



Guide to V2G/V2B basics: aggregators

AUTHORS

Brieuc Giard	Andrés Pinto-Bello	Quentin Donnette	Michael Villa
smartEn	smartEn	smartEn	smartEn
Marion Malafosse			
smartEn			



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Executive Summary

The following document presents comprehensively the business opportunities of V2G and V2B for aggregators. It aims to provide them with a user-friendly guideline explaining how such technologies work, how it is financially beneficial to adopt them as part of their portfolio, and in what type of markets. Finally, specific opportunities for different target groups are highlighted.

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List of Acronyms

Acronym	Description
aFRR	Automatic Frequency Restoration Reserve
DER	Decentralise Energy Resource
DSF	Demand-Side Flexibility
DSO	Distribution System Operator
EV	Electric Vehicle
FCR	Frequency Containment Reserve
LFM	Local Flexibility Market
V1G	Smart Charging
V2B	Vehicle-to-Building
V2G	Vehicle-to-Grid
V2H	Vehicle-to-Home
V2L	Vehicle-to-Load
V2X	Vehicle-to-Everything

What is Vehicle-to-X (V2X)?

Bidirectional charging enables the charging and discharging of an electric vehicle (EV) based on external signals (price, carbon intensity, tensions in the grid) and the needs of the vehicle user. It is an evolution of smart charging (V1X) where the charging process is being modulated, advanced, postponed, slowed or accelerated, based on external signals. Bidirectional charging can interact with the grid, Vehicle-to-Grid (V2G), a building/home (V2B/H) or with another asset (Vehicle-to-Load, V2L). Such a technology allows the EV to go beyond being a transport asset, to become a ‘battery on wheels’, providing services to the energy system, the building/home and to the EV driver.

V2G and V2B are mature technologies which can bring huge benefits to the energy system. Yet, their development is not widespread across Europe. Aggregators¹– or interested stakeholders that want to expand their business models towards aggregation – can support the adoption of these technologies, by integrating EVs in their portfolio of assets used to trade in different energy markets. Likewise, stakeholders involved in the energy sector can be interested in becoming aggregators thanks to V2X.

While V2G and V2B are still in the early stages of deployment, all major vehicle manufacturers have already committed to develop and launch compatible models in the short term.² And while, regulatory, policy, and grid barriers are preventing the rapid uptake of these technologies, some countries, and successful trials show the potential for all the involved stakeholders, i.e., EV users, Charging Point Operators, car manufacturers, aggregators and System Operators.

V2Market has prepared two guides, the one you are currently reading addressed at aggregators, and a second one addressed at EV owners. This guide aims to explain in a user-friendly way how V2G and V2B work, how it is financially beneficial to adopt these technologies as part of an aggregator’s portfolio, and what types of markets are more beneficial for these types of assets. Finally, we highlight specific opportunities for different target groups.

¹ According to the Electricity Directive, aggregation means ‘a function performed by a natural or legal person who combines multiple customer loads or generated electricity for sale, purchase or auction in any electricity market’

² smartEn & DNV, “Assessment of the regulatory framework of bidirectional EV charging in Europe”, 2023.

What makes V2G and V2B different to other Distributed Energy Resources (DERs)?

EVs that are charged through V2G and V2B provide specific benefits compared to other DERs bringing particular value to aggregators' portfolios.

The EV can perform V2G/B services when plugged. As it can be plugged up to 95% of the time in some countries³, it gives aggregators significant flexibility to manage this asset and make it respond to price signals.

V2G and V2B are also a source of demand-side flexibility that can be used throughout the whole year and on longer time horizons, which is not necessarily replicable by other demand-side resources (e.g., heating is mostly used during winter and/or cold weather periods).

Compared to other small-scale DERs, especially at the household level, EVs have a large battery, averaging at around 40 kWh and going up to 100kWh,⁴ several times bigger than stationary batteries for residential buildings, around 13 kWh⁵. Their power (7 to 11 kW) also makes them one of the biggest decentralised energy assets, when compared to heat pumps (3 to 5kW) or rooftop PV (4 to 9kW). This capacity makes their flexibility highly valuable and easier, through pooling of numerous assets, for aggregators to reach the minimum bid sizes mandated in different electricity markets which can be significant (up to 5MW) depending on the type of market (e.g., ancillary services or wholesale markets).

Many electricity markets, in particular those providing products for System Operators like ancillary services, still require a service provider to submit both demand turn up and turn down bids (i.e. upward and downward flexibility). Although this requirement is slowly being removed from different markets, following the implementation of the 2019 Electricity Market Design, and asymmetrical bids should become the norm in the future, V2G has the benefit of being able to provide both symmetrical and asymmetrical bids. It is an added value compared to smart charging, which can only provide downward flexibility. This ultimately eases the process for aggregators to manage their portfolios and access more markets.

³ <https://www.transportenvironment.org/te-united-kingdom/articles/shared-vision-tackling-the-barriers-to-electric-car-clubs-in-the-uk>

⁴ <https://www.eonenergy.com/electric-vehicle-charging/running-costs-and-benefits/battery-capacity-and-lifespan.html>

⁵ <https://www.greenmatch.co.uk/solar-energy/solar-panels/solar-batteries/size>

Business models and financial opportunities for aggregators

Electricity markets

EVs thanks to V2G can provide flexibility in numerous electricity markets, from wholesale to ancillary services and local congestion markets. In light of the increased stress to the system caused by massive electrification and the expected needs for grid reinforcements, it is particularly beneficial for grid balancing services. For example, EVs are already participating in Frequency Containment Reserve (FCR) and Automatic Frequency Restoration Reserve (aFRR).⁶ The latter is particularly relevant as it offers two revenue streams – capacity and energy remunerations, as opposed to only payments on activation.⁷ EVs pooled together, provide fast responses to signals that make them valuable assets to Transmission System Operators. V2G is also the perfect match to the increased volatility in our system, due to variable renewable sources becoming the main electricity provider. Aggregated EVs can act as buffers, reducing price spikes and stabilising revenues for renewable generators. The impact on electricity markets of geopolitical shocks, and the opening of ancillary services to more demand-side assets, should reinforce the business case for V2G even further. Likewise, EVs present a considerable potential to participate in wholesale markets⁸, providing that they are open to DERs.

As electrification accelerates and more and more variable generation is connected on the distribution networks, a growing number of European Distribution System Operators (DSO) are now facing significant grid congestions in the short and medium term, reinforcing the business case for V2G – and V2B to some extent – to also participate at distribution level. The participation of V2G in Local Flexibility Markets (LFMs) would be valuable to tackle grid congestion and further integrate electrified and decentralised assets in the distribution grids. Providing the appropriate price signals to the consumer can also reinforce V2B as consumers will inject back to their building at times of high prices. Although such markets are still in their infancy, they are expected to grow as the main tool of flexibility procurement for DSOs, in accordance with EU law.

Finally, because of their large batteries, EVs can also obtain payments from capacity remuneration mechanisms and flexibility support schemes to ensure system adequacy during peak consumptions times in countries which have one e.g., Belgium or France.

⁶ “Accelerating to net-zero: redefining energy and mobility”, Elia Group, 2020.

⁷ “Incremental profitability evaluation of V2G-enabled aFRR services for semi-public EVSE infrastructure: a case study in Belgium”, Andrei Goncearuc *et al.*, 2023.

⁸ For example, in Spain 98% of the total energy traded happens on wholesale markets.

Innovative business models

While V2G can fit within the more traditional aggregation activities, a series of innovative business models are being developed to provide better services to consumers, and facilitate the most efficient use of the batteries. The servitisation business model is an innovative business model to facilitate the activity of aggregators managing EV batteries while removing the risk and the burden of the upfront costs for the consumer. In this model the end user owns the EV, but the aggregator owns the battery, the charger or other DER and provides to the consumer a charging service, based on their driving needs. For the end user, it means a reduced upfront cost of typically around 25%, reduced risks and complexities, while enjoying all the benefits of owning a vehicle. For the aggregator, it means better control of the load, and accessing full benefits from the energy markets, as no redistribution of the financial revenues earned from the participation of the EV battery is needed. The V2Market project, has created a contract template for this business model, freely available to all interested parties⁹.

Aggregators can also diversify their business offers and offer contracts to end-users with self-generation schemes, e.g., solar panels, which would ultimately generate additional revenue opportunities. It is particularly relevant for V2B, as consumers could self-produce and consume clean electricity thanks to the combination of the solar panel and the EV battery. Hence, aggregators can provide dynamic tariffs or other management tools to consumers, on top of their usual business practices.

Different business opportunities based on different target groups

Aggregators should tailor their business offerings based on the different end-user segments and their capabilities. User-groups might bring different complexities to aggregators; for example, a residential customer will not charge his EV at the same time as a customer parking at their office building. For the first one, the charging session mostly occurs in the late afternoon and at nighttime, while for the second it is during the day. This is important to take into account when designing an asset portfolio.

Corporate fleets represent a very good entry point for aggregators, allowing them to control a large pool of EVs, with similar predictable behaviours, from the outset. Corporate fleets are currently Europe's biggest car market, accounting for more than half of new car sales.¹⁰

⁹ For more information, please check V2Market deliverables D4.2 (The EPC Servitisation model) and D4.3 (Infographics) available on V2Market website.

¹⁰ <https://www.transportenvironment.org/articles/the-corporate-cars-problem-and-what-europe-can-do-about-it>

Although the electrification rate is currently quite low, legislative development could increase the share of EVs and ultimately benefit aggregators. For public actors, open procurement for the renewal of their fleet might represent an opportunity and bring value to aggregators. Indeed, public actors could alleviate the cost of purchasing new EVs thanks to their participation in the energy markets through an aggregator, while showing citizens an efficient spending of public money. For aggregators, it would also bring certainty as public contracts are often signed over the mid or long term.

New registrations of EVs for individuals tripled between 2020 and 2022, going from 5% to 15% of the share of total cars sold.¹¹ If this trend goes on, it will represent a crucial opportunity for aggregators. Self-consumption schemes are particularly interesting for residential consumers, as they could reap massive financial benefits while gaining autonomy in their energy patterns. Aggregators would be inspired to expand their business offers and couple EVs with solar offers.

Conclusion

The massive electrification of the transport sector and the increased volatility in the energy system brought by renewables force the EU to find new solutions. V2G and V2B are mature technologies which should take growing importance in the near future as they enable the cost-effective integration of variable renewable energy in the energy system. Aggregators should grasp this opportunity by becoming early adopters and integrating EVs as part of their portfolios through different innovative business models, benefitting from a diversified pool of smart assets that allow them to access a more varied number of electricity markets. While there are still regulatory barriers facing V2X and DSF access to markets, there is a clear trend of removing these barriers, through the implementation of European legislation.¹²

¹¹ *Ibid.*

¹² “V2X enablers and barriers: assessment of the regulatory framework of bidirectional EV charging in Europe”, smartEn, 2023.

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 guide to V2G/V2B basics used the following V2Market material:

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.



The Owner-Aggregator contracting guide

This document relates to contractual guidelines to be used by EV owners and aggregators to support the assessment and tailoring of their contractual arrangements in any context.



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.

