Why Bidirectional Charging Isn’t the EV Game-Changer You Might Think… Yet!

The topic of bidirectional charging is as popular in the e-mobility enthusiast community as the “Last Christmas” song every December—you literally can’t escape it. But whenever you try researching some information behind the basic definition of what bidirectional charging actually is, you might get inundated with an overwhelming array of Wikipedia articles with dubious sources at the bottom. We say it’s time to clear the fog around this topic.

What Means Bidirectional?

Bidirectional means "in two directions" or "both ways." In the context of charging electric cars, it is used to describe the ability of electricity to flow in both directions.

What is Bidirectional EV Charging?

Bidirectional EV charging allows power to flow both ways: from the grid to your electric vehicle and back from the vehicle to the grid or another device. Unlike traditional charging, which moves power in only one direction (from the grid to the car), this method provides new possibilities for energy management and efficiency.

As we explained in one of our previous blog posts, charging an electric car is a lot about converting power from AC (alternating current) to DC (direct current).

The rule of thumb is as follows: power accepted by the grid is always AC, while power accepted by your car battery is always DC.

When you are charging your electric car, AC coming from the grid is converted into DC. This conversion occurs either within the charger itself, as is the case with DC charging stations, or within the vehicle when you use an AC charger. **And if you want to move power back to the grid, it needs to go through a reverse conversion process, which isn't possible with a regular charger.**

Electricity generated by a PV system, on the other hand, starts as DC power. In theory, a DC charger could directly charge a battery without additional conversion, potentially offering an advantage. However, the costs associated with this, such as the bidirectional wallbox Quasar priced at around 6,000 euros, often outweigh the benefits.

How Does Bidirectional Charging Work?

Normal AC chargers are not able to perform any power conversion. So how does bidirectional charging work? AC and DC bidirectional chargers ensure transforming power back from car-friendly electricity (DC) back to normal home electricity (AC).

This way, you can take the energy stored in the car's battery and use it to power your house or give some back to the grid.

Advantages of bidirectional EV charging

- **Improved energy demand management**: Bi-directional EV chargers help balance local power demand by utilising stored car energy, preventing surges at peak times.
- **Energy resale opportunity**: Homeowners with bi-directional chargers may potentially sell excess energy in the future to local utilities, benefiting a wide range of users.

What Can Bidirectional Charging Be Used For?

Bidirectional charging can be used for things like providing power to your house appliances, selling it to the grid, or powering an isolated reindeer farm as Hyundai did. Here are three main ways you can take advantage of two-way charging:

V2L: Vehicle to Load

So far, this is the most developed method of bidirectional charging. **It allows you to use electricity from your electric car battery for charging low-consumption devices.** Imagine making your morning cup of delicious cappuccino just by connecting a coffee machine directly to your vehicle when camping. To use vehicle-to-load bidirectional charging, you need a normal Schuko socket in the

electric car to which you can connect electrical devices on the go. Or you need an adapter for the type 2 charging port of your car, such as Hyundai offers for the IONIQ 5 and IONIQ 6. Its maximum power output is only 3.7 kW, but for powering up a hairdryer or a kettle it's plenty enough.

V2G: Vehicle to Grid

With V2G, electric vehicles can collect power when the demand is low and send it from their batteries back to the public power grid during peak hours. Consider people coming back home from school and work, cranking up their air conditioners, turning on the lights, and maybe firing up the blender for a refreshing smoothie. On top of that, many of them start charging their electric cars. All in all, it's like a power party where the public grid is the one getting a hangover. Simply put, the electrical system in the entire area suffers from high loads.

Solution? When electricity demand is high, EVs can supply electricity to the grid, acting as a distributed energy source. Conversely, during off-peak hours, they can recharge.

The goal of bidirectional charging, in this case, is to contribute to grid stability and reduce the need for additional power plants. The maximum power output of the energy returning to the grid has not yet been established, but one of the manufacturers, sun2wheel, offers pre-orders for **bidirectional DC chargers** with a maximum power rating of 10 kW in both ways. **Bidirectional AC chargers are slowly entering the market, but it is still a challenge to find one to order.**

V2H: Vehicle to Home

V2H enables your electric car to supply electricity from its battery to your home or any other building. Similar to V2G, this process involves a DC-to-AC converter in the EV charger. The difference is that in this case, the energy is supplied to the electrical system of a particular building.

Accordingly, one practical use is optimising energy consumption at the residential level. For instance, you can charge your EV during the night when your TV, blender, and washing machine are all taking a nap and electricity demand is low. Then, you

can use that stored energy to power your own home during the day when electricity usage is higher. This way, you not only contribute to power grid stability but also save money due to fluctuations in electricity prices.

Another possibility is to combine excess photovoltaic power with a bidirectional charger. By doing so, you can generate electricity, store it in your vehicle and receive a bonus from the grid operator for supplying electricity during peak demand periods. Although this remains a theoretical concept for now, it has promising potential for the future.

Electric Car Models Suitable for Bidirectional Charging

So the situation is as follows: A whole range of electric cars are now being launched on the market with the hardware for bidirectional charging, but without the appropriate software or suitably priced wallboxes, you unfortunately don't get much out of it.

These cars can charge bidirectionally

Model	Plug	AC/DC	Art
Nissan Leaf	CHAdeMO	DC	V2H / V2G (prepared)
Nissan eNV200[1]	CHAdeMO	DC	V2H / V2G (prepared)
Mitsubishi [1] Outlander / iMIEV	CHAdeMO	DC	V2H / V2G (prepared)
Hyundai Ioniq 5/6	Schuko	AC (1-phase)	V2L
Kia EV6 / Niro EV	Schuko	AC (1-phase)	V2L
MG 4 / 5 / Marvel	Schuko	AC (1-phase)	V2L
Skoda Enyaq (with 77 kWh)	CCS	DC	V2H / V2G (prepared)
Volvo EX90	Schuko / Type 2 / CCS	AC (1/3 phase) / DC	V2L / V2H / V2G (prepared)
VW ID.3 , ID.4 , ID.5 , ID Buzz (with 77 kWh)	CSS	DC	V2H / V2G (prepared)
Polestar 3	Schuko / Type 2 / CCS	AC (1/3 phase) / DC	V2L / V2H / V2G (prepared)

[1] Model(s) no longer available.

The VW ID.5, for instance, is technically equipped for vehicle-to-home charging with a capacity of 77 kilowatt hours, but there are currently no suitable, affordable AC wallboxes and VW is currently still limiting bidirectional charging to 4000 hours or

10,000 kWh. This means that if you use your car as a storage unit and draw electricity for your household appliances for 11 hours a day, e.g. when you are not producing PV electricity, bidirectional charging will be switched off after a year. Such a scenario is not profitable. The few bidirectional charging stations, including mainly DC charging stations that promise vehicle-to-grid and vehicle-to-home capabilities, are in some cases extremely expensive and rather unaffordable for private households. Some are priced at more than €20,000, making it a costly gamble for early adopters, because who knows if these expensive charging stations will be considered obsolete in a few years when the technology evolves because they don't have the latest features.

Furthermore, car manufacturers are increasingly running pilot projects to gather empirical values for the technology. Hyundai, for example, is currently testing "real" vehicle-to-grid or vehicle-to-home charging using customised software in the IONIQ 5, and Nissan is also busy collecting data. As part of the i-rEzEPT project, thirteen Nissan Leaf vehicles have been in use in private households since October 2020. However, as the Japanese car manufacturer relies on CHAdeMO as the charging connection, the practical implementation within Europe is questionable. This is because CHAdeMO connections are gradually dying out in Europe and, therefore, no V2G or V2H wallboxes are available here.

Wallbox for Bidirectional Charging

With the new go-e wallbox, bidirectional charging is now possible. The go-e Charger PRO is ISO 15118 V2X ready and Plug & Charge ready, meaning it's hardware-compatible for bidirectional charging. However, the necessary software is still required, and some regulatory hurdles need to be cleared before you can actually charge bidirectionally with our or any other AC wallbox. Plug & Charge is also hardware-ready and will enable the authorisation, activation, and billing of charging sessions in the future, without the need to activate the process via RFID or app. A new era of charging can now begin.

Examples of Bidirectional Charging in Practice

Bidirectional charging still seems a bit unrealistic, despite being mentioned at nearly every e-mobility conference. The topic has been around for a while, but what has been done to date? Let's look at some examples where bidirectional charging has been used in practice:

V2G, V2H and V2L at Tesla

Cybertruck with its controversial design, delivers all the bidirectional charging capabilities. EV owners can power electronic devices or tools using power outlets built into their Cybertruck. The vehicle has two 120 V outlets (up to 20A), two 120 V outlets (up to 20A) and one 240 V outlet (up to 40A) in the cargo bed. Charging other electric cars with up to 9.6 kW is also possible. Cybertruck can even provide home backup power with up to 11.5 kW of power.

V2G, V2H and V2L at Nissan

The car manufacturer has approved the Fermata Energy FE-20 bidirectional charger for use with the Nissan LEAF in the US. The LEAF is now ready to use the FE-20 charger to either charge its battery or send energy back to a building or the grid (V2G).

V2G, V2H and V2L at Hyundai

For owners of Hyundai IONIQ 5 / 6, it’s enough to plug a special V2L adapter into the type 2 socket to power a coffee machine or even charge an electric bicycle.

Why is Bidirectional EV Charging Development so Slow?

Bidirectional EV charging development is slow because theoretical profitability doesn’t always translate to real-life gains. In addition, it can potentially reduce the lifespan of the car battery. Currently, a smart charger is enough to provide you with a power safety net.

Let’s dive into details!

- **Legal questions unanswered**

How should the electricity that is fed back into the grid be taxed? After all, an electric car owner could charge his car at his employer's office with tax benefits and even for free, and then feed it back into the network at home for money.

- **Shortens the life of the car battery**

It’s not like energy is leaving your car's battery without it noticing anything. Constant charging and discharging ages the battery, potentially leading to it having to be replaced sooner. This would mean a considerable amount of avoidable waste, as the battery cannot be fully recycled or reused, at least not at the moment.

In addition, the battery of an electric car is one of the most expensive components of the vehicle. Who guarantees the battery's service life in the case of bidirectional charging and what happens if the battery has to be replaced prematurely? It is still completely unclear who will pay for the costs of a possibly necessary early battery replacement in this case. Will it fall upon the car manufacturer, the grid operator, the electricity provider, or the vehicle owner? Until these uncertainties are addressed, practical implementation of bidirectional charging will face significant challenges.

- **A regular smart charger is enough**

A lot of EV owners are interested in bidirectional charging because it is like a safety net, ensuring that they won’t be caught off guard by power outages and pay less for electricity. However, it's essential to note that this promising technology isn't quite ready to deliver these advantages just yet.

The good news is, though, if you have a smart wallbox that controls the charging current to prevent overloading the grid, many features of bidirectional charging become unnecessary.

- **Sounds more profitable in theory than it is in real life**

When it comes to discussing bidirectional charging, most people talk about grid stability without mentioning making money with it. At the end, it feels like there is an elephant in the middle of the room. Well, yes, in theory, you can profit from selling electricity back to the grid when it’s more expensive. But before that, you will have to buy an expensive bidirectional charger and select an electric car according to

whether it supports this type of charging. Also, the car battery may need to be replaced sooner than if it was not used for two-way charging. **And let's remember the main thing: none of this is possible yet, as the components required for this type of charging have not yet been fully developed.**

Do You Need Bidirectional Charging?

At the moment, you don’t need bidirectional charging. Despite the exciting potential of bidirectional charging, there's a simpler and more immediate solution available: a smart wallbox with dynamic load balancing and flexible tariff charging like our go-e Charger.

The go-e Charger, especially when paired with the go-e Controller or another compatible energy management (EMS) system, offers numerous practical advantages:

- **Power reliability:** Dynamic load balancing ensures a steady power distribution, eliminating power outages.
- **Cost efficiency:** Flexible electricity tariffs help reduce charging costs by charging your car when electricity is cheapest.
- **Grid stability:** Load shifting and peak shaving contribute to a more stable grid. Moreover, with the go-e Charger and the go-e Controller or other EMS, you can take advantage of excess photovoltaic charging and supply excess solar energy to your electric vehicle's battery.
- **Enhanced comfort:** You can easily control both the go-e Charger and the go-e Controller via a dedicated app. In addition, the combo offers automatic phase switching, energy monitoring and full control over power flows in your building for a smoother charging experience.

YouTube video: https://youtu.be/HVdaSFmbMZo?si=oQIO3YiWnhbbEdVk

Why is it stealing the spotlight?

Well, the problem that bidirectional charging is trying to solve is power balancing. And one of the great challenges for the power grid at the moment is the mass

charging of electric vehicles, which often happens simultaneously. Many people come home from work and start charging their cars. Accordingly, this puts a heavy load on the power grid.

The energy consumption when charging an electric vehicle is higher than that of washing machines, air conditioners or other household appliances that most people have at home.

Smart chargers, including our go-e Charger Gemini and Gemini flex, rely on static load balancing to keep things in check. Static load balancing involves applying predetermined limits within your charger's settings. For instance, you (or your electrician) can establish a maximum power consumption threshold of, say, 10 kW. You definitely should take this into account when charging with several charging stations simultaneously. This way, you balance the load, trying not to draw more than the network can offer at one time.

But the true magic happens when you team up the go-e Charger with the go-e Controller or another compatible energy management system.

YouTube video: https://youtu.be/Mtq1Zk5l9qo?si=l3uxkZTT2ZIv2YRl

The Controller automatically manages the charging power of the connected go-e Chargers, adjusting it in real-time to align with the current electrical load. With dynamic load balancing, if your house suddenly experiences a spike in power demand, such as turning on multiple appliances or an electric heater, the system can temporarily reduce the charging power to ensure that your home's electrical grid remains stable and doesn't overload. Once the peak in demand subsides, the charging power can automatically increase again.

Furthermore, load shifting is another solution offered by go-e. This means, you can schedule charging for times when electricity demand is low - usually at night.

Two-Way EV Charging: Will It Stay or Will It Go?

So what will happen next? Well, it's best not to get your hopes up, as there are still many questions to be answered before bidirectional charging technology can

confidently enter the market. All in all, it is likely to grow its popularity over the next few years.

In addition, even as more bidirectional chargers become available, their price is likely to be significantly higher than traditional smart chargers, at least in the beginning. For instance, you can already pre-order dcbel r16 DC chargers, with a price starting at €6,900. Yes, it is DC. **There are no AC bidirectional solutions available yet.**

So as you see, the two-way charging concept is still pretty raw. Fingers crossed that the development process continues successfully. But for now, if you want to make sure to not stress out the grid too much, simply get yourself a smart charger like the go-e Charger or, for even better results, combine it with the go-e Controller or other energy management systems.