SHARED VISION ON FUTURE DEVELOPMENT OF V2X IN THE EUROPEAN UNION

Executive summary

The green and digital transformation brings new challenges and opportunities for the automotive sector and beyond. One particularly exciting area is the smart integration of electric vehicles (EVs) into the energy system. Key to this integration will be bidirectional charging: vehicle-to-grid (V2G), vehicle-to-home (V2H), and in general vehicle-to-everything (V2X) will need to take place in all vehicle segments as the fleet energy storage capacity continues to grow.

The deployment of renewable energies must be significantly accelerated to meet the EU's target of reducing greenhouse gas emissions by 55% by 2030. This will increase the need for flexibility and storage in the energy system. Bidirectional charging can support the energy transition by helping EVs provide flexibility to the grid, and increasing benefits to the customer, grid operators, and other stakeholders.

The most challenging obstacles currently lie within the regulatory framework, characterized by issues such as double taxation, complex metering and control requirements, lack of harmonised standards for home and grid integration, and market discrimination against mobile, decentralized flexible energy resources. These hurdles hamper the development of viable business cases.

The sector is seeing the emergence of numerous new players. It is essential to have an in-depth discussion about their roles and responsibilities and identify suitable business models for each. These models will vary for each player. For vehicle manufacturers, for example, there will be distinct models specific to light-duty vehicles and heavy-duty vehicles, given their different missions. For EV charging infrastructure, the model would differ for AC or DC charging technologies given the use cases they are applied to.

Policy makers should consider the following essential insights from the automotive sector to ensure the effective functioning of this market and stimulate the end user:

- V2X solutions offer long-term benefits for everyone, presenting significant business potential and contributing positively to the EU's environmental goals of decarbonisation in conjunction with grid stability and energy resilience.
- Harmonizing standards and ensuring their implementation across the entire EU is essential. This applies to both vehicles and back-end systems, including certification and homologation.
- The new markets must be built on partnerships. The automotive industry is eager to contribute to new solutions, but clear and fair roles and responsibilities need to be established. Customers expect their vehicles to serve primarily for transporting

passengers or goods, but they can also be rewarded for the flexible and optimal use of the EV's battery. Vehicles can also contribute to grid stabilization and participate in energy markets.

- All future solutions depend on sufficiently robust, flexible, smart and digital grids. Investment into capacity and flexibility of the European grid network is essential to allow V2x solutions to provide benefits for all relevant players.
- The EU must ensure the completion of tasks related to unidirectional smart charging. This includes establishing seamless connectivity for the growing number of EV users to easily charge their vehicles across the EU. This would also pave the way for the uptake of bidirectional charging.
- Clearly defining roles and responsibilities for all involved parties, including vehicle manufacturers, is crucial. Currently, original equipment manufacturers (OEMs) as well as charge point operators (CPOs) are not fully considered as an integral part of the energy system and a significant contributor to an optimized grid design. Establishing these definitions within the existing role model framework[1] will enable the development of appropriate business models based on these responsibilities in the future.
- Differences between vehicle segments must be reflected, acknowledging the different use cases for LDVs and HDVs.
- Differences between charging scenarios must be reflected given the differences of use cases between high power charging (DC) on the road and low power charging (AC) at home and everything in between.

Why e-mobility can offer more than just decarbonisation of the transport sector

The most difficult stage of the energy transition still lies ahead of us. The deployment of renewable generation must be rapidly accelerated to reduce greenhouse gas emissions by 55% by 2030. This will significantly increase the need for flexibility and storage in the energy system[2][3]. Fortunately, this will coincide with the growing availability of EVs (also considering the CO2 targets which aims for 100% electrification of new passenger vehicles by 2035)[4]. Offering financial incentives to EV customers for providing renewable energy services would be the most cost-efficient alternative to traditional centralized, power plant-based renewable energy compensation.

[1] Details can be found on: https://eepublicdownloads.entsoe.eu/clean-documents/EDI/Library/HRM/Harmonised_Role_Model_2023-01.pdf
[2] As an example, within the German energy system alone, in 2022, around 8,000 GWh of renewable electricity had to be curtailed because the energy system could not integrate it cost-effectively which could be used once offer is available.
[3] The European Commission estimated that the energy system needs to increase its daily flexibility by 133% in 2030, and by 250% from 2030 to 2050. Source: Staff Working Document accompanying the Reform of the Electricity Market Design.
[4] Details could be found on: https://www.eea.europa.eu/en/analysis/indicators/co2-performance-of-new-passenger

EVs offer a unique advantage beyond transportation; with bidirectional charging technology they can double as mobile power banks, capable of providing grid services and participating in energy markets, by drawing power from and feeding electricity back into the grid.

With the 100% CO2 reduction target for light-duty vehicles set for 2035 in mind, these vehicles offer significant decentralized storage capacity and flexibility for the grids.[5] To enable that, all stakeholders including from the energy sector, infrastructure providers and OEMs have to establish an interoperable and user-friendly ecosystem, including standardization processes which need to be completed. The most challenging obstacles are currently regulatory rather than technical.

Partnership is a way forward (defining the role of different sectors)

The transition to EVs signifies an increased electrification at the demand and supply side. This changes the way we envisage the energy system. Proactive consumers can now activate the flexibility of their assets: for example, an EV driver with bidirectional charging can provide valuable grid resources that support cost-effective investments in grid infrastructure. As the EV fleet becomes a crucial component of the energy ecosystem, forming effective partnerships between the energy and e-mobility sectors becomes increasingly important for seamless mobility and a resilient energy sector across the EU. The foundation of these partnerships should be built on a clear definition of the involved roles with the dedicated responsibilities of each sector, where e.g. the energy supplier is responsible for optimizing the energy related costs and the e-mobility sector is responsible for ensuring and optimizing the mobility and recharging needs of the driver with respect to the energy ecosystem.

Signatures of the declaration, both on the side of vehicles manufacturers and infrastructure operators are making significant progress in designing and launching vehicles capable of being grid-integrated, thereby unlocking additional value for customers and all participants in these new value chains. Furthermore, this transition provides an opportunity for OEMs to become active participants in these emerging value chains.

Robust, flexible and smart grids are pre-requisite for V2x applications

Road transport electrification will not happen unless Europe's electricity system is ready for the increased demand. Grids across the EU will need to be reliable, flexible and smart if we are to realise the expected benefits of smart charging (unidirectional or V1G) and V2X applications.

[5] In case of German for example, with the German Federal Government aiming for 15 million electric vehicles by 2030, these vehicles could offer a storage capacity surpassing that of all currently installed German pumped-storage power plants by at least 19 times

This is valid both for enabling smart solutions for homes and private consumers, but also to allow solutions for transport operators. Therefore, we need smart, but also robust grids. V2X enabled vehicles can help to further penetrate renewables and reduce overall cost of grid expansion/ modernization.

How V2X technologies could benefit everyone and why bidirectional charging should become gradual standard

Electric cars can act as short-term (hours/days) mobile storage units. Their full potential within the energy system will be unlocked when drivers have the option and incentive to feed electricity back to where it is needed, whether to a building or the grid.

For the user it is important that the technology is user friendly, interoperable and provides financial benefit to reduce the Total Cost of Ownership (TCO) of their EVs. Bidirectional EVs and charging stations should be available at reasonable prices and functionally interoperable across all scenarios and OEMs.

Installing bidirectional charging equipment (such as wall-boxes) must be straightforward for both customers and technical service providers. Integration into an energy management system and registration processes with distribution grid operators should be transparent, easy to execute, and digital. This process should be harmonised across different grid operators.

However, bidirectional charging presents unique challenges for heavy-duty vehicles (HDVs) in commercial operations, where uptime and total cost of ownership (TCO) are critical. Unlike passenger cars, HDVs operate continuously and don't return to a depot every night. They also have an average annual energy consumption roughly 100 times that of a car. While bidirectional charging could offer benefits like depot load balancing, irrespective of the vehicle segment, the decision to enable it should ultimately be left to customers, based on their specific vehicle usage needs.

Bidirectional charging has the potential to provide significant flexibility options, enhancing system stability, improving the security of electricity supply, and maximizing the use of existing renewable energy generation capacity to avoid curtailment. Grid operators, with regulatory support and incentives, should intensify their efforts to digitize the grids, and support the seamless integration of decentralized, small-scale flexible assets.

To enable smooth, secure and interoperable processes between all involved elements and stakeholders (EV, EVSE, CPO, Grid Operators, aggregators, and other flexibility service providers), roles and responsibilities must be defined, and various data points need to be shared via standardized communication protocols. Ongoing discussions between the automotive industry and the energy sector within the Sustainable Transport Forum are focused on crafting a thorough set of essential data points required to facilitate successful V2X use cases, and to also support future business models.

Key challenges ahead that need to be met in order to make this happen:

- Enable commercialisation options for V2X at EU level

  Even when technologies to integrate EVs into energy grids are available, the criteria and approaches for installation and operation remain fragmented and highly localized. The EU needs sufficient and appropriate charging infrastructure (decentralized, low power output, long standing times) to support the proliferation of V2X functionality.

- Provide a favourable fiscal framework for V2X services

  In order to make intermediate storage economically attractive, there should be an adjustment in the tax burden. In some Member States, feed-in fees are charged; in others, intermediate storage is considered 'consumption' and is thus fully burdened by taxes, fees and levies. Such differences prevent successful business models for V2X. Furthermore, energy fed back into the grid incurs additional taxation upon consumption, further complicating and increasing the costs associated with V2X business models. To promote the systemic benefits of V2X, such barriers should be removed.

- Improve metering

  Metering concepts must be adjusted to ensure that only relevant energy consumption qualifies for tax exemptions. This adjustment should be carried out in the most practical and straightforward manner to ensure both customer convenience and fraud prevention. Likewise, smart meters rollout should be scaled up, and Dedicated Measurement Devices (DMDs) enabled as they play a key role at measuring the amount of flexibility to be activated.

- Enhance customer benefits

  Both electricity prices and network tariffs play a key role. Introducing consumers to time-varying electricity prices encourages implicit flexibility and can benefit the grid by encouraging load shifting away from peak periods. Price signals from network charges and static and dynamic time of use (TOU) and dynamic elements in electricity and network tariffs provide end users with the necessary price signals to adjust their energy consumption. This is in conformity with the Electricity Market Design and should be implemented by Member States without further delay.

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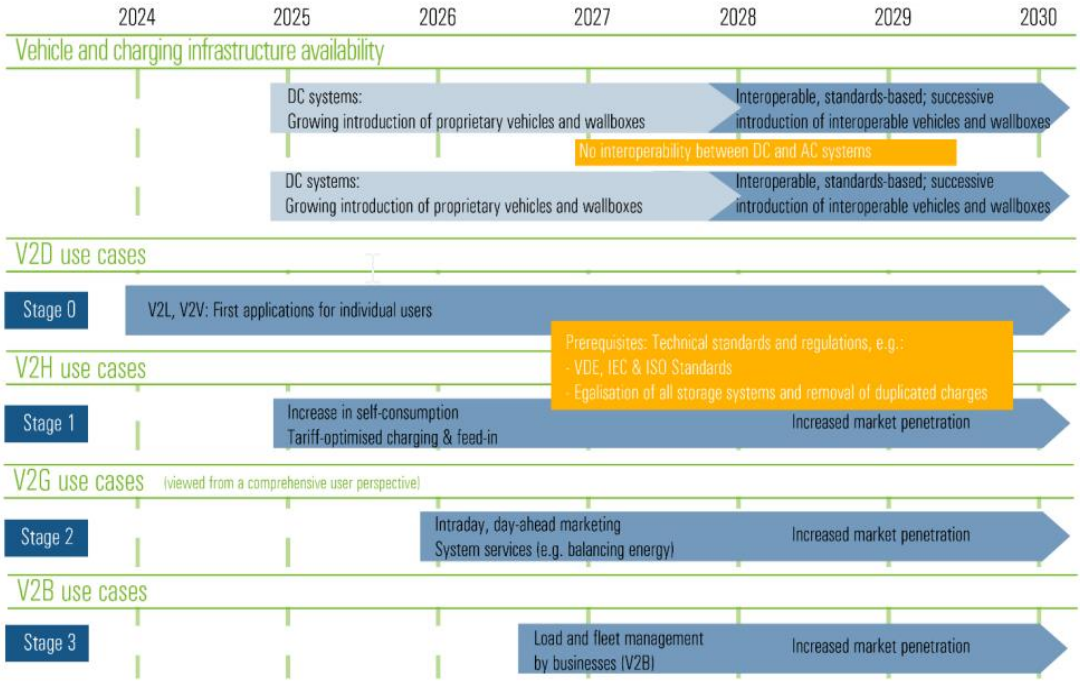
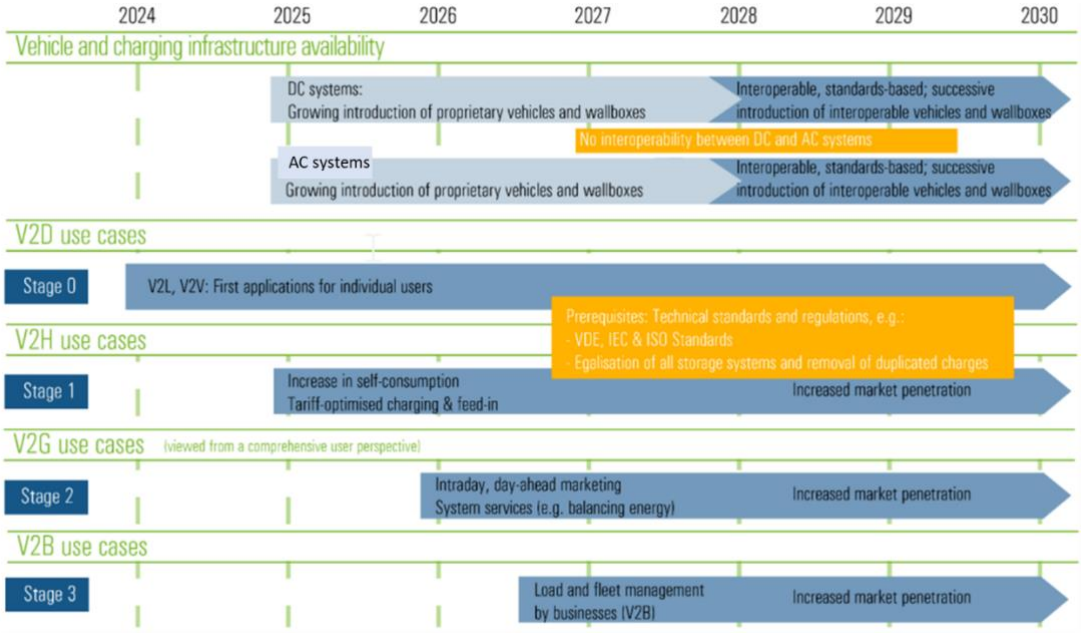
Annex 1: Timeline[6]





[6] https://nationale-leitstelle.de/wp-content/uploads/2024/07/20240716_bidirectional-charging.pdf

Annex 2: Definitions

Bidirectional charging is defined in the Alternative Fuels Infrastructure Regulation (AFIR) as follows: “bidirectional recharging means a smart recharging operation where the direction of the electricity flow can be reversed, allowing that electricity flows from the battery to the recharging point it is connected to”

It builds on the ‘smart recharging’ minimum definition within AFIR, which means ‘a recharging operation in which the intensity of electricity delivered to the battery is adjusted in real-time, based on information received through electronic communication’ and also needs to be further developed.

Source: V2Market project