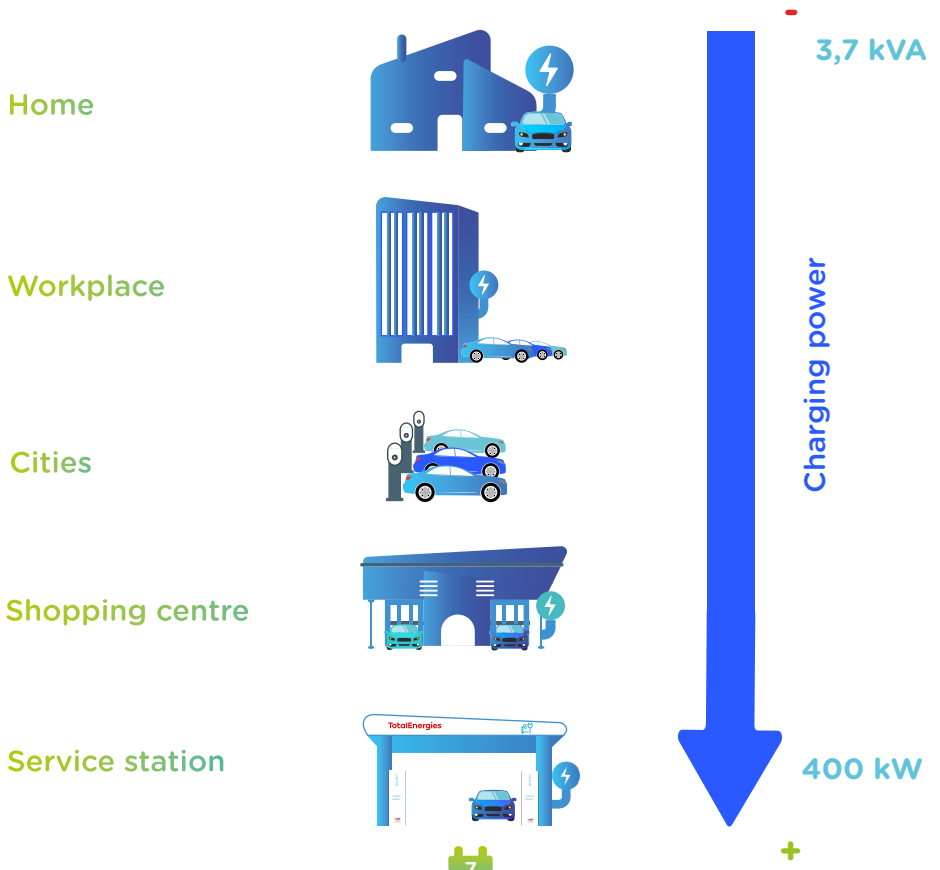


Electric chargers

There are **different types of electric chargers** depending on use.

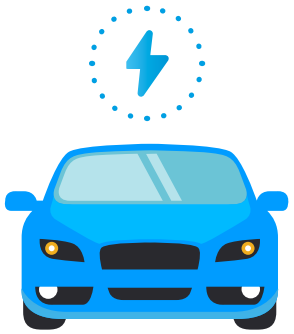
As a general rule, **AC chargers** that deliver **3.7 kVA to 43 kVA** are found **in homes, workplaces, parking lots for establishments open to the public, and on public roads.**

Unlike AC chargers, **DC chargers** can deliver power of **up to 400 kW.** These chargers are generally found **in service stations, dedicated high-power charging hubs and in some establishments open to the public.**



Different types of electric vehicles

There are **different types of electric vehicles:**



100% electric vehicles are fully powered by a rechargeable electric battery. They draw on an electric motor to spin their wheels, with no help from an internal combustion engine. Electric vehicles can be charged from **a domestic plug socket or a dedicated charger.**

Hybrid vehicles are fitted with **a combustion engine** (petrol or diesel) **combined with one or several electric motors.** Within this category, you'll find:

rechargeable hybrid vehicles (also known as PHEVs, or Plug-in Hybrid Electric Vehicles): the electric motor battery can be **charged via electric current** (domestic plug sockets, chargers).

classic hybrid vehicles (also known as HEVs, or Hybrid Electric Vehicles): the electric motor battery **charges as you drive using kinetic energy.**

Key players in electric mobility

Dip your toe into the world of electric mobility, and you'll discover a whole new world of key players and acronyms.

A Charge Point Operator (CPO) is responsible for the technical and commercial operation of a charging network. A CPO:

- sets up the facilities,
- activates networks of chargers,
- oversees and manages facilities,
- takes care of maintenance and user support,
- sells the charging service to eMSPs or to electric drivers directly, depending on the payment method used.

An eMSP (*e-Mobility Service Provider*) **sells and markets a charging service via a mobility card** in the form of a one-off purchase or subscription.
This card **allows users to log into public chargers, access and pay for charging sessions across charging networks that accept their card.** The eMSP directly manages all commercial and administrative relations with its customers.

Interoperability is a key concept in the electric mobility sector by which **various CPOs and eMSPs can communicate between one another.** Thanks to interoperability, a charging operator is able to accept mobility cards issued by several different eMSPs across the networks it operates. Conversely, an eMSP gives to its user's access to chargers run by a range of different CPOs.
For this accessibility to be possible, CPOs and eMSPs sign sales contracts and forge technical ties that give their users the freedom to roam.

Everything you need to know to charge your electric vehicle

Understanding the mechanisms behind electric charging

To charge your electric vehicle as efficiently and smoothly as possible, there are several points to bear in mind:

1 The maximum power accepted by your electric vehicle

It **is the vehicle that dictates to the charger how much power its battery can receive,** not the other way round! A vehicle that supports a maximum of 50 kW can never take more than 50 kW during a charging session — even if you connect it to a charger that delivers 400 kW. Remember to check the maximum power accepted by your vehicle on alternating current (AC) and direct current (DC) chargers to get the most out of your charging sessions (check the manufacturer's user guide for details). The maximum power accepted by the vehicle is not the same depending on whether it is connected to AC or DC current.

2 The power delivered by the charger

The power delivered by the charger impacts on the charging time. **The higher the power output, the faster the charging session.**

3 Battery capacity

This is the amount of energy, **measured in kWh**, that the battery can store while charging and deliver to the motor. **The greater the battery capacity, the longer the charging time.**

4 Battery charge level

The power received during charging depends on the battery's charge level. Generally speaking, **depending on the vehicle's charging curve, charging power begins to gradually drop from 40%. When the battery level reaches 80%, the charging speed decreases considerably.**

5 Using the incorrect charging cable

If the driver charges his electric vehicle with a charging cable that is not suitable for the charger, **the power being delivered may be limited.**

6 Battery temperature

The temperature of the battery has a direct influence on how long it takes to charge. **If the temperature of the battery is high** (as a result of driving or hot weather), **the power delivered may be reduced and the charging time extended** to allow the battery to return to a normal temperature. In freezing temperatures and when the battery is cold, charging may take longer as it is less receptive to the power being delivered.

Understanding an electric vehicle's driving range

An electric vehicle's driving range can vary depending on several factors, such as **battery capacity, vehicle type, driving conditions, speed, external temperatures,** and the use of auxiliary equipment:

- **Battery capacity** is generally expressed in kilowatt hours (kWh). The greater the battery capacity is, the greater the electric vehicle's range.

- **Driving conditions** can affect range, too. Driving at high speeds, sudden acceleration and mountain driving can all reduce range compared to slower, more even driving on flat roads.

- In addition to this, **outside temperatures** can impact the battery performance. In cold weather, range can drop slightly as the inside of the vehicle and the battery itself both need heating.

It's important to note that vehicle manufacturers generally provide range estimates based on standardised driving conditions established by the Worldwide Harmonised Light Vehicle Test Procedure (WLTP). This is a global standard developed to measure CO2 emissions, fuel consumption and range for vehicles, including electric vehicles.

Choosing the right charger for your electric vehicle

When selecting the ideal charger for your electric vehicle, there are various criteria to take into account:

- **The maximum power accepted by your electric vehicle:** A vehicle that supports a maximum of 50 kW can never take more than 50 kW during a charging session — even if you connect it to a charger that delivers 400 kW. Remember to check the maximum power accepted by your vehicle (AC/DC charger) **to optimise your charging sessions and costs as a result.**

- **The time you have available:** if you have several hours to charge your electric vehicle, you should opt for an AC charger: slower but cheaper. On the contrary, if your charging time is limited (around 45 min.), you should opt for a DC charger, which is faster.

- **How you use your electric vehicle:** the way you plan on using your vehicle matters. **An electric vehicle can be charged in various places.** Opt for slow charging when you need to fully charge your vehicle (at home, cities). For on-the-go charging in the middle of a journey, and depending on the time you have, go for fast or high-power charging (in service stations, car parks, etc.).

The different payment methods for charging your vehicle

Unlike conventional combustion-powered vehicles, where you pay for fuel using a bank card or in cash, the process of paying to charge your electric vehicle works a little differently.

There are several ways you can charge your electric vehicle:

Using the card issued by the Charge Point Operator (CPO).

Paying directly by bank card either online (via QR Code) or using a bank card reader. If you pay by bank card, you'll be billed at the public tariff for the (CPO) network you are charging on.

Paying by mobility operator card, which gives you access to an extensive network of chargers. The price you will pay is the rate set by your mobility operator.

Getting ready for a trip in your electric vehicle

Getting ready to hit the road in an electric vehicle requires forward planning **to ensure your trip is seamless.** Here are our tips for preparing a trip in your electric vehicle:

Map out your itinerary:

Before you go, **use trip planner apps with the electric vehicle option activated** to plan your route. These apps can **show chargers available along the way and provide information on the power they deliver.** There are also route planners especially for electric vehicle drivers such as A Better Route Planner.

Check your range:

Make sure you know **your electric vehicle's range** and check it will be enough for the distance you intend to travel before reaching your next stop. Keep in mind that range can vary depending on factors such as **speed, weather conditions, and whether or not you use air-conditioning and heating.**

Check charging compatibility: Check **your electric vehicle's charging sockets are compatible with the plugs at the chargers you plan on using.** While standards and norms are becoming increasingly widespread, some electric vehicles may require adaptors to connect to certain chargers.

Prepare your charging app:

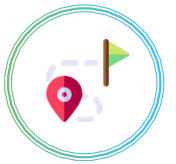
If you plan on using **specific charging apps or mobility cards,** make sure they are downloaded and configured before setting off to make your charging experience as smooth as possible.

Check software updates:

Make sure your electric vehicle has the latest version of its battery and navigation management software. This can **enhance the accuracy of range estimates and provide up-to-date information on the chargers.**

Map out your starting point and final destination:

If possible, pinpoint chargers at both your starting point and final destination. This will **let you charge your vehicle while you are parked,** ensuring you are able to set off with enough battery.



Glossary

C

Charging area:
All chargers within a given area.

Charging space:
Parking spot reserved for electric vehicle charging, completing with a charge point.

Charge point:
A charge point is an infrastructure for charging a single electric vehicle at a time. Charge points are associated with a parking space. Depending on the type of charger or the regulations that apply, a charge point may or may not be equipped with an attached cable.

Charging time:
Duration of time in which a vehicle's battery is supplied with electrical energy.

Connection time:
Duration of time in which a vehicle remains connected to a charger, irrespective of whether the battery is charging.
Billing in €/min. or €/kWh + €/min means you will be billed for the time you remain connected.
Billing in €/kWh means you will only be billed for the energy delivered.

CPO (Charge Point Operator):
The CPO has two roles. It installs, operates, and ensures the smooth and maintenance of the chargers. It also markets and sell charging services to two types of clients:
electric vehicle drivers who will pay by bank card using an POS terminal (point of sale) or bank card, and eMSP clients.

E

eMSP (e-Mobility Service Provider):
An eMSP sells and markets a charging service via a mobility card in the form of a one-off purchase or subscription. This card allows users to log into public chargers, access and pay for charging sessions across charging networks that accept their card. The eMSP directly manages all commercial and administrative relations with its customers.

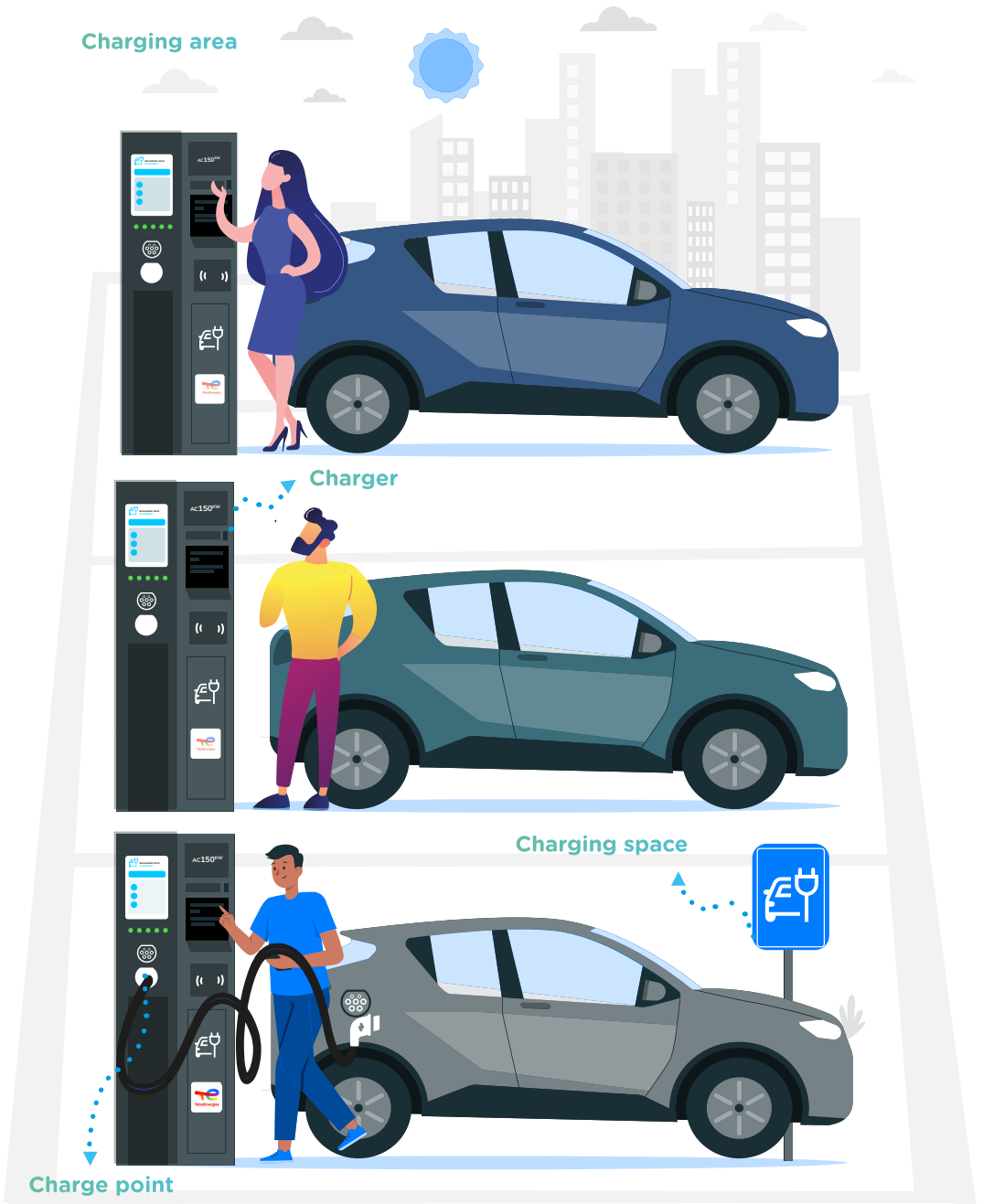
K

kVA:
Unit of electrical power that refers to the apparent power a domestic meter can deliver. kVA is the unit used to measure this apparent power in AC chargers.

kW:
Unit of electrical power that refers to the active or real power (output or demand) for an electric device at a given moment in time, meaning its capacity to deliver or consume an instantaneous amount of energy.

kWh:
A unit of measurement for electrical energy. This refers to the amount of energy delivered or consumed by an electric device over the course of an hour. Note that a device consumes in kWhs, not in kWs.

At a glance



In a nutshell...

You now have a solid grasp of the basics of electric mobility. Don't forget these **three key takeaway points** for seamless and efficient charging.

Takeaway points:

- **The maximum power accepted by your electric vehicle**

  A vehicle that supports a maximum of 50 kW can never take more than 50 kW during a charging session — even if you connect to a charger that delivers 400 kW. The vehicle dictates the power that can be accommodated in the battery.

- **Understanding your vehicle's charging curve**

  The charging curve varies depending on car type and the power of the charger. Some vehicles have charging curves in stages, while others have continuous curves. Generally speaking, charging power begins to gradually drop from 40%, with a significant loss of power from 80% on. The last few percentage points of a battery are the hardest to charge.

- **The power delivered by the charger**

  As a general rule, a more powerful charger will result in a shorter charging time. Direct current (DC) charging is faster than alternating current (AC) charging. Online tools are available to help you estimate the charging time based on the power of your charge point.

By drawing on these key concepts, you'll always be able to optimise your charging sessions with complete peace of mind.

FAQ

Why is the power received by my EV lower than the power mentioned on the charger?

The difference between the power received by the electric vehicle and the expected power can be explained in several ways:

- **The maximum power accepted by your electric vehicle**

  You are charging on a charger that delivers a higher power than the one your electric vehicle can support. For example, if your vehicle can support up to 50 kW and your charger delivers 150 kW. In this scenario, the electric vehicle will automatically limit power to 50 kW.

- **Battery charge level**

  The power you receive can also be affected by the battery charging level. Generally speaking, depending on the vehicle's charging curve, when the battery level reaches 80%, charging drops considerably.

- **Using the incorrect charging cable**

  If a driver charges his electric car with a charging cable that is not suitable for the charge point, the power being delivered may be limited.

- **Battery temperature/weather conditions**

  Battery temperature impacts directly on charging capacity and how long it takes.
  If the battery's temperature is high (following a stretch of driving or because the weather is hot), the power delivered and charging time may drop to allow the battery to cool. In freezing temperatures and when the battery is cold, charging can take longer as it is less receptive to the power being delivered.

Why do prices differ depending on whether you use a bank card or mobility card?

If you pay by bank card: you will pay the public rate set by the network (CPO) you have chosen to use. The price will be displayed on the charger.

If you pay with your mobility card: the price you pay is the rate set by your mobility provider. This explains why there's a difference between the price displayed on the charger by the charging operator, and the price set by your mobility service provider.

How long will it take to fully charge my electric vehicle?

There is no fixed charging duration that applies to all electric vehicles. It's important to note, however, that there are several factors that determine charging time:

- **Battery capacity:** the greater the battery capacity, the longer the charging time.
- **Battery charging level:** it takes less time to charge a half-full battery than it does a completely empty one. However, as a general rule, in most consumer electric cars charging speed plummets when the battery level reaches 80%.
- **The charger's power:** this impacts directly on charging speed. The higher the power delivered by the charger, the shorter the charging time (provided the vehicle supports the maximum power delivered by the charger).
- **The maximum power supported by your electric vehicle:** if your vehicle supports high power, the charging session will be quicker. To find out the maximum power supported by your electric vehicle, check its technical specs.
- **Use of a suitable charging cable:** if a driver charges his electric car with the wrong charging cable for the charger he is using, the power being delivered may be limited.
- **Weather conditions:** the weather can directly impact battery temperature, and on its charging capacity and charging time as a result. If the battery's temperature is high, the power delivered and charging time may drop to allow the battery to cool. In freezing temperatures and when the battery is cold, charging can take longer as it is less receptive to the power being delivered.

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