EVBOX

Everything your business needs to know about DC charging

Introduction

As the electric vehicle market continues to grow, businesses across the world are starting to embrace electric mobility. Whether they're looking to electrify their fleet or offer charging facilities to their drivers or customers, more and more businesses are considering investing in EV charging stations.

However, with all the available options out there it can be challenging to find the optimal charging solution that matches the exact needs of your business. If you're looking for a fast charging solution that can fully charge EVs within minutes, DC charging stations might be the right choice for your business.

But what is DC charging exactly?

This guide explains the difference between AC and DC charging, what to look out for when considering a DC charging solution, and gives an introduction to smart charging.

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Chapter 01

The difference between AC and DC charging

There are two electrical currents that can fuel an electric vehicle (EV), Alternating Current (AC) and Direct Current (DC). Before diving in any further, there are two things to keep in mind:

> The power that comes from the grid, i.e., your domestic socket, is always AC.
>
> The energy that is stored in batteries is always DC.

AC and DC, not AC/DC

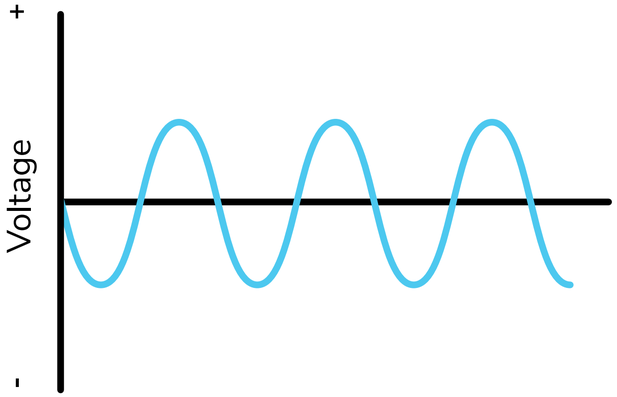
AC and DC are two entirely different types of electrical current. Both travel in different directions, flow at different speeds, and have different applications. AC/DC are a hard rock band that, despite having an album titled “High Voltage,” have nothing to do with electrical currents or EV charging.

AC is an electrical current, or flow of charge, that periodically changes direction, i.e., it alternates. It is generated from renewable sources that use rotating generators, such as wind or hydropower turbines. Because AC can be transported over long distances efficiently, virtually all of the world’s electricity grids deliver AC power, which is why you can find it in your home and office.

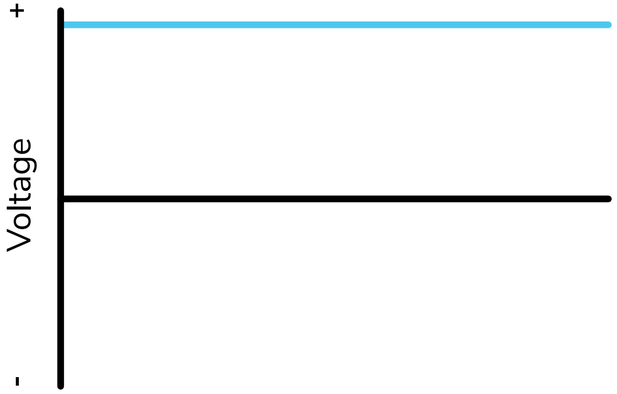
DC is an electrical current that always moves in a straight line and can be generated by renewable power technologies such as solar panels. Among other things, DC can be used for energy storage and LED lighting.

Batteries store DC power, and though you may have never realised it, every time you charge a device, the charger converts the AC power from the grid into DC power for your device’s battery.

In short, we get AC power from the grid and this is converted into DC power so it can be stored in batteries, such as the one used to power an EV.



AC (ALTERNATING CURRENT):
→ Electricity grid



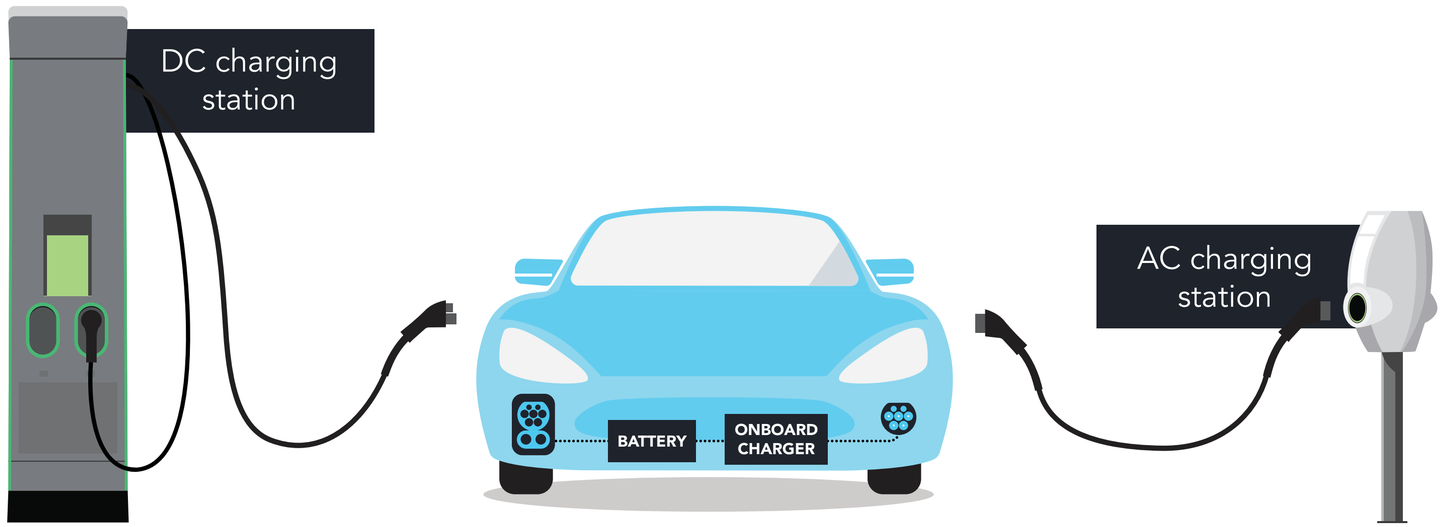
DC (DIRECT CURRENT):
→ Battery

AC and DC charging in electric mobility

When we talk about charging an EV, the main difference between AC and DC charging is **where** the conversion from AC to DC takes place. No matter whether an EV uses an AC or DC charging station, the EV's battery will still only store DC energy.

When you use a DC charging station, the conversion from AC (from the grid) to DC happens within the charging station—allowing DC power to flow directly from the station into the vehicle's battery.

Because the conversion process happens inside a charging station (that houses a large converter) and not within the EV itself (that houses a smaller converter) charging the battery takes far less time. As a result, DC charging stations can provide up to 350 kW of power and fully charge an EV within 15 minutes.



Charging speeds

Next to the direction in which the current flows and the ways it can be generated, there is another differentiator between AC and DC charging: The charging curve. With AC charging, the power flowing to an EV represents a flat line (so, not much of a curve at all). This is due to the relatively small onboard charger that can only receive a limited power spread over longer periods.

This is because the EV's battery initially accepts a quicker flow of power but gradually asks for less as it reaches full capacity.

Imagine an empty glass as the EV's battery, a water bottle as a DC charging station, and the water inside that bottle as the power. At first, you can quickly fill the glass with water, but you'll need to slow down as you get to the top, to prevent the glass from overflowing.

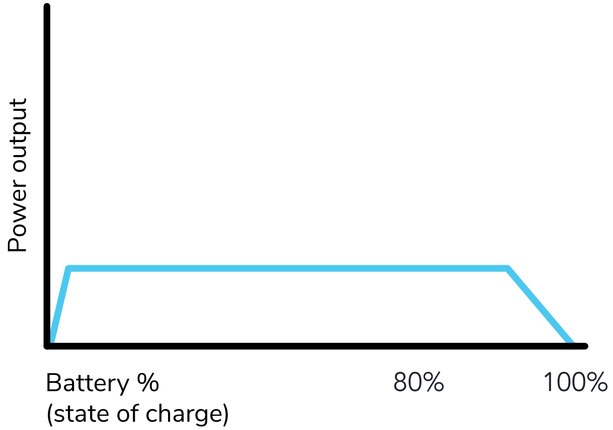
This is the reason why EVs require less power once the battery is around 80 percent full. This is illustrated by the degrading curve in the image at the bottom-right of the page.

Other factors that can affect charging speeds:

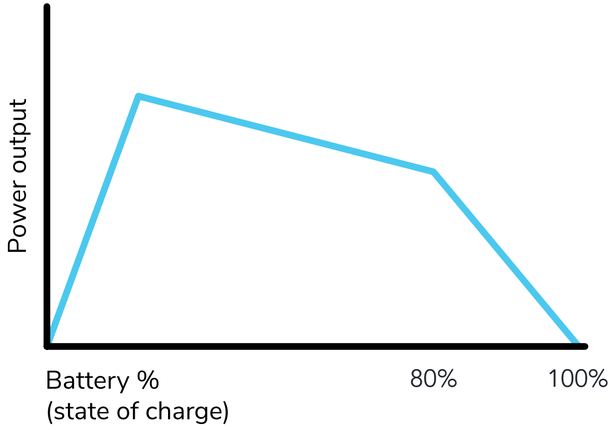
Battery percentage (state of charge). Due to the charging curve, the time it takes for a battery to charge to the initial 80 percent may be the same it takes to reach from 80-100 percent.

State of the EV's battery. As EV batteries are charged and used, they degrade incrementally. The state of a battery affects how much current an EV can accept.

Weather conditions. Colder temperatures can affect charging speeds since lithium-ion batteries—those used to power EVs—are sensitive to low temperatures.



AC (ALTERNATING CURRENT)



DC (DIRECT CURRENT)

Fast charging

When using an AC charging station, the conversion to DC happens inside the EV via an onboard charger, which is often limited in terms of speed and efficiency.

With DC charging, the conversion takes place within the fast charging station before it reaches the vehicle. Because the charging station houses a much larger converter compared to the one inside the vehicle, it is possible to deliver more power at a faster rate, reducing the charging time significantly.

Chapter 02

A closer look at DC charging

DC charging is often considered to be the best option for businesses looking to provide electric vehicle charging as a service or help electrify their fleet.

But when considering investing in high-power charging stations, there is no one-size-fits-all solution, and DC charging stations are available in different shapes and sizes.

This chapter gives an overview of the most important things to consider when it comes to investing in DC charging stations for your business.

Different shapes and sizes

When it comes to DC charging stations, you'll want to know exactly how big or small your shiny new station's footprint is.

Broadly speaking, there are two types of DC charging station architecture:

Standalone charging stations are comprised of a single unit and can usually deliver between 50kW and roughly 250kW of power. Because of this, standalone charging stations can help businesses efficiently utilize the space at their location.

Split charging stations with split architecture, as you can imagine, often come with two main components: a **user unit** and a **power unit.**

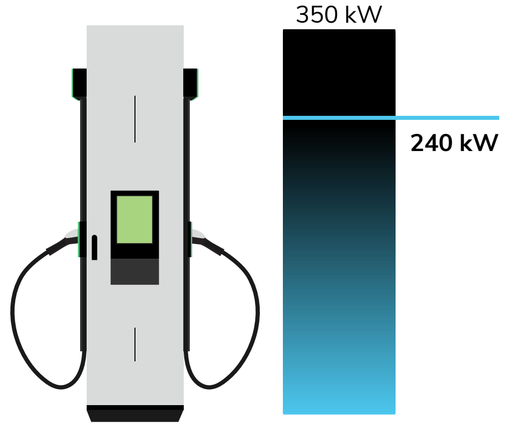
The **user unit** is essentially the customer-facing part of the charging station. Here, drivers plug in their EVs and initiate a charging session using a form of user interface—most likely a digital display that also allows charge cards, tokens, key fobs, and credit cards to be swiped.

The **power unit** contains power converters (converting AC grid power to DC) that deliver DC power to the user unit. These units are often located behind the scenes; likely around the corner and out of a driver's line of sight.

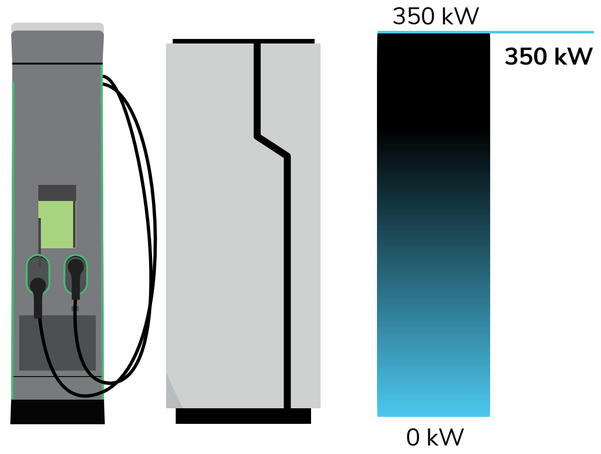
Charging stations with split architecture offer a higher power output than standalone stations: usually between 175kW and 350kW.

This is due to having an entire unit dedicated to receiving, converting, and delivering power.

The overall footprint is larger with two separate units, but the driver often only sees and interacts with the sleeker, more aesthetically pleasing user unit.



STANDALONE



SPLIT

Charging cables and charging times

DC charging stations come with fixed cables that are attached to the station itself.

Despite being attached to the charging station, fixed DC charging cables often have power outputs that aren't always equipped to deliver the maximum power from a DC charging station to an EV. **Yes, you read that correctly.**

The power that flows to an EV, and the time it takes to charge up a battery is not just dependent on the charging cables or even stations.

By design, vehicles are limited in the amount of power that they can receive; something that is often misunderstood or overlooked by drivers.

Regardless of the charging station's output, EVs dictate what they can recieve.

For example, while a Tesla Model 3 can accept 250 kW, a Nissan Leaf can only accept about 50 kW.

Making the connection

Connectors are located at the end of charging cables and fit the charging socket of EVs. Depending on the country in which the vehicle is manufactured, it can be compatible with different connectors. Sockets can refer to both an EV's inlet as well as the port on a charging station that accepts loose AC charging cables.

Some DC charging stations can provide up to 350 kW of power and fully charge an EV in 15 minutes.

Until the late 2010s, the European market was dominated by EVs from Japan and South Korea. Therefore, most AC and DC charging stations are equipped with the Japanese standard as well as the European standard sockets and cables.

However, in 2020, one of Japan's best selling brands, Nissan, announced that its EVs made for Europe will use CCS2 as well. This means that unless local requirements stipulate otherwise, your charging location should mainly consist of stations offering CCS2 compatibility.

In addition, many regions require a standard AC socket to be available on the DC station; allowing EVs with the more common AC Type 2 socket to make use of the location.

North America follows the same path as Europe. The healthy rivalry between CCS1 and CHAdeMO has swayed in favor of the former after Nissan's decision. Following on, Nissan has also made a decision to launch vehicles with the standard plug: CCS1. And without local standards that require AC sockets, DC stations in North America don't have them.

CHARGING CURRENT	DIRECT CURRENT (DC)			
Connector type and background	 **CCS 1** North American standard Up to 350 kW	 **CCS2** European standard Up to 350 kW	 **CHAdeMO*** Japanese standard Up to 400 kW	 **GB/T** Chinese standard Up to 240 kW
Europe	✗	✓	✓	✗
North America	✓	✗	✓	✗
South America	✓	✓	✗	✓
China	✗	✗	✗	✓
Japan	✗	✗	✓	✗

**There are no vehicles on European roads with CHAdeMO allowing more than 125 A at 50kW*

What does this all mean for businesses and drivers?

Charging times. That's the bottom line. The output of the charging station will greatly impact how fast an EV charges.

Offering high-power DC fast charging at your location could be the difference between a one-off customer and a loyal, repeat customer that has suddenly found the best place in town to charge their EV and grab a bite to eat.

On the right, you can see the charging time for EVs with batteries large and small.

TYPE OF EV	CITY EV	LARGE EV	CARGO VAN	TRUCK AND BUSSES	
Average battery size	50 kWh	100 kWh	75 kWh	200 kWh	300 kWh
Power output per charging port	Average time to charge the battery from 20% to 80% SoC*				
50 kW	53 min	1 h 48 min	1 h 20 min	3 h 35 min	5 h 23 min
90 kW	30 min	1 h	45 min	2 h	3 h
120 kW	22 min	44 min	33 min	1 h 30 min	2 h 14 min
150 kW	18 min	36 min	27 min	1 h 12 min	1 h 48 min
180 kW	15 min	30 min	22 min	1 h	1 h 30 min
210 kW	12 min	24 min	19 min	51 min	1 h 16 min
240 kW	11 min	22 min	16 min	44 min	1 h 7 min
270 kW	9 min	19 min	14 min	39 min	59 min
300 kW	8 min	17 min	13 min	35 min	53 min
330 kW	8 min	16 min	12 min	32 min	48 min
350 kW	7 min	15 min	11 min	30 min	46 min

For illustrative purposes only and does not reflect actual charging times

Charging time under 1 hour

Charging time under 30 min

Charging time under 15 min

Chapter 03

DC smart charging

Having a higher power output is not the only feature of DC charging. In fact, there are a number of features that make DC charging easier for businesses and customers to utilize. This is where smart charging comes in.

What is smart charging?

Smart charging balances the supply and demand of electricity intelligently.

It enables EVs, the grid, and charging stations to communicate with each other and, in doing so, optimize the flow of electricity based on specific needs or preferences.

For example, charging stations can be set to distribute power when it's greenest to do so, synced with personal calendars to optimise efficiency or fill up batteries during low-peak hours to reduce costs.

This innovative way of charging benefits station owners by offering insights and control, while offering additional comfort and personalization options to drivers.

Smart charging includes all features that optimize EV charging infrastructure and minimize the load impact (demand for electricity) of EVs.

Smart charging balances the supply and demand of electricity intelligently

How does it work?

Smart charging works by controlling the power, timing, and direction of individual charging sessions, and takes into account customer and vehicle needs, infrastructure limitations, renewable energy generation, electricity costs, grid conditions, and ancillary grid service markets.

Essentially, the goal of smart charging is to distribute power accordingly between charging stations (and/or between a cluster of charging stations) and a location.

A (load) balancing act

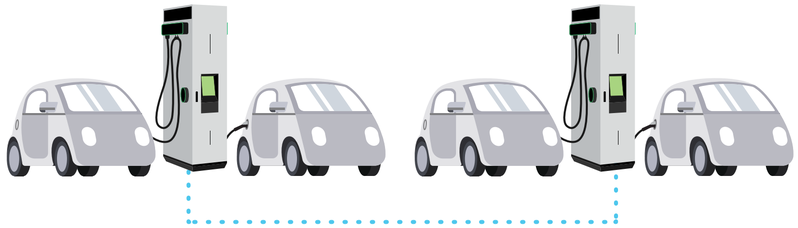
In smart charging terms, there are two ways to categorize the distribution of power: cluster load balancing and dynamic load balancing. You can also think of this as power-sharing.

> **Cluster load balancing** refers to the power that is distributed between charging stations. The total power available at a location dedicated to EV charging has already been set via **OCPP** manually. So, it's easier to think of this as power distribution at the station level.
>
> **Dynamic load balancing** can be considered as the level above cluster load balancing as the power set aside for EV charging is adjusted automatically based upon the total power usage at a location. Essentially, the automatic adjustment happens as power flows from the grid to a location that includes a cluster of charging stations and other appliances as well.

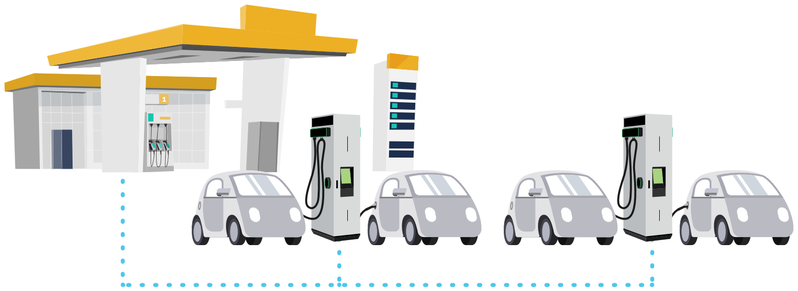
Businesses should be aware of the impact of load balancing as both options allow locations to more efficiently use and distribute power depending on a business's priorities.

Plus, the balancing acts that take place at either station or location level help businesses avoid costly grid upgrades, make more power available for EV charging, and reduce overall electricity costs.

CLUSTER LOAD BALANCING



DYNAMIC LOAD BALANCING



Simultaneous charging

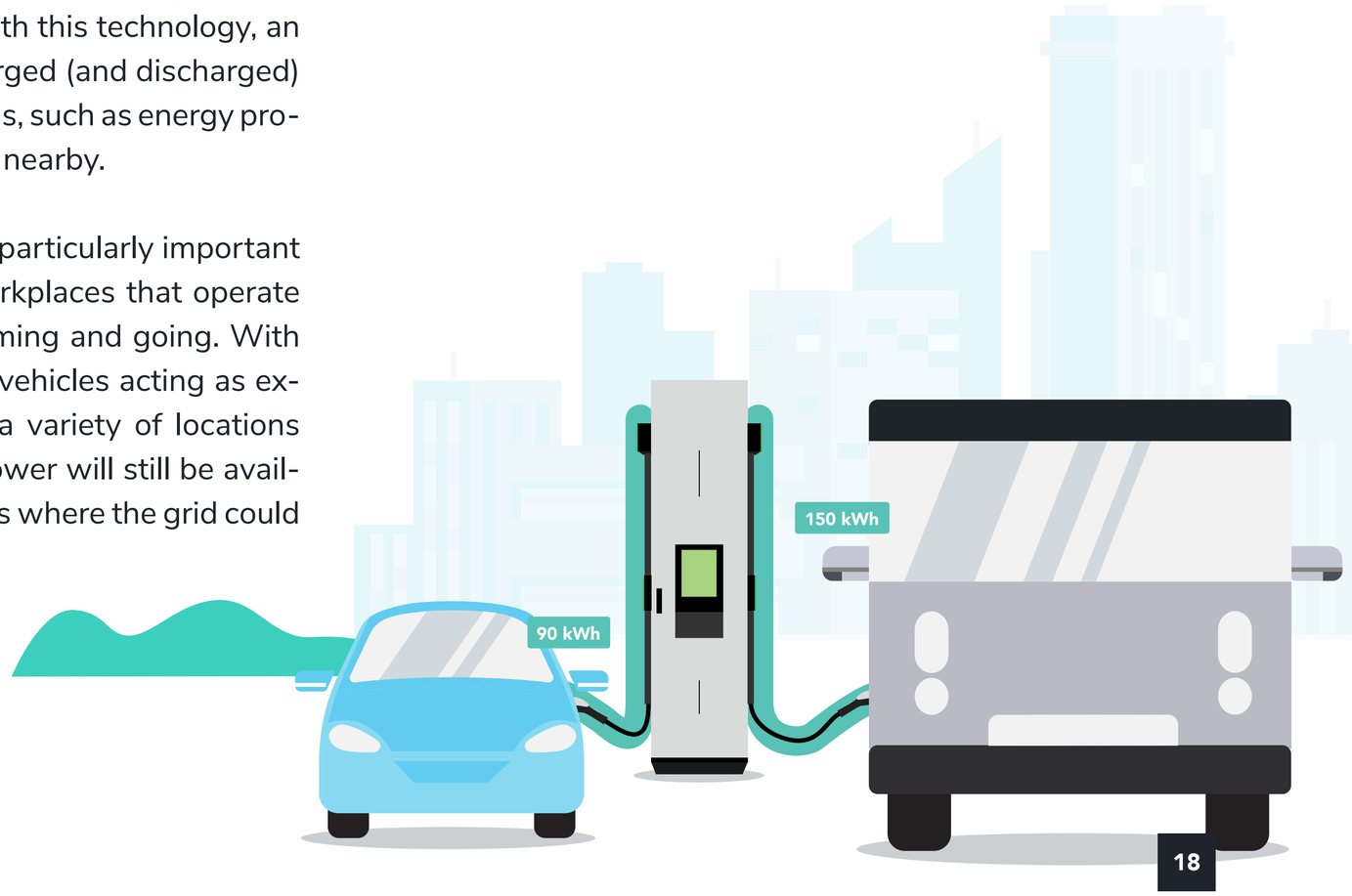
Being able to charge multiple vehicles is a smart charging feature that relies heavily on load balancing to be successful. Simultaneous charging isn't just applicable to DC charging either. Some charging stations allow AC Type 2 sockets to be used while also having DC charging via CCS or CHAdeMO. The AC and DC sockets don't share the same components as AC charging uses the EV's onboard charger.

Load balancing and simultaneous charging will greatly benefit businesses operating and managing fleet depots, fast charging hubs (such as highway stops), and workplace parking spots.
As EV adoption increases, so will the demand for EV charging: smart charging features are the reason that businesses and customers can make the most of electric mobility in a way that is efficient for everyone.

Taking the power back (to the grid)

Vehicle to Grid (V2G) technology allows energy to be pushed back to the power grid from the battery of an EV. With this technology, an EV's battery can be charged (and discharged) based on different signals, such as energy production or consumption nearby.

V2G technology will be particularly important for fleet depots and workplaces that operate with lots of vehicles coming and going. With potentially hundreds of vehicles acting as external battery storage, a variety of locations can rest assured that power will still be available in the circumstances where the grid could become overwhelmed.



What does this mean for your business?

If you are looking to invest in EV charging then smart charging is something that you need to be aware of. Smart charging features facilitated by next-generation charging stations can convince EV drivers to choose your location and will enable your business to increase efficiency and lower costs.

Start smart charging today

EVBox provides a range of charging stations that make the most of smart charging for businesses around the world. For a complete list of tech specs and use cases, as well as more information, take a look at our portfolio of DC charging stations designed for every business looking to electrify its operation.

View portfolio

About EVBox Group

Founded in 2010, EVBox Group empowers forward-thinking businesses to build a sustainable future by providing flexible and scalable electric vehicle charging solutions. With its extensive portfolio of commercial and fast **EVBox** charging stations, as well as scalable charging management software engineered by **Everon**, EVBox Group ensures that electric mobility is accessible to everyone.

EVBOX GROUP AT A GLANCE

250k+
charging ports powering EV drivers

70+
countries powered by EVBox

5k+
fast charging ports installed worldwide

20k+
business customers worldwide

EVBOX

Powering our sustainable future