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Roundtable 3 - Integration of EV to the grid – Challenges & opportunities related to how to make the grid greener and more flexible
Conclusions

Eurelectric has launched a series of Roundtables dedicated to increasing visibility of DSOs viewpoints and perspective on the issues pertaining to the whole E-Mobility ecosystem, reuniting the relevant stakeholders and identifying the bottlenecks pertaining to the deployment of E-Mobility in relation to the distribution grids.

Introduction:

The third Roundtable was dedicated to challenges & opportunities to make grids greener and more flexible. It was preceded by a survey where participants could provide valuable input for the discussions. The roundtable was focusing on three main technologies: smart charging and V2G. This roundtable touches upon both public and private charging infrastructure.

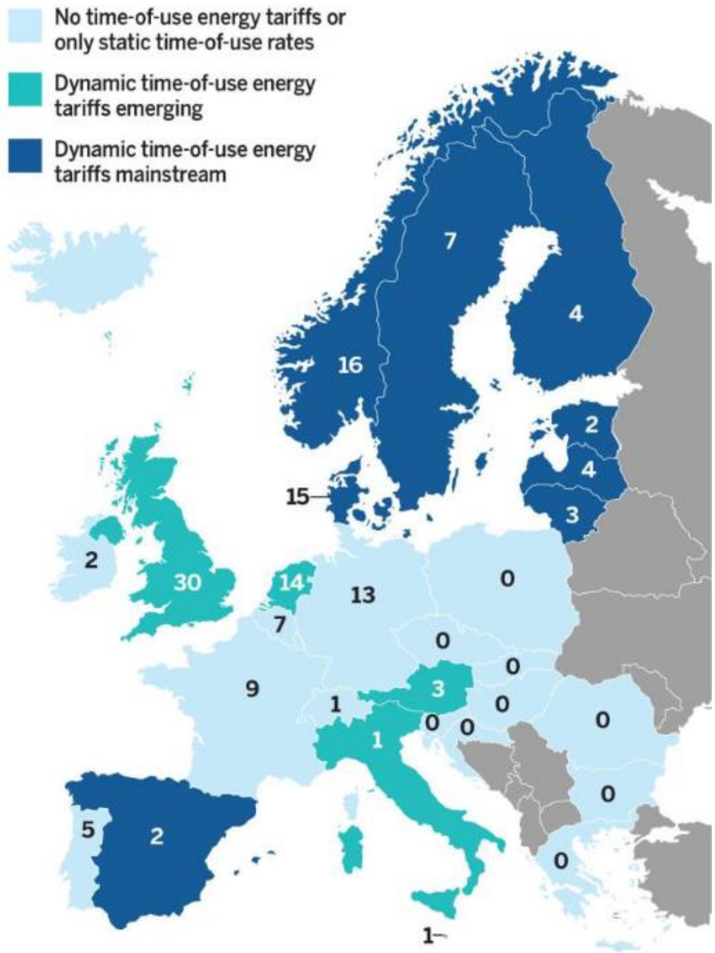
In our previous roundtable, we discussed and advocated for the use of flexibility solutions as a way to alleviate congestion by harvesting demand side flexibility through optimised EV Smart charging and Demand Side Flexibility. Roundtable members analysed these solutions, by highlighting the role that smart (uni-directional) charging, V2G (bi-directional charging) may help in tackling congestion in both public and private charging. While smart charging might be considered a technological prerequisite to any V2G solution, we define V2G solutions as technologies that enable the Electric Vehicles and/or the load infrastructure to deliver active and/or reactive power flow (or any other system services) to the grid. Smart charging on the other hand first and foremost describes situation where (active) power is being taken off the grid (in a smarter way) and or distributed to less congested periods of the day. For each technology, roundtable members examined its current state of play, the existing definitions, the state of applicable legislation, the benefits brought by these technologies, the key enablers and bottlenecks of these technologies.

I) Smart Charging:

1) Elements for a common understanding

State of Play of smart charging:

While the market for smart charging tariffs and service is taking up rapidly in Europe (ca. 150 dedicated smart EV charging tariffs and services were available to customers mid-2022), they are very unevenly distributed across European markets (see map below, absolute figures indicated). Their availability of smart charging services depends strongly on general favourable energy market regulatory framework, for example the availability of generic time-varying pricing, as well as consumers' awareness of these - below market. This map reflects how much smart charging is developed in Europe. We are also presenting the ecosystem of actors behind smart charging.



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[1] *Regulatory Assistance Project (2022): The time is now: smart charging of electric vehicles*

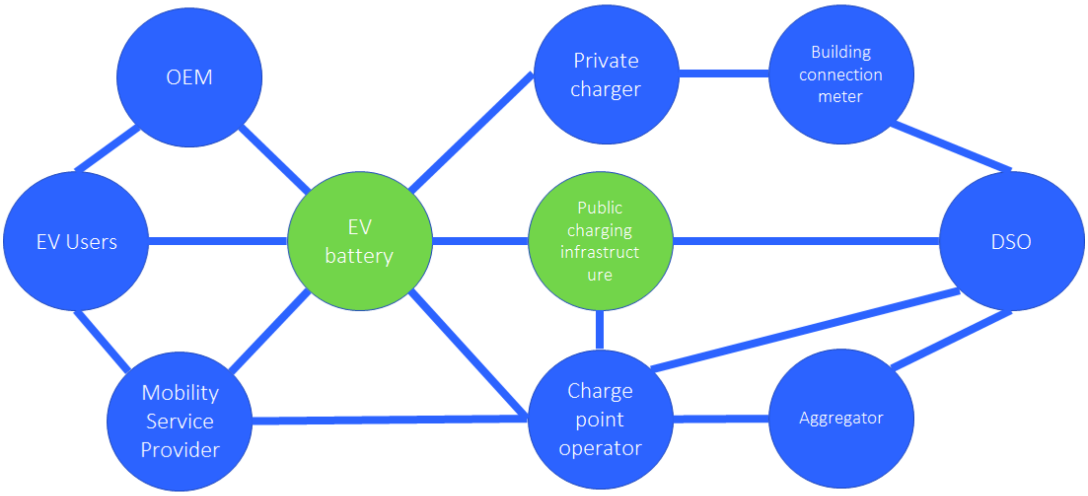


Figure 1 – The different actors involved and their interactions for smart charging

Definition of Smart Charging in legislation:

There are several official definitions for smart charging. We are examining two of the existing definitions, not so much as to challenge them but primarily as to build a common understanding based on the features highlighted in those definitions.

The first one is proposed in the European Commission's initial proposal to revise AFIR and more particularly Art 2.59 which states that:

"smart recharging' 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"

The second one is proposed by CEN CENELEC, the European Committee for electrotechnical standardisation. Within the Ad Hoc Group Smart Charging under Mandate 468, CEN CENELEC defines smart charging in the following terms:

"smart charging of an EV is when the charging cycle can be altered by external events, allowing for adaptive charging habits, providing the EV with the ability to integrate into the whole power system in a grid- and user-friendly way. Smart charging must facilitate the security (reliability) of supply and while meeting the mobility constraints and requirements of the user. To achieve those goals in a safe, secure, reliable, sustainable and efficient manner information needs to be exchanged between different stakeholders"

Several points are highlighted in these definitions:

- The Alteration of the charging cycle by external factors which opens up the discussion about the financial incentives to facilitate smart charging, e.g. charging tariffs
- Smart charging should create benefits for the final consumer as well as for the management of the grid
- The crucial role of the information exchanged which raises the question of the type of information exchanged, under what regulatory framework and under what communication protocols

The importance of Smart Charging in legislative proposals:

Regarding public infrastructure, the European Commission's initial proposal to revise AFIR and more particularly Article 5-8 states that:

"Operators of recharging points shall ensure that all publicly accessible normal power recharging points operated by them are capable of smart recharging"

Regarding private infrastructure, under Article 12-6 of the European Commission's initial proposal to recast EPBD, *"Member States shall ensure that the recharging points referred to in paragraphs 1, 2 and 4 are capable of smart charging"*

2) Smart charging as a tool for accelerating EV roll-out:

One of the benefits of smart charging is that it allows for faster connections under certain conditions. We would like to showcase two successful use cases of smart charging allowing for faster connections.

Case study: Vattenfall Eldistribution Conditional Connection Agreement in Sweden

In Sweden, Vattenfall Eldistribution is proposing a new product: voluntary conditional connection agreements for big customers and aggregated chargers for connections of 10KV and above. The customers get a guaranteed minimum connection on top of which stands a conditioned connection. As a technical requirement, the customer is required to have the ability to steer their equipment and have an API.

When the DSO wants to activate power reduction for a client, a call is sent through an API asking the client to steer their equipment – meaning reducing the consumption of their equipment or deciding to favor the consumption of some equipment of their portfolio while diminishing or shutting down the consumption of other equipment - 2 hours before the expected steering based on a forecast. The call is made 50 minutes prior to the steering if metering data is being used or if the forecast is not good enough. The DSO does not have the ability to steer or control directly what the client does, but the mechanism is working very well.

In Sweden, a national dialogue on harmonized communication protocols was launched and is expected to close in January 2023 to simplify communication between the actors and the different DSOs. For now, the protocols retained are OSCP and Open ADR.

The main benefits for these conditional connection agreements are that they significantly reduce connections time for new customers because they do not require grid reinforcement. These benefits have drawn a lot of new customers applying for Vattenfall Eldistribution's conditional connection agreements.

Finally, it is somewhat difficult to predict beforehand how many times Vattenfall Eldistribution would call a client that subscribed to a conditional connection agreement: understanding consumption and usage patterns is key and closely linked to the question of data, especially data of heavy load clients and historical information. However, as these conditional connection agreements are quite new, Vattenfall Eldistribution is constantly improving its data collection methods.

The DSOs is facing multiple challenges and opportunities:

- How to better manage the grid based on market-based price signals
- How to answer to local congestion
- How to integrate RES sources and local generation
- How to better use the new opportunities from EVs and heat pumps

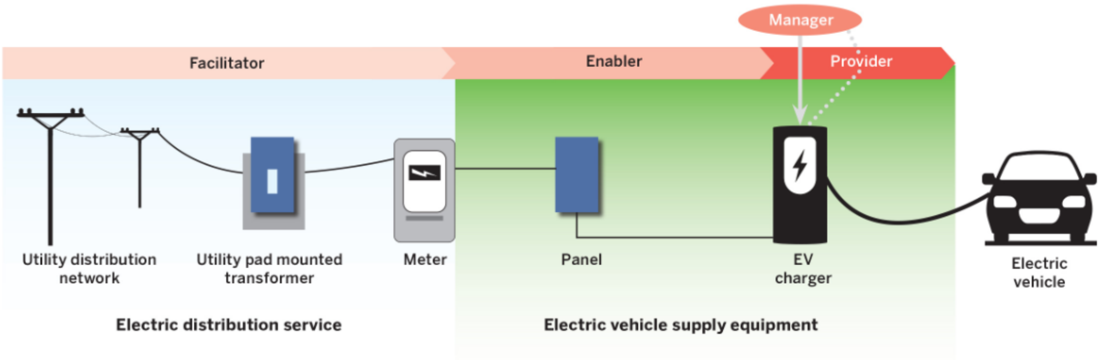
For instance, in Norway which boasts the highest EV penetration in the world, the use of a tariffs-based approach meant that EV charging used to take place at night. However, with the increase of RES sources and local generation, the EV charging has shifted during daytime. The overlap of the general expectation of price signals and grid usage is becoming more and more complex and calls for new solutions: smart charging is one of them. The Swedish and Norway examples highlight the idea that smart charging ideally is coupled with cost-reflective tariffs for DSOs to manage grid congestions.

However, the degree to which these benefits can be reaped depends on overall state of the grid. In Portugal for instance, on low voltage point, new secondary substations are being built for ensuring protection cables, not because of a lack of capacity, therefore in that case smart charging is not providing faster connections. In Portugal, the use cases where smart charging provides faster connections are difficult to find, however, regarding connection reinforcements there are use cases being explored that can speed up the process. The use case for smart charging heavily depends on national states of plays that need to be fitted within a proper electromobility model.

A key element of the equation is also the understanding of where the smartness stands and where it should happen. Different models could be proposed:

- Smartness activated at DSO level where the DSO has full control of behaviour smart charging process
- A More Market based approach, where CPO would activate flexible tariffs

The multiple models proposed highlight that there is not a unique way for smart charging and that multiple solutions need to be experienced and explored. Several initiatives such as the Energy Regulators Regional Association survey that includes among other topics the role of DSOs in building market for smart charging[2] or legal options such as a DSO controlled model of managed charging in Germany[3] were launched to explore the potentialities offered by these new models. The figure shown below illustrates the areas of responsibility for four potential utility roles in providing public charging:



[2]

1) The Benefits of smart charging

Smart charging can be beneficial to the final customer, to the grid and to the environment in a broader sense.

Regarding final customers, smart charging can be beneficial since it allows costs savings, comfort, ease of use and foster self-consumption pattern.

Regarding the grid, smart charging allows flexibility to reduce peaks in electricity demand as well as voltage control and deferred infrastructure upgrades as well as faster connection times as seen above.

Indeed, many EV smart charging pilots have demonstrated that increased peak demand from Charging can be effectively managed. Previous work shows that smart charging could reduce the necessary investment in distribution grids by at least 50% by 2030[3]. A recent large-scale investigation on dynamic time-of-use electricity tariffs shows that households (especially those with EVs) can significantly reduce their demand during the evening peak. While this might not completely remove the need for grid reinforcements, the ability to postpone them in some areas can help operators to build out the existing network more efficiently.

Finally, regarding the achievement of the Green Deal targets, smart charging allows the integration of more renewables while ensuring lower cost for wholesale and retail electricity prices as we will show subsequently.

An important feature of wholesale electricity markets is that the average electricity costs passed on to consumers through retail prices are lowered if consumption of electricity during peak hours is reduced and if more electricity is being consumed during periods of low, or even negative, prices. In

[2] Sources: Regulatory Assistance Project: June 2020: Building a market for EV charging infrastructure: A clear path for policymakers and planners
[3] *Agora Verkehrswende, Agora Energiewende, Regulatory Assistance Project. (2019). Distribution grid planning for a successful energy transition – focus on electromobility.*

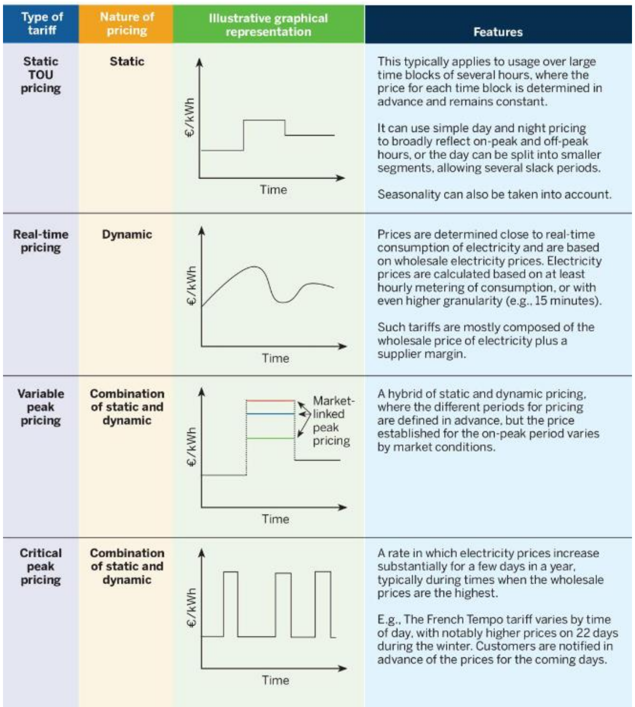
other words, all electricity consumers, including those who do not use an electric vehicle, benefit if EV drivers charge their vehicles smartly. The same is true for the costs of operating the grid: by shifting EV charging to periods of lower demand – and possibly increased local renewables production – grids can be operated more efficiently, reducing costs for all network users in case of increased demand there would be – possibly – not such a signal, which may result in a flattened price curve over time.

Proposed recommendations:

- After acknowledging the benefits created by smart charging, we are advocating **for a mandatory obligation regarding smart charging.**[4]
- After understanding the lack of awareness of final customers regarding the benefits that smart charging carries, we strongly advocate **for advertising campaigns and sharing of best practices issued by the relevant E-Mobility players to highlight these benefits based on the best practice set up in the UK with the Smart Charge Points Act 2021** which sets all new chargers to "smart" by default and mandates consumer information[5]
- Regarding customer empowerment, we support the **full transposition by the relevant National Authorities of the Energy Market Directive that aims to increase the active role of consumers in the energy system**

1) The Financial incentives to be set up for smart charging e.g charging tariffs for the final consumer:

As an introductory matter, here is an explanatory chart on charging tariffs:[6]



According to RAP's report: The time is now: smart charging of electric vehicles[7], In Europe, we observe a wide variety of charging tariffs: Overall, we found 139 tariffs and services across Europe specifically incorporating EV smart charging. Multiple smart charging services exist that can easily work with these tariffs, as all the prices are based on the day-ahead market. The total number of tariffs compatible with smart charging is therefore greater than 139. While there is significant geographical variance across Europe, EV uptake appears to be a logical reason for electricity providers to start introducing tariffs targeted at home charging and for start-ups to develop smart charging services. Car manufacturers increasingly acknowledge the potential of

[4] The revision of the AFIR and EPBD legislative files are under discussions as this document is released
[5] https://www.legislation.gov.uk/ukdsi/2021/9780348228434/contents
[6] *IRENA, International Renewable Energy Agency: Innovation Landscape Brief*
[7] *https://www.raponline.org/wp-content/uploads/2022/04/rap-jb-jh-smart-charging-europe-2022-april-26.pdf*

smart charging. Renault is a shareholder of the smart charging service Jedlix, which offers branded versions of its service to Renault and Hyundai drivers.

However, it is important to make the distinction between private and public charging.

For Private Charging:

A ToU network tariff adapts very well to electric vehicle charging at home. ToU with different energy charges in different periods will charge a low price per kWh in off-peak hours. If the capacity of the charger is lower than the contracted capacity of the home, it will be relatively cheap to charge the vehicle by night.

ToU network tariffs with different capacity charges are an efficient cost-reflective solution for pricing home electric vehicle charging. In these tariffs, the capacity charge in off-peak hours is low, thus it is cheap to contract additional capacity to be used in off-peak hours.

For an electric vehicle using 15 kWh/km and 10,000 km/year, the yearly cost for network tariffs and levies will be reduced from 263 €/year (under the current standard flat network Used capacity for a Spanish average household consumer (contracted capacity up to 10 kW) tariff) and 192 €/year (under the best available volumetric ToU tariff) to 16.2 €/year (under the new capacity and energy ToU network tariff).[8]

The energy transition should bring a significant increase in flexible loads such as electric vehicles and heat pumps with storage. These loads can withdraw energy in off-peak hours when the network is far from congested. ToU with time discrimination in capacity and energy charges allow increases in contracted capacity and energy used at low cost for the user, since this would be accommodated in the grid with very little extra investment.

For Public Chargers:

Network tariffs are a relevant cost for electric vehicle public chargers. Network tariffs with capacity charges have a negative impact while their utilisation is low (the cost per kW must be distributed among a small amount of energy), specially for fast, high capacity, chargers. In Spain, with the old network tariff, the capacity charge could have an impact of 5-7 €/charge. On the contrary, ToU tariffs do not benefit public chargers, as these are frequently used during peak hours. A volumetric tariff can overcome this impact. Therefore, some countries have introduced specific network tariffs to support public charging points, with lower capacity charges. Italy and Portugal have a purely volumetric tariff, with no capacity term.[9]

The lower revenues of the electricity system are more than compensated over time, as this new demand, which would not have been so significant otherwise, develops. In the medium term, with many electric vehicles and higher utilisation of public chargers, well designed network tariffs should not have a negative impact on this activity. Connection charges have a relevant impact on EV public

[8]https://cdn.eurelectric.org/media/5499/powering_the_energy_transition_through_efficient_network_tariffs_-_final-2021-030-0497-01-e-h-2ECE5E5F.pdf

[9] https://cdn.eurelectric.org/media/5499/powering_the_energy_transition_through_efficient_network_tariffs_-_final-2021-030-0497-01-e-h-2ECE5E5F.pdf

chargers, especially for fast and super-fast chargers installed relatively far from high-capacity distribution networks.

However, some cases are more complex: for instance, in Portugal, the network tariffs are charged by the electric mobility supplier directly to the EV user. Since there is no relation between the CPO and the electric mobility supplier, there is no incentive through network tariffs for the CPO, which owns the charger connected to the grid, to limit or increase demand at certain times, which is a big barrier for the implementation of smart charging or conditional connection agreements.

For more sophisticated electricity tariffs, coupling this system of charging tariffs with automation and dedicated customers applications can be explored

For more sophisticated electricity tariffs, automation is an easy-to-use solution. Software can translate the user's mobility needs into the data needed to optimise energy flows, such as the required volume in kilowatt-hours, time and charging power. The driver benefits from the vehicle being charged, and even heated or cooled, at the desired time of departure — with very little effort on their part. More information on the intended car usage, gathered from direct user input or perhaps calculated through a self-learning mechanism, means the system can develop a better charging plan. Analysis of usage patterns can help predict future needs, reducing the need for active user interaction with the smart charging process on a day- to-day basis.

The main bottlenecks regarding effective dynamic retail prices include the lack of availability of smart meters and taxes and levies that dampen the varying prices from wholesale markets.

Proposed recommendations:

- After acknowledging the importance of smartness at customer level (smart meters**), we call for the complete transposition into national law of the Electricity Directive fostering smart meters at individual level**
- After acknowledging the importance of smartness in the load infrastructure and at customer level, we seize the opportunity presented by the EU Action Plan on Digitalising the energy system to **encourage the Commission efforts to support the European Union Agency for the Cooperation of Energy Regulators (ACER) and the national regulatory authorities (NRAs) in their work to define common smart grid indicators, as well as objectives for these indicators,** so NRAs can monitor smart and digital investments in the electricity grid annually as of 2023
- After acknowledging the importance of smartness in the load infrastructure, we seize the opportunity presented by the EU Action Plan on Digitalising the energy system **to encourage the Commission efforts to support the development of a Digital Twin of the EU Electricity Grid**
- **We call for the removal of unnecessary taxes and levies in the wholesale market** that are unnecessary burdens preventing effective dynamic retail prices for smart charging

2) The Role of data sharing and data content:

For both technologies - smart charging and V2G – one of the key elements is to bring a lot of stakeholders in a short amount of time in an automated way. Big technical problems such as data collection and treatment methods (which are not being discussed here) need to be solved but the communication between actors is the most fundamental issue. The importance of communicated and coordinated command for grid management calls for the use of aggregation. As a use case, we would like to present an example: the INGA project in Germany.

Case study: INGA Intelligent Grid application for Distribution System Operators in Germany

The Main idea of INGA (Intelligent Grid application for Distribution System Operators) is to mitigate the problems related to the communication between DSOs and CPOs (both private and public) for the needs of the DSOs by providing a common platform bringing together the backend of CPOs with the DSOs. The platform is neutral, centered around DSOs services and was launched in July 2021. The project started off with EVs but could be extended to heat pumps as well and other distributed flexibility sources.

The communication protocol used for INGA is Open ADR which allows the exchange of information related to dynamic pricing, power limitations, time and connection points. It also allows a lot of freedom for providing tailored information to the market depending on the legislation of the country. In Germany, the current legislation does not require any additional technology, but any other countries that are looking into this problem – Norway for instance -, that shall not be an issue. However, the INGA model can be difficult to implement in some countries: in Spain for instance, negotiations with the National Regulatory authority are necessary.

The project has been up and running for 1,5 years, involves 4 DSOs and more than 1500 charging points. From a practical point of view, when a DSO detects or forecasts a congestion, the DSO calculates the power quota for each affected CPO (i.e. sum of connection points) and restricts the max. available power to e.g. 80 % for the next three hours. The benefit seen is that the DSO is not steering and indicating which resource is used for coping with the limitation since it is up to the market to decide which resource will get the power. As the area of congestion is important and covers multiple charging points, the curtailment of power delivered per individual charging point is quite low, which does not pose any major drawbacks to CPOs. The DSOs have no forceful way to make the customer comply with restricting his power, however, if the customer insists on not complying with the DSOs, they risk of getting their reduced grid usage fees revoked. Finally, it is in the best interest of participants to play by the rules and DSOs are trusting this approach.

Indeed, CPOs and end users benefit from reduced costs as a law in Germany offers lower grid fees (~4.5 cents for every kwh consumed) to users which loads could be managed by DSOs. However, in order to benefit from reduced tariffs, the users need to purchase dedicated certified meters which makes the adoption, especially for private households, more difficult because of how expensive these meters are. Another benefit similar to the Swedish example is the faster connection times for new customers.

Regarding the information on smart charging:

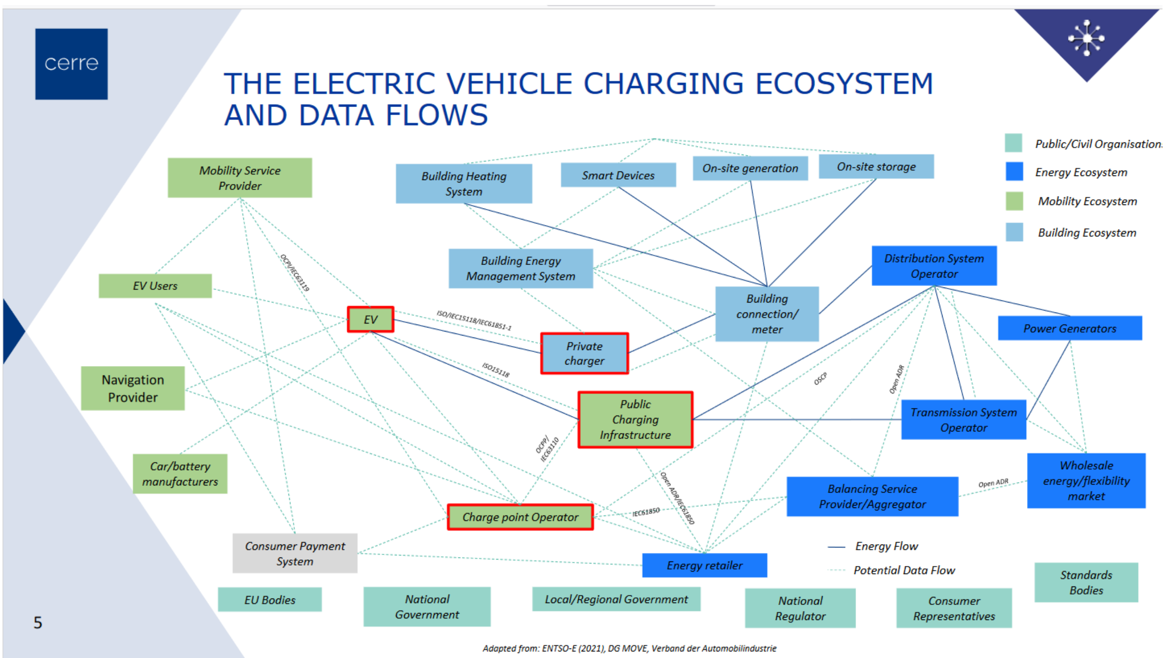
A comprehensive overview of data for smart charging can be structured in three main parts: the content of the information shared, the format and protocols for the sharing of data supported by a proper regulatory framework.

Regarding content of information, relevant information pertains to the battery (including state of charge, power setpoint and capacity), the user needs (including priority of charging compared to ability to wait, pricing for different times of download and potentially dynamic battery charging depending on exact network balancing needs and prices as they evolve over time), charging location and cost structure of the charging point.

Some of these elements are sensitive and need to be disclosed in such a way that no business case shall be endangered.

Regarding protocols and formats,

Here is a diagram presenting the electric vehicle charging ecosystem and its data flows



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While the Regulatory Assistance Project Standards for EV smart charging report[11] showcases in detail the role and application of selected standards, here is a quick overview of the standards mentioned by the participants:

- **ISO 15118-20:** ***Road vehicles -- Vehicle to grid communication interface*** is a proposed international standard defining a vehicle to grid (V2G) communication interface for bi-directional charging/discharging of electric vehicles. The standard provides multiple use cases like secure communication, smart charging and the Plug & Charge feature used by some electric vehicle networks

[10] *CERRE: ENERGY DATA SHARING: THE CASE OF ELECTRIC VEHICLE (EV) SMART CHARGING*
[11] https://www.raponline.org/wp-content/uploads/2022/12/ECOS-RAP-standards-for-EV-smart-charging-2022-dec.pdf

- **IEC 61851** is an international standard for electric vehicle conductive charging systems
- **IEC 63110** is an international standard defining a protocol for the management of electric vehicles charging and discharging infrastructures
- **IEC 62746-10-1 ED1 (Open ADR 2.0b)** is a communication protocol that specifies a minimal data model and services for demand response (DR), pricing, and distributed energy resource (DER) communications. It can be leveraged to manage customer energy resources, including load, generation, and storage, via signals provided by grid and/or market operators.
- **Open Charge Point Protocol** is an application protocol for communication between Electric vehicle (EV) charging stations and a central management system
- **IEC 63119** Information exchange for charging EVs everywhere – roaming: It aims at creating an internationally harmonised way for secure payment services and roaming, so that contracts for charging services remain valid across borders and charging station operators
- **EN 50491-12** Customer Energy Management (CEM) standard allows for a smooth integration of the EV into the Energy Management Systems.

Regarding the legislative frameworks

There are overarching principles and legislative frameworks regulating data in the EU:

- **The General Data Protection Regulation (GDPR)** enshrined a general data portability right for individuals
- **The Payment Service Directive 2 (PSD2**) introduced a rule on sector-specific access to account data
- **The Regulation on the free-flow of non-personal data** encouraged the development of self-regulatory codes of conduct to facilitate data sharing practices in business-to-business relationships
- **The Open Data Directive** aimed at promoting business-to-government data sharing collaboration supporting the wide availability and re-use of public sector information for private or commercial purposes
- **The Data Governance Act** pointed to increase trust in sharing data, lower transaction costs linked to business-to-business and consumer-to-business data sharing, and harmonise conditions for the use of certain public sector
- **The Digital Markets Act (DMA) and the Data Act** introducing interoperability obligations in the recently adopted and in the proposal for a Data Act

More specifically for the energy sector:

- **The Electricity Directive** has requested Member States to ensure the deployment of smart metering systems which should be interoperable, in particular with consumer energy management systems and smart grids

- **The proposed revision of RED II** introduces measures addressing the need for real-time access to basic battery information (such as state of health, state of charge, capacity and power set point) for facilitating the integration-related operations of domestic batteries and electric vehicles

- The Energy Performance of Buildings Directive (EPBD) establishes that Member States shall ensure that the building owners, tenants and managers can have direct access to their building systems' data and, at their request, the access or data shall be made available to third parties

Three main tendencies are emerging and need to be supported:

- The strong reliance on **Application Programming Interfaces (APIs)** as a key enabler to ensure a sound and effective data-sharing ecosystem
- The shift towards **interoperability**
- **In situ data right** for both individuals and firms, which implies that, rather than moving data from the platform, users are allowed to use their data in the location where they reside and to determine when and under what conditions third parties can access their in-situ data

Proposed recommendations:

- Regarding APIs and interoperability, we support the EU Action Plan on Digitalising the energy system. We especially endorse and advocate for:
  - **Adoption by the Commission of an implementing act on interoperability requirements, and non-discriminatory and transparent procedures for access to metering and consumption data** (as provided by article 24 of the Electricity Directive 2019/944 "Interoperability requirements and procedures for access to data")
- **Promoting a code of conduct for energy-smart appliances to enable interoperability and boost their participation in demand response schemes**
- Regarding in-situ access right, we **support the provisions of PSD2 on in-situ access right**

II) V2G (Vehicle to Grid)

Our assumption is that most of the times, vehicle to grid would probably fall within the definition of Vehicle to system, understood as a reserve product: the party buying the service is either a balance responsible party or a TSO in its role of balancing responsible party or in its role of system operation responsible.

1) State of play:

It is important to shift the focus on batteries and the data it generates which involve 3 parties:

- The OEM as the manufacturer of the vehicle
- The User as the owner of the battery and the data related to its usage
- The MSP as needing access to the battery data for charging

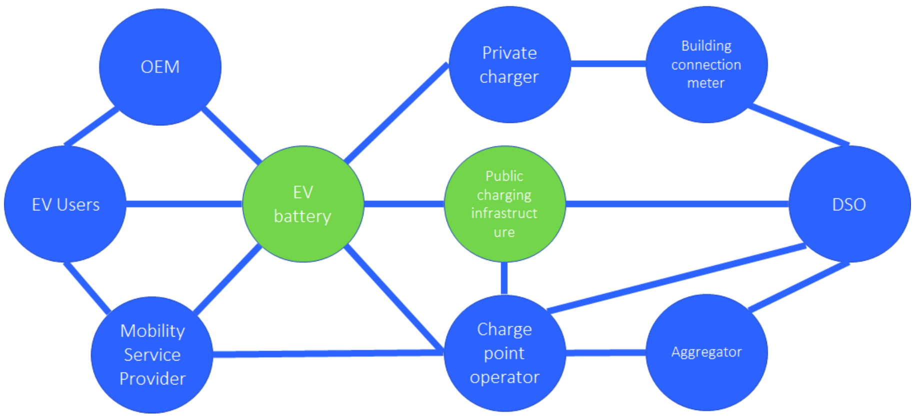

Figure 2 – The different actors involved and their interactions for V2G

Definition:

As a preliminary note, we are going to focus on V2G (Vehicle to Grid) but it is important to understand that V2G is part of a broader technology V2X (Vehicle to X) that allows the vehicle to give back electricity to any form of equipment.

Under the European Commission's initial proposal to revise AFIR and more particularly Article 2.9, V2G is defined as follows:

"bi-directional recharging' means a smart recharging operation where the direction of the electricity flow may be reversed, allowing that electricity flows from the battery to the recharging point it is connected to"

The technical elements of V2G are also defined within the ISO 15118 standard, which specifies the type of standard protocols for a V2G connection between a vehicle and the grid, as well as key indicators.

We would like to complement the V2G definition set up in the initial proposal of the European Commission for AFIR by highlighting several points that we deem crucial in V2G:

- Alteration of the electricity flows which opens the discussion to the financial incentives to be set up for V2G e.g tariffs/fees and whether V2G shall be considered as a generation energy source
- The crucial role of the information exchanged which raises the question of the type of information exchanged, under what regulatory framework and under what communication protocols, in particular interoperability of data
- The advantages as well as the drawbacks that this technology carries

State of the legislation:

Under the European Commission's initial proposal to revise AFIR and more particularly Article 13 -1, it is stated that:

"National policy framework shall contain at least the following elements:

measures necessary to ensure that the deployment and operation of recharging points, including the geographical distribution of bidirectional charging points, contribute to the flexibility of the energy system and to the penetration of renewable electricity into the electric system;"

Under the European Commission's initial proposal to revise AFIR and more particularly Article 14-4, it is stated that:

"On the basis of input from transmission system operators and distribution system operators, the regulatory authority of a Member States shall assess, at the latest by 1 30 June 2024 and periodically every three years thereafter, the potential contribution of bidirectional charging to the penetration of renewable electricity into the electricity system. That assessment shall be made publicly available. On the basis of the results of the assessment, Member States shall take, if necessary, the appropriate measures to adjust the availability and geographical distribution of bidirectional recharging points,

in both public and private areas and include them in their progress report referred to in paragraph 1."

Under the European Commission's initial proposal to recast EPBD, it is stated in Article 12 – 6 that:

"Member States shall ensure that the recharging points referred to in paragraphs 1, 2 and 4 are capable of smart charging and, where appropriate, bidirectional charging"

2) The benefits of V2G:

V2G can be beneficial to the final customer, to the grid and to the environment in a broader sense.

Regarding final customers, the benefits gained pertain to comfort, ease of use, cost savings and reliability of electricity supplies.

Regarding the grid, V2G allows flexibility to reduce peaks in electricity demand as well as voltage control (and other auxiliary services) and deferred infrastructure upgrades.

Finally, regarding the achievement of the Green Deal targets, by actively contributing to reinjecting electricity into the grid, V2G has positive effects on the achievement of the objectives of the Green Deal as a whole.

Proposed recommendations:

- After acknowledging the potential benefits that the V2G technology could bring and depending on what further research on the technology will reveal, **we advocate for the deployment of V2G ready infrastructure when appropriate**.[12]
- We would recommend that **European codes should consider the fact that injection of power into the grid could come from different locations (rather than a fixed location).** This would allow AC V2G from cars which would a cheaper solution to implement.
- Push the legislation so **that DSOs assess the potential contribution of bidirectional charging to the penetration of renewable electricity into the electricity system.** That assessment shall be made publicly available and be based on a common European methodology, to be defined by ENTSO-E and the EU DSO Entity.

3) Points to be highlighted:

The grid capacity to absorb the impact of V2G

While some DSOs such as RTE have deemed the technology to be ready to be integrated into the grid, it is legitimate to ask ourselves whether DSO are ready to welcome the technology. During the

[12] The revision of the AFIR and EPBD legislative files are under discussions as this document is released

discussions, DSOs have highlighted that more dialogue and research needed to be done for V2G, as well as strengthening the business case for the technology.

Voltage issues:

A key element important for V2G is voltage issues. For domestic charging infrastructure, voltage issues need to be tackled by the domestic energy management system that needs to provide support voltage for domestic connection first and then for the local area. For public infrastructure, solving voltage issues directly relate to the regulation issue and the aggregation problem which can be tackled using statistical analysis. Therefore, it is important that more research needs to be done for seeing at what voltage level support from EVs should be provided.

The impact of V2G on the battery

A big question to be asked to components manufacturers relate to the lifecycle of their components, especially the battery regarding the use of V2G. Indeed, studies are not consensual on the role that V2G has on battery life cycle and life expectancy. The lack of consensus over that question may be a bottleneck for the widespread adoption of this technology. As a conclusion, further research needs to be made.

The business case for V2G

While most V2G project are still in a pilot phase, we could expect fleets to be the first to enter a viable V2G market business case because they have the right combination of technology, portfolio effect and statistical analysis competences that would enable them to take part to reserve markets. However, there are still significant prices differences between a unilateral and bilateral charger: a bidirectional charger costs up to 3 times more than a unidirectional charger. The readiness of vehicles is also going to be a key element for the success of the technology. Currently only a couple manufacturers are producing V2G ready vehicles. Volvo have also announced that they will produce V2G vehicles in the near future.

Question of data sharing:

This is a key topic for V2G. The section dedicated to data sharing and data content is important for building a good understanding of the issues related to data.