

Thinking of Going Electric? Get Up to Speed on V2G/V2B!

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List of Acronyms

Acronym	Description
EV	Electric Vehicle
V2B	Vehicle-to-Building
V2G	Vehicle-to-Grid
V2H	Vehicle-to-Home

WHAT IS VEHICLE-TO-X (V2X)?

Bidirectional charging enables the charging of the Electric Vehicle (EV) to go in both directions. It can be charged and discharged to the grid – Vehicle-to-Grid (V2G), to the Building/Home (V2B/H) or a connected asset (Vehicle-to-Load, V2L). This technology allows the EV to go beyond being a transport asset, and become a ‘battery on wheels’, providing services to the energy system and the EV driver.

Built upon the knowledge of the project V2Market, this document aims at providing a comprehensive understanding of V2G/V2B, to raise awareness and incentivise every type of EV owner (citizens, public entities and businesses) to adopt this technology.

How does bidirectional charging through V2G and V2B work?

An aggregator is a type of energy company that pools flexible electric assets (e.g., EVs, electric heating, electric water boilers, etc.) and trades their capacity in different energy markets

Bidirectional charging implies an automated process that is managed through a service provider. This could be the consumers’ usual energy supplier or an independent aggregator. Based on the consumer’s consent, this company will manage the EV battery and optimise its use based on price signals in electricity markets, and use the capacity to either charge or discharge into the grid, or the building taking advantage of price fluctuations.

In some cases, this might require the consumer to adapt their behaviour, or the state of charge of the vehicle. However, the consumer will always be able to set up a level of charge based on their preferences that will never be surpassed. In exchange, different incentives are offered to the consumer to adapt their behaviour, this can be in the form of direct payments, or a significantly reduced charging bill.

Under no circumstances is the consumer’s comfort impacted, as charging preferences are transmitted to the third party beforehand. Likewise, the consumer can at any time take over the charging and discharging process through a digital application.

Today, bidirectional charging is only available on a few car models, although most car manufacturers have put forward a release date for at least one model¹ that embeds this technology. It is expected that, progressively, harmonised standardisation and interoperability across most car manufacturers in Europe will ease consumers' access to bidirectional charging.

To extract the full value of bidirectional charging, it is necessary to keep the vehicle plugged into the charging point as much as possible while not on the road, even when the battery is full. This allows the service provider to optimise the use of the battery, and allows the EV driver to take advantage of lower electricity prices and additional financial revenues.

What are the benefits for EV owners?

There are different use cases of V2G/V2B that can be illustrated through real-life examples with different types of financial benefits for EV owners.



V2X business case. Source: V2Market project

¹ smartEn & DNV, “Assessment of the regulatory framework of bidirectional EV charging in Europe”, 2023.

V2G benefits

The EV owner can benefit from bidirectional charging thanks to **dynamic energy pricing**. It means that consumers receive favourable price incentives based on the times when they charge or discharge the vehicle. What dictates the differences in price are the needs of the electricity system, which is reflected in the different electricity markets. At a time when electricity demand is very high, e.g., in the early evening when most people arrive home after their workday, electricity prices will be higher. The other way around, when there is significant cheap renewable energy being injected in the grid, e.g., during a sunny day, electricity prices will be low. The most important benefits occur during peak periods, when the energy system is under stress and prices are high.

The company Octopus launched the first public V2G tariff in the UK in early 2024.² Based on a V2G-compatible car and charger, it offers a dedicated tariff to the EV driver, ultimately offering **free charging** to the consumer. According to Octopus, a typical consumer subscribed to that tariff pays £230 to charge an EV on a yearly basis, compared to the £1,000 per year to charge with a normal tariff. To reach such benefits, the EV owner will need to respect basic conditions such as the amount of time the car needs to be plugged to the (bidirectional) charging point, and a limit of energy recharging a month.

A different model involves aggregators. An aggregator is a type of energy company that pools flexible electric assets (e.g., EVs, electric heating, electric water boilers, etc.) and trades their capacity in different energy markets. The EV owner would sign a contract with an aggregator, that would take over and manage – based on consumer's consent – the charging process of the EV based on the energy prices in different markets, i.e., reducing or increasing the charging process, or charging and discharging the EV to the grid. In such cases, the EV owner could directly be rewarded by the aggregator, by receiving part of the profit made thanks to the management of the EV battery. Such benefits can amount **up to 1.800€/year/EV**.³

² <https://octopus.energy/power-pack/>

³ https://parker-project.com/wp-content/uploads/2019/03/Parker_Final-report_v1.1_2019.pdf



Source: Nuvve

Finally, another solution that is currently being contemplated is the servitisation model. In this case the energy service provider or the aggregator owns the battery of the EV and provides the bidirectional charger to the customer. The consumer still owns the vehicle, while the energy service provider takes over the risk and management of the battery, and pays the charging of the vehicle.⁴ This would result in a cheaper upfront investment – around **25% less expensive than a classic EV, and the guarantee that the battery of the EV could be changed when needed**. This business model still respects the consumer preferences with regards to the state of charge and use of their vehicle.

V2G: the affordability driver for EVs

SERVITIZATION

OWN THE CAR

BATTERY As a Service
Belonging to the aggregator/battery financier

Approx **25%**

LOWER PURCHASING PRICE OF THE CAR

PAYMENT ON A SUBSCRIPTION PER KM BASIS

BIDIRECTIONAL CHARGER INCLUDED

BATTERY REPLACING WHEN NEEDED

→ For both **INDIVIDUALS** and **FLEETS** ←

Subject to Aggregators contractual terms.

Source: V2Market project

⁴ The consumer will pay the energy service provider through a subscription (daily, weekly, monthly etc.). For more information, look at V2Market deliverables D4.2 (The EPC Servitisation model) and D4.3 (Infographics) available on V2Market website.

V2B benefits

V2B technology, in particular when combined with self-generation of renewable electricity e.g., solar photovoltaics on rooftops, brings further benefits to the consumer. Charging the vehicle thanks to the energy produced by the solar panels on the rooftop, and discharging to the home or building when needed, ensures maximising the use of renewable generation and ensures cheap energy, providing potentially massive savings to the EV owner. For example, the company dcbel created a charger which gathers different technical devices (inverters, batteries, charger) in one, to provide specific services for consumers who have solar energy on their roof, and an EV.⁵ Compared to a traditional internal combustion engine, **savings can go up to around 5000€/year**.⁶

V2B technology is particularly relevant when the EV owner is part of a local energy sharing scheme⁷, be it a formal scheme (renewable/citizen energy communities) or not. Thanks to a third party managing the different decentralised energy assets at the local level, the EV can play a role in self-balancing the different loads. It would take advantage of the local renewable energy being produced, to store such energy and feed it in the buildings when needed. The EV owner is remunerated based on the services provided or could receive discounts on his energy bills, depending on the type of local scheme in place and based on the contractual agreement with the energy service provider.

Both technologies, V2G and V2B, can be combined, maximising the benefits for the consumers.

Different needs for different actors

Different consumer-types, e.g., public entities, citizens, businesses will have differing needs and expectations from their vehicles. Hence the offerings and benefits are adapted to their specificities.

Public entities

Public entities (municipalities, regions, local administration, etc.) are often seen as the first movers when it comes to adopting technologies and promoting climate-neutral practices. They own buildings with significant energy consumption and large vehicle fleets. V2G and V2B can not only facilitate the management of both buildings and vehicle



⁵ <https://www.dcbel.energy/uk/solar/>

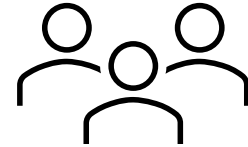
⁶ *Ibid.* This estimate integrates the electricity costs.

⁷ A local energy scheme refers to a situation where consumers form a community managing, producing, storing, or consuming energy collectively. This can be done through the establishment of an entity (e.g., citizen energy community), but not necessarily.

fleet, but also reduce public entities' costs while **promoting energy-efficient practices, and ultimately saving taxpayers' money.**

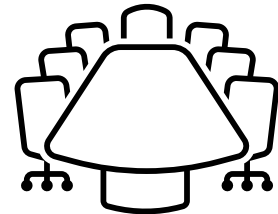
Citizens

V2G and V2B would provide considerable savings in their electricity bills and provide additional revenue streams, while lowering the overall cost of owning an EV. Also, while a general concern from citizens is an accelerated ageing of the battery, **bidirectional charging could actually prolong the lifetime of an EV battery compared to an unmanaged charging process, thanks to the charging optimisation conducted by the aggregator or service provider.** Finally, the EV could serve as storage if combined with on-site renewables, avoiding the need to purchase other devices.



Businesses

A bidirectional-ready fleet of EVs can be a crucial asset for businesses. It can **reduce their operational expenses and help to transition from internal combustion vehicles to EVs.** As EVs are mostly parked at the office, having an energy system provider managing this pool would provide grid services and associated revenues to businesses. If renewables are installed on-site, this could also maximise their utilisation by considerably reducing the energy bill of the company. Such benefits would be particularly relevant for businesses subject to seasonality, as they would maintain some income during the low season.⁸ A large pool of vehicles would also be easier to manage for an aggregator to participate in the energy markets.



⁸ For example, this can be the case for a car rental company. During the low season when fewer people rent cars, instead of reducing the pool such cars could participate in V2G services. This would bring additional revenues to the company.

Conclusion

V2G and V2B are mature technologies which should take a growing importance in the near future with the massive electrification of the transport sector. EV owners would greatly benefit from it, by saving money and earning revenue thanks to the use of their batteries as a storage asset, and it can also bridge the affordability gap of an EV. In this aspect, contacts with energy service providers and aggregators should be facilitated.

Resources

This document is based on insights gained from V2Market projects. If you want to explore these insights further, all related documents are freely available on the V2Market website. The reports used include:

Design Thinking Structure

This report provides a preliminary assessment of the commercial potential of V2G/V2B services, based on an interdisciplinary literature review and analytical tools.



Value Proposition Canvas

This document highlights the benefits that services developed through V2Market can provide to different stakeholders. Stakeholders considered include EV owners and users, fleet and car-sharing operators, utility companies, facility managers, charging point operators, Distribution System Operators (DSOs), ESCOs, energy communities, aggregators, and financial actors.



EPC Servitisation Model

This report relates to the Hybrid EPC-servitisation contract templates for incorporating V2G, including the integration of monitoring and verification of energy savings from the V2G technology.



Infographics

V2Market developed infographics showcasing the economic benefits of V2G in an attractive way, using different scenarios and financial schemes, including servitisation.



Economic viability studies

This report describes the economic viability potential of V2G in 6 different scenarios of battery and electricity prices.

