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CEER Report on Electric Vehicles: Network Management and Consumer Protection

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Council of European Energy Regulators asbl
Cours Saint-Michel 30a, Box F – 1040 Brussels, Belgium
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INFORMATION PAGE

Abstract

The aim of this report (C23-DS-CRM-161-03) is to present an overview of the development of electric mobility and the main issues for national regulators, with a view to deploying charging infrastructure in CEER member countries, integrating electric mobility into energy systems, and taking account of consumer concerns. It sets out several courses of action for national regulators to ensure the sustained development of electric mobility, in line with European objectives, as highlighted in the Alternative Fuel Infrastructure Regulation (AFIR).

Target Audience

national regulatory authorities, energy suppliers, traders, gas/electricity customers, the electric mobility industry, consumer representative groups, network operators, Member States, academics, and other interested parties

Keywords

electric vehicles; charging infrastructure; alternative fuels; power systems; flexibility; consumer protection; consumer participation

If you have any queries relating to this paper, please contact:
CEER Secretariat
Tel. +32 (0)2 788 73 30
Email: brussels@ceer.eu

Related Documents

CEER Documents

- Report on Innovative Business Models and Consumer Protection Challenges, September 2021, Ref. C20-CRM-DS-03-03
- ACER/CEER Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2021, October 2022
- CEER Views on Electricity Distribution Network Development Plans, 24 November 2021, Ref: C21-DS-72-03

External Documents

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EXECUTIVE SUMMARY

Background

While the development of electric mobility raises major issues for the mobility sector in general, it also has a profound impact on the power system. The aim of this report is to address the main challenges identified for the electrical system and its stakeholders, and the levers of action at the disposal of European energy regulators to overcome them.

First, charging infrastructure is needed to support the development of electric vehicles. This report looks at the powers of regulators to ensure that they are deployed at a controlled cost and at a sufficient pace to meet European targets. The regulation of network operators, the inclusion of the new costs generated by electric mobility in network tariffs, and the management of new stakeholders are some of the topics covered in this report.

In addition, electricity demand fits into a complex energy transition that also involves the integration of renewable energies and the decentralisation of production capacity. The associated need for flexibility is growing, and electric mobility plays a central role in tomorrow's power system. It must be fully integrated to decarbonise transport, while minimising its impact on the power system, and even contributing to the flexibility potential that the system will need in the future. This report therefore looks at the tools available to the regulator to control this impact, encourage smart charging behaviour and develop the contribution of electric vehicles to power system flexibilities.

Lastly, the development of electric mobility is changing consumer expectations. On the one hand, from the point of view of their ability to participate in the market in general, notably by managing their recharging and clearly identifying the offers best suited to their needs.

On the other hand, from a consumer-protection perspective, ensuring that the information provided is comprehensible, that the general level of service provided is reliable, and that consumers can find an equal level of service throughout the European Union.

The report explores the best practices available to regulators to achieve these objectives.

Objectives and Contents of the Document

The aim of this report is to present the challenges associated with the development of electric mobility from three angles: the deployment of charging infrastructure; the integration of electric mobility into networks; and the consideration of consumer needs. Specifically, this report seeks to provide an insight into the options available to national regulators; to highlight best practices; and to reflect on feedback from CEER member countries in these three areas. This report states several suggested actions for national regulatory authorities (NRAs), including adapting the regulation of system operators to the new challenges and costs induced by electromobility, implementing incentives to smart charging through network tariffs and working together with system operators to monitor the impacts of electric vehicles on the power system, as well as encouraging consumer participation and ensuring consumer protection and empowerment.

The content of the document is as follows:

- Deployment of charging infrastructures in the CEER member countries;
- System integration of electric vehicles; and
- Consumer issues.

Brief summary of the conclusions

The report concludes that energy regulators have an important role to play in integrating electric mobility into the energy system. Whether in the application of their existing powers, in the formal evolution of their competencies under national legal frameworks, or in their ability to collaborate with relevant stakeholders, such as grid operators and energy suppliers, regulators have a range of options at their disposal to meet the challenges addressed in this report. The report provides examples of actions NRAs may find helpful in considering their approaches to electromobility within their national mandates, supported by real-life best practice case studies from across CEER member countries.

1 Introduction

Electric vehicles (EVs) are quickly becoming an integral part of European mobility landscape and the energy transition in the transport sector. The number of battery-only electric passenger vehicles in CEER member countries (MCs) surpassed 1 million for the first time in 2020. This is already three times more than the number recorded in 2018.[1] This number does not include hybrid electric vehicles (HEV); otherwise, the figure would be even higher. For instance, in 2017, the number of battery-only and hybrid electric cars was around 2 million already.[2]

The electrification of mobility has been identified as a precondition for successfully reducing dependence on fossil fuels; it also contributes to the reduction of air and noise pollution.[3] Recent technological advances, particularly in the development of rechargeable car batteries, and the scale of public policies enabling the uptake of EVs, have contributed to the steady development of a European EV market.

Converting the fleet of passenger cars, light commercial vehicles and heavy-duty vehicles requires the deployment of charging points accessible to the public or private sector, in towns and cities, in private parking areas, freeway service areas and on company premises. These charging points are a complement to home charging points, which are currently the main mode of charging in several European countries.

However, the time it takes to connect charging stations can affect the pace of charging infrastructure deployment. The costs of equipping, connecting, and reinforcing networks must be kept under control to ensure economic sustainability, particularly for households, taxpayers, and network users (Chapter 2).

It is therefore vital to encourage a shift towards smart charging behaviours by enabling services to optimise the total costs of the electrical system. Moreover, EV batteries can provide an additional building block for the development of renewable energy sources (RES) and their integration into power systems, as they represent a potentially significant storage capacity under the right technical and economic conditions (Chapter 3).

Despite the recent volatility in the electricity prices, the crisis experienced by energy markets since 2021 should not (be allowed to) discourage the electrification of transport over the long term. While the crisis has brought issues of consumer protection and affordability to the fore, the long-term role of the transition to EVs for the decarbonisation of the transport sector remains significant.[4] Thanks to the flexibility they bring, EVs can contribute to security of supply and supply-demand balance and can be an asset in times of crisis. Nonetheless, it is important that consumers are sufficiently involved in the transition and are able, and willing, to participate as e-drivers. This requires good understanding of consumer expectations, attitudes and behaviours on the part of policy makers, as well as having in place appropriate protections, with a particular regard for disadvantaged groups who are less able to participate.

The changing mobility landscape means that the challenges facing consumers are evolving, for example, in terms of price transparency and overall quality of service from new service providers like charge point operators (CPOs) and other enablers. This includes fair access to charging infrastructure both on a national level and cross-border, avoiding lock-in effects of energy or service contracts. Recent policies and industry efforts have helped to advance the possibilities and protections in public charging thanks to improved interoperability of charging

[1] Passenger cars in the EU, Eurostat, 2022. Retrieved from: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger_cars_in_the_EU
[2] Number of electric cars is on the rise, Eurostat, 2019. Retrieved from: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20190507-1
[3] Noise Emission Models of Electric Vehicles Considering Speed, Acceleration, and Motion State, Int J Environ Res Public Health, 2023. Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9959875/
[4] IEA (2022), Electric Vehicles. Technology deep dive, IEA, 2022. Retrieved from: https://www.iea.org/reports/electric-vehicles

stations, payment methods and the standardisation of information available across Europe (Chapter 4).

The 'Fit for 55' package and the Alternative Fuel Infrastructure Regulation (AFIR) set ambitious targets for the development of electric mobility and charging infrastructure in Europe. The European texts are aimed primarily at Member States (MS), as the addressees of these recommendations and objectives. Most policy options are in the hands of national and local governments to implement these objectives through public policies (e.g., via subsidies for the purchase of EVs or installation of charging stations or making public aid for charging stations conditional on the presence of a charging control system). Nonetheless, national regulatory authorities (NRAs) can also have both direct and indirect roles in facilitating electric mobility.

Role of NRAs

NRAs are responsible for setting electricity transmission and distribution tariffs, or their methodology, or both, which in turn reflect the costs incurred by network operators and the evolution of their missions. Electric mobility represents a growing volume of investment for grid operators, both to connect charging infrastructures and to reinforce networks to meet electricity needs, particularly during peak periods. Regulators are also responsible for ensuring that network operators meet their obligations to other market participants, in particular energy suppliers, service and infrastructure operators and end consumers. Regulation also extends to consumer issues; particularly where the mandate of regulatory authorities includes consumer protection. These general powers to regulate the energy market apply by extension to the challenges of electric mobility.

National legislative and regulatory frameworks may confer further responsibilities on energy regulators, more specifically oriented towards the organisation of electric mobility. However, this landscape of NRA competences is highly heterogeneous, **as highlighted by a recent survey of NRAs conducted as part of the drafting of this report** (for details, please see Annex 1).

The survey had asked NRAs from CEER MCs to provide examples of regulatory actions taken in the areas of network preparedness and deployment of charging infrastructure, system integration of electric vehicles, and consumer participation, protection and empowerment. The results provided an insight into the existing regulatory landscape and varying mandates:

- NRAs often lack a *direct* mandate to intervene in the EV market. Indeed, a number of NRAs stated that specific responsibilities resided with relevant government departments (e.g. alongside transport, energy or industry);
- However, recognising the opportunities and challenges of the transition to EVs, many have leveraged their *existing* powers, for example to regulate distribution system operators (DSOs), set tariffs, allow trials and sandboxes, or strengthen consumer protection, to take action. Indeed, of the **20** responses received, **14** NRAs responded positively with an example of a regulatory action taken in at least one of the three areas. In addition, **three** NRAs provided at least an example of either a planned action or work indirectly related to facilitating electromobility in at least one of the areas. Only **four** NRAs expressly stated no regulatory work has been carried out to date. Some NRAs have also indicated that they are planning to carry out work in the future.
- Across the three surveyed areas, respondents gave most examples (**13** out of 20) of current or future actions in relation to facilitating deployment of recharging infrastructure, typically via DSO regulation to remove barriers to new connections. **Twelve** NRAs showcased examples of their current or future work on EV-related consumer issues, including information provision, price transparency or setting of standards; and **ten** NRAs provided examples of actions in the area of system integration, such as running a sandbox service for innovators, putting requirements on DSO business planning, or involvement in vehicle-to-grid (V2G) trials.

The results also seem to suggest that the development of electromobility is not necessarily tied to the intervention of NRAs as illustrated by the example of Norway, a country with an advanced rollout of EVs but where the NRA does not have a direct mandate.

Generally speaking, electric mobility is a sector that is becoming fully integrated into the management of national and European energy systems, in terms of market development and the evolution of distribution and transmission infrastructures. In this sense, regulators are already, or will necessarily be, confronted with the need to adapt existing regulation of the players they already oversee, or develop approaches to meet new challenges and respond to new business models.

From this perspective, the aim of this report is to present the challenges associated with the development of electric mobility from three angles: the deployment of charging infrastructure; the integration of electric mobility into networks; and the consideration of consumer needs. Specifically, this report seeks to provide an insight into the options available to NRAs, highlight best practices and reflect on feedback from CEER MCs in these three areas.

Overview of relevant regulations

In July 2021, the European Commission submitted the proposal for a Regulation on the deployment of alternative fuels infrastructure to the European Parliament and to the Council, as part of the 'Fit for 55' package.

This regulation aims, first, at ensuring "that there is a sufficient infrastructure network for the (re)charging or (re)fuelling of road vehicles or vessels with alternative fuels; second, to provide alternatives to the use of on-board engines (powered by fossil fuels) for vessels at berth or stationary aircraft; and third, to ensure full interoperability and user friendliness of the infrastructure"[5]. Following almost two years of collegial and inter-institutional discussions, a compromise text was found on the entirety of the Regulation.

The Regulation comprises ambitious quantitative and qualitative objectives to be met by MS at different deadlines, among which:

- *Power output objectives*: A power output of at least 1.3 kW per battery electric light-duty vehicle and 0.8 kW per plug-in hybrid light duty vehicle is provided through publicly accessible recharging stations; this objective stands until EVs and HEVs represent 15% of MS' total light duty vehicles fleet.
- *Geographical distribution of charging points*: Along the Trans-European Transport Network (TEN-T) core network, publicly accessible recharging pools dedicated to light-duty vehicles are deployed at a maximum distance of 60 km in between them, in each direction of travel: by 31 December 2035, each recharging pool shall offer a power output of at least 600 kW and include at least two recharging points with an individual power output of at least 150 kW. This objective is met through intermediate milestones in 2027 and 2030. Some exceptions are provided in the regulation for TEN-T roads with an inferior traffic. These distances must also apply to neighbouring countries on their cross-border sections of TEN-T core and comprehensive networks.
- *National policy frameworks*: By 1 January 2025, each Member State shall prepare and send to the European Commission a draft national policy framework for the development of the market as regards alternative fuels, including an assessment of

[5] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU of the European Parliament and of the Council. Retrieved from: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021PC0559

current and future development of market and infrastructure, national targets and objectives, policy and measures necessary to ensure reaching their objectives.

- *Technical assessments*: By 30 June 2024 and periodically every three years after, MS shall assess how the deployment and operation of recharging points could enable EVs to further contribute to the flexibility of the energy system, including their participation in the balancing market, and to the further absorption of renewable electricity.

Other directives, either at the stage of provisional agreements or already in effect, which refer to EVs include:

- The proposal for a directive of the European Parliament and of the Council on energy efficiency, recognising that charging infrastructure 'is one of the necessary elements in the transition', states in its preamble that public authorities should 'make their best efforts to install recharging infrastructure in buildings they own or occupy in line with the requirements of the Energy performance of buildings directive'[6].
- Article 12 b of the Energy Performance of Buildings Directive prescribes that MS shall ensure the installation of pre-cabling for every parking space to enable the installation, at a later stage of recharging points for EVs, electrically power-assisted cycles and other L-category vehicle types. In addition, Article 12 (4) mentions that MS shall ensure the installation of pre-cabling for every parking space **in new residential buildings. In residential buildings undergoing major renovation**, MS shall ensure the installation of pre-cabling or, where technically and economically unfeasible, ducting for every parking space to enable the installation, at a later stage, of recharging points for EVs and electrically power-assisted cycles and other L-category vehicle types; MS shall ensure that the pre-cabling is dimensioned to enable the simultaneous use of recharging points on all parking spaces.
- The current Renewable Energy Directive (RED) states that interoperability and harmonised data formats and standardised data sets should be made available to the use of electricity market participants, so that it can be read by electronic communication devices such as EV charging points (article 20a (1)). It also states that MS should ensure that the national regulatory frameworks don't discriminate against the participation of EVs in electricity markets, directly or through aggregation (article 20a (4)).[7]

The below table sets out a high-level overview of "suggested actions" which NRAs may consider when developing their approach towards electric mobility, subject to their remit and national context. These suggestions are linked to practical case studies illustrating approaches taken by different MS across three thematic areas covered by this report. In addition, Annex 1 of this report provides further examples of the role of NRAs from 20 CEER MCs.

[6] Proposal for a directive of the European Parliament and of the Council on energy efficiency (recast) (COM(2021)0558 – C9-0330/2021 – 2021/0203(COD)). Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022AP0315

[7] Directive of the European Parliament and of the Council amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0557

Suggested actions	Case study reference	Page
Suggested action 1: • NRAs to introduce exemptions to facilitate the deployment of charging infrastructure within the framework of the prerogatives conferred by national law.	CS 1 (Norway)	21
Suggested action 2: • NRAs to monitor the time taken by transmission system operators (TSOs) and DSOs to carry out connections and repairs; and • NRAs to monitor and evaluate the performance of TSOs and DSOs based on a limited set of indicators, at NRAs' discretion.	CS 2 (France)	22
Suggested action 3: • NRAs to express an opinion on subsidy mechanisms/public policies within the framework of the prerogatives entrusted to them by national law, when setting network tariffs, to ensure that they are fair, stable and acceptable; and • NRAs to monitor or supervise the development of Distribution-Network Development Plans.	CS 4 (France) CS 5 (Finland)	28, 29
Suggested action 4: • NRAs to implement a framework for alternative/flexible connections.	CS 6 (Norway) CS 7 (GB)	30
Suggested action 5: • NRAs to work with TSOs and DSOs to monitor the impacts of EV charging on the system and its contribution to flexibility; • NRAs to ask TSOs and DSOs to publish network data to facilitate the choices of location for new charging points; and • NRAs to take steps to costs of network connections.	CS 8 (Germany) CS 9 (GB)	32, 33
Suggested action 6 (system integration): NRAs to adapt network tariffs to incentivise smart charging: • Time-of-use tariffs with high time-differentiation, reflecting network costs; and • Differentiated contractual capacity limit to incentivise EV charging in off-peak hours.	CS 10 (Italy)	40
Suggested action 7 (consumer participation): NRAs to take action to reduce barriers to EV uptake, including: • Raising awareness of the benefits of EV ownership, particularly in relation to smart charging; • Identifying and removing potential regulatory barriers that prevent innovators and new business models to enter the market; and	CS 11 (Italy)	47

Suggested actions	Case study reference	Page
• Carrying out more research into consumer attitudes towards EV ownership, with a particular attention to consumer behaviour in EV charging.		
Suggested action 8 (consumer protection): NRAs to utilise existing powers and processes to ensure compliance with both existing and new regulations, including: • Oversight of market participants' adherence to European or national regulation; • Regular reporting on the state of the market • Taking compliance or enforcement action when appropriate; and • Providing guidance for innovators to more easily navigate the regulatory environment.	CS 12 (Germany) CS 13 (Netherlands) CS 14 (GB)	50, 51, 52
Suggested action 9 (consumer empowerment): NRAs to consider facilitating consumer access to information about public charging, for example: • Publishing or maintaining centralised public registers and maps; and • Publishing or maintaining platforms providing information about offers in the public charging market.	CS 15 (Germany) CS 16 (Poland)	55, 57
Suggested action 10 (other issues) NRAs to identify regulatory gaps and monitor emerging issues, including in areas of: • Equity; • E-roaming; • Interoperability; and • Data.		

Table 1 – List of suggested actions and included case studies

2 Deployment of EV charging infrastructure

2.1 State of the art: context and objectives

According to 2023 data from the Alternative Fuels Observatory, more than 500,000 publicly accessible charging points were deployed in the EU, among which 14% (70,800) suitable for fast charging and 6% for ultra-fast charging (30,600)[8] (see **Error! Reference source not found.**). The geographical distribution of charging points varies widely between MS, with 55% of charging points concentrated in three MS, the Netherlands, Germany, and France[9,10] (see **Error! Reference source not found.**). This mirrors an uneven distribution of EVs across Europe, with the Nordic and Benelux countries having the highest EV uptake as percentage of their national vehicle stock.[11]

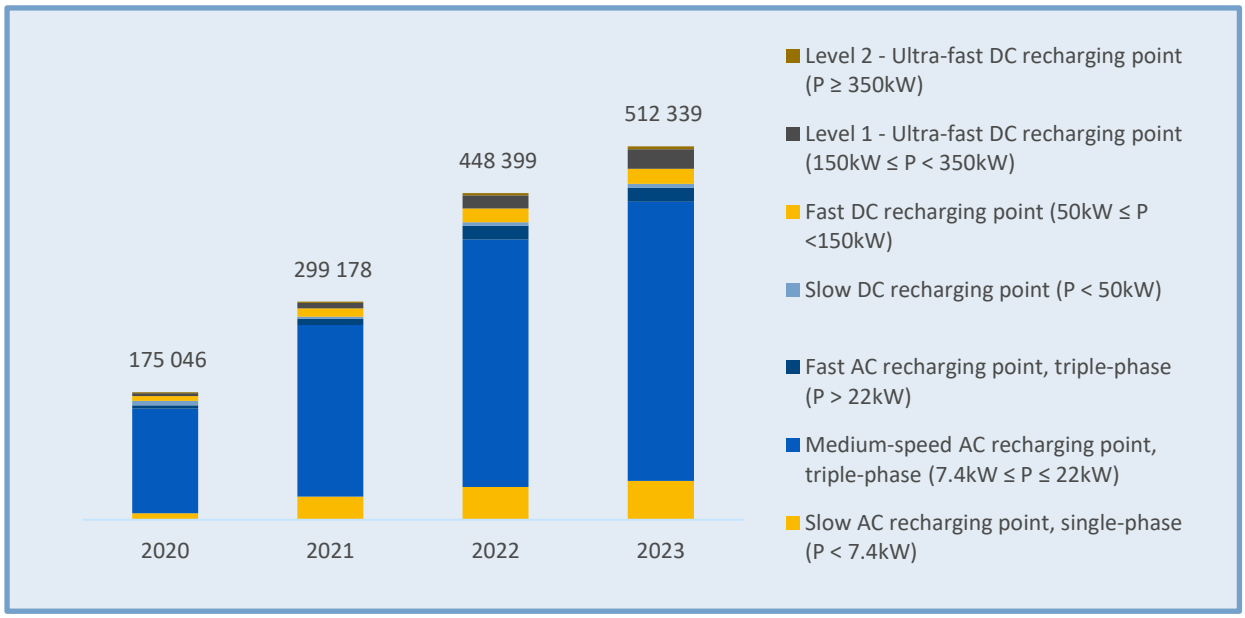


Figure 1 - Development of the number of publicly accessible recharging points in the EU (2020-2023)

Accelerated growth in the number of charging points will be needed in the coming years to meet the targets set by AFIR. According to different studies conducted in recent years, the number of required public charging points will be more than 2 million by 2030 (according to the NGO Transport & Environment[12] 1.5 million in 2025 and 2.9 million in 2030; according to the European Automobile Manufacturers' Association's estimates[13], 1 to 2.4 million charging

[8] Alternative fuels observatory (2023), 'European Union (EU27)', https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/european-union-eu27
[9] Infrastructure for charging electric vehicles: more charging stations but uneven deployment makes travel across the EU complicated, European Court of Auditors, 2021. Retrieved from: https://op.europa.eu/webpub/eca/special-reports/electrical-recharging-5-2021/en/
[10] EV charging statistics 2023, Zapmap 2023. Retrieved from: https://www.zap-map.com/ev-stats/how-many-charging-points
[11] State of the Industry Report, Charge up Europe, 2023, p.12. Retrieved from: www.chargeupeurope.eu/2023-state-of-the-industry
[12] EU needs 15 times more public chargers by 2030 to help become climate neutral – analysis, Transport and Environment, 2020. Retrieved from: https://www.transportenvironment.org/discover/eu-needs-15-times-more-public-chargers-2030-help-become-climate-neutral-analysis/
[13] European EV Charging Infrastructure Masterplan, European Manufacturers' Association (ACEA), 2022. Retreved from: https://www.acea.auto/files/Research-Whitepaper-A-European-EV-Charging-Infrastructure-Masterplan.pdf

points by 2025 and 2.9 to 6.8 million by 2030, in addition to 29.4 million private charging points). According to ChargeUp Europe, the total amount of charging infrastructure in the EU will increase to 25 million charging points in 2030[14].

To ensure sustained development of EVs, MS and non-EU MS MCs will have to oversee the deployment of charging infrastructure in sufficient volumes, adequate power outputs and harmonious distribution.

Country	Number of publicly accessible charging points
Netherlands	132,722
France	100,664
Germany	87,871
United Kingdom	43,626
Italy	34,730
Belgium	31,227
Sweden	26,618
Norway	25,585
Spain	24,892
Austria	18,080
Denmark	14,180
Finland	7,641
Portugal	6,764
Poland	4,179
Czech Republic	3,758
Hungary	3,324
Luxembourg	3,068
Ireland	2,441
Slovakia	2,020
Romania	1,805
Slovenia	1,518
Croatia	1,180
Bulgaria	1,100
Greece	1,092
Latvia	531
Lithuania	422
Estonia	288
Cyprus	187
Malta	41

Table 2 - Distribution by CEER Member Countries of the number of publicly accessible recharging points (2023)[15]

2.2 Ensuring a minimal distribution of EV charging points on national territories

Given the recent development of electric mobility in Europe, urban areas are more likely to count more charging points to satisfy the users of electric vehicles, face the fastest growth in their deployment and have the highest utilisation rates. For instance, a 2019 report published in France[16] shows that the 25% of least-used publicly accessible charging points account for

[14] State of the Industry Report, ChargeUp Europe, 2023. Retrieved from: https://www.chargeupeurope.eu/2023-state-of-the-industry

[15] European alternative fuels observatory (2023), https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/european-union-eu27/infrastructure, and CEER Member States

[16] Ministère de la transition écologique et solidaire, ministère de l'Économie et des finances (2019), Etude sur la caractérisation des besoins en déploiement d'infrastructures de recharge pour véhicule électrique, https ://www.ecologie.gouv.fr/sites/default/files/2019-07-Rapport-IRVE.pdf

just 4% of charges, whereas the 25% of most-used charging points represent up to 55% of charges. With equal pricing, this represents a 1 to 13 revenue ratio between the two.

The AFIR goals set in terms of minimum kW per circulating EV imply a very low energy/capacity ratio, i.e., a very low average utilisation rate (4-6%, regardless of the total number of circulating EVs) and, consequently, a difficulty to recover costs for CPOs, a rise in network tariffs and a higher chance for high charging rates applied to drivers.[17]

Investors could naturally be inclined to either increase the tariffication of the least used charging points, dimensioning charging stations to minimise revenue loss or to optimise revenue with the lifespan of the charging infrastructure, or even to neglect the least frequented and least profitable areas. This hypothesis is supported by the wide disparity in charging infrastructure installation costs, depending on the power delivered and utilisation rates. For instance, in Italy, data collected by ARERA shows that the typical utilisation rate varies from 1% for ultra-fast chargers (with investment costs from 230 to 450 €/kW) to 8% for slow chargers (with investment costs from 100 to 200 €/kW).[18]

This observation raises the issue of 'charging deserts" in MS, as pointed out by the report 'Electric Vehicle Charging market study' of UK's Competition & Markets Authority (CMA), which defines this concept as follows:

"*Off the motorway in remote locations like rural areas or at tourist spots (where connection costs are high, but demand may be lower), the business case for commercial investment in rapid en-route charging may be weak. This increases the risk of 'charging deserts' emerging which could deter EV take-up, both for EV drivers living in those areas and for those travelling to or through them.*"

The geographical distribution of charging stations is the subject of particular attention by the AFIR, which requires MS to ensure that enough publicly accessible recharging points are installed "…in a manner that also guarantees accessibility of all territories, in particular at public transport stations, such as port passenger terminals, airports or railway stations". Deployment of these publicly accessible recharging points is particularly important in residential areas with a lack of off-street parking and where vehicles typically park for extended periods of time.

The AFIR considers not only the importance of minimum territorial coverage, but also the complementarity of charging infrastructure locations, whether publicly accessible or private, regarding utilisation profiles, types of habitats and local planning. This objective was already captured by Directive 2014/94/EU which stated that MS shall ensure, by means of their national action frameworks, that an appropriate number of recharging points open to the public are set up.[19]

In this perspective, it is important to avoid the risk of charging deserts on MS' territories by ensuring a minimal distribution of charging points, which will deliver a minimum level of service in areas where private actors are not incentivised or where the market signals are not sufficiently high. Denser areas benefiting from more favourable economic conditions can be left for market actors.

[17] It is accepted that energy need for EV charging will not be very high (on average approximately 2000-2500 kWh/EV/year) and that most of the energy will be charged at home or at work (as it is cheaper and easily available for longer periods); we can then estimate that no more than 500-700 kWh/EV/year will be charged at publicly accessible charging points (PACP). This means that, even when the EV market will be fully deployed, average utilisation rate of PACPs will not exceed 4=6% = (500-700 kWh/year)/(1,3 kW)/(8760 h/year).
[18] ARERA (2021), 'AUTO ELETTRICHE: analizzati 225 dispositivi di ricarica, costi variabili per slow e fast. In media 1200 euro per le wallbox 'intelligenti"', https://www.arera.it/it/com_stampa/21/210503.htm
[19] Directive 2014/94/EU Article 4, DIRECTIVE 2014/94/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - of 22 October 2014 - on the deployment of alternative fuels infrastructure - (europa.eu).

Even if determined by mobility needs, the choices of implementation of charging infrastructure should consider the network availability, through the price-signal of the connection cost and delay.

What NRAs can do

Although NRAs are not directly targeted by AFIR or the Directive 2014/94/EU, they can be designated by national laws to supervise and control the deployment of electric vehicles on the territories of MS in several ways:

- Encourage DSOs to foster transparency and cooperation with stakeholders involved in the deployment of charging infrastructure, for example to enable accurate analyses of local scenarios for the development of electric mobility and anticipate the impact on the networks, based on local indicators such as housing types and demographic density, and projections of EV market penetration in their area;
- Supervise the development of Distribution Network Development Plans (D-NDPs); and
- Ensure compliance of distribution system operators with their obligations under Directive 2019/944[20] for instance if DSOs are allowed by MS to own, develop, manage, or operate EV charging points by way of derogation.

The Directive states that in certain circumstances, provided that no other party, following an open, transparent, and non-discriminatory tendering procedure, subject to review and approval by the regulatory authority, has been granted the right to own, develop, manage, or operate EV charging points, or would be able to provide such services at a reasonable cost and in a timely manner.

2.2.1 The role of NRAs in controlling DSOs' Distribution Network Development Plans

Article 32 of Directive 2019/944 set out a new obligation for DSOs serving more than 100,000 customers. They must publish a network development plan at least every two years, in consultation with stakeholders, indicating the investments planned for the next five to ten years "…focusing, inter alia, on the main distribution infrastructure needed to connect new generation capacity and new loads, including EV charging points." The document must also offer "transparency regarding the necessary medium- and long-term flexibility services', including the use of alternative resources to grid expansion, such as 'the use of load shedding, energy efficiency and energy storage facilities".

DSOs are required to prepare and publish such plans. In this context, and as shown in CEER's report "Views on Electricity Distribution Network Development Plans"[21] NRAs are entitled to monitor the progress, request information from DSOs, to check distribution network plans against preexisting requirements. For example, the NRA may have to request further details regarding the forecasted flexibility services, or the projects necessary to connect new loads and injection capacities.

Where applicable, the NRA may also check that the draft version of the plan complies with national and regulatory requirements. NRAs could promote a process for DSOs to elaborate on D-NDPs to ensure that DSO planning methodologies are transparent, easy to understand and promote network efficiency.

Thus, the Directive gives NRAs a general competence to supervise DSO's approach to the development of the grid. Within this general competence, the development of electric mobility

[20] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast) (Text with EEA relevance.), https://eur-lex.europa.eu/legal-content/FR/TXT/?uri=CELEX%3A32019L0944

[21] CEER Views on Electricity Distribution Network Development Plans, 24 November 2021. Ref: C21-DS-72-03

can be subject to such supervision, from the perspective of infrastructure deployed within reasonable timescales and at controlled costs, and from the perspective of integration within the electricity system.

2.3 Reducing connection delays for charging infrastructure

To meet the decarbonisation and electric mobility targets set out in the 'Fit for 55' package and the AFIR, a high level of public and private investment will be essential, as well as the coordinated action of the various entities that play a decisive role in the development of electric mobility.

Recently published data[22] on the process of installing charging points on highways in several European countries shows that the average time for approval can vary from 20 months (in Portugal for instance) to less than 5 months (in the case of Spain). Other countries, such as France and the Netherlands, take 14 and 13 months respectively, although low voltage connection projects may require shorter timeframes. Such delays can be encountered in other types of location, e.g., due to delays inherent to the various administrative[23]. In many cases, this duration could hinder the development of the charging point network.

Therefore, to ensure an efficient development of charging infrastructure, it will be important to mobilise all involved stakeholders and to foster general DSO efficiency in processing connection requests.

What NRAs can do:

- Introduce exemptions to facilitate the deployment of recharging infrastructure within the framework of the prerogatives conferred by national law (see case study 1);
- Monitor the time taken by TSOs and DSOs to carry out connections and repairs (see case study 2); and
- Monitor and evaluate the performance of TSOs and DSOs based on a limited set of indicators, at NRAs' discretion.

Case study 1 (NVE-RME) – Regulatory framework on EV charging infrastructure in Norway

The EV charging stations in Norway has risen sharply in the last years, with more than 6,000 public charging stations, and estimates counting on 1,500-2,000 charging stations for heavy duty vehicles in 2030. This represents a heavy-duty charging station every 60-100 km on the main roads.

Charging stations are developed and operated by both municipalities and private companies, such as electricity retailers. EVs are subject to a wide range of policies and schemes.

There are several policies in place to promote EVs in Norway. These include, among others, VAT exemption, registration tax exemption, reduced parking fees in some cities, reduced rates on ferries and partial access to bus lanes. In terms of charging stations, Enova SF (a fully-owned subsidiary of the Ministry of Climate and Environment), administers a support scheme in which they offer investment support for fast charging stations. In total, there is a comprehensive set of policies and schemes being applied to facilitate growth of EVs in Norway.

The role of DSOs

[22] European EV charging infrastructure masterplan (pp. 55 to 58), ACEA, 2022. Retrieved from: https://www.acea.auto/files/Research-Whitepaper-A-European-EV-Charging-Infrastructure-Masterplan.pdf
[23] As eMobility accelerates, can utilities move EVs into the fast lane?, EY, 2022. Retrieved from: https://www.ey.com/en_gl/energy-resources/as-emobility-accelerates-can-utilities-move-evs-into-the-fast-lane

For information: Most public charging stations in Norway are connected to voltage levels 22 kV and below. There are approximately 90 DSOs owning and operating distribution and/or local distribution networks in Norway.

DSOs are obliged to accept grid connection requests from charging stations on equal terms as those offered to other network users, *i.e.,* there is no specific regulation of charging stations in terms of grid access. Thus, charging stations are guaranteed network access provided they are willing to pay the connection charge (see below) and the associated network tariffs. Requests for access are handled by the DSOs on a first come first serve basis, which means that charging stations compete with other market participants seeking connection. As the demand for network capacity has soared, an increasing number of planned charging stations may experience delayed grid connection due to the lack of available network capacity.

Any grid investment triggered by connecting new customers to the grid, or from reinforcing the grid for existing customers, is covered by the relevant customer through a connection charge. This is a one-time payment, and mandatory for the DSOs to collect from grid customers triggering grid investments on all voltage levels. Further, the DSOs provide an estimate of the connection charge without undue delay after receiving the grid connection request. This gives the customers the opportunity to make a well-informed decision on whether to establish a charging station at the relevant site, or if they should change to a location with better network capacity to reduce the connection charge.

No trading license requirement for public charging stations

All companies conducting businesses in Norway which involve the operation of electricity networks or the production and/or the trading of electricity, are required to obtain a trading license from the NRA. Operators of charging stations are, however, exempted from this requirement. The exemption applies to providers of charging services in connection with commercial buildings, public charging stations (both regular EV and heavy-duty vehicles) and parking facilities with charging services.

The Norwegian example shows that prioritisation of EV infrastructure projects is not crucial for the deployment of EV charging points. Other levers can be activated by NRAs, such as trading licence exemption, to ensure a simpler connection process and the operation procedures for charging station owners and developers. Another example lies in incentive-based regulation of connection delays (see case study 2).

Case study 2 (CRE) – Incentive-based DSO regulation in France

In the latest and ongoing network tariff period for the power distribution operator Enedis[24], CRE introduced a new performance indicator measuring the average connection delays per category of connection, including all withdrawal and injection connection projects.

For each category of connection, CRE set an increasing yearly goal: for instance, for connections < 36 kVA with network extension: 150 days in 2021 to 121 days in 2024. Each category of connection is associated with an incentive, both in terms of bonus and penalty. For instance, for connections < 36 kVA with network extension:

- Penalty: €16.2 per day beyond the goal limit per connection realised in the calendar year;
- Bonus: €10.1 per day under the goal limit per connection realised in the calendar year; and
- The penalty cannot exceed €2.5m and the bonus cannot exceed €1.75m.

[24] CRE (2021), Délibération du 21 janvier 2021 portant décision sur le tarif d'utilisation des réseaux publics de distribution d'électricité (TURPE 6 HTA-BT), https://www.cre.fr/Documents/Deliberations/Decision/tarif-d-utilisation-des-reseaux-publics-de-distribution-d-electricite-turpe-6-hta-bt

The DSO publishes a yearly report on the quality of service and both bonuses and penalties are referenced and counted in the annual tariff update and in the associated mechanism of the *compte de régularisation des charges et des produits* (catch-up account for profits and costs).

The case of collective housing

In the case of collective housing, the number of apartment buildings to be equipped in order to achieve the objectives for the development of electric mobility is significant. In this regard, in May 2021, CRE issued a favourable opinion on the implementation of delay indemnities to encourage DSOs to meet the connection deadlines. The decree framing the conditions at which DSOs can pre-finance charging infrastructure investment costs for apartment buildings states that connection delays beyond 6 months after the date of acceptance by the applicant of the connection agreement, the DSO is obliged to pay the owner or the co-owners' association 0.55% of the total cost (excluding VAT) of the collective infrastructure for each week exceeding the deadline.

To minimise connection delays, several regulatory approaches can be adopted, whether it is regulatory exemptions to simplify connection procedures or the activity of project developers, or incentive regulation with financial implications for network operators, to encourage them to control the processing time for connection requests, including in a context of increasing connection requests.

More generally, a well-defined and systematic collaboration between different stakeholders is a way to ensure that a multi-factor perspective is taken into consideration, involving grid operators, project developers and public authorities, as recommended by the International Energy Agency (IEA) in its Manual for Policy Makers.[25] Several MS have taken such initiatives, such as Italy where DSOs and CPOs agreed on a Memorandum of understanding regarding procedures to be followed in the development of charging points.

Public experiments have been conducted in MS to test more efficient governance frameworks, to support a faster development of charging infrastructure networks. In the Portuguese case, such experiment was launched by the government between the newly created public agency dedicated to this mission and charging point operators *via* 10-year concession contracts.

Case study 3 (ERSE) – Installation and conception of public charging stations in Portugal

The need to strengthen the national EV charging network, especially fast charging, led the Portuguese government to promote the installation of nine hubs (EV charging) in several cities of the country with high demand and 12 ultra-fast charging stations in the main cities of the interior. The initiative was included in the Economic and Social Stabilisation Programme and financed by the Environment Fund.

This initiative aims at supporting the development of the charging network in public spaces in a faster and more agile way. The installation of charging points in public spaces sometimes takes time due to the procedures involved, such as the licensing of the public space by the municipalities and the connection to the grid.

[25] Grid integration of electric vehicles, IEA, 2022. Retrieved from: https://www.iea.org/reports/grid-integration-of-electric-vehicles

The designated entity responsible for implementing this plan, MOBI.E, is a public company that manages the charging network and promotes electric mobility more broadly in Portugal. The main tasks of this company in this project were therefore to install the charging equipment and the corresponding connections to the electricity network (connection of the charging stations to the electrical board of the hub, as well as to its power supply branch and, if necessary, to the corresponding transformer station) and, in partnership with the municipalities, to select, provide and license the installation space.

Each Hub allows 18 vehicles to be charged simultaneously. It consists of:

- One ultra-fast charging station (160 kW);
- Three fast charging stations (50 kW); and
- Five standard charging stations (22 kW).

The 12 ultra-fast charging stations, each located in a different city, allow two vehicles to be charged at each station.

The global investment for this initiative was €3 million and the implementation period was one year.

While the stations were being installed, a concession process for the operation of these stations was carried out to licensed CPOs for a period of ten years, guaranteeing the operation and maintenance of the stations during this period.

2.4 Reducing costs associated to EV charging points installation

Controlling and reducing costs will be key factors in determining the speed of deployment of EV charging networks. However, the price of connecting publicly accessible chargers to the grid can vary from country to country, depending, for example, on the power of the connection point and the distance from the grid. According to Cenex[26] and the UK CMA, the cost of connecting a slow publicly-accessible charging point to the grid can vary between €1,000 and €11,000, while the cost of a fast charger can vary between €28,000 and €34,000. These figures are indicative for 2021 and may change due to technological improvements or inflation in different countries. Regarding private charging points, namely installing chargers at home, a 7.4kW wallbox costs between €500 and €1,500.

Although most of the investment in developing the charging infrastructure will be private, there will be an important public contribution. Subsidies or credit facilitation to cover start-up costs have proven to be effective tools in incentivising the adoption of EVs and bolstering the expansion of charging infrastructure, but the increasing number of connection requests will weigh financially, both on public budgets and on network tariffs, depending on the cost-carrying models. On the one hand, by reducing the financial burden on consumers and businesses, subsidies encourage investment and participation in the EV market. On the other hand, transparent price signals send a message of true incurred costs and/or profitability to consumers and businesses that is biased by subsidies.

[26] Cenex (2021), Electric vehicle infrastructure barriers. Research report for Transport & Environment, https://www.cenex.co.uk/app/uploads/2021/04/Electric-Vehicle-Infrastructure-Barriers-FINAL.pdf

2.4.1 Variable impact depending on the type of infrastructure installed

The impact of electromobility on the grid, and thus on total connection costs and reinforcement costs, will depend on the pace of deployment of chargers, on the typology of installed chargers depending on grid, habitat and regional planning configurations. Feedback from NRAs shows big disparities between MCs when it comes to the types of chargers that are currently installed. For instance, in France, most private at-home chargers installed today have a low power output (usually under 7.4 kVA) and do not require that the DSO increases the contracted power of the household or reinforces its connection to the grid. On the other hand, in Austria and Germany, the most common private charging stations have a maximum power output of 11 to 22 kW. Publicly accessible charging points also show such disparities, with a majority of slow AC recharging points (single-phase, under 7.4 kW) installed in France, whereas in Germany, the proportion of medium-speed AC recharging points (triple-phase, up to 22 kW) and ultra-fast DC recharging points (up to 350 kW) is significantly higher[27,28] (see Figure 2).

Therefore, the type of chargers installed will have a significant impact on the costs induced by the development of electromobility, both for publicly accessible charging points and for private chargers. This is particularly important for private charging. Several recent statistics show that the share of at-home charging is about 80% to 90% of total charging behaviour in countries like France or the UK.

In France, this observation does not lead to significant reinforcements of the grid capacity in private spaces, most charging needs are being achieved without adapting the *contractual* power and the *connection* power and thus without large grid reinforcements.

In other configurations, local grid congestion can occur if many EVs are being connected at the same time. This risk can and should be mitigated by the implementation of smart charging incentives and solutions (see chapter 3). The IEA argues[29] that public subsidies should be granted only for installing charging points that meet smart charging requirements, to foster a smart 'vehicle-grid' integration based on flexibility. In this perspective, several MS have conditioned the granting of public subsidies to flexibility-friendly chargers' specifications.

[27] European Alternative Fuels observatory (2023), European Union (EU27), https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/european-union-eu27
[28] EV charging statistics 2023, Zapmap, 2023. Retrieved from: https://www.zap-map.com/ev-stats/how-many-charging-points
[29] Grid integration of electric vehicles, IEA, 2022. Retrieved from: https://www.iea.org/reports/grid-integration-of-electric-vehicles

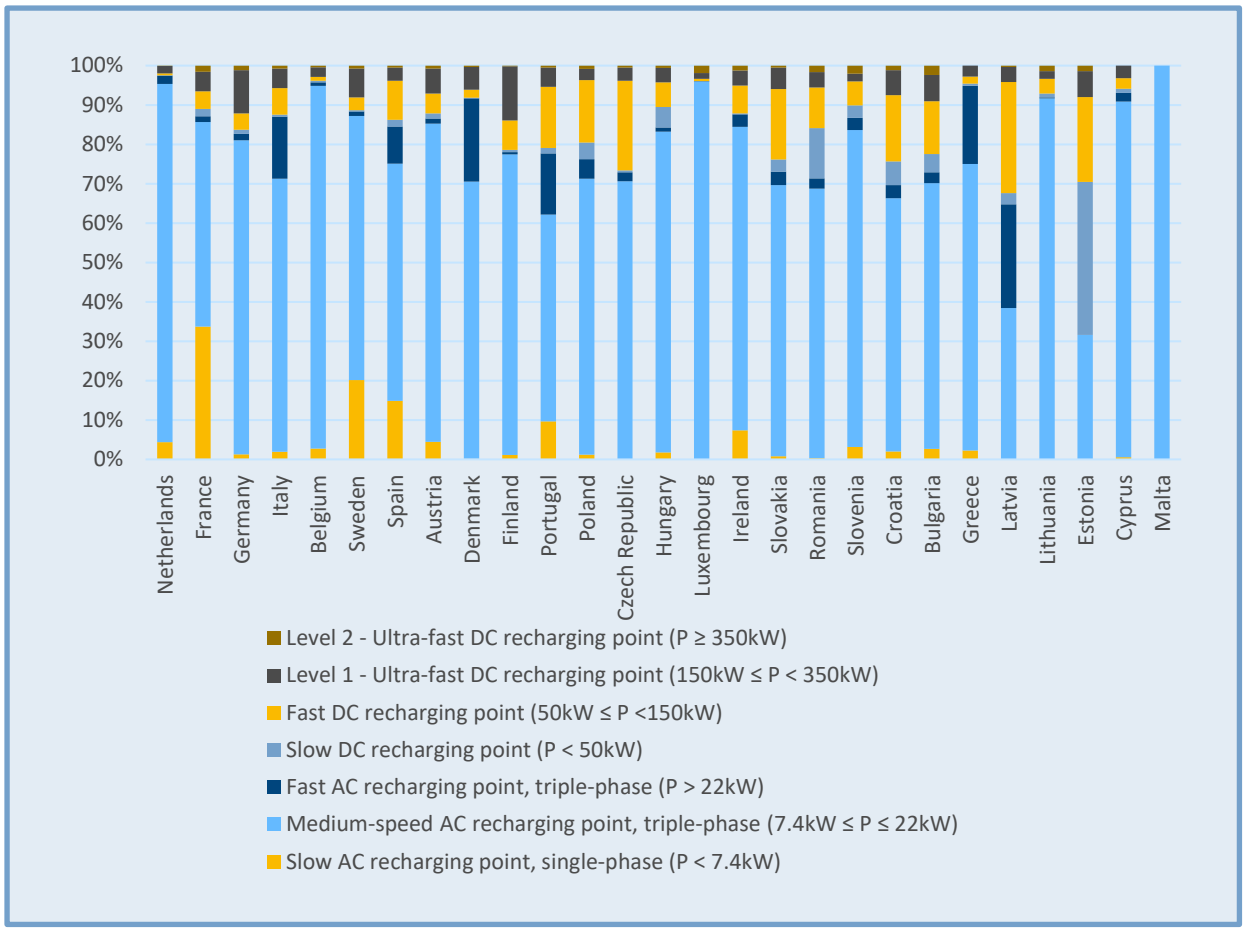


Figure 2 - Types of publicly accessible charging points installed in Member States (in %)[30]

2.4.2 Flexible connections: advantages and limits

Alternative connections (also called flexible connections) enable project developers and operators to connect charging stations in anticipation of grid reinforcements, in exchange for temporary capacity reductions under certain conditions[31]. Alternative connections are already well-known in the realm of intermittent renewable energy integration into the grid. Until recently, the standard solution was to dimension the connection to convey the maximum production capacity from the production unit to the grid. To support the development of renewable production capacity, DSOs introduced alternative connection solutions that allow project developers to choose a connection with less expensive charges and shorter delays, in exchange for the ability for the DSO to limit the amount of power injected into the grid according to the grid capacity. Nevertheless, the infrastructure project developer can be contractually ensured the ability to inject a minimum amount of power into the grid at all times, and the right to inject more when the grid allows it.

[30] European Alternative Fuels Observatory (2023), 'European Union (EU27)', https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/european-union-eu27
[31] CEER Paper on Alternative Connection Agreements, 30 May 2023. Ref: C23-DS-83-06

Such solutions are increasingly developed for charging infrastructure and offer many advantages to both system operators and charging infrastructure developers, as experienced in Norway (see case study 5). For instance, a charging point can be connected to an existing point of delivery and share the power output with other final uses, thus not being exploited to its full capacity. Other types of optimisations are possible, such as combining local production and self-consumption or local stationary storage.

What NRAs can do:

- Set or approve, on the basis of transparent criteria, transmission and distribution tariffs or their calculation methods, or both;
- Express an opinion on subsidy mechanisms/public policies (see case study 3) within the framework of the prerogatives entrusted to them by national law, when setting network tariffs, to ensure that they are fair, stable and acceptable;
- Supervise experiments/trials carried out by DSOs as part of regulatory sandboxes or experimental services;
- Work with TSOs and DSOs to monitor the impacts of EV charging on the system and its contribution to flexibility (see Chapter 3); and
- Ask TSOs and DSOs to publish network data to facilitate the choices of location for new charging points (see Chapter 3 and case study 7).

2.4.3 The role of NRAs in setting network tariffs

Article 59 of the Directive 2019/944 of 5 June 2019 concerning common rules for the internal market in electricity states that NRAs shall fix or approve, “in accordance with transparent criteria, transmission or distribution tariffs or their methodologies, or both”. The energy transition is changing the infrastructure and the equipment demands – in the context of this report, the electrification of mobility is creating new investment needs for network operators, and therefore new expenses to be covered by network tariffs.

Network tariffs, which are intended to cover network operators’ costs to enable them to make the necessary investments and operate the network, are paid by network users. They represent a pooling of the network operator's expenditure in carrying out its monopoly duties and are passed on to consumers irrespective of the investment they may have individually generated.

From this point of view, the increase in the number of uses of the grid resulting from the development of electric mobility (connection of recharging points, grid reinforcement, flexibilities to enable recharging management) is bound, in the medium and long term, to increase the network tariffs at the expense of grid users. It is therefore important to guarantee the technical and economic rationality of investments made by grid operators, the overall the optimum of expenditure and incentives for operators to be efficient, in order to guarantee the acceptability and fairness of grid tariffs.

In the context of the development of the electric mobility, and because of the new expenses that it generates, it is therefore the responsibility of the regulatory authority to ensure that network tariffs cover the expenses incurred by operators as a result of the public policies which were put in place by national governments. In addition, the regulatory authority should ensure that the network tariffs are equitable and fair for consumers.

Case study 4 (CRE) – Overview of the main 'rebate rates' covered by distribution network tariffs

Category	Rebate rate	Expiration date
Publicly accessible charging points which are part of a charging point roadmap and have an output <250 kVA	75%	31 December 2025
Publicly accessible charging points on high-speed roads and motorways service areas with an output ≤5000 kVA, if the service area is not already equipped with a charging point with an output >60kVA	75%	31 December 2025
Private charging point with an output <10kW on an existing low voltage installation ≤36kVA, excepted collective housing	80%	N/A
Other charging infrastructure in low voltage	40%	N/A
Other charging infrastructure in high voltage	30%	N/A

Table 3 – Overview of rebate rates covered by distribution network tariffs in France

'Rebate rates' refer to the levels at which connection costs are covered by network tariffs. A 40%-rate means that 40% of the connection costs are not borne by the connection applicant, but by the distribution system operator, and are mutualised in the network tariffs.

In 2022, CRE issued a favourable opinion on the conditionality of network tariff rebates for publicly accessible charging points[32]. In application of the 2019 Law on mobility, the implementation decree published on the 6 February 2023 states that the level of coverage by the power distribution network tariffs is by derogation increased to 75% for the connection of publicly accessible charging points that are developed within a local charging point roadmap (*Schéma directeur des infrastructures de recharge de véhicules électriques*, or SDIRVE).

Charging point roadmaps are an optional strategic document introduced by the 2019 Law on mobility to support the deployment of EV charging points and ensure its adequacy to present and future local needs for such infrastructure. It gives the local authority responsible for the development of electric mobility (for instance the city or another authority to which it transferred its competence) the responsibility to orchestrate the deployment of public charging points with other public and private actors. It consists of 1.) a diagnosis of the need for EV charging points: existing points, needs, number of EVs on the territory; 2.) development strategy (targets, calendar, associated resources); and 3.) implementation of a monitoring and evaluation tool for the project as well as the publication in open data of certain data and results of the project following the validation of the scheme by the prefect.

It aims at defining, amongst other considerations, how many charging points are required in three to five years, the type of charging points needed (e.g., slow or fast charging, and AC or DC), the most adequate localisation (e.g., public areas, public parking facilities, touristic areas, or residential areas), and whether charging points should be concentrated in a few charging stations or rather geographically spread.

[32] CRE (2022), Délibération du 13 décembre 2022 portant avis sur le projet d'arrêté relatif au niveau de la prise en charge par le tarif d'utilisation des réseaux publics d'électricité du raccordement aux réseaux publics d'électricité des infrastructures de recharge de véhicules électriques et hybrides rechargeables ouvertes au public qui s'inscrivent dans un schéma directeur de développement des infrastructures de recharge, https://www.cre.fr/Documents/Deliberations/Avis/projet-d-arrete-relatif-au-niveau-de-la-prise-en-charge-par-le-tarif-d-utilisation-des-reseaux-publics-d-electricite-du-raccordement-aux-reseaux-pu#:~:text=%C3%A9lectricit%C3%A9-,D%C3%A9lib%C3%A9ration%20de%20la%20CRE%20du%2013%20d%C3%A9cembre%202022%20portant%20avis,v%C3%A9hicules%20%C3%A9lectriques%20et%20hybrides%20rechargeables

The purpose of this mechanism is to associate, from an early stage, all the parties involved in the development of charging points, including DSOs, and charging point developers and operators.

In its decision №2022-331, CRE issued a positive opinion on the conditionality of a derogatory increased rebate for publicly accessible charging points, limited to charging points developed in the realm of a local charging points roadmap (SDIRVE) and with an output inferior or equal to 250 kVA. It argues that a faster development of EV charging points can call for a derogatory higher rebate if it is 1.) temporary and 2.) adaptative to characteristics of the charging points or location (i.e., aims at a better territorial distribution of charging points). It also considered that despite the by-derogation rebate, the procedures of the decision were designed to reduce the risk of oversizing. That may result from the attenuation of the price signal on connection costs.

Case study 5 – State aid for EV infrastructure deployment in Finland

Finland is a sparsely populated country with long distances between population centres, especially when compared to central Europe. The lack of EVs, especially in Eastern Finland, presents a chicken and egg dilemma for the operation of public charging services. On the one hand, the current battery-operated fleet of EVs is insufficient to support privately operated charging services. On the other hand, the lack of public charging infrastructure may put off some consumers from purchasing a fully electric vehicle. Since 2018, the government of Finland has operated a subsidy scheme to solve this dilemma.
Through the scheme, support is provided for EV charging points. The supported charging points are privately owned and privately operated. Recipients of the support are selected based on a closed bidding process. The Finnish NRA manages the scheme.
A key criterion for project eligibility is 24/7 non-discriminatory public access. A failure to comply with any of the eligibility criteria results in disqualification of the bid ahead of the auction. For supported projects, failure to comply with any eligibility criteria or any ranking criteria will result in either a full or a partial denial of funding. Supported investments must be completed within 20 months and beneficiaries must apply for payment within 22 months. The support is fully ex-post, i.e., all support is paid after successful deployment.
The budget for each auction is fixed. There are no corridors, i.e., all recharging points with a recharging power exceeding 22 kW bid against each other. However, there are predetermined ranking criteria, which lower the comparative bid amount. Lowest bid wins. The comparative bid amount determines the outcome of the bidding process.
The most recent auction in March 2023 had a budget of €8.3 million and a total of 511 recharging points were selected for government support. Currently, the total number of public recharging points in Finland is approximately 1,700. In the March 2023 auction, the following ranking criteria were applied.

Cost factor multiplier	**Criterion**	**Share of all bids and accepted bids**
0.7	The project property is located within one kilometre from a road that is part of the comprehensive TEN-T network.	66% / 71%
0.9	More than one simultaneously available charging point.	All, except one bid.
0.85	The charging capacity of all charging points is at least 150 kW but less than 300 kW.	14% / 9%

0.75	The location includes at least one recharging point, which has a charging capacity of at least 350 kW and is suitable for heavy-duty EVs.	25% / 23%
0.9	The total charging capacity is at least 300 kW but less than 1,400 kW.	66% / 60%
0.5	The total charging capacity is at least 1,400 kW but less than 3,500 kW.	6% / 7%
0.3	The total charging capacity is at least 3,500 kW.	No bids.
0.9	A debit card is accepted as a payment method.	72% / 68%

Table 4 – State aid for EV infrastructure development in Finland

Case study 6 (NVE-RME) – Regulatory network for alternative connections

The available capacity in the grid is limited in many places in Norway. Investments and upgrades in infrastructure are often costly and the lead times are long. Charging stations that want to establish themselves in a certain area are at a risk of having to wait several years to get a connection.

It must be underlined that regulation of flexible connections is not specific for public charging stations; it applies to all new connections.

A charging station owner and the DSO may enter into an agreement for flexible connection (non-firm capacity contract on disconnection or limitation of consumption). The DSO shall inform the charging station owner about the possibility of entering into such agreements. In the agreement, it shall be clearly defined when and for how long the limitation or disconnection can last. This arrangement is only applicable to new connections.

The charging station shall not receive compensation for limitation of consumption or disconnection. The advantage the charging station owner has when entering such an agreement is:

1) Faster connection; and
2) Lower connection charge.

The socioeconomic benefit of flexible connections is to facilitate better utilisation of the existing grid and to avoid or postpone eventually necessary grid upgrades.

Case study 7 (Ofgem) – Reform of access rights

As part of the *Access and Forward-Looking Charges Significant Code Review,* which reduced the costs faced by customers seeking new connections, Ofgem reviewed access rights and took decisions to ensure that a standardised non-firm access option is available for larger network users and to introduce clear curtailment limits and end-dates for non-firm access arrangements.

The reforms seek to enable more efficient use and investment into the distribution network by encouraging DSOs to take a more strategic approach to network planning and reinforcement, investing ahead of the need in many cases and considering alternative approaches to reinforcement for meeting capacity needs of their customers.

Background:

Network access rights define the nature of users' access to the network and the capacity they can use. There are two broad access right models:

- **Firm access:** This is the most common connection arrangement under which DSOs must ensure that there is sufficient network capacity available at all times (other than under specific rare circumstances).
- **Non-firm/curtailable access:** In exchange for quicker and/or cheaper access, users with flexible connections can have non-firm access to the distribution network. In recent years, DSOs have increasingly been offering flexible connections as an alternative to paying and/or waiting for the network reinforcement that may be required for a standard connection.

Firm access arrangements provide the most certainty and protection; however, in some cases they may lead to delays where network reinforcements are required to facilitate a new connection. They can also be more expensive if capacity is not required at all times.

On the other hand, non-firm access arrangements may be advantageous in constrained areas of the network prior to reinforcement taking place by saving costs and time of connections, or where capacity can be modulated. However, Ofgem's review found that arrangements can be poorly defined, with no standard definition of curtailment. How these arrangements work in practice can also vary across DSOs.

What did Ofgem do?

Ofgem reviewed access right definitions and made the following decisions:[33]

- **Non-firm (curtailable) access arrangements** will be available to users where there is a requirement for reinforcement and a specific network need for curtailment to manage local network constraints. However, small users[34] will not have access to these arrangements to protect themselves against potential detriments;
- **Curtailment limits for non-firm connections** – the distribution network operator will set curtailment limits and include these in the connection offer to the connecting customer, who will have to abide by those limits. If the network operator needs to curtail above this limit, then they must procure this service from the market; and
- **End dates for non-firm arrangements** – non-firm arrangements will have explicit end dates, after which the connection will need to be made firm or non- curtailable. Exceptions apply where the customer has not requested a firm connection or if the high-capacity cap is triggered and the customer does not wish to contribute to reinforcement costs above the cap.

The key expected benefits are:

- More consistent access rights arrangements, particularly in the context of more congested distribution networks;
- Reduced risk and greater certainty for connecting parties: Users on flexible arrangements will have better certainty as to the amount of curtailment they can expect, and what happens when they are curtailed; and
- Arrangements continue to be useful to DSOs in proactively managing constraints: DSOs are better incentivised to provide network capacity in a timely manner, enabling more efficient use of and investment into the distribution network.

[33] Access and Forward-Looking Charges Significant Code Review: Decision and Direction, Ofgem, 3 May 2023. Retrieved from: https://www.ofgem.gov.uk/publications/access-and-forward-looking-charges-significant-code-review-decision-and-direction

[34] Understood as households and non-domestic users that are billed on an aggregated and non-site-specific basis or who are metered directly using whole current meters.

Case study 8 (BNetzA) – Planning regions in Germany

In Germany, the legislator has provided for the formation of so-called 'planning regions' during the 2021 amendment of Sec.14d of the German Energy Industry Act. 'Planning regions' are associations of DSOs in geographically contiguous regions. Within a planning region, the DSOs create a regional scenario on the expected developments of the electricity network.

In the 2022 amendment of the German Energy Industry Act, the legislator laid down more specific requirements regarding the content of these regional scenarios. A regional scenario consists of a development path that takes into account both the targets set by law for the long-term target year of 2045, other climate and energy policy targets set by the federal government, as well as probable developments for the next five and ten years. The regional scenario shall include:

- Information on connections already made, expected connections, and maximum possible connections of the various generation capacities and loads;
- Information on expected feed-ins and offtakes; and
- Assumptions on the development of other sectors, in particular the building and transport sectors.

The new requirements intend to strengthen foresighted network development and, for example, to bundle infrastructure measures.

The regional scenarios serve as a common basis for the respective network development plans of each DSO, that take these inputs into account.

In addition to DSOs' individual network development plans, BNetzA, the German NRA, asks DSOs to answer a questionnaire during the network development plan process, where they have to comment, among other topics, on:

- Reporting procedure of charging infrastructure, including obstacles;
- Expansion/extension due to charging infrastructure;
- Electromobility coverage;
- Data basis;
- Studies and pilot projects;
- Sample cases for capacity planning;
- Consumption-related network congestion; and
- Use of network charge reduction.

BNetzA evaluates the data submitted and subsequently publishes a report on the status and expansion of the distribution networks.

Case study 9 (Ofgem) – Reducing cost of network connections in Great Britain

Between 2018 and 2022, Ofgem carried out *Access and Forward-Looking Charges Significant Code Review*[35] with the objective to ensure electricity networks are used efficiently and flexibly, reflecting users' needs and allowing consumers to benefit from new technologies and services while avoiding unnecessary costs on energy bills in general.

Ofgem's decision to amend the Access and Forward-Looking Charges has resulted in a lower overall connection charge for connecting customers and specifically the cost they face when their connection results in wider distribution network reinforcement, which under most circumstances has been removed altogether.

Background:

Enabling new connections to the distribution network, such as EV charging points, attracts charges associated with required work. These include:

- Charges associated with installation of new assets to extend the existing network to the customer (**extension assets**): under previous arrangements, these would be paid by the connecting customers; and
- In some cases, additional charges for the upgrade or expansion of capacity of the existing shared network assets (**reinforcement**): under previous arrangements, these costs would be shared between the connecting customer (via an upfront connection charge up to one voltage level above their point of connection) and all DSO's customers through use of system charges.

`**Connecting customers**´ also receive a locational price signal in the form of higher/lower ongoing use of system charges and connection costs. This is intended to encourage connections where there is spare network capacity.

Ofgem's review of the existing arrangements identified several **issues**, including:

- **Ineffective signals and 'free rider' effect**: Prospective connecting customers are incentivised to wait until reinforcement has been triggered by another customer before requesting a connection. This may result in unnecessary delays in new connections such as EV charging points;
- **Incremental reinforcement:** DSOs recover funding for reinforcements through connection charges which are paid by the connecting customer. As such, they are incentivised to wait until they receive requests for new connections, instead of taking a proactive approach to invest in network reinforcements; and
- **Barrier to net zero:** Price signals may not align with the need for new connections in strategically important locations, e.g. EV charging stations across the road network. This could create barriers to investment and delays in deployment of key low carbon technologies.

What did Ofgem do?

To address the identified issues, Ofgem took the following key **decisions**:

[35] Access and Forward-Looking Charges Significant Code Review: Decision and Direction, Ofgem, 3 May 2023. Retrieved from: https://www.ofgem.gov.uk/publications/access-and-forward-looking-charges-significant-code-review-decision-and-direction

First, remove the contribution to reinforcement for demand connections. This means that connecting customers pay only for extension assets and the costs of reinforcements are borne by all DSO customers through the use of system charges (thus also reducing reinforcement locational price signals). This decision is expected to help remove barriers to investment in low carbon technologies:

- It lowers the upfront costs of connecting new EV charging stations (and other demand connections); and
- It makes it easier for DSOs to be more proactive in network reinforcement by allowing them to recover associated costs without risks.

Secondly, retain and strengthen existing protections for bill payers – specifically:

- Introduce a high-cost cap for demand connections: This decision ensures that consumers are better protected from the cost increases associated with the most expensive connections;[36]
- Retain charges for reinforcement costs of connections deemed to be speculative;[37] and
- Retain the current treatment of three phase connections, that is where a phase or voltage upgrade is requested by the customer but is not necessary for the DSO to provide the required capacity, the customer will be required to pay in full for the requested upgrade.[38]

In addition, **reduce the contribution to reinforcement for *generation* connections**. This means that ´**connecting customers**´ pay for extension assets and a contribution towards reinforcement at the voltage level at point of connection, but further reinforcements are funded by all DSO customers via use of system charges.

	Extension assets	Reinforcement assets at connection voltage	Reinforcement assets at connection voltage +1
Current arrangements	Connecting customer pays 100%	Connecting customer pays a proportion of the reinforcement costs	Connecting customer pays a proportion of the reinforcement costs
New arrangements (Demand)	Connecting customer pays 100%	Fully funded by the DNO via DUoS	Fully funded by the DNO via DUoS
New arrangements (Generation)	Connecting customer pays 100%	Connecting customer pays a proportion of the reinforcement costs	Fully funded by the DNO via DUoS

Table 5 – Overview of extension and reinforcement assets in Great Britain

[36] The high-cost cap is a threshold for reinforcement costs, above which the connecting customers are required to pay in full. It is a backstop to protect against inefficient decision-making and a small number of excessively expensive projects. The new demand cap is set at £1720/kVA, which equates to <5% of new connections in each distribution region. This threshold should not have an impact on the deployment of connections of EV charging points.

[37] Speculative developments may have the following characteristics: unknown load requirements; unclear timing of development; the requested capacity caters to future expansion rather than immediate end-user requirements; the requested capacity caters to future speculative phases of development; no requested connections for end-users. Plans for public EV charging stations may in some cases, exhibit some of these characteristics (e.g. reserving capacity for future expansion). However, the expectation is that DNOs [i.e. DSOs] will apply due discretion.

[38] This decision should not harm the deployment of home EV chargers: As long as the need for a three-phase connection is determined by the DNO to be required to support the customer's capacity, the new connection charge boundary will apply, and the consumer will not be charged for reinforcement costs.

3 System Integration

Charging management consists of modulating the electrical power or the time slot during which the vehicle is charged, to optimise the use of the electrical system according to different criteria (electricity price, network tariff, network condition, connection, etc.). The increasing proportion of EVs on the road, the increasing share of variable renewable energy in the electricity mix and the limited capacity of the electricity network pose a challenge for efficient system integration. Charging management could help reduce the cost of electric mobility's integration into the grid and consequently lower the cost and carbon emissions of the electricity system, through the flexibility charging management can provide, as opposed to unmanaged charging.

There are different levels of control:

Natural charging	No charging management. The vehicle is charged as soon as it is connected to the charging point.	
Behavioural adaptation alone	No control system. The users decide by themselves to connect their vehicle at the optimal time, according to their needs and the cost of recharging.	Example: the user manually launches his/her recharging at the right time or adapts his/her trips.
Non-dynamic automatic control	Charging is programmed at the times defined by the user, generally according to the peak/off-peak rate.	Example: Control via the metering system, to charge depending on time-of-use tariffs.
Smart charging	Charging periods are automatically calculated according to the user's needs, the battery level, the connection capacity, the cost of recharging and multiple constraints.	Example: Real-time price-based charging.
Bidirectional smart control	Charging and injection periods (V2G / V2B / V2H) are automatically calculated according to the battery level, the energy price, the network tariffs, and multiple constraints. Participation in system services is also possible.	Example: Management by an aggregator.

Table 6 – Charging management models

3.1 Electric mobility may generate impacts on the electricity networks, which should be anticipated

EVs can have different types of impact on the grid: they can affect the capacity limits of the different components of the network (such as lines and transformers), affect the power quality for the end users through voltage variation and harmonic distortions, and affect the larger power system with the increase in peak consumption, increasing the need for expensive production capacity/peaking units.

In the study titled *Effect of electromobility on the power system and the integration of RES* (2018), the European Commission assesses that natural charging, without any behavioural change, will accentuate load peaks in 2030 due to the increased charging in hours of high residual load (in particular in evening hours). This implies a higher risk on the security of supply and a higher cost of electricity (network infrastructure, additional storage or thermal capacities, high marginal cost of production). For example, in Germany, the expected energy not served (EENS), which is the annual energy demand that is expected not to be met by generation, could equal 71 GWh, corresponding to a share of 1-2% of total electricity demand and 17 hours with loss of load per year.

While inflexible high-power charging, such as '*en-route'* fast charging, can put pressure on the local distribution grid due to the high-power requirements, it currently constitutes only a minor share of the total charging sessions and most people are likely to charge at home in the future as well, both for economic and comfort reasons. Ultimately, most vehicles will charge at low power and stay connected for long periods of time, enabling various types of charging strategies (from simple charging management to smart charging). In Europe, a GPS-based study[39] also found that the share of the private fleet in motion at the same time never exceeded 12%, with some areas as low as 5%, indicating the massive grid-integration potential of electrified private mobility.

In the UK, models suggest that without smart charging, peak demand could be increased by 19 to 26 GW (representing 32 to 44% of current peak demand) in 2050, where smart charging would reduce this by 6 to 15 GW and V2X could reduce peak demand in 2050 by a further 8 to 20 GW.[40]

In case of automated price-based charging, there is a risk that all EVs start recharging simultaneously, resulting in a great surge in power demand. In case of dynamic tariffs, such risk should not be overestimated as the start time for charging would depend on the battery level and capacity. The risk is more pronounced in the case of nation-wide simple time-of-use ('ToU') tariffs. Some mitigation measures exist, such as charging signals from the meter, with shifts in the starting time. Nevertheless, the potential impact of electric mobility on the grid should be assessed regularly.

Charging use case	Impacts	Opportunities
Home charging	Overloading issues expected for high levels of EV penetration with high levels of simultaneity and voltage issues for rural areas.	Off-peak charging or reduction of variable renewable energy curtailment via load shifting depending on connection time duration and charging time.
Workplace and destination charging	Lower probability of overloading issues due to larger capacities typical in commercial or industrial zones.	• Potential increase of consumption of solar generation due to typical daytime connection; • For the workplace: flexibility potential can be facilitated by a fleet manager; and • For destination charging: flexibility potential might be limited depending on the dwelling time.
Public roadside charging	Similar issues to home charging, especially with higher power drawn from three-phase charging.	Similar flexibilities possible for destination and home charging. However, strategies to increase utilisation by encouraging car-switching once fully charged may limit the potential.
En-route charging (also called opportunity or top-up charging)	Potential high-power draw. Depending on the power and volume required, dedicated transformer or stationary storage serving as a buffer might be required.	• Limited demand response flexibility due to short or non-existent surplus connection time; and • Higher power system participation may be possible if buffer storage is installed.

[39] Paffumi, E., De Gennaro, M. and Martini, G., (2021), European-wide study on big data for supporting road transport policy, https://publications.jrc.ec.europa.eu/repository/handle/JRC110870

[40] National Grid ESO (2021), Future Energy Scenarios 2021, https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2021

Charging use case	Impacts	Opportunities
Depot charging	• Expected high-power draw due to larger volumes and numbers of vehicles served; • Dedicated substation might be needed, but the added cost can remain viable due to the nature of the commercial operation; and • Network upgrades might encounter land use restrictions, especially if located in dense urban areas.	• Fleet predictability and load management offer high potential for load shifting, variable renewable energy, curtailment reduction and bidirectional charging due to larger battery capacities and existing fleet control; and • Flexibility potential might be limited to a few hours depending on the parking period and trip scheduling.
Battery swapping	• Limited overloading issues due to charging control within the battery-swap station; and • May require dedicated feeders depending on the station size.	Full 24/7 bidirectional interaction with the grid and the aggregated capacity could facilitate renewable energy offtake. Battery charging management can help reduce asset ageing.

Table 7 - Grid impacts and opportunities for charging use cases[41]

3.2 A first level of passive charging management could help to reduce the global costs of the electricity system

Enedis, France's largest DSO, has highlighted in its study on the behaviour of EV users that 42% of residential charging happens in the evening[42], meaning that the demand for electricity for EV charging may correspond to the peak electricity demand periods for other domestic uses. As the domestic charging need is rarely urgent, EV recharging represents a significant source of flexibility in electrical demand, through the postponement of recharging to periods of lower demand on the network.

With simple static charging management, electricity consumption for EVs could be postponed through incentives to times of low residual demand, for example overnight or in the afternoon (depending on the country and season), which would reduce system costs.

3.2.1 Time-of-use-based charging could help reduce the occurrence of peak loads

In a context of pressure on the security of electrical supply, charging management is essential for the electrical system, both technically and economically. It should therefore be incentivised via ToU tariffs which reflect time-differentiated network and production costs. Even simple ToU tariffs can provide an effective incentive through a price signal that varies over the course of the day or the week, with pre-defined prices that provides security and visibility to consumers.

Such peak and off-peak tariffs already exist but are not very common in all MCs, despite their potential to help reduce the need for both peak electricity production and grid investments. They can also be integrated with a home EV charger through a smart meter or even an in-built timer (at almost no cost). However, while these tariffs have the potential to reduce most congestions associated with EV charging, their success will depend on a large-scale uptake by consumers.

[41] Table copied from: Grid integration of electric vehicles, IEA, 2022. Retrieved from: https://www.iea.org/reports/grid-integration-of-electric-vehicles
[42] Utilisation et recharge : enquête comportementale auprès des possesseurs de véhicules électriques, Enedis, 2021. Retrieved from: https://www.enedis.fr/sites/default/files/documents/pdf/enquete-comportementale-possesseurs-de-vehicules-electriques.pdf

Even though smart meters are needed for more complex tariffs, they are not necessary for a basic two-periods pricing. Therefore, even in MCs with no or limited smart meter rollout, NRAs can work on the generalisation of ToU network tariffs. This price-signal can then in turn be passed-through to consumers in supply contracts. In addition to this first signal, suppliers should also be able to differentiate the prices in ToU energy tariffs. For economic efficiency, the price differentiation should reflect the differences of marginal cost between the different periods. That is why decision makers should be careful not to unduly flatten the flexibility incentive when designing market tools or public interventions to protect consumers.

The study of the European Commission on the *effect of electromobility on the power system and the integration of RES* in 2018[43] found that in Germany, the EENS in 2030 could be reduced by 80% if 90% of EV owners charged following ToU tariffs. The same report came with the analysis that the use of ToU tariffs could result in the reduction of mean marginal costs across all EU countries by 13% (22% with real-time pricing).

However, it is important that ToU tariffs are set at the right time depending on network congestions and wholesale prices. As for network tariffs, it is important that the DSOs are able and incentivised to diversify and update regularly the peak and off-peak periods according to the evolution of local network utilisation.

The risk of a one-size-fits-all tariff and charging management is the simultaneous start of all EV charges, with negative effects on balancing and networks, that could render the measure counterproductive. This can be mitigated with a randomised delay of activation when the charging is managed through the meter (as done in France for hot water tanks). The alternative is the coexistence of several tariff structures, or a finer price differentiation (up to – but not necessarily – dynamic tariffs), that would give the incentive to start charging at a differentiated time according to the energy needed by the battery. The resulting aggregated load curve of all EV smart charging with dynamic tariffs would more likely be bell-shaped rather than a right-angle triangle with a two-periods tariff.

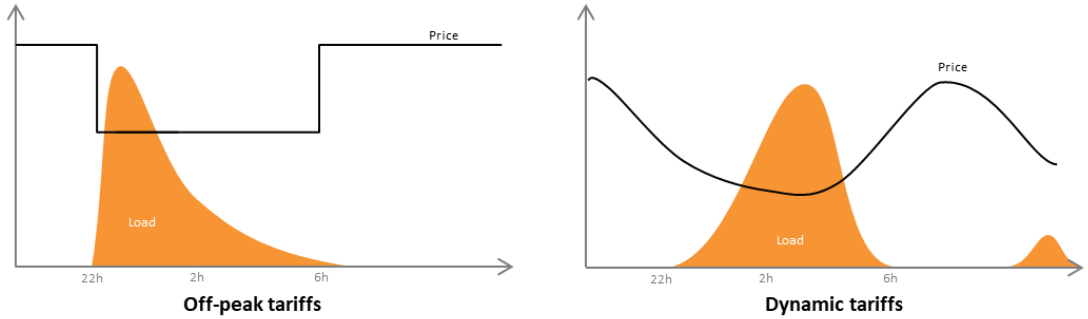


Figure 3 - Power load from a large number of EVs charging depending on tariffs

Default off-peak charging in the UK

After a consultation on EV smart charging, the United Kingdom has introduced, in the frame of the Electric Vehicles Regulations 2021, a regulatory requirement for new private charging points to be, by default, configured not to charge during periods of high demand (8am-11am, 4pm-10pm) and to introduce a random start-up delay, even though users are still able to by-pass this setting.

[43] Effect of electromobility on the power system and the integration of RES, European Commission, 2 July 2018. Retrieved from: https://energy.ec.europa.eu/publications/effect-electromobility-power-system-and-integration-res-study_en

Some of the uses of charging points accessible to the public have a potential for flexibility that should not be ignored. This flexibility can take the form of parking for longer than the charging time required, or the ability to plan and postpone the need to recharge. Public charging infrastructure can also provide an incentive to charge at the best time (according to energy prices, network conditions or charging infrastructure saturation). The Regulatory Assistance Project[44] has pointed out that in addition to the optimisation of the investments and the energy production, dynamic tariffs and smart charging on public charging stations is a way to reduce the gap between EV users able to charge at home and those relying on public charging points. Making public charging more accessible through ToU pricing can motivate drivers without home parking to switch sooner to an electric car.

Pricing structure of public charging points can offer different rates for different periods based on the different costs it faces. In addition to the cost of energy, this includes infrastructure costs in order to optimise availability and use rate of charging points to avoid over-investment. Public authorities should be careful not to restrict the pricing of charging points. They should also ensure that charging points can be installed competitively, in order to maximise the quality of service and minimise prices for users, while avoiding abuses of local monopolies.

In two other pertinent examples, in Germany, a project experiment is being carried out on real-time pricing in fast chargers.[45] In Portugal, it is possible to choose the energy supplier of public charging points. The electricity supply contract and the network tariff are decoupled from the CPO, thanks to a regulated central operator (EGME).[46]

3.2.2 Power modulation depending on the power contracted by the customer can also limit the need for grid development and the occurrence of congestion

Tariffs proportional to the power contracted provide an economic incentive to flatten one's consumption in order not to increase its subscription. Power modulation depending on the power subscribed helps to avoid demand peaks, by adapting the charging power to the instantaneous consumption of other uses behind the same meter. It requires the transmission of data from the smart meter (real-time monitoring of the consumption of the site) to the smart charger. The value from this optimisation can be obtained in the form of economies on the network tariff (no increase of the contractual capacity limit) and on connection costs (no need to upgrade the connection to the network).

When the charging point is not directly connected to the owner's house (in apartments, for example), one solution would be to regroup virtually the delivery points of the house and the charging point and to incentivise the customer in that way to charge the car when not consuming in the house, to reduce simultaneity with conventional load in households. This needs to be economically incentivised through reduced network tariffs (through the mutualisation of the contractual capacity limit).

[44] Burger, J., Hildermeier, J., Jahn, A. and Rosenow, J. "The time is now: smart charging of electric vehicles", 27 April 2022, Regulatory Assistance Project. Retrieved from: https://www.raponline.org/knowledge-center/time-is-now-smart-charging-electric-vehicles/

[45] E.ON Innovation and LEW launch fast charging stations with dynamic pricing model, 27 January 2022 : https://www.eon.com/en/innovation/innovation-frontline/innovation-news/eon-innovation-and-lew-launch-fast-charging-stations.html

[46] Entidade Reguladors dos Serviços Energéticos: https://www.erse.pt/en/eletric-mobility/functioning

Additionally, national or local governments sometimes subsidise consumers buying an EV and/or a charging point. Those subsidies could be conditioned to customers buying low-power (for instance below 7 kW) and/or smart charging points. For instance, in 2022, Ireland has restricted its 'EV Home Charger Grant', a residential charging station subsidy program, to the purchase of only 'smart' charging stations (allowing a remote control of the recharge according to external signals transmitted, for example, by the electric meter) referenced on SEAI's (Sustainable Energy Authority of Ireland) 'Triple E' registry, certifying such equipment which is the most energy efficient. Companies are also encouraged to equip themselves with this type of terminal rather than other models via an accelerated tax deduction mechanism (Accelerated Capital Allowance (ACA)).

A smart-charging-compatible condition for subsidies does not guarantee that smart charging will be effectively used if the incentive is not sufficient. Ex-post control can be complex, but MCs could study the possibility to grant subsidies to EV or charging points on the basis of the percentage of the energy charged off-peak.

Case study 10 (ARERA) – Increase the power subscribed during the off-peak season in Italy

In Italy, since July 2021, an experimental initiative has been launched by ARERA (Decision 541/2020/R/eel). The electricity point of delivery for smaller users is equipped with a breaker in order to check customer´s compliance with the 'technically available capacity", equal to 1.1 times the contractual capacity limit (CCL) on which the network tariff is calculated. The most common CCL is 3 kW, a relatively low level that can hinder diffusion of modern EVs. Customers can ask to increase the CCL. In that case the network tariff would be adjusted. In order to promote EV smart charging at home, low voltage customers with CCL not higher than 4.5 kW are allowed to increase the 'technically available capacity" to 6.0 kW only during the night hours (from 23:00 to 7:00), plus all the hours on Sundays and holidays, i.e., when the network usage is lower. Such capacity extension is granted only if a 'smart wallbox' for private EV charging is installed.

Requirements for admission to such an initiative are specified as follows: clients have a charging point installed permanently to the electrical system (no portable devices are allowed, as certification must be provided to guarantee compliance to all safety regulations) and such charging point must be able to offer smart charging functionalities, i.e.:

a) Monitor and record energy consumption and transmit this remotely to a third party designated by the client; and

b) Receive and process information provided and react to it by adjusting the rate of charging or discharging.

In the large majority of LV grids, users with CCL ≤ 4.5 kW are connected following technical standards that guarantee full security in absorbing continuously up to 6.6 kW. For this reason, we expect almost all applications to this initiative will be managed remotely by DSOs, without any need to go on-site. The 'modulation' of the technically available capacity over time is obtained through smart metering functionalities, and customers are not requested to pay any increase of its network tariff.

In 24 months, approximately 2,000 admission requests have been received, with 70% of these fulfilled all requirements and were activated. More than 200 models of wallbox, produced by 40 manufacturers, have been certified to be compliant with these 'smart requirements'.

Extra cost for installing a smart wallbox rather than a 'dumb' one does not appear to be relevant. Nevertheless, the number of participants has not been very high or, at least, not high enough to stimulate balancing service provider (BSP) initiatives aimed at exploiting such flexibility resources. Based on the results of clients' surveys recently completed by GSE (Gestore dei Servizi Energetici), clients with EVs seem to be in favour of this opportunity offered by ARERA, however many EV drivers do not yet appreciate the advantages offered by wallboxes or, alternatively, have already bought a 'dumb' one and are not keen to change it.

What NRAs can do:

- Propose mandatory time-of-use network tariffs with high time-differentiation, reflecting the network costs[47]; and
- Differentiate contracted power to incentivise EV charging in off-peak hours.

3.3 Smart unidirectional charging could enable to better manage the electricity grid and even reduce the costs of the electricity system

The electrification of transport could result in an increase of peak loads on distribution networks and generate additional infrastructure or flexibility costs. In case EVs are charged smartly (at the right time) and stop charging in case of overloads, this issue could be minimised. Going further, charging a car directly from a renewable asset could help optimise the network dimensioning.

3.3.1 Power modulation by the DSO for congestion and voltage management

In exchange of lower network tariffs, some charging point operators can agree to give the DSO the ability to take control of the charging power, either through a direct communication with the charging point or through temporary curtailment of the meter allowed power. Consumer acceptance should be taken into account while designing such schemes.

[47] Report on Electricity Transmission and Distribution Tariff Methodologies in Europe, January 2023, ACER: https://www.acer.europa.eu/Publications/ACER_electricity_network_tariff_report.pdf

Germany network tariffs with DSO control[48]

The German government had proposed to include in the network tariffs the possibility of giving control of certain equipment to the DSO in return for tariff reductions, in addition to the ability to subscribe 'interruptible' capacity at a reduced rate compared with firm capacity. This initiative, implying consumption control by a single operator with limited consumer choice, has faced opposition from consumers who considered it intrusive. The risk of slowing down competition and innovation in smart charging should also be assessed when discussing DSO intervention on charging management.

3.3.2 Smart charging can be incentivised through real-time pricing.

With the increase share of RES in the European electricity mix, more flexibility will be needed to respond to electricity demand in periods of low production and/or high demand. With variable prices, if suppliers transfer the variability to final customers through variable electricity supply contracts, EV owners could have a real incentive to charge when prices are the lowest. This means *implicit demand side response* where customers optimise their behaviour based on real-time prices. Customers need a smart meter (measuring every quarter/half hour or every hour) as well as a smart charging point and may also require an aggregation service.

NRAs and policymakers have a role in protecting consumers with real-time pricing from high increases in case of a crisis. For example, to incentivise flexibility, NRAs and policymakers could require the coupling of long-term hedging to a spot exposure.

3.3.3 Participation to local flexibility markets thanks to an adequate market design.

Local flexibility markets are emerging as an alternative to network reinforcements. With the move towards general electrification and the development of decentralised RES, the flexibility needs for grid may increase.

Local flexibility markets can provide one of the responses to the risk of congestion generated by the integration of new use cases and renewables. As such, the flexibility potential offered by EV charging should be offered on these markets. In fact, the charging points distribution across the country can represent a source of flexibility that is particularly well-suited to meet these needs. NRAs should work with DSOs towards an easier participation of distributed flexible assets and to improve transparency on future network needs.

In its report on smart charging, the Regulatory Assistance Project[49] stated that with an aggregator managing the charging in accordance with the user's need, stacking multiple flexibility services does not increase complexity for the user.

3.4 The opportunity of smart bidirectional charging for the electric system will need to be assessed.

Smart charging and V2G could reduce total costs of energy, not only for EV owners, but also for non-EV owners through a better optimised utilisation of the electricity network and generation infrastructure. In addition to shifting demand away from peak periods, smart charging can help integrate renewable power by charging in windy or sunny periods and help voltage and congestion management. Finally, with the development of V2G, EVs can even act as a mini local energy storage and inject electricity to the grid.

[48] Jahn A., Burger J. and Rosenow J. (2021), "Trust, not control: Germany, EVs and the power of consumer choice", 7 September 2021, Euractiv. Retrieved from: https://www.euractiv.com/section/electricity/opinion/trust-not-control-germany-evs-and-the-power-of-consumer-choice/
[49] Ibid.

At present, V2G standardisation has not yet been reached and the standardisation process for both vehicles and chargers is not expected to be completed before 2025. So far, the number of EVs and of electric vehicle supply equipment (EVSE) capable of bidirectional flows is very low. Besides technical issues, economic challenges should also be carefully considered. A pilot project in the United Kingdom has highlighted the importance and difficulty to set up an effective remuneration scheme for motivating EV owners to offer such services to the grid.

Even though monodirectional smart charging already enables taking advantage of the flexibility potential of EVs, V2G enables one to go further. Indeed, it enhances the power that can be offered on frequency markets. From the network point of view, the economic added value of V2G will depend on the degree of charging management in Europe. If ToU-based charging is widespread, the electric system may not have a significant need for such technology. Otherwise, V2G could be helpful, as only a few vehicles using this technology would be needed.

3.5 Conclusions

Effective integration of electromobility into the electricity system relies on:

- Optimisation of the localisation and connection of EV charging infrastructures to minimise grid investments needs; and
- Smart charging, to adapt the charging period and power call according to grid costs, electricity prices or other flexibility markets.

Most of the measures that incentivise smart charging are economic incentives, making smart charging profitable for EV users. To that end, simple ToU tariffs should be widespread and attractive, both for private and public charging. Flexibility markets should present no barriers to EV participation. In addition to these economic incentives, experience shows that technical standardisation and consumer awareness are also very important aspects to consider.

4 Consumer Issues

With the increasing numbers of EVs, new regulatory issues arise for possible new market entrants, as well as for consumers driving EVs. This chapter examines two aspects of consumer issues: consumer participation, and protection & empowerment of consumers. Some of the issues are cross cutting in the fields of energy law and consumer law. Drawing on examples of best practices across MCs, the chapter demonstrates how NRAs can facilitate consumer participation in the EV market within their mandate and what role they can play across certain areas of consumer empowerment.

4.1 EV development in the context of volatile energy prices

A study carried out by BEUC between July 2020 and March 2021 found that, compared to petrol/diesel cars, EVs prove the better long-term investment, taking into account total cost over its lifetime. [50] Its conclusions were based on the following assumption:

- A medium sized electric car will in general achieve higher mileage over its lifetime;
- Purchasing costs are partially offset by existing national subsidy schemes and incentives; and
- Running costs of EVs are lower due to off-peak hours charging being substantially cheaper than petrol/diesel.

The energy crisis and with it the rising electricity prices could pose a threat to the financial attractiveness of EVs based on the proposition that charging an EV is cheaper than filling a car with petrol. A significant increase in wholesale energy prices took place in the second half of 2021. Gas prices in October 2021 were 400% higher than in April of the same year. Many MCs use gas for electricity generation; therefore, this increase had a strong impact on the average electricity costs.[51] Average household electricity prices in the EU increased from €13.41 per 100 kWh in the first half 2021 to €24.01 per 100 kWh in the second half of 2022.[52] If energy prices remain high for a considerable amount of time this can have a negative effect on the development of an electric fleet. Price incentives on consumers may be diminished as a result of sustained high electric prices.

However, EV charging costs are not so straightforward and depend on various factors such as location, charging speed and the Mobility Service Provider (MSP) and CPO involved. On average, around half of the levelised cost of charging is made up of the electricity costs in Europe. Other costs such as installation, CPO, infrastructure and taxes roughly make up the other half. These price drivers can also be looked at by policy makers to influence price levels.[53]

4.2 Consumer participation

Consumer participation is a key precondition for a successful transition towards EVs. This includes:

[50] BEUC (2021), ELECTRIC CAR OWNERSHIP: AN AFFORDABLE OPTION FOR ALL CONSUMERS, p.5. www.beuc.eu/sites/default/files/publications/beuc-x-2021-040_electric_car_ownership-an_affordable_option_for_all_consumers.pdf

[51] ACER/CEER (2021), Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2021, 44783ab3-410c-1560-319f-664677d934e0 (ceer.eu)

[52] Eurostat (2022), Electricity price statistics, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Electricity_price_statistics#Electricity_prices_for_household_consumers. Data available at : https://ec.europa.eu/eurostat/databrowser/view/nrg_pc_204/default/table?lang=en

[53] Lanz L, Noll B, Schmidt TS, Steffen B. (2022), Comparing the levelised cost of electric vehicle charging options in Europe, Nature Communications. 2022 Sep 8;13(1):5277. doi: 10.1038/s41467-022-32835-7. PMID: 36075887; PMCID: PMC9458728.

- Active and sustained consumer uptake of electric vehicles;
- Behavioural shift towards smart charging; and
- Consumer ability to access and actively use EV products and services.

A key consideration across these areas is sufficient *consumer protection* and *empowerment* at each stage of the consumer journey from the initial purchase of an EV to the day-to-day use of EV services. We address this issue in the latter part of this chapter.

4.2.1 Consumer uptake

The level of EV penetration varies significantly between MCs. Research in the UK[54] has suggested that key barriers to EV adoption are:

- High upfront costs associated with an EV purchase;
- Lack of charging infrastructure near the home;
- Concerns over short battery life and public charging infrastructure;
- Time it takes to recharge; and
- General lack of awareness of maintenance and ongoing costs.

What can NRAs do?

While NRAs' remit in this area may be limited, there are a number of actions regulators can take to address these identified barriers. Soft tools may include working with industry to improve consumer awareness of the benefits of EVs, as well as carrying out consumer research to better understand consumer concerns. In some MS, NRAs may be able to take more direct action, for example, using its regulatory functions to deliver investment to infrastructure[55] or administer support schemes aimed at EV adopters.

4.2.2 Shift towards smart charging

Smart charging means optimising charging patterns to avoid consumption at peak times. It is both one of the main benefits of EVs (allowing consumers to shift their demand to times when electricity is cheaper) and an important factor in integrating EV loads to ensure that the higher overall demand as a result of electrification of transport and heat is spread out evenly and does not lead to strain on electricity networks and high system costs.

Consumers can optimise their charging manually (by plugging and unplugging their EV at different times or updating their smart charging settings to match price signals) or take advantage of automation or a third-party control (that means that price signals automatically influence EV charging pattern).

However, data suggests that some EV users continue to charge their vehicle at peak times when charging at home.[56] This may be for a number of reasons, including:

- Lack of awareness of smart charging options or benefits;
- Lack of awareness or access to time-of-use tariffs which would provide price incentives;
- Lack of smart functionality on home-chargers; and
- Habit of plugging in the EV when getting home and leaving it to charge overnight.

[54] Ofgem (2021), Consumer survey 2021: summary of research findings on electric vehicle users, Figure 1, p.2. www.ofgem.gov.uk/publications/consumer-survey-2021-summary-research-findings-electric-vehicle-users

[55] In GB, Ofgem is delivering a £300m investment for low carbon projects, including improving EV charging infrastructure, via regulation of electricity networks.

[56] In 2021 Ofgem Consumer Survey 25% of plug-in vehicle users stated they usually charge their EVs at peak times. Ofgem (2021), Consumer survey 2021: summary of research findings on electric vehicle users, p.3.

Some of these barriers could be turned into opportunities for smart charging, for example, by improving automation and linking smart charging to effective price-signals, which could increase the proportion of less engaged EV users charging smartly. However, this may be held back by reluctance or resistance in allowing a third-party take control of home charging. It is worth noting that many of the current EV users, except countries where EV ownership is already high, are 'early adopters', who tend to be younger, more educated, and more open to new technologies. This suggests that as EVs become more common, the challenge of bringing about behavioural change for smart charging may increase.

What can NRAs do?

NRAs can play a role in addressing some of these barriers to encourage smart charging. Regulators can raise awareness of the benefits of smart charging, encourage development of smart charging offers, particularly ToU tariffs,[57] help consumers find and compare available smart tariffs, or work with consumer groups and industry to improve trust in solutions for automated smart charging. Where relevant, regulators might also consider taking regulatory action to mandate default, or *opt-out,* smart charging settings for new chargers. However, research is needed to determine the effectiveness of different factors influencing consumer choice.

4.2.3 EV products and services

Another important factor of consumer participation is the ability to access and actively use EV products and services. These can encourage the uptake of EVs by **lowering charging costs**, **improving consumer experience** and familiarise consumers with broader engagement in the energy market, therefore unlocking the benefits of decarbonisation to wider consumer groups.

The most common products aimed at EV users are bespoke ToU tariffs which incentivise shift in demand-side response, allowing consumers to save money by charging their EV in off-peak periods. The potential to lower one's household's energy bills may be the most attractive proposition of engagement with smart products, including EVs. For some consumers, this may also be their first experience with demand-side flexibility and can lead to greater participation in the energy market for other aspects of individual energy use, such as use of dynamic pricing for home supply. Indeed, research has showed that the adoption of ToU tariffs is higher among EV owners compared to general population.[58]

EV services can go beyond supply tariffs and may include other innovative offers, such as access to public charging or smart charge management service. Together, these can improve the **consumer experience** of owning and running an EV.

What can NRAs do?

Regulators can take different steps in two broad areas:

1. Fostering a market environment which encourages the **emergence** of innovative business models: For example, the completion of smart meter rollout and the implementation of settlement reforms can open a market for dynamic price contracts.[59]

[57] In the same 2021 Ofgem Consumer survey, 67% of plug-in EV users said they 'would be likely to use smart charging systems in the future to reduce the cost of their household's energy bill". Ofgem (2021), Consumer survey 2021, p.4.

[58] For example, in consumer research carried out by Ofgem in 2020, 44% of respondents who were EV owners said they were on a time-of-use tariff, compared to 12% among all consumers. See Ofgem (2020), Ofgem consumer survey 2020: Decarbonisation insights, p.57. www.ofgem.gov.uk/publications/ofgem-consumer-survey-2020-decarbonisation-insights

[59] CEER published a report on implementation of dynamic price contracts, which can be found here: https://www.ceer.eu/documents/104400/-/-/2cc6dfac-8aa7-9460-ac19-4cdf96f8ccd0

NRAs can also review existing regulations to identify potential blockers of innovation and, where appropriate, take action to ensure that innovators and new business models are able to enter the market. This may include providing advice on navigating existing regulations or even granting derogations; and

2. Addressing barriers which may be preventing certain consumer groups from **accessing** existing products and service. For example, NRAs can conduct own research on consumer attitudes and behaviours and work with the industry to raise awareness of the opportunities and risks of smart products among consumers.

Case study 11 (ARERA) – consumer protection in V2G applications

In 2020, the Italian Government adopted a decree aimed at promoting the spread of V2G applications (both monodirectional and bidirectional) in several different ways, to foster the integration of EVs into the grid. Moreover, the decree aimed to allow vehicles to offer dispatching services through charging stations (often aggregated by BSPs). The decree lays out standards and procedures to facilitate the roll-out of technology to integrate battery vehicles in the power grid. Two measures are worth mentioning here:

a) ARERA and the Italian Electrotechnical Committee have been asked to issue a new technical standard defining the requirements that need to be met by any smart charging point that is willing to take part in a V2G initiative. Such technical standard will allow charging devices to be officially certifiable as 'smart', making them more easily identifiable by customers and offering aggregators homogeneous technological features and communication interfaces; and

b) GSE Spa (a state-owned company in charge of managing national incentive schemes in the energy sector) has been asked to issue guidelines for operators involving consumers in V2G initiatives, to guarantee that the latter are fully informed of the technical and economic consequences of such a choice.

Regarding point a): the technical standard and specifications have been issued in April 2023, as an annex to the "Reference technical rules for the connection of active and passive users to the LV electrical Utilities". The development of new wallboxes based on this technical standard is now under way by a few Italian manufacturers.

Regarding point b): after public consultation and agreement with ARERA and the Ministry for Economic Development, at the end of 2020, GSE Spa published an informative procedure outlining the structure of information to be provided by BSPs and MSPs to clients.

Such information should:

A) Change depending on the accessibility of the charging point, either private or publicly accessible, as in the latter an MSP is likely intermediating the relationship between e-driver and BSP;

B) Be provided both before (ex-ante) and after (ex-post) the V2G service has been exploited;

C) Depend on the type of service provided (e.g. V1G or V2G); and

D) Concern the state of charge (SoC) of the EV battery after the service has been provided (to be expressed also in terms of km), potential impacts on the health of the battery and on the guarantee offered by the car manufacturer, and economic benefit of the service.

Before providing a V2G service, e-drivers must be given the opportunity to accept or decline and to set limits, for example in terms of minimum acceptable final state of charge.

4.3 Consumer protection and empowerment

Technical developments in recent years have brought about significant improvements in both the price and the capacity of EV batteries. Equally, owing to high market pressures and competition, innovation has led to proliferation of new technical solutions.

By using the different types of charging technologies, the onus currently lies on the consumer to understand for what they are paying for. One of the implications of these developments is the issue of **billing and price transparency** for the consumer. This applies both in the case of public charging and home charging.

4.3.1 Price transparency and billing

Price transparency is one of the basic consumer rights,[60] which should be safeguarded for EV users at all stages of the EV charging process, including pre-contractual and during billing. This applies both in public and private charging scenarios, each discussed in turn below.

4.3.1.1 Public charging

Public charging points for EVs are charging points not used on private property (i.e. by one individual billing point). Public charging points are available to every user and are usually on street-sides, at retail shopping centres, government facilities or other parking areas. The tariffs are decided upon by the charging point owners.

In accordance with existing EU consumer law, the total price, or the manner in which it is calculated, should be available to the consumer.[61] In the case of refuelling a conventional car this is usually done by setting the price *per litre*. The pricing for EV charging differs and this is not yet harmonised on an EU level. Various ways in which prices can be calculated clearly include:

- Per-session fees;
- Per-minute fees;
- Per-kWh pricing models; and
- Tiered pricing based on the EV's maximal charging speed.

Two key risks associated with price transparency at public charging are:

- Lack of transparency around the costs of charging and billing between the different charging points; and
- Charging fees are often not transparently displayed at public charging points.

Together, these issues can lead to a lack of consumer trust in public EV charging as well as to a negative customer experience, especially when EV charging leads to high – or higher than expected – costs for the consumer.

One of the main instruments to build consumer trust and improve transparency in public charging is **establishing uniform charging and payment standards** across MS. The current AFIR proposal seeks to address these concerns by aiming to:[62]

[60] Directive 2011/83/EU, art. 5.

[61] Directive 2011/83/EU of the European Parliament and of the Council of 25 October 2011 on consumer rights, article 5, paragraph 1 sub c.

[62] Proposal for a regulation of the European Parliament and of the Council on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU of the European Parliament and of the Council, article 3, COM(2021) 559 final, art. 5. Accessible at: https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52021PC0559

- Make card payments (both via card readers and contactless) and QR code payment available to consumers at public charging points for ad-hoc charging[63];
- Ensure key price components (and at minimum the following: price per session, per minute and per kWh) are clearly displayed for consumers at charging points;
- Make MSP prices reasonable, easily and clearly comparable, transparent and non-discriminatory;
- Make the MSP prices available to end users before charging;
- Prohibit cross-border e-roaming costs; and
- Where relevant, to give consumers the right not to make use of automatic authentication at public charging stations and charge on an *ad-hoc* basis, or use another contract-based charging solution offered at the charging point. That option should be transparently and conveniently displayed for the consumer.

This proposed regulation has the potential to achieve better consumer outcomes in price transparency through greater harmonisation of billing standards across MS. NRAs will have to play the role to ensure that these benefits can be realised. Indeed, preamble 41 of the regulation states that: *'Member States should make use of a wide range of regulatory (…) incentives and measures to reach the mandatory targets and implement their national policy frameworks (…).'*[64]

What can NRAs do?

NRAs can utilise their existing powers and processes to monitor the compliance with both existing and new regulations. Examples of these are:

- Oversight of market participants' adherence to European or national regulation – as illustrated in case study 11 below (BNetzA);
- Regular reporting on the state of the market; and
- Taking compliance or enforcement action when appropriate – as illustrated in case study 13 below (ACM).

NRAs can also give guidance to industry in implementing the regulation in their national context. This may include helping the industry navigate the new regulations, or existing rules in new scenarios – as illustrated in case study 14 below (Ofgem).

For ease of price comparison in public charging, platforms providing information about offers in the EV charging market are mentioned as a possible solution in the Norwegian Ministry of Transport's National Charging Strategy.[65] NRAs could host such platforms themselves or make data available that makes it possible for private operators to create a market portal on their own initiative. Accessible information of the price and the availability of public charging services can facilitate better competition among CPOs. However, as identified in the national charging strategy report, there may be a risk of tacit cooperation on price harmonisation and oligopolistic behaviour among CPOs, which would eventually lead to higher prices.

Case study 12 (BNetzA) – Ordinance on Minimum Technical Requirements for the Safe and Interoperable Installation and Operation of Publicly Accessible Charging Points for Electric Vehicles in Germany

[63] Under Art. (2), this requirement will apply to operators of public charging stations with a power output below 50kW. Operators of public charging stations with a power output of at or above 50kW will be required to facilitate card payments only from 1 January 2027.
[64] Ibid, preamble 41.
[65] Norwegian Ministry of Transport (2023), National charging Strategy, p.48. www.regjeringen.no/en/dokumenter/national-charging-strategy/id2950371/

Charging Point Ordinance (LSV)

Requirements for operators of public charging stations to offer their customers different payment methods (payment debit or credit card) have been safeguarded via law in Germany through the Ordinance on Charging Points passed by the Federal Government.

The Ordinance entered into force on 17 March 2016 and was amended by Article 1 of the "First Ordinance Amending the Ordinance on Charging Points" of the Federal Law Gazette on 1 June 2017 (BGBl. I p. 1520). It implemented the European requirements of Directive 2014/94/EU.

This ordinance regulates the minimum technical requirements for the secure and interoperable construction and operation of publicly accessible charging points for electric vehicles as well as other aspects of the operation of charging points such as authentication, use and payment.

EVs are defined in the Regulation as a pure battery EV or an externally chargeable HEV of categories M1 and N1 as defined in Annex II Part A of Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007. Charging points are accordingly facilities which are suitable and intended for charging EVs and at which only one EV can be charged at once.

The second amendment to the Charging Point Ordinance was published in the Federal Gazette on 10 November 2021 and came into force on 1 January 2022. Specifically, with the amendment to the Charging Point Ordinance, the Federal Government is transposing the EU Directive 2014/94/EU of the European Parliament and of the Council into German law. The main amendments are:

1. Uniform payment system for spontaneous charging ('ad-hoc charging')

From July 2023 on, the operator of a publicly accessible charging point must offer at least one contactless payment credit and debit card. Common credit card systems include Mastercard and VISA, which are used worldwide. The common debit card system in Germany is the Girocard, as every holder of a current account usually has at least one such card.

2. Standardised data interface

Charging points that go into operation on or after 1 March 2022 must have a standardised interface that can be used to transmit authorisation and billing data as well as dynamic data on operational readiness and occupancy status.

3. Type 2 vehicle coupling at normal charging points

With the amendment, normal charging points (up to 22 kW) are also permitted, which are exclusively equipped with a Type 2 vehicle coupling (permanently attached charging cable). Previously, this was only the case for fast charging points (over 22 kW).

4. Changed obligation to notify

The Federal Network Agency (the NRA, BNetzA) must be electronically notified of new publicly-accessible charging points no later than two weeks after commissioning instead of four weeks before construction as was previously the case. Operators have to provide evidence that rapid charging stations are compliant with the technical requirements, especially since the Federal Network Agency may also request further evidence if necessary.

Role of the NRA

The NRA may regularly verify the compliance with the technical requirements under section 3(1) to (5) of the Charging Point Ordinance and the requirements under section 4 of the Charging Point Ordinance.

The NRA may require that a charging point should be retrofitted if a technical requirement under section 3(1) to (5) of the Charging Point Ordinance or a requirement under section 4 of the Charging Point Ordinance is not complied with.

The NRA may prohibit the operation of a charging point if a technical requirement under section 3(1) to (5) of the Charging Point Ordinance or a requirement under section 4 of the Charging Point Ordinance is not complied with or if compliance with the notification and verification requirements under section 5 of the Charging Point Ordinance is not demonstrated.

Case study 13 (ACM) – Enforcement of price transparency in public EV charging in the Netherlands

According to the consumer law regarding the manner in which the price is calculated, the price must be transparent to consumers before they conclude an agreement. In the EV sector, prices were/are often non-transparent. Prices are not clear to consumers at the level of the MSPs and at the level of the various charging stations. ACM has conducted an enforcement project in the EV sector.

Pre-phase of the investigation

Since as early as 2017, the ACM had been receiving signals that prices on the EV market, especially regarding public charging, were unclear. At the time it was recognised that the market was still in early stages of development. ACM did not want to hold back this growing market. During talks with the sector, it was also recognised that at this stage most EV drivers were businesses (in the form of leasing construction etc.). The consumer law does not apply equally in that case.

In 2020, the situation was reassessed. ACM was still receiving considerable complaints about price transparency. Research also showed that the share of consumers in EV driving had grown. It was decided to investigate the situation further.

Consequently, ACM studied its legal position towards price transparency on the EV market. According to the consumer law, or the way price is calculated, the price has to be transparent to consumers before concluding an agreement. This can be done by clearly showing the sum and/or price per kWh on the website before a consumer enters into the agreement. In the EV sector, prices were often non-transparent.

Since the market was still relatively new, ACM decided to hold a sector wide meeting in which ACM explained the price transparency rules to all parties present. ACM showed their results and answered questions for the parties. ACM also explained that starting two months after the sector meeting it would actively monitor and enforce these rules in the sector.

Phase 1

The first phase of the project focussed on MSPs and transparency in the first stage of EV charging. This is the first party the consumer comes across. Before the sector meeting the largest and well-known MSP website was investigated, and infringements were identified. This was the base line of the project.

In the period after the sector meeting, the same websites were captured once more. In almost all cases the price transparency was improved. No formal action had to be taken.

Phase 2

During the first phase of the project ACM noticed a shift moving from the use of physical charging cards to the use of applications connected to consumers' credit cards. The assumption was that the use of applications will become the standard in the future.

Therefore, it was deemed necessary to check part of the largest application using MSPs as well. The same price transparency rules apply to these parties: the prices should be transparent and clear before entering into an agreement.

Seven of the largest applications using MSPs were actively checked, out of which four were not compliant with the price transparency rules. ACM informally demanded that these parties make ensure compliance with the consumer law, which all four did. No formal action had to be taken.

Results

By recognising that it was a market in development, ACM did not halt the development of EV driving in the Netherlands. ACM communicated clearly and provided clarity about how to apply the consumer law in this market and sent out a warning that companies involved had to comply within a set amount of time. Almost all companies either complied or complied swiftly afterwards. Therefore, no formal action in the form of fines or penalty payments had to be taken. Overall, the price transparency improved considerably in the market.

Case study 14 (Ofgem) – Taking charge: selling electricity to EV drivers in GB

In Great Britain, the NRA (Ofgem) has published a guidance which clarifies what rules apply under different existing charging models. The guidance considers eight common scenarios for EV charging: Home, Destination, Forecourt, On-street, Home and roam, Peer-to-peer, Mobile on-demand, and Fleet.

It then explains the concept of 'supply', what it means to be a licensed or exempt supplier, what reselling is, and key takeaway points about the supply rules governing EV charging. Its target audience are innovators, CPOs, local authorities, EV drivers, fleet operators, trade associations, investors, and innovation support providers.

4.3.1.2 Private charging

Estimations based on results from the Norwegian EV driver survey in 2021 show that as much as 80% of EV charging takes place at home.[66] At-home charging carries a number of advantages, notably cost and convenience as consumers can benefit from lower electricity rates. Additionally, they are not dependent on a public charging infrastructure.[67] To charge an EV at home, consumers generally need a charging point installed and a signed contract with an electricity supplier to charge their EV.

Consumers may be able to enter separate supply contracts for at home EV charging and their general household electricity consumption. In its Electricity Market Design proposal, the European Commission has suggested the option for 'split supply models':

[66] Scale (2022), Report on consumer behaviour (1st edition), p.16. https://scale-horizon.eu/publications/
[67] IEA Report: Global Electric Vehicle Outlook 2022

> *Member States shall ensure that all customers are free to purchase electricity from the supplier of their choice. Member States shall ensure that all customers are free to have more than one electricity supply contract at the same time, and that for this purpose customers are entitled to have more than one metering and billing point covered by the single connection point for their premises.*[68]

Rationale:

> *Consumers should be able to choose the supplier which offers them the price and service which best suits their needs. Advances in metering and sub-metering technology combined with information and communication technology mean that it is now technically possible to have multiple suppliers for a single premises. If they so wish, consumers should be able to use these possibilities to choose a separate supplier notably for electricity to power appliances such as heat pumps or electric vehicles which have a particularly high consumption or which also have the capability to shift their electricity consumption automatically in response to price signals.*[69]

This gives consumers more flexibility and other benefits. Equally, however, having more than one electricity supply contract can create risks; for example, lack of transparency so that consumers enter into supply contracts on unfavourable terms or so that they conclude contracts they do not really need.

In addition to having a supply contract, consumers can make use of emerging bespoke EV services, e.g. aggregation services providing flexibility (via an EV battery), load control and demand side response. It is crucial that regulation, and its enforcement, can keep up pace with these new business models to ensure adequate consumer protection.

What can NRAs do?

Existing regulations already provide a degree of protection to EV drivers. NRAs should ensure compliance with these regulations. For example, the Electricity Directive already requires MS to ensure that "*all customers are free to purchase and sell electricity services, including aggregation, other than supply, independently from their electricity supply contract and from an electricity undertaking of their choice*" and that "*a customer wishing to switch suppliers or market participants engaged in aggregation, while respecting contractual conditions, is entitled to such a switch*" within a set time period.[70] Equally, the Directive establishes requirements on billing standards.[71]

However, there are areas where further regulation may be needed:

- First, existing rules may not address new scenarios arising from the emergence of services aimed with at-home EV charging, including aggregation, load control or demand side response services. A question may arise whether NRAs should offer bespoke protections for EV drivers beyond those afforded to them as energy consumers; and
- Secondly, the increasing market complexity due to rapidly developing new business models raises legal and regulatory challenges for ensuring that all market participants follow common rules and a level-playing field.

[68] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Regulations (EU) 2019/943 and (EU) 2019/942 as well as Directives (EU) 2018/2001 and (EU) 2019/944 to improve the Union's electricity market design, Explanatory Memorandum, Article 2 (2). Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0148&qid=1679410882233
[69] Ibid. Recital 46.
[70] Electricity Directive, Articles 13 (1) and 12 (1), respectively. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32019L0944
[71] Ibid. Article 18.

NRAs have a role to play in identifying regulatory gaps or specific vulnerabilities, keeping existing regulation up to date, and where relevant, helping implement additional protections. For example, in the United Kingdom, Ofgem is working with the government Department for Energy Security and Net Zero to bring in new regulation for remote energy usage optimisation through Energy Smart Appliances (ESAs), such as EV charging points. Under the current proposals, ESAs will be required to meet minimum standards on cyber security, interoperability, data privacy and grid stability. Activities relating to load control will also be made licensable and placed under the regulation by Ofgem.[72]

This new regulation will extend to not only EV charging points but all ESAs which may include devices such as heat pumps. This example highlights the need for a long-term holistic approach towards integration of all kinds of emerging demand side response appliances.

As part of this, regulators may also need to consider implementation of proposals allowing consumers to have more than one metering point. In particular, it is for considerations whether submetering devices comply with the rules in the Metering Instruments Directive (MID).[73]

Availability of private charging

It is worth noting that private charging may not be available to certain consumer groups. For instance, people living in flats or rented accommodation (e.g. in inner cities) may not have access to off-street parking and, as such, not be able to have a charging point installed at or near their home. This issue may be pronounced in some MS more than others. For example, research among EV drivers in Norway and the Netherlands[74] showed that, while in Norway 97% of EV drivers have access to private parking, in the Netherlands only 67% of current EV drivers do. Crucially, only 41% of Dutch population have a private parking spot,[75] suggesting EV drivers are unrepresentative of the general population and highlighting the risk of accessibility to electromobility for potentially large segments of the population.

No access to home charging means reliance on public charging infrastructure alone, lest those consumers be precluded from EV ownership altogether. Consumers without access to off-street parking are also more likely to have other potential vulnerabilities, such as lower income, making it more challenging to invest into an EV. Policymakers and regulators should pay particular attention to the impacts on vulnerable groups, and the issue of equity more generally, during the transition to EVs.

4.4 Availability of public charging points

Although EV charging is expected to be dominated by private charging (whether at home or a workplace),[76] the availability of public charging points is one of the key concerns for an effective EV rollout, at least for consumers with limited access to private charging. Public fast chargers or even ultra-fast chargers of up to 350 kW located on highways and other main transport corridors are crucial to enable longer trips, encourage consumers that lack access to private charging to purchase an EV, help tackle range anxiety as a barrier for EV adoption, and enable charging of heavy good vehicles (HGVs).[77] In Europe, the latest AFIR proposal includes gradual requirements to provide recharging infrastructure for cars and HGVs:

[72] BEIS (2022), Energy Bill Policy Statement: Energy Smart Appliances and Load Control. Accessible at: /www.gov.uk/government/publications/energy-security-bill-policy-statements-and-draft-regulations
[73] Measuring Instruments (MID) Directive 2004/22/ECDirective 2014/32/EU. https://single-market-economy.ec.europa.eu/single-market/european-standards/harmonised-standards/measuring-instruments-mid_en
[74] Scale (2022), Report on consumer behaviour (1st edition), p.15. https://scale-horizon.eu/publications/
[75] ANWB (2021). Elektrisch Rijden Monitor 2021. www.anwb.nl/belangenbehartiging/duurzaam/elektrisch-rijden-monitor-2021
[76] Private chargers are expected to account for 90% of all chargers by 2030. IEA (2022), Global EV Outlook, p.121. Retrieved from: www.iea.org/reports/global-ev-outlook-2022
[77] Ibid, p.125.

- For cars and vans: a power output of 1.3 kW per battery-powered EV provided by publicly accessible recharging infrastructure; fast charging stations of at least 150 kW every 60 km by 2025; and
- For HGVs: min output of 350 kW to be deployed every 60 km and every 100 km from 2025 onwards. Complete network coverage to be achieved by 2030[78].

With this expected growth of public charging infrastructure, NRAs can have a role in facilitating consumer access to information about available public charging points; for example, by publishing or maintaining centralised public registers and maps. These can provide information to EV drivers about the location as well as detailed technical aspects of public charging points, as illustrated by case studies 15 (BNetzA) and 16 (URE) below.[79]

Case study 15 (BNetzA) – Charging map including technical specifications in Germany

Publicly-accessible charging points for electric vehicles must contain minimum technical requirements. To check that these requirements are met in accordance with the Charging Point Ordinance, the operators are obliged to report their publicly accessible charging infrastructure to the Federal Network Agency (the NRA, BNetzA). Reported charging points are published (with consent of the operator) on a general map for information.

The operator can report the charging point electronically. The collected information is available for public and service provider (e.g., information about charging plugs).

https://www.bundesnetzagentur.de/DE/Fachthemen/ElektrizitaetundGas/E-Mobilitaet/start.html

63,806 regular charging points and 12,755 fast charging points were reported to the Federal Network Agency as being in operation as of 1 December 2022.

[78] European Commission (2023), Press release, 'European Green Deal: ambitious new law agreed to deploy sufficient alternative fuels infrastructure', Retrieved from: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1867

[79] A similar service exists in Scotland, provided by Charge Place Scotland. Retrieved from: https://chargeplacescotland.org/

The map is published as follows:

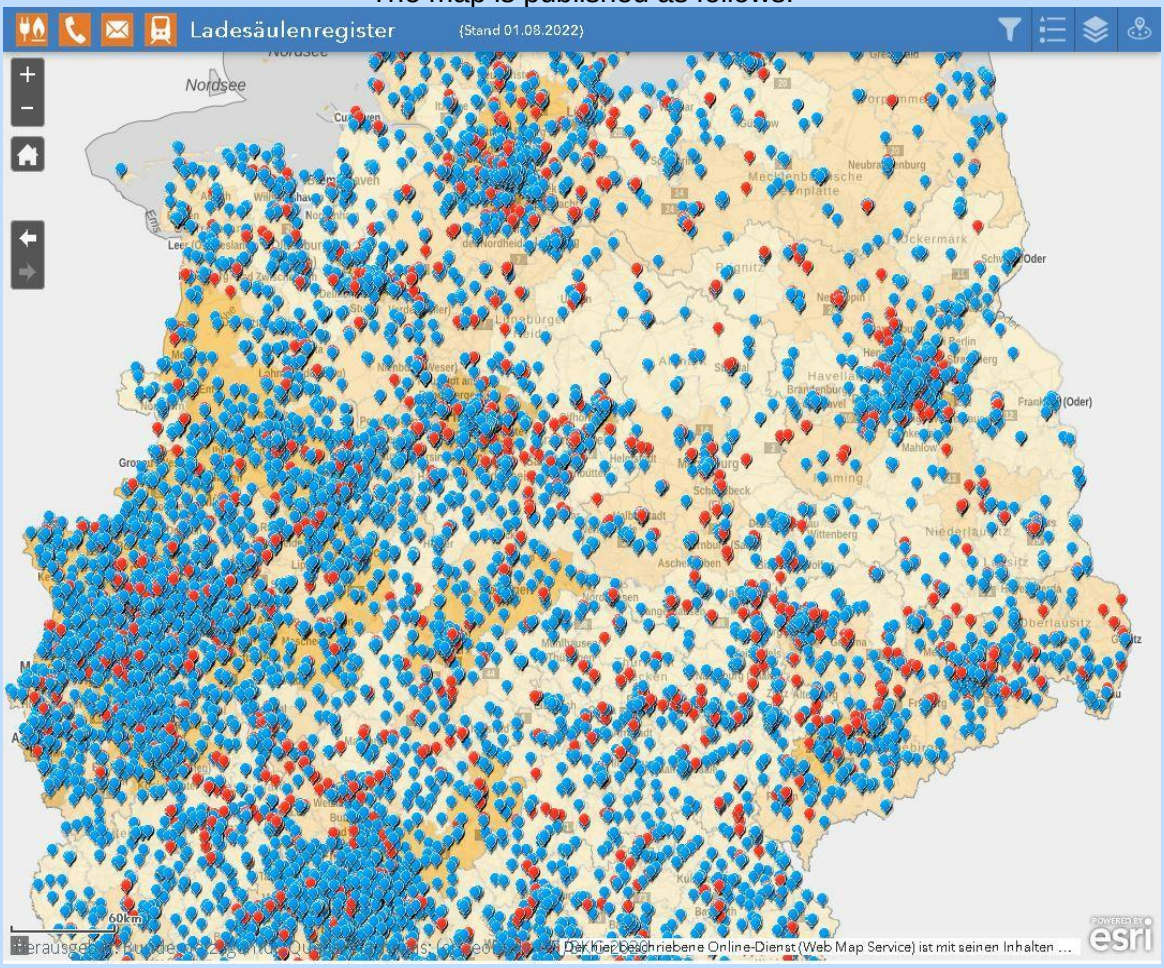


Figure 4 – Overview of electric vehicle charging points in Germany

Functionalities of the interactive map

The map shows the charging facilities of all operators who have completed the notification procedure of the Federal Network Agency and have agreed to publication on the internet. The Charging Point Ordinance does not enable a complete recording of the entire German charging infrastructure. The number of publicly accessible charging facilities in Germany is therefore larger than shown. Beside the location, the following information is available by clicking on the respective charging point:

- Operator;
- Address;
- Metering information; and
- Technical Equipment.

In addition, the map in the top bar offers additional functionalities such as a proximity search or filtering by plug type.

Case study 16 (URE): Availability of charging points in Poland

Legal basis

In Poland, the Act on Electromobility and Alternative Fuels has applied since 2018.

The Act specifies, among others, rules for the development and operation of infrastructure for the use of alternative fuels in transport, including the obligations of operators of generally accessible charging stations and charging service providers.

Connecting public charging stations to the grid

The connection to the power grid of the road public transport charging infrastructure and publicly accessible charging stations with high-power charging points (more than 22 kW) is carried out firstly, before connecting other demand facilities.

Fees for connecting to the power grid of the road public transport charging infrastructure and publicly accessible charging stations have been set at a preferential rate: For connecting to the power grid with a voltage higher than 1 kV and not higher than 110 kV, the fee is determined on the basis of one-sixteenth of the actual expenditure; for connecting to the power grid with a voltage of not more than 1 kV, the fee is determined based on the tariff rates, calculated on the basis of one-sixteenth of the average annual investment expenditure on the construction of network sections used to connect these entities.

Register of Alternative Fuels Infrastructure

In accordance with the provisions of the Act on electromobility and alternative fuels, the public Register of Alternative Fuels Infrastructure is kept by *Urząd Dozoru Technicznego* (Office of Technical Inspection). The register is kept so as to provide users of electric and natural gas vehicles with information facilitating the use of these vehicles. Operators of publicly accessible charging stations are required to report information about the stations to the Register.

The Register contains information about:

1) Coordinates of the natural gas stations;
2) Coordinates of publicly accessible charging stations for EVs;
3) Current prices of alternative fuels in places indicated in the register; and
4) Availability of charging points installed in publicly accessible charging stations.

The locations of publicly accessible charging stations are shown on an interactive map[80].

Interactive map functionality

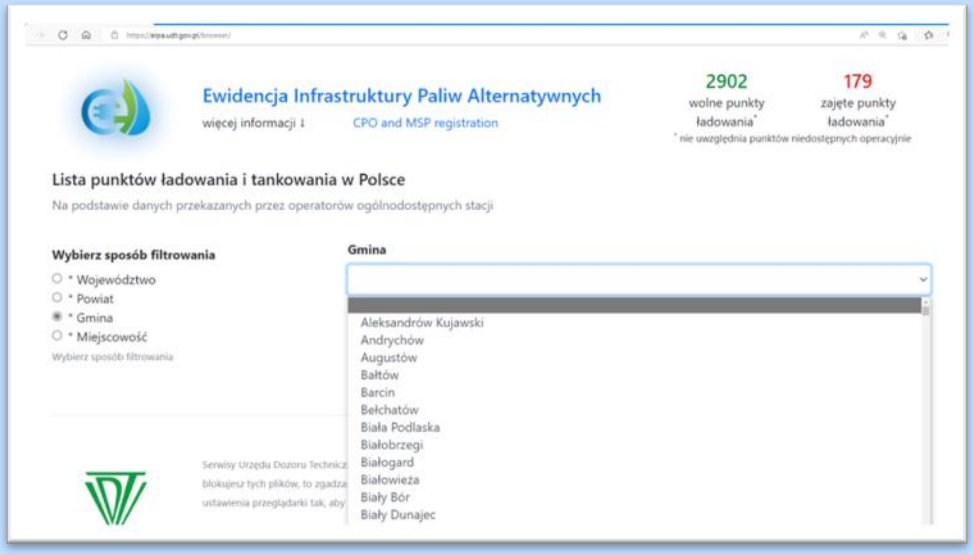
The map shows publicly accessible charging stations of all operators who, in accordance with the provisions of the Act, reported charging stations to the Alternative Fuels Infrastructure Register.

In addition to the location, the following information is available by clicking on the respective charging point:

- Address;
- Operator;
- Opening hours;
- Power of charging points; and
- Prices.

[80] See: https://eipa.udt.gov.pl/

In the Register, it is also possible to specify locations of charging stations for individual administrative units: voivodeships, counties, municipalities and cities.



The register also includes the current statistics on the number of free and occupied charging points. Of course, in addition to the official register, information on charging stations is also published by charging service providers on their own websites.

4.5 Other issues: eRoaming services, interoperability and data

In addition to the consumer participation and empowerment and protection issues highlighted above, there are a range of issues which may currently go beyond NRAs' direct remit, such as in the areas of eRoaming, technical interoperability or data availability.

4.5.1 eRoaming

EV charging roaming (eRoaming) enables EV drivers to charge at any charging station with their customer account managed by their MSP. ERoaming is a partnership between different CPOs and MSPs to provide EV drivers with the optimal universal charging service by creating a roaming EV charging network. However, charging points belong to different EV charging networks and are operated by different CPOs. EV drivers should be able to charge in all EV networks without encountering barriers or additional costs. The AFIR proposal aims to eliminate cross-border eRoaming charges.[81] NRAs should assume an active role in ensuring compliance with these regulations. Further steps may include additional requirements on CPOs to:

- Implement at least one open and free to use non-proprietary protocol. This would help ensure that public charging points have at least one communication protocol for roaming agreements (without precluding use of additional protocols; and
- Allow non-discriminatory access to charging points to third-party MSPs offering eRoaming services[82].

[81] Art. 15 (6), https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52021PC0559
[82] HEV TCP (2022), Final report – Task 39: Interoperability of e-mobility services, pp.21-22. https://ieahev.org/tasks/39/

4.5.2 Interoperability: technical and cybersecurity standards

Common technical standards for public chargers will also be needed across MS/MCs to unlock interoperability in EV charging. Currently, there is a lack of vehicle compatibility when looking at the chargers as there are three different DC fast chargers used by different EV manufacturers:

- The SAE Combined Charging System (CCS);
- CHAdeMO which is used by Nissan and Mitsubishi; and
- Tesla Supercharger (only for Tesla drivers).

Cybersecurity is of vital importance in the deployment of EV charging infrastructure, both from whole-system security and resilience to hacking, and privacy. Authorities can improve cybersecurity by requiring minimum technical standards in public tenders. Many national and local governments in Europe already do so. In the Netherlands, ElaadNL the knowledge and innovation centre for smart charging infrastructure, published a guideline for cybersecurity requirements developed by the European Network for Cyber Security (ENCS) to be used in public tenders.[83] However, requirements are often not formalised or remain informal. The design of EV Public Key Infrastructure (PKI), the technology facilitating the secure transfer of electronic information, e.g. user or charging point authentication, may also give rise to risks to interoperability, for example:

- Lock-in effects where a consumer is only able to use a charging point connected to the PKI chosen by their EV manufacturer; and
- Adverse impacts on competition where PKI management can lock out parties from accessing the system[84].

4.5.3 Data

Data exchange can be seen as a prerequisite for smart charging services. Improving access to data across the full value chain can optimise EV services and can help the development of new business models. This could be achieved by giving EV drivers ownership of proprietary EV data to allow participation in the flexibility market. Access to proprietary EV data such as state of charge could enable flexible contracting with MSPs or easier communication of driver preferences for the development of dynamic smart charging.[85] At the same time, clear rules for data exchange are needed to counter potential vulnerabilities of increased data flows and protect consumer privacy.

The data is also crucial in the context of the development of new legislation due to the complexity of the EV ecosystem and the need for policy makers and regulators to 'get things right'. The dependency on academic research and innovation and corresponding delays in necessary scientific data have been identified as major barriers to the establishment of new legislation. This in turn inhibits consensus on policies and complicates harmonisation. Prevailing uncertainties about legal and regulatory framework can lead to delays in the emergence of new business propositions.[86]

What can NRAs do?

Across these areas, there is a case for best practice sharing and potential harmonisation across MS. NRAs can have a role in mapping the impact of these emerging issues on consumers in individual MS as well as highlighting these issues to relevant policy makers,

[83] ElaadNL (2017), EV Charging Systems Security Requirements. Accessible at https://elaad.nl/en/projects/cybersecurity/
[84] Ibid, p.30.
[85] Scale (2022), Stakeholder Analysis, p.33. https://scale-horizon.eu/publications/
86 Ibid., pp.36,39.

including through international forums.

5 Conclusions

This report has highlighted challenges and, through examples of best practices, the potential roles of NRAs in ensuring that the development of electric mobility can meet European decarbonisation targets, while being economically and technically sustainable for the energy system and the consumers.

The report places particular emphasis on the importance for NRAs to address the three dimensions of electric mobility addressed, depending on the development of the sector on their national territory, their legal prerogatives and the public policies put in place by governments. In particular:

- When it comes to **supervising the deployment of charging infrastructure**, the regulatory framework for network operators and the methods used to calculate network tariffs will have to meet the requirements of the transition to electric mobility, including equity and sufficient network capacity, to ensure that these players contribute fully and rationally to the development of electromobility;
- To facilitate the integration of electric mobility in the power system, proper incentives should be given to optimise the location and the connection of charging infrastructure, as well as to charge at the best possible time regarding the system costs. **Widespread simple time-of-use tariffs and charging management** will be the key tools. Regulators should monitor the EV charging impacts on the system and the participation on flexibility markets without barriers for electric vehicles; and
- Regulators have a role to play in **encouraging consumer participation in electromobility** and **ensuring consumer empowerment and continued protection**. In the former case, this may include carrying out research to better understand consumer attitudes, expectations, and behaviour, working with industry to promote awareness of the opportunities and risks of EV ownership, or ensuring a fair environment for the development of enabling EV services. NRAs may look to adapt existing regulation or introduce new rules to ensure appropriate consumer protection in the EV market, including cost and billing transparency when charging at home or in public. NRAs may also consider facilitating better access to information on public charging, including location and pricing. Moreover, NRAs can monitor emerging issues, including the areas of interoperability, data and e-roaming. Finally, NRAs can also work with policy makers to help ensure a continued and successful EV rollout as well as prevent outcomes detrimental to consumers.

Annex 1 – List of Abbreviations

Term	Definition
AC	Alternating Current
AFIR	Alternative Fuels Infrastructure Regulation
AT	Austria
BE	Belgium
BEUC	*Bureau Européen des Unions de Consommateurs*
BG	Bulgaria
BSP	Balancing service provider
CEER	Council of European Energy Regulators
CMA	Competition and Markets Authority
CPO	Charge point operator
CY	Cyprus
CZ	Czechia
DC	Direct Current
DE	Germany
DK	Denmark
D-NDPs	Distribution network development plans
DNO	Distribution network operator
DSO	Distribution system operator
EE	Estonia
eRoaming	EV charging roaming
ES	Spain
EV	Electric Vehicles
EVSE	Electric vehicle supply equipment
FI	Finland
FR	France
GB	Great Britain
GES	*Gestore dei Servizi Energetici*
GGP	Guidelines of Good Practice
GR	Greece
HEV	Hybrid electric vehicle
HGV	Heavy good vehicle
HR	Croatia
HU	Hungary
HV	High voltage
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
LV	Low voltage
MC	CEER Member Country
MS	Member States
MSP	Mobility Service Provider
MT	Malta
NL	Netherlands
NRAs	National Regulatory Authorities
PL	Poland
PT	Portugal
RED	Renewable Energy Directive
RES	Renewable Energy Sources
RO	Romania
SE	Sweden
SEAI	Sustainable Energy Authority of Ireland
SI	Slovenia

Term	Definition
SK	Slovakia
SO	System operator
TEN-T	Trans-European Transport Network
ToU	Time-of-use
TSO	Transmission system operator
UK	United Kingdom
V1G	Vehicle-to-Grid with unidirectional power flow
V2B	Vehicle-to-Building
V2G	Vehicle-to-Grid
V2H	Vehicle-to-Home
VREG	Regional energy regulator of the region of Flanders, Belgium

Annex 2 – NRA survey on electromobility

We have sought information on actions and work NRAs across CEER Member Countries have undertaken in the three main areas addressed in this report: deployment of recharging infrastructure, integration of EVs into the electricity system, and consumer participation and protection.

We received **20** responses from NRAs representing CEER Member Countries, as well as one from a regional regulator. The results show a diversity of approaches and competencies, with some NRAs actively involved in all, or at least some, of the three areas, and others lacking an express remit in relation to electromobility.

Of the 20 responses, **14** NRAs (AT, CZ, DE, FR, GB, IS, IT, MT, NL, PL, PT, RO, SI, SK) responded positively to at least one of the three questions. In addition, **two** NRAs (HU, NO) and one regional regulator (BE – Flanders) provided at least an example of either a planned action or of a work indirectly related to facilitating electromobility in at least one of the areas. Only **four** NRAs (AL, EE, HR, SE) expressly stated no regulatory work has been carried out to date.

Of the three areas, regulators reported having carried out most regulatory work in facilitating deployment of recharging infrastructure, with **13** regulators providing examples of current or future work. These examples included (non-exhaustive):

- Operating registry of charging station registry
- Removing barriers to grid connections via:
  - Monitoring, reviewing, setting or changing network tariff structure
  - Incentivisation of DSOs to reduce delays of new connections
- Advising government on new policies and legislation
- Providing allowance to DNOs to invest in network upgrades

Ten regulators had responded with examples of current or future work in the area of system integration (including two examples of indirect actions); these included (non-exhaustive):

- Issuing regulations and technical standards for grid connections
- Developing common regulatory approach and model for integration of controllable (flexible) devices, including EV chargers and heat pumps
- Providing a sandbox service for innovators
- Requiring DSOs to undertake analysis of network flexibility in their business planning
- Issuing requirements and standards for charge points taking part in V2G
- Participating in, or facilitating, V2G trials

12 regulators provided examples of current or future work directly or indirectly related to the area of consumer participation and protection. These actions included (non-exhaustive):

- Hosting a tariff calculator or look-up tool for public charging on its website
- Enabling multiple supply contract models
- Preparing regulations and minimum standards for public charge points, incl. on price transparency and interoperability; overseeing compliance of public charge points with minimum technical requirements
- Working with CPOs to make payments and billing more transparent
- Outlining information to EV owners on V2G
- Carrying out research into the state of play of EV charging systems, opportunities and barriers, to support future regulation
- Carrying out research among EV drivers
- Publishing guidance for innovators

Questions asked in the NRA survey:

Have you undertaken any regulatory work specifically on electric vehicles?

1. Regarding the deployment of charging infrastructure?
    - For example, does it have the power to give an opinion or decide on subsidies for charging infrastructure and their inclusion in network tariffs, has it implemented incentive-based regulation (e.g., to encourage DSOs to control connection delays for charging infrastructure)?
2. Regarding the integration of electric vehicles into the electricity system?
    - For example, regarding power modulation, regulatory sandboxes for innovative projects, reflexion on local flexibility needs etc.
3. Regarding consumer participation and protection regarding EV market?
    - For example, have you conducted research on consumer behaviour, published any recommendations to market actors or introduced any measures to improve consumer protection, (e.g. in terms of price transparency and interoperability of charging stations)?

Legend to the assessment of responses:

	Response included an example of work/action **undertaken directly in relation** to the given area
P	Response included an example of work/action **planned to be undertaken** in the given area in future
R	Response included an example of **undertaken work/action indirectly related** to the given area
	Response **expressly stated no work/action has been undertaken** in the given area
	No response provided

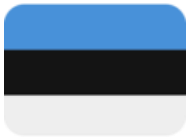
Survey Results

MC (NRA)	Area	Ass't	NRA response
AL (ERE) 	Deployment of recharging infrastructure		No regulation in place yet
	EV integration into the electricity system		No regulation in place yet
	Consumer participation & protection		No regulation in place yet
	Other comments		For the moment in Albanian power legislation, any measures regarding the electric vehicle are not yet foreseen. However, there are several charging stations deployed in the capital and even some other cities which are used in public parking slots for any customer and there are several charging stations which are used form the taxi companies. Nothing is regulated yet by the regulator, but ERE has published a study available on ERE's website (in the Albanian language): www.ere.gov.al/images/files/2022/08/26/Vleresim_mbi_Makinat_Elektrike.pdf
AT (E-Control) 	Deployment of recharging infrastructure		E-Control operates Austria's official charging station registry (*Ladestellenverzeichnis*, accessible at: www.ladestellen.at), an initiative of the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology which provides the location and other information for public charging stations (there is an obligation to register public charging stations). Grid users are encouraged to contact E-Control if there are questions/difficulties/delays with regard to grid connection of recharging stations. The dispute settlement service offered by E-Control can be addressed by grid users encountering difficulties or being in conflict with system operators or electricity companies.
	EV integration into the electricity system		E-Control has recently issued uniform rules and regulations regarding grid connection of charging stations and technical requirements in the TOR, the "Technical and Organisational Rules for the Electricity Market", which become legally binding for grid users and system operators concluding a grid connection contract. These rules include: • System operators must be notified about grid connection of charging stations above 3.68 kW.

MC (NRA)	Area	Ass't	NRA response
			• Charging stations below 10 kVA may be connected without prior consent of the system operator (a notification suffices); • For charging stations with 10 kVA or more, the SO's consent is required. The system operator may suspend the connection request in case of justified technical issues. The SO is required to respond to requests within 4 weeks and in case of a suspension, it has to inform the grid user about the technical reasons and possible alternative options/configurations for immediate grid connection; and • Charging stations above 3.68 kW must have a bidirectional digital communication interface that facilitates remote control commands and must provide various charging programs, such as time programming and low-power-charging. (These rules are intended to pave the way for implicit and explicit flexibility and will enter into force with 1 Jan 2024.) E-Control supports and participates in advisory boards of research projects related to e-mobility and charging infrastructure.
	Consumer participation & protection		To improve price transparency, E-Control is offering a variety of applications to help consumers to find the optimal solutions: • For charging at home or at work, the tariff calculator for households and for small businesses can be used to find the cheapest electricity supplier: It has been operational on the website of E-Control almost since electricity market liberalisation and is not a specific tool for the electromobility segment but includes the products of all suppliers active on the Austrian electricity customer market. It offers the opportunity to customise load profiles for the price comparison; it is thus possible to account for specific e-vehicle charging profiles. • For charging at publicly available charging stations without any contracts (e.g., charging-cards), the so called "ad-hoc"-prices are included in the aforementioned "*Ladestellenverzeichnis*"; and • For charging at publicly available charging station with contracts, E-Control will release a special charging-tariff-calculator during this summer, that will allow customers to compare all available offers from e-mobility-provides especially for their needs. Furthermore, E-Control is the appointed ID registration organisation (IDRO) for Charging-Points-Operators (CPO) and E-Mobility-Providers (EMP). For more information on IDRO, see: https://benelux-idro.eu/en/more-about/id-registration-repository-idrr

MC (NRA)	Area	Ass't	NRA response
BE – Flanders regional regulator (VREG)  	Deployment of recharging infrastructure		No tariff-related regulatory work has been conducted pertaining to the installation of charging infrastructure explicitly.
	EV integration into the electricity system		No
	Consumer participation & protection	P	No, not specifically. However, regarding consumer participation in the market VREG is exploring options to have multiple supply contracts behind an access point so that consumers could have a supply contract for the EV that is different from the original supply contract. Today a customer can have a separate supply contract for an EV, but this requires the introduction of a separate access point.
CZ (ERÚ) 	Deployment of recharging infrastructure		According to Czech legislation (the Energy Act), it is not necessary to have a license to operate charging stations (the operation of charging stations is governed by the Fuel Act). The ERÚ has approved the requirements for the connection of electric vehicles and charging stations to the distribution system (Distribution System Operation Rules). A special distribution tariff for owners or lessees of EVs is approved in the framework of the issued price decision. The promotion of electro-mobility through subsidy policy is the responsibility of the State (Ministry of Environment) not the ERÚ. Currently, the purchase of EVs for the public sector (for municipalities, universities, registered churches and other public sector institutions and others) is supported.
	EV integration into the electricity system		ERÚ does not carry out regulatory activities in this field.
	Consumer participation & protection		ERÚ does not carry out regulatory activities in this field. Ministry of Industry and Trade carried out a study as a part of the National Action Plan (NAP) in the area of electromobility, CNG, LNG and to a limited extent also hydrogen technology (or fuel cell technology).

MC (NRA)	Area	Ass't	NRA response
DE (BNetzA) 	Deployment of recharging infrastructure	P	In Germany, the Federal Ministry for Digital Affairs and Transport (BMDV) coordinates and controls activities to expand the charging infrastructure. Further planned measures in the field of electromobility and grid connection and other regulatory areas have been collected in the *Masterplan Ladeinfrastruktur II der Bundesregierung* (Masterplan for Charging Infrastructure II of the Federal Government), *accessible at:* https://bmdv.bund.de/SharedDocs/DE/Anlage/G/masterplan-ladeinfrastruktur-2.pdf?__blob=publicationFile Furthermore it is currently being examined to what extent hurdles for the grid connection can be removed through standardisation of the technical connection conditions.
	EV integration into the electricity system		Integration of controllable consumption devices and grid connections (§14a Energy Industry Act) Under §14a Energy Industry Act BNetzA has commenced proceedings on 24 November 2022 to integrate controllable consumer devices, such as charging infrastructure for electric vehicles and heat pumps, into electricity distribution systems. The purpose is to create a nationwide regulatory framework for arrangements between network operators and suppliers or end users on network-oriented control of controllable consumer devices. With the agreements in place, the network operator can prevent an imminent overload of the network in case of technical urgency. The decision based on the proceedings mentioned above is about ensuring that heat pumps and private electric vehicle charging points can be connected to the grid without delay. The electrification of the heating and mobility sector is important for the transition of the energy system. The growing number of heat pumps and electric vehicles will lead to higher simultaneous loads in the grid, especially on low voltage level. This means that we will need well-equipped electric distribution systems. Therefore, a timely and forward-looking monitoring and expansion of the distribution networks is vital. The planned specifications aim to meet the high demand for new consumption equipment without negatively impacting consumers' comfort to any significant extent and help to avoid delays in connecting consumption equipment to the electricity network. In addition, consumers receive a reduction on their network charge in return for providing network operators the right to lower electricity consumption of the controllable devices. The obligation to implement network expansions in an anticipatory manner remains unaffected. BNetzA will develop the detailed model for the integration of the controllable consumer devices and will start a second consultation soon. Based on the incoming input, BNetzA aims at finalising the proceedings towards the end of this year.

MC (NRA)	Area	Ass't	NRA response
			Information and updates regarding the proceedings are published on BNetzA's website.[87]
	Consumer participation & protection		BNetzA lists the publicly accessible charging points reported to it in the charging point map and a graphic showing the distribution of publicly accessible charging points across the federal states, provides general information on grid connection issues and the change of supplier. Publicly accessible charging points for electric vehicles must comply with minimum technical requirement. In order to be able to check compliance with these requirements in accordance with the Charging Point Ordinance (LSV; based on the 2014 Alternative Fuels Infrastructure Directive (AFID)), operators are obliged to report their publicly accessible charging infrastructure to BNetzA. Notified charging points can be published on the charging point map with the consent of the operator. BNetzA can request operators of publicly accessible charging points to comply with the technical requirements for the interoperability of charging points and to retrofit charging points. *For more details, see BNetzA case study in Chapter 4 of this report.*
EE (Konkurentsiamet) 	Deployment of recharging infrastructure		No
	EV integration into the electricity system		No
	Consumer participation & protection		No
FR (CRE)	Deployment of recharging infrastructure		CRE issued opinions on subsidies schemes for charging infrastructure: for instance, the 2019 Law on mobility (*Loi du 24 décembre 2019 d'orientation des mobilités, dite « LOM »*) states in its article 68 that the level at which connection costs for publicly accessible charging infrastructure is covered and mutualised in networks tariffs is determined by the administration after consulting CRE. In this context, CRE issued a favourable opinion on the 75% rebate rate (see case study 3 in the report) and welcomed the fact that the increased rebate for bollards open to the public (excluding express roads and motorways) will henceforth be targeted solely at infrastructure whose overall

[87] For more information, see Bundesnetzagentur - §14a EnWG Steuerbare Verbrauchseinrichtungen (available in German)

MC (NRA)	Area	Ass't	NRA response
			characteristics comply with a local roadmap. It stated in previous decisions that, if a special rate of rebate were to be introduced, it should be temporary and modulated according to the characteristics of the charging points, or at the very least allow for uniform national coverage. CRE established incentive-based regulation to encourage DSOs to maintain a high level of quality of service, including connection delays for all types of connections like charging infrastructure. For instance, it set an objective of a 30% time reduction for connections by the end of the current network tariff period, i.e. 2024 (without specific address to charging infrastructure). On the basis of a decree giving CRE such competence, CRE proposed the minister in charge of energy the lower and upper limits of the financial contribution of connection demand issuers in collective housing (*Délibération de la Commission de régulation de l'énergie du 12 avril 2023*)
	EV integration into the electricity system		In its 2018 report on electric vehicles, CRE expressed several recommendations in favour of the development of smart charging, in particular through the use of smart meters, to encourage the development of power supply solutions and services using smart charging. More generally, CRE monitors the deployment of industrial prototypes and other innovative products and services linked to the rollout of electric mobility, some of which are the subject of investment by the DSOs or the State. It issues reports assessing these initiatives and providing feedback. In May 2022, CRE published its first report on smart grid demonstrators, providing feedback on a number of projects relating to the control of recharging and the integration of electric vehicles into the grid. The 2019 law on energy and climate introduced a regulatory experimentation mechanism (also known as a "sandbox") in the energy sector. Under this system, CRE can grant exemptions to the conditions of access and use of networks and facilities in order to deploy innovative technologies or services on an experimental basis to promote the energy transition and smart networks and infrastructures. To date, no project linked to the development of electric mobility has been submitted to the regulator.
	Consumer participation & protection		CRE is in charge of all issues relating to the organisation and development of the retail electricity and gas markets, from the angles of regulation and procedures, the development of upstream and downstream competition, and production. In this regard, the development of electric mobility is subject to overall supervision that encompasses network issues and retail market issues. In its 2018 report, CRE recommended, for example, that energy suppliers propose innovative products and services and encourage their customers to recharge their EVs at the right time, by proposing tailored pricing offers that take into account the particular use of electric vehicles.

MC (NRA)	Area	Ass't	NRA response
GB (Ofgem) 	Deployment of recharging infrastructure		Ofgem has made decisions under the networks *ex-ante* price control known as RIIO (ED2) in a number of areas: Load Related Expenditure[88] • DNOs have been provided with an ex-ante allowance of £3.2bn to invest in network upgrades to support the rollout of EVs amongst other things • This *ex-ante* allowance includes adjustments to match a net zero compliant Future Energy Scenario (FES), System Transformation, for low carbon technology (LCT) uptake • An agile package of uncertainty mechanisms will enable DNOs to invest immediately and without administrative burden if LCT uptake exceeds this scenario New connections[89] For customers connecting at the lower voltages ('Minor Connections'): • The connections element of the Customer Satisfaction Survey helps to drive improvements in the quality of service that DNOs provide to customers seeking a minor connection • The Time to Connect incentive includes targets for "Time to Quote" (TTQ) and "Time to Connect" (TTC), with DNOs earning financial rewards or penalties in line with performance against targets For 'Major Connections': • For connections at higher voltages, generation customers and other unmetered connections, the Major Connections Customer Satisfaction Survey will penalise companies if they perform poorly against targets DSO[90] • There are baseline expectations for DSO that are intending to promote visibility and efficient dispatch of distributed energy resource (DER) that would include EVs.

[88] More information can be found in *RIIO-ED2 Final Determinations Core Methodology Document*, Chapter 3, available at: www.ofgem.gov.uk/sites/default/files/2022-11/RIIO-ED2%20Final%20Determinations%20Core%20Methodology.pdf
[89] Ibid, Chapter 5
[90] Ibid, Chapter 4

MC (NRA)	Area	Ass't	NRA response
			• Overall DNO performance will be assessed through the DSO incentive which will reward or penalise companies based on an *ex-post* review of DNOs' delivery of their DSO activities Ofgem has also carried out *Access and Forward-Looking Charges Significant Code Review* which resulted in reduction of barriers to network connection by reducing EV connection charges associated with reinforcement of shared network, which under most circumstances have been removed altogether (see www.ofgem.gov.uk/publications/access-and-forward-looking-charges-significant-code-review-decision-and-direction; for more details see Ofgem case study, Chapter 2 in this report).
	EV integration into the electricity system		Ofgem is working with the UK Government and industry to progress smart charging defaults (pre-set charging at off-peak times); to remove barriers for V2X; and to develop enablers such as data and communications for dynamic smart charging. Specifically, Ofgem is working on improving price signals for flexible network usage via network charging reform and implementation of market-wide half-hourly settlement. In March 2023, Ofgem published a Call for Input on the Future of Distributed Flexibility, proposing three possible archetypes of a common digital energy infrastructure to promote market access for flexible consumer energy resources owned by households (including EVs). This is designed to provide a route to market for domestic EV owners to offer flexibility services. www.ofgem.gov.uk/publications/call-input-future-distributed-flexibility
	Consumer participation & protection		Ofgem has carried out consumer research to understand experience and needs of EV drivers. The research findings included: • As early adopters, the EV drivers needed to undertake a lot of proactive research, finding out information from a variety of sources • Most of the EV drivers who charge at home, plug in when they get home and leave it overnight, creating opportunities for smart charging • Charging experiences varied, but public chargepoint accessibility and usability issues were a barrier for using an EV for longer journeys. www.ofgem.gov.uk/publications/qualitative-user-research-electric-vehicle-drivers Ofgem has also published a guidance which clarifies existing regulation around electricity supply in the context of eight different charging models (see www.ofgem.gov.uk/publications/taking-charge-

MC (NRA)	Area	Ass't	NRA response
			selling-electricity-electric-vehicle-drivers; for more details see Ofgem case study in Chapter 4 of this report). More broadly, Ofgem's *Innovation Link* offers support on energy regulation to innovators looking to trial or launch new products, services, methodologies or business models. More information can be found here: www.ofgem.gov.uk/energy-policy-and-regulation/policy-and-regulatory-programmes/innovation-link
HR (HERA) 	Deployment of recharging infrastructure		HERA does not have the authority to give opinions or decide on subsidies. HERA takes action to control connection delays for all users. HERA has not attributed network tariffs specific to electric vehicles.
	EV integration into the electricity system		HERA has not taken actions related to the integration of electric vehicles.
	Consumer participation & protection		HERA has not conducted research related to electric vehicles. The Ministry responsible for transport and infrastructure is responsible for all issues under this item.
HU (MEKH) 	Deployment of recharging infrastructure		The regulator has no mandate to issue an opinion on the subsidies for the charging infrastructure, or on their inclusion into the network tariffs. There is no distinction regarding the network charges for the charging infrastructure, the same network charges apply to them like in case of any other costumers. The DSOs are not incentivised to install more charging points. The DSOs develop the network based on the demand for electricity submitted by the operators of charging points, and the DSOs do not distinguish between consumer demands, they asses the demands of clients (be it a charging point operator or any other) in order of submitting and give them economical information.
	EV integration into the electricity system	P	Currently there is no such project, but since 1 September 2022 the legal framework for regulatory sandbox is in force; thus, the possibility for such endeavours exists. The NRA has not received such request so far.
	Consumer participation & protection	P	The review of the framework for electromobility is ongoing, and an assessment is being prepared. After the review of the assessment the regulatory framework will be adjusted in order to enhance the electromobility market and allow the market participant more efficient operation and market entry.

MC (NRA)	Area	Ass't	NRA response
IS (NEA) 	Deployment of recharging infrastructure		OS has been: • Monitoring that connection charges are paid by the owner of the charging station instead of spreading the cost over all the DSOs' customers (although it seems the DSOs are usually not collecting the full cost of these connections). • Asking DSOs and the TSO to change their tariff structure to fairly reflect the costs of charging stations, in terms of how the peaks are calculated with respect to the month of the year and time of the day.
	EV integration into the electricity system		DSOs and the TSO can apply for R&D incentive of 0.3% of asset base in revenue cap. OS is requesting that DSOs and the TSO analyse the use of flexibility in their investment plans and help them with that analysis to speed up the process.
	Consumer participation & protection		OS has asked the owners of charging stations to make the payment process easier to use and more transparent. OS intervened in the certification of charging stations to provide an adjustment period while standards are set, rather than stop the rollout of the stations.
IT (ARERA) 	Deployment of recharging infrastructure		ARERA can be asked by the Government to express formal opinions about draft decrees or regulations; this has been the case, for instance, before issuing Ministerial Decree 30 January 2020 about promotion of support schemes for Vehicle-to-Grid initiatives (see *Decision 394/2019/I/eel*, available in Italian). From 2018 to 2020 ARERA was formally involved in the institutional working group constituted by Italian Ministry of Infrastructures and charged to write the National Plan for Charging Infrastructures. Regarding connection delays, in the framework of Directive 2019/944 implementation, ARERA launched a public consultation regarding network development plan to be issued by the DSO: proposals have been formulated in order to foster cooperation between DSOs and CPOs, so that the deployment of EV charging infrastructures and the extension and reinforcement of distribution grids can be coordinated and optimised.

MC (NRA)	Area	Ass't	NRA response
	EV integration into the electricity system		ARERA has promoted a few initiatives aimed at fostering power modulation and aggregation by BSPs: • From 2020 to 2023 ARERA and the Italian Electrotechnical Committee were asked to issue new technical standards defining the requirements that need to be met by any smart charge point that is willing to take part to a V2G initiative; such technical standards will allow charging devices to be officially certifiable as "smart", making them more easily identifiable by customers and offering aggregators homogeneous technological features and communication interfaces • Since 2021 ARERA has been involved in an experimental initiative for private charging at home, offering free increase in contractual capacity limit at night providing "smart wall-boxes" have been installed (Decision 541/2020/R/eel) • Since 2021 regulatory experiments regarding local flexibility can be proposed by DSOs and must be approved by ARERA (decision 352/2021/R/eel), including the exploitation of EV charge • Since 2018 EV charging infrastructure can become part of aggregates (called UVAM), managed by BSP in order to offer flexibility services to the TSO (decision 300/2017/R/eel).
	Consumer participation & protection		ARERA has not issued any decision regarding such topics, but it has been part of institutional working groups that drafted two documents: • A procedure outlining the information to be provided by BSPs to vehicle owners taking part in V2G initiatives, in order to enable assessments of the effects of service provision on the technical life of EV batteries and their compatibility with the warranties offered by vehicle manufacturers (see case study included in the EV report) • Outline of the information to be stored and made available to the public by the National Charge point Platform (official online service where all CPOs should register their charging infrastructure in publicly accessible places). Additionally, in order to extend public consultations held in 2019, in 2020 ARERA promoted working groups gathering all main stakeholders related to e-mobility, DSOs, suppliers and car manufacturers, in order to share knowledge base, data and proposals for new regulation. As one of the outputs of these working groups, in May 2021 ARERA published a report regarding its first survey about EV charging systems, analysing technical and economic features of the devices available on the market for purchase by consumers, companies, public institutions or charging point

MC (NRA)	Area	Ass't	NRA response
			operators: the report supported new regulatory initiatives and empowered consumers with a comprehensive overview of a complex sector.
MT (REWS) 	Deployment of recharging infrastructure		In general, the Regulator has as one of its functions to (i) to submit its opinion to Government on the formulation of policy in relation to matters regulated under the REWS Act. In practice the Regulator is a member of the national Governing Committee on Public Charging Infrastructure.
	EV integration into the electricity system		*No*
	Consumer participation & protection		The Regulator has not carried out any research; however, with respect to charging of electric vehicles REWS reports the following: • The Regulator approved regulated tariffs specific for electric vehicles charging; and • The Regulator contributed to the preparation of Publicly Accessible Electric Vehicle Charging Infrastructure Regulations (S.L. 545.38) which, among other things, introduce provisions on price transparency and interoperability of charging stations and require that operators of publicly accessible charging infrastructure operate under a licence issued by the Regulator. Further information can be found at: https://rews.org.mt/#/en/sdgr/519-authorisation-to-act-as-an-operator-of-publicly-accessible-electric-vehicles-charging-infrastructure
NL (ACM) 	Deployment of recharging infrastructure	R	As NRA, ACM previously clarified that the installation of the charging infrastructure itself is a commercial activity, and not considered part of the regulated tasks of the DSO. As with any (new) connections, the DSO is of course responsible for the connection and transport to/from the charging infrastructure. ACM has incentive-based regulation (benchmark) for DSOs on TOTEX basis. This means that DSOs have an incentive to efficiently accommodate the need for new capacity for electromobility, but ACM does not have further electric mobility specific direct revenue drivers or other specific incentives targeting electro-mobility.

MC (NRA)	Area	Ass't	NRA response
			ACM needs to formally approve DSO investment plans on a bi-annual basis. One of the particular areas of attention in these investment plans and ACM's evaluation is electro-mobility and, more specifically, whether DSOs demonstrate that they sufficiently take into account possible future developments in this area. ACM is currently investigating the need for possibly multiple modifications to, for example, Net Code and/ or Tariff Code, which are relevant for electro-mobility and impact the roll-out of charging infrastructure. An example is the introduction of static or dynamic time differentiated tariffs.
	EV integration into the electricity system		*No response*
	Consumer participation & protection		ACM carried out a compliance case to ensure price transparency in the EV market. For details, please see case study 12 in Chapter 4 of this report.
NO (NVE-RME) 	Deployment of recharging infrastructure		NVE-RME does not have the power to decide on subsidies for charging infrastructure. However, Enova SF (owned entirely by the Ministry of Climate and Environment) subsidises some types of charging infrastructure (charging infrastructure for vans and some public charging stations). Network tariffs for public and private charging infrastructure follow the same tariff models as other connections. The DSOs are obligated to connect all new customers without undue delay, but there is no regulation to control connection delays for charging infrastructure specifically.
	EV integration into the electricity system	R	Not specifically related to EV. However, NVE-RME wants to stimulate increased participation in R&D activities to support a more efficient operation and utilisation of the electricity network. To achieve this, NVE-RME has designed a scheme where distribution companies receive full financial coverage for up to 0.3% of their regulatory asset base for R&D projects that meet certain criteria. In addition, in 2021 a new tariff model was implemented in order to stimulate smarter utilisation of electricity through the implementation of capacity-based fixed component.
	Consumer participation & protection		NVE-RME has not taken any regulatory work specifically on EV when it comes to consumer matters. All consumer matters are dealt with as a general matter and specified to the energy using component, here EV.

MC (NRA)	Area	Ass't	NRA response
PL (URE) 	Deployment of recharging infrastructure		Connection of public road transport charging infrastructure and publicly available charging stations with high-power charging points (greater than 22 kW) to the power grid is carried out in the first place before connecting other load installations. Fees for connecting the charging infrastructure for public road transport and publicly available charging stations to the power grid have been set at a preferential rate: • For a power grid with a rated voltage higher than 1 kV and not higher than 110 kV, the fee is determined on the basis of one sixteenth of the actual expenditure; and • For a power grid with a rated voltage not higher than 1 kV, the fee is determined based on the fee rates included in the tariff, calculated on the basis of one-sixteenth of the average annual investment expenditure for the construction of network sections used to connect these entities. The Parliament is working on new legislation to support the construction of charging stations. Under the draft regulations, the power distribution system operator (DSO) will be asked to include in its development plan the necessary investments for connecting EV charging points located at publicly available charging stations in accordance with the plan of the General Director for National Roads and Motorways. The General Director is responsible for developing a plan for the location of publicly available charging stations along the roads of the TEN-T core network (Trans-European Transport Network) and charging points which are part of the charging infrastructure for public road transport. Development plans prepared by DSOs and tariffs containing, for example, fees for connecting charging stations are subject to approval by the President of the Energy Regulatory Office.
	EV integration into the electricity system		*No response*
	Consumer participation & protection		In Poland, NRA does not directly conduct regulatory work or research into consumer behaviour. The Office operates on the basis of existing law but participates in consultations on new legislation.
PT (ERSE)	Deployment of recharging infrastructure		With regard to the deployment infrastructure, ERSE does not decide on subsidies for the charging infrastructure or on the location of the infrastructure. With respect to possible incentives for connection delays, this infrastructure will be treated in the same way as the others, without any special treatment

MC (NRA)	Area	Ass't	NRA response
	EV integration into the electricity system		ERSE has an ongoing regulatory revision which has several subjects. Enabling aggregation and demand response are some of the main targets of this revision, which will open the door for integration of EVs in the electricity system. Pilot projects and experimental regulation are effective means of adapting regulation and accepted by ERSE. There is an ongoing pilot project for demand response that ERSE plans to develop to consider aggregation. The DSO has also an ongoing pilot project for local flexibility markets. Specifically, in the area of electromobility, ERSE has already run a pilot project that aimed to evaluate the contribution of electric vehicles in peak shaving and providing system services (frequency and regulation reserves), in the island of São Miguel, Azores.
	Consumer participation & protection		In Portugal, there is a specific code for electric mobility thar regulates: • Rules on relations between players in the electric mobility sector; • Metering and data handling concerning EV charging data and consumption data; • Allowed revenues and regulated tariffs; • Quality of service; • Market prices oversight; and • Transparency obligations. The legal framework foresees the creation of an Electric Mobility Network Managing Body (or EGME) and that all charging stations are interoperable. This regulated operator has obligations regarding the information of consumers such as: availability of charging points, prices and available market operators, as well as making available information regarding the electric mobility network. ERSE also monitors prices charged by suppliers for supply of electric mobility and charging stations and develops commercial offers simulators.
RO (ANRE) 	Background to the regulatory approach in Romania		The legislative provisions approved by Romanian Parliament through *Law № 372/2005 regarding the performance of buildings*, states the obligation of the Romanian Energy Regulatory Authority (ANRE) to approve a specific regulation regarding a simplified procedure applied by DSOs in order to connect the points of recharging for EV to the network. Furthermore, the *Energy and natural gas law №123/2012* stipulates the obligation of DSOs to approve the rules of connection to the distribution networks of the private and public recharging points in accordance with ANRE regulations.

<table>
<tr><th>MC (NRA)</th><th>Area</th><th>Ass't</th><th>NRA response</th></tr>
<tr><td></td><td>Deployment of recharging infrastructure</td><td></td><td>For the implementation of these legislative provisions, ANRE has approved Order no.103/2022 - Procedure for network connection of the recharging points for electric vehicles.

The connection times established in the procedure are lower than for other categories of networks user as set out in the following table:

<table>
<tr><th>Deadlines for DSOs</th><th>EV</th><th>Other users</th></tr>
<tr><td>Technical permit issuance</td><td>15 days</td><td>30 days</td></tr>
<tr><td>Connection contract (transmitting to applicant as draft)</td><td>3 days</td><td>5 days</td></tr>
<tr><td>Connection contract (concluding the agreed contract)</td><td>3 days</td><td>5 days</td></tr>
<tr><td>Putting into function of the installation</td><td>2 days</td><td>5 days</td></tr>
</table>

The procedure applies both to public and private recharging for:

a) Connection of a new consumption site, consisting of one or more recharging points for EV
b) Connection of a new consumption site/consumption and production site, with/without storage facilities, with recharging points
c) The installation of one or more recharging points for electric vehicles at an existing place of consumption/place of consumption and production, with/without a storage facility

According to the Energy Law, the Regulation for the connection of users to public electricity networks and the Tariffs Methodologies, connection charges for consumers are shallow so DSOs have the obligation to do and to finance the reinforcements of the grid that are necessary for the connection. This rule also applies to the connection of EV charging points.

According to the energy law, DSOs are not allowed to own, develop, manage or operate recharging points for EV, unless the DSO owns recharging points exclusively for its own use.</td></tr>
<tr><td></td><td>EV integration into the electricity system</td><td></td><td>There are no specific technical regulations for the components of the EV recharging station. The same technical requirements applied to consumption places (regardless of the type/specificity of consumption) are also applied for EV recharging stations.</td></tr>
</table>

MC (NRA)	Area	Ass't	NRA response
	Consumer participation & protection		No other rules applying specifically to electric vehicles were issued.
SE (Ei) 	Deployment of recharging infrastructure		No
	EV integration into the electricity system		No
	Consumer participation & protection		No
SI (AGEN-RS) 	Deployment of recharging infrastructure		The NRA has no power to decide on subsidies; these are under the purview of the government. However, a specific tariff for public EV charging (connection charge and network usage charge for public charging infrastructure connected to LV) was introduced in 2016 (for fast charging stations at the freeways) and then refined in 2019 (extended to all charging infrastructure connected to LV). These tariffs will be abolished by the newly introduced network charging methodology in 2024, among other novelties, aimed at removing any differentiation among network users according to the type of network use. The "output-based regulation" at the system level (e.g. DSO or distribution area) has been extended to smart grid domain implicitly addressing the integration of charging infrastructure (through hosting capacity KPI) encouraging the DSO to introduce measures in order to assure efficient deployment of recharging infrastructure.[91]
	EV integration into the electricity system	R	The newly introduced network charging methodology will introduce several time blocks, two seasons and the excess capacity charge above the contracted capacity; thus power modulation is considered to be inherently provided by price signals of the overall network charging methodology.

[91] For more information, see *Vsebina Uradnega lista* | *Uradni list* (uradni-list.si), Annex 5: RS_-2022-123-02907-OB~P011-0000.PDF (uradni-list.si) (available in Slovenian)

MC (NRA)	Area	Ass't	NRA response
			Besides, the regulatory sandbox has been in place for TSO and DSO research and innovation projects, several are currently active (e.g. EV4EU and INCIT-EV are Horizon Europe projects) and also interconnected with development of local flex markets.
	Consumer participation & protection	R	Firstly, a public consultation with several milestones has been carried out. The process started in 2012 and has been concluded in 2017.[92] Later on, active consumer and demand side flexibility measures in several following consultations have considered the outcomes of the consultation that has been focused on electric mobility. The latest regulatory work implicitly related to electromobility was a public consultation on the independent aggregation in 2020, comprising the "split supply" model which was included in CEP implementation (new Law on energy supply[93]). In addition, regulatory measures have been taken to remove some normative barriers and to enable consumer more active role and participation. The "split supply" model introduced by CEP implementation, allowing more than one supplier per network user's connection enables the introduction of electromobility-specific dynamic pricing for electricity supply on the level of charging station "behind the main meter" that can bring benefits to EV owners based on low or negative spot prices and may strengthen the competition on the market. No explicit research on consumer behaviour and protection has been conducted besides the aforementioned consultation, which has focused on electric mobility and addresses some of these aspects.
SK (URSO) 	Deployment of recharging infrastructure		A new decree of URSO valid form January 2022 enables a more effective tariff structure for charging electric cars. The decree introduces the possibility of a larger variable component of the distribution tariff during charging electric cars, so that the operator of the charging station pays according to the actual amount of electricity transferred. This relatively detailed technical regulation will significantly simplify the operation of chargers. DSOs in Slovakia are already introducing new types of preferential two-band tariffs for charging stations and households (DD4, DD5 and DD6 tariffs).[94]

[92] See Elektromobilnost (1. cikel) - Zaprta (odločitev sprejeta) - Agencija za energijo (agen-rs.si) and Elektromobilnost (2. cikel) - Zaprta (odločitev sprejeta) - Agencija za energijo (agen-rs.si) (available in Slovenian)

[93] www.uradni-list.si/glasilo-uradni-list-rs/vsebina/2021-01-3349?sop=2021-01-3349 (available in Slovenian)

[94] More information can be found at: https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2023/107/20230401 (available in Slovakian)

MC (NRA)	Area	Ass't	NRA response
	EV integration into the electricity system		*No response*
	Consumer participation & protection		*No response*

Annex 3 – Overview of charging technologies

Electric vehicles must be charged using direct current (DC); however, in practice both AC and DC technology is used by charging points.

- Alternating-current (AC) is used by slow and some fast-charging units. An in-car inverter converts AC to DC, which then recharges the battery. This can be done at 'level 1' equivalent to a maximum home outlet of 3.7 kW or 'level 2', which can reach 22 kW but requires a 3-phase supply point.
- DC recharging, also known as level 3 or direct-current high-power recharging converts the AC from the grid to DC before it enters the vehicle and recharges the battery without the need for an inverter in the vehicle itself. Commonly called 'DC fast charging' (officially called 'DC high-power recharging'), it operates at powers from c.25-50 kW to more than 350 kW.

There is also the possibility to charge the EV wirelessly. For example, in dynamic charging, wires located under the road wirelessly transmit electric power to a receiver in the car. This technology allows powering moving vehicles.

In May 2021 ARERA published the results of its first survey about EV charging systems, analysing technical features of the devices: The study investigated the technical and economic features of the charging systems available on the market for purchase by consumers, companies, public institutions or charging point operators. Information for the survey was collected by ARERA contacting 24 device manufacturers, both Italian and international (either with devices already installed in Italy or with interesting products on offer). Market offering was particularly rich in the Slow and Quick segments (i.e. up to 22 kW, utilising alternating current), while lower competition was highlighted for higher-power devices. Availability and prices of smart devices, suitable for offering V1G and/or V2G services, were also assessed, showing that bidirectional charging was not purchasable in the market. Attention was also paid to stand-by absorption of charging devices, estimating that by 2030 it could increase total energy need for EV charging by at least 3%.

It is important to highlight that some charge points can be equipped with chemical storages, in order to optimise the withdrawal of energy from the grid, thanks to peak shaving: a few devices are already available on the market that, thanks to the storage, can offer ultra-fast charging (from 150 to 350 kW) based on a LV connection (e.g. 50 kW). Integration of storage system and charging infrastructure can go well beyond this application, offering a completely off-grid charging experience; It is in fact important to highlight that the draft proposal of AFIR defines 'recharging point' as 'a fixed or mobile, on-grid or off-grid interface that allows for the transfer of electricity to an electric vehicle".

Annex 4 – Comparison between slow, quick, fast, and ultra-fast charging points

Slow charging points	Quick charging points	Fast charging points	Ultra-fast charging points
c.2.3 - 3.6 kW	7 – 22 kW	25 – 50 kW	From 50 kW up to 350 kW
AC	AC (rarely DC)	DC	DC
Slow charge: 8-14h	Quick charge: 4-6h for 7 kW units, c.2h for 22 kW units	Fast charge: 1-2h	<1h (80% can be achieved within 20-40 mins)
Cheaper to install and use, especially at home – may not require upgrade to supply point	Can be more expensive to install at home (22 kW chargers require a 3-phase supply) but less expensive that rapid chargers in public charging	More expensive to use[95]	Expensive to install and use
Typically, suitable for home charging only (exception in some streetlamps)	Suitable for both home and public charging, e.g. workplaces, supermarkets	Suitable for public charging only: in some urban areas and in in most rural areas	Suitable for public charging only: motorways Necessary for charging of electric HDV

[95] As of April 2023, the average price of charging at public charge points in the UK was 51p/kWh for slow and fast charge points (with power up to 22kW), and 75p/kWh for rapid and ultra-rapid charge points (with power over 25kW). For up-to-date data, see Zap Map Price Index, accessible at: www.zap-map.com/ev-stats/charging-price-index

Annex 5 – About CEER

The Council of European Energy Regulators (CEER) is the voice of Europe's national energy regulators. CEER's members and observers comprise 36 national energy regulatory authorities (NRAs) from across Europe.

CEER is legally established as a not-for-profit association under Belgian law, with a small Secretariat based in Brussels to assist the organisation.

CEER supports its NRA members/observers in their responsibilities, sharing experience and developing regulatory capacity and best practices. It does so by facilitating expert working group meetings, hosting workshops and events, supporting the development and publication of regulatory papers, and through an in-house Training Academy. Through CEER, European NRAs cooperate and develop common position papers, advice and forward-thinking recommendations to improve the electricity and gas markets for the benefit of consumers and businesses.

In terms of policy, CEER actively promotes an investment friendly, harmonised regulatory environment and the consistent application of existing EU legislation. A key objective of CEER is to facilitate the creation of a single, competitive, efficient and sustainable Internal Energy Market in Europe that works in the consumer interest.

Specifically, CEER deals with a range of energy regulatory issues including wholesale and retail markets; consumer issues; distribution networks; smart grids; flexibility; sustainability; and international cooperation.

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More information is available at www.ceer.eu.