SUSTAINABLE TRANSPORT FORUM

Recommendations for public authorities on:

procuring, awarding concessions, licences and/or granting support for electric recharging infrastructure for passenger cars and vans

Version 1 – adopted by STF on 2 December 2020

Acknowledgements

These Recommendations have been drawn up for the Sustainable Transport Forum by the European Commission with the assistance of TNO - a Dutch research organisation with expertise in sustainable transport policy, and POLIS - the network of European cities and regions cooperating for innovative transport solutions, both under the EAFO 2.0 contract with the European Commission.

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These Recommendations are meant to provide practical guidance for public authorities that plan to organise tendering procedures for the deployment or operation of recharging infrastructure for electric vehicles. It includes several examples of real-world situations and recommendations for these public authorities. These are not exhaustive, meaning that it is likely that there exist numerous other very good examples. The examples and best practices provided are merely a reflection of information that was provided as part of this STF exercise. Moreover, not all recommendations can be applied to all circumstances nor can all examples. Therefore, they should not be interpreted as the only way, or even the best way, to realise recharging infrastructure.

Finally, for the avoidance of doubt, please note that these Recommendations are based on input received from public authorities and other experts contributing to this exercise. Nothing in the Recommendations must be read as an expression of the opinion or position of the European Commission, TNO or POLIS, who have merely facilitated this process.

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1. Introduction

1.1 Context

By the latest tally, road transport accounts for more than one quarter of the EU's greenhouse gas emissions - second only to energy supply.[1] [1]In 2017, transport[2] was responsible for more than 30% of the EU's total CO2 emissions, of which 71.7% came from road transport.[3] Within the road transport segment, passenger cars account for the lion's share of CO2 emissions, with over 60%.[4] Moreover, GHG-emissions from transport have been increasing consistently in recent years, in stark contrast to the trend in other sectors, notably the energy supply sector.[5]

Moreover, other pollutant emissions from transport - such as nitrogen dioxide, particulate matter and ground-level O3 - are the most significant causes of premature deaths in the EU, with estimates of more than 400.000 premature deaths each year, including 68.000 directly linked to nitrogen dioxide (NO2).[6]

In order to achieve the Paris Agreement objective of keeping the increase in global temperature well below 2°C, and to pursue efforts to keep it to 1.5°C, in November 2018 the Commission set out its vision for a climate-neutral EU, looking at all the key sectors and exploring pathways for the transition. The Commission followed in December 2019 with the Communication on the European Green Deal which confirms the ambition of making Europe the first climate-neutral continent by 2050. This ambition has since been confirmed by the European Parliament and Council. For transport, the European Green Deal sets the objective of effectively reducing transport GHG emissions by 90% by 2050.

In the European Green Deal Communication[7], the Commission also announced its intention to propose, among others, more stringent air pollutant emissions standards for combustion-engine vehicles and to revise, by June 2021, the 2019 legislation on CO2 emission performance standards for cars and vans[8] - - thereby ensuring, among other policy initiatives. a clear pathway towards zero-emission mobility from 2025 onwards.

As part of the European Green Deal implementation, on 4 March 2020 the Commission proposed the first European Climate Law[9] to enshrine the 2050 climate-

1 European Environmental Agency (2020), Annual European Union greenhouse gas inventory 1990–2018 and inventory report 2020, page 71, Figure 2.4 (data are for 2018); available here: https://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2020.

2 Excluding international maritime (international traffic departing from the EU), but including international aviation.

3 DG MOVE, EU Transport in figures: Statistical pocketbook 2019, p. 143 and p. 151; available here: https://op.europa.eu/en/publication-detail/-/publication/f0f3e1b7-ee2b-11e9-a32c-01aa75ed71a1.

4 Ibid, p. 155.

5 European Environment Agency (2020), Annual European Union greenhouse gas inventory 1990–2018 and inventory report 2020, p. 71.

6 European Environment Agency Report No 10/2019, Air quality in Europe — 2019 report, p. 8; available here: https://www.eea.europa.eu/publications/air-quality-in-europe-2019/. EEA statistics indicate that road transport was, in 2018, for example responsible for more than 38% of EU NO2 emissions: https://www.eea.europa.eu/data-and-maps/dashboards/air-pollutant-emissions-data-viewer-3.

7 COM(2019) 640 final, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, The European Green Deal; available here: https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf.

8 Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 setting CO2 emission performance standards for new passenger cars and for new light commercial vehicles, replacing and repealing Regulations (EC) 443/2009 (cars) and (EU) 510/2011 (vans). This Regulation started applying on 1 January 2020.

9 COM/2020/80 final, Proposal for a Regulation of the European Parliament and of the Council establishing the framework for achieving climate neutrality and amending Regulation (EU) 2018/1999 (European Climate Law); available here: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1588581905912&uri=CELEX:52020PC0080.

neutrality target into law. In September 2020, the Commission published the Communication on the Climate Target Action Plan, which proposes to increase the EU ambition for reduction of GHG-emissions by 2030 to at least 55% and sets out possible pathways to achieve this reduction across various sectors of the economy. The analysis underpinning the Climate Target Action Plan points to the need to have much of the vehicle stock, and close to the entire passenger car stock, changed to zero-emission vehicles by 2050. The reduction of at least 55% GHG-emissions by 2030 has been introduced in a revised Commission proposal for the European Climate Law. The Commission is working on a new Sustainable and Smart Mobility Strategy for publication by the end of 2020 that will outline the transition needs for the transport sector and provide information on the policy initiatives the Commission will take to this end in the following years.

Some of the Union's regulatory interventions, most notably the CO2 emission performance standards for cars and vans, are already starting to have their effects: vehicle manufacturers are increasingly investing heavily in low- and zero-emission alternatives and in particular in battery-electric passenger cars. Dozens of new models have been announced for release in the next couple of years[10], including in middle price segments, increasing the attractiveness and appeal to consumers of low- and zero-emission vehicles. Not unimportantly, demand for such cars is also growing quickly, often spurred by purchase incentives. EAFO 2020 YTD figures indicate that 7.5% of new passenger car (M1) registrations in the EU are BEVs (3.7%) or PHEVs (3.8%), while another 1.7% are fuelled by CNG (0.6%) or LPG (1.1%).[11] In view of this, a rapid and wide market deployment and uptake of these low- and zero-emission vehicles, and in particular electric vehicles, is expected in the next couple of years.[12]

The deployment of alternative fuels infrastructure must keep pace with these developments; it should not become a barrier to market development. Moreover, the infrastructure must not only be physically there, it must also be easy to use.

The stakeholder consultation on key policy needs and options for action in Alternative Fuels Infrastructure deployment and consumer services, conducted by the Sustainable Transport Forum ("STF") in 2019[13] found that a vast majority of respondents considered it particularly necessary to accelerate, the roll-out of recharging infrastructure for light-duty electric vehicles by 2025. At the same time, respondents to the stakeholder consultation also identified manifold issues with the interoperability between, and user-friendliness of recharging stations - for example in relation to access, payment options and price transparency.

In its Green Deal Communication[14] the European Commission states its intention to review the Alternative Fuels Infrastructure Directive in 2021. It has confirmed this

10 Transport&Environment, Report 'Electric surge: Carmakers' electric car plans across Europe 2019-2025' (Brussels), available here: https://www.transportenvironment.org/publications/electric-surge-carmakers-electric-car-plans-across-europe-2019-2025.

11 See the European Alternative Fuels Observatory's EU vehicle and fleet overview: https://www.eafo.eu/countries/european-union/23640/vehicles-and-fleet

12 IEA, Global EV outlook 2020 (Paris), available here: https://www.iea.org/reports/global-ev-outlook-2020

13 Sustainable Transport Forum Report 'Analysis of stakeholder views on key policy needs and options for action in Alternative Fuels Infrastructure deployment and consumer services', available here: https://ec.europa.eu/transport/sites/transport/files/2019-stf-consultation-analysis.pdf

14 COM(2019) 640 final, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, The European Green Deal; available here: https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf.

planning in the Commission Work Programme for 2021; the proposal is planned for summer 2021.

In the Green Deal, the Commission estimates a possible fleet of up to 13 million electric vehicles in 2025[15] and notes that such a fleet would require the number of publicly accessible recharging points to grow from approximately 200,000 in 2020 to at least 1 million in 2025.

As the 2019 STF stakeholder consultation confirmed that few to no recharging points are commercially viable with the current EU fleet of BEVs and PHEVs [16], it can be expected that varying degrees of public funding for recharging points will be required on many occasions for some time to come. This will in turn result in public authorities at all levels of government at some point being confronted with choices to be made regarding the deployment of a widespread recharging point infrastructure in their territories. They will have to address issues around planning (e.g. where best to install recharging points, speed of roll-out, criteria for expanding the network and identifying the most suitable recharging solutions for specific locations), technical choices (e.g. what type of rechargers are wanted, or needed by the market, and what they should offer to users, how do authorities want the market to develop - for instance in terms of market competition, etc.) while at all times balancing options against long-term climate objectives (e.g. reducing car use overall, ensuring smart recharging, etc.).

This poses a number of challenges[17], but also creates opportunities - for instance to stimulate and accelerate the deployment of cost-efficient, grid-beneficial, truly interoperable and user-friendly solutions while avoiding to (co-)fund infrastructure that does not meet certain minimum requirements.

1.2 Objectives

Innovation and investment in alternative fuel infrastructure for commercial road transport is one of the most impactful and rapid ways of reducing CO2 emissions in the transport sector, due to the high modal share, globally, of commercial goods and passenger transport by road. For this reason, public authorities should support the deployment of alternative fuels refuelling infrastructure, at scale, to enable transport operators to adopt alternative fuels rapidly. Infrastructure availability and standards must be harmonised between governments to allow cross-border operations.

In particular, through their concession or licence award procedures, public procurement procedures or grant award procedures, public authorities at all levels of government can help shape market developments in the area of electromobility. They can learn from the experience of frontrunners, by avoiding the mistakes they may have made and borrowing those practices that have proven to be successful.

Moreover, sharing experience and building common recommendations can help to support a coherent network of infrastructure that supports its easy and seamless use and thereby helps to accelerate the ramp up of vehicles.

15Ibid, Section 2.1.5.: Accelerating the shift to sustainable and smart mobility

16Two thirds of respondents to the 2019 STF stakeholder consultation believe that public funds are required for normal charging infrastructure while significantly more -around 90%- see funding needs for the significantly more expensive fast recharging points (above 22kW).

17The 2019 STF stakeholder consultation revealed that many public authorities are still struggling with concession tenders: 50% of respondents expressed concerns around existing concession practises (concession timing, transparency and competitiveness were amongst the most pressing issues identified).

That is the objective of these recommendations: provide a toolkit for authorities that are either looking to procure recharging infrastructure or to award concessions for their roll-out and/or operation, possibly linked to the granting of government support. By offering an overview of best and innovative practices by frontrunners, we aim to develop a set of minimum recommendations to public authorities seeking to support the deployment of recharging infrastructure in their territories.

1.3 Rationale of this report

At its plenary meeting in 2019, the Sustainable Transport Forum, the formal expert group that assists the Commission on the implementation of the Alternative Fuels Infrastructure Directive[18], unanimously agreed to focus its work in 2020 on the development of "Guidelines on minimum quality requirements for infrastructure and best practices for public tendering". The mandate asked for the development of a toolkit for public authorities who want to grant concessions for or procure alternative fuels infrastructure, based on best practices from different contracting authorities and building on the findings of the STF 2019 stakeholder consultation as the evidence base.[19]

The STF further instructed that the exercise should focus on gathering information and formulating recommendations on:

- Getting best value for money: e.g. pooling of purchases
- Possible options to identify needs: what – where?
- Quality of infrastructure: uptime requirements and penalties
- Interoperability: access, communication protocols, etc.
- Consumer information: data provision and price transparency
- Competition: maximum prices and duration of concessions
- Future needs: technological and social evolutions

Final recommendations should be proposed for adoption at the 2020 STF plenary.

1.4 Process for drafting of the Report and methodology

Following the mandate provided by the STF 2019 plenary, the European Commission facilitated a process for STF members to draft recommendations for public authorities, with the assistance of TNO - a Dutch research organisation with expertise in sustainable transport policy, and POLIS - the network of European cities and regions cooperating for innovative transport solutions, both under the EAFO 2.0 contract with the European Commission.

As a first step in the process, an eQuestionnaire was drawn up, attached as Annex 4, to gather input and learn from the experiences of Europe's cities, regions and Member States in relation to concessions, procurement and subsidy schemes for alternative fuels infrastructure. The eQuestionnaire was distributed to public authorities in Europe:

18 The Sustainable Transport Forum ('STF') was established on 23 April 2015 by Commission Decision C(2015) 2583 final to provide the Commission with advice on all subjects related to the Alternative Fuels Infrastructure Directive. The Sustainable Transport Forum consists of representatives of the European Commission, representatives for the 28 Member States and 32 expert associations involved in transport policy, which have been selected following a call for applications in 2015. Pursuant to Article 5(3) of the Decision establishing the Sustainable Transport Forum, the Commission can, on an ad hoc basis, call upon other experts to conduct its work. Cities and regions are represented at the Sustainable Transport Forum through POLIS, which is one of the 32 selected expert associations. Eurocities is also often invited to participate to dedicated STF workstreams as an ad hoc expert organisation.

19 See footnote 5.

European Member States, EEA countries and the UK, but also European cities and regions. A total of 38 contributions were received in response to the eQuestionnaire; a number of these included or referred to publicly available detailed tender specifications. The responses were first analysed and summarised by POLIS, who also followed up with certain respondents and other stakeholders for additional information, and provided further references used in these recommendations. Moreover, specific support and input was provided by EUROCITIES - the network of major European cities.

Further input was gathered from a number of Charge Point Operators (CPOs) and electromobility experts who had indicated a willingness to participate in this process at the end of the 2019 STF stakeholder consultation.

As a second step, the draft report was core reviewed by a core drafting team including representatives of European cities and e-mobility experts. As part of this core review, additional best practices and experiences were included in the report.

An overview of respondents and contributors is provided in section 1.6 and Annex 3.

Together with the findings of the STF 2019 stakeholder consultation, the inputs received from the respondents to the eQuestionnaire and electromobility experts provide the evidence base for these Recommendations.

Since not all participants have replied to all questions, the total number of respondents may have varied for each question. Therefore, where percentages of respondents are provided in these Recommendations (e.g. "85% of respondents considered that…"), these percentages refer to the number of respondents that replied to that particular question with a specific position (to avoid any misunderstanding, this excludes "No opinion / I don't know" responses), not to the amount of participants that provided answers to the eQuestionnaire overall. Throughout the Recommendations, the former will be referred to as 'respondents', while the latter will be referred to as 'participants'.

A first draft of the Recommendations was subsequently shared with a core review group consisting of a few interested cities and electromobility experts. Following this, a second draft was shared with the STF members for final comments. These have all been duly summarised in this report, which was subsequently adopted by the STF Plenary on 1 December 2020.

1.5 Focus and limitations to scope

1.5.1 Electric recharging infrastructure

Although the mandate provided by the 2019 STF plenary referred to alternative fuels infrastructure generally, the topics the plenary asked to be included in the Recommendations indicated that the focus would be on electric recharging infrastructure.

Due to the expected rapid and substantial uptake of electric vehicles in the coming years, roll-out of at least 1 million or more recharging points by 2025 could be necessary according to the ambition set by the Green Deal. In this context, it can reasonably be expected that most, if not all, municipal, regional and national public authorities in the EU will at some point in time be required to publicly procure, award concessions or grant government support for the construction and operation of recharging points in their territories. In other words, recommendations, based on best practices, for publicly procuring, awarding concessions or granting government support for the construction and operation of recharging points are both more urgent, and will reach a much wider audience.

Moreover, a focus on electric recharging is also justified by the fundamental technical difference of supplying electricity to a vehicle instead of a fuel, with all its technical, commercial and legal consequences. This in particular means that it is much more challenging for public authorities to plan the deployment and develop tender specifications for recharging infrastructure than for any other (alternative fuels) refuelling infrastructure. For instance, the lower range of electric vehicles in combination with slower recharging times means more infrastructure is needed than for any other fuel. In consequence, this means that recharging infrastructure is likely to occupy more public space than any other (alternative) fuels infrastructure - in particular in urban agglomerations. Another example is the added complexity caused by the direct connection of recharging stations to the electricity network and the impacts this may have on grid stability, if not performed in a smart way.

For these reasons, the focus of this STF exercise is on electric recharging infrastructure. This notwithstanding, the eQuestionnaire has left scope for respondents to highlight specific needs for recommendations for other alternative fuels infrastructure. The responses confirmed the focus of this exercise to be correct. A majority indicated that they had not organised any public procurement procedure, concession award procedure or granted government support for other alternative fuels infrastructure in the past three years. Only hydrogen was able to elicit a notable number of responses (11 replies). Developments in this area should be monitored closely, so that a similar exercise can be undertaken for hydrogen refuelling infrastructure once more experience has been built-up and can be shared.

1.5.2 For passenger cars and vans

These Recommendations moreover focus on recharging points for passenger cars and vans (M1 and N1 category of vehicles according to UNECE standards [20]). Passenger cars and vans ('light commercial vehicles') are responsible for around 13% and 2.7%, respectively, of total EU emissions of carbon dioxide (CO_2).[21] In 2017, passenger cars and vans accounted for more than 73.5% of total CO_2 emissions from road transport in Europe.[22] It is therefore the segment with the lowest hanging fruit - in particular since the technologies exist to entirely decarbonise this transport segment. Moreover, for the next five years, automakers have announced plans to release another 200 new electric car models[23], manifesting the mainstream commercial deployment of electric vehicles. This makes the deployment of a widespread and sufficiently dense recharging network pertinent and urgent.

It is however important to highlight the role that public authorities will increasingly have to play in deploying or facilitating the deployment of recharging infrastructure for other electric vehicles, namely:

(i) L-category vehicles, i.e. 2-, 3- and 4-wheel

20More info on vehicle categorisation according to UNECE standards available here: https://ec.europa.eu/growth/sectors/automotive/vehicle-categories/

21Calculated based on figures from European Environment Agency EEA Report No 2/2020, Monitoring CO2 emissions from passenger cars and vans in 2018, p. 11 ; available here: https://www.eea.europa.eu//publications/co2-emissions-from-cars-and-vans-2018.

22Ibid.

23IEA, Global EV outlook 2020 (Paris), available here: https://www.iea.org/reports/global-ev-outlook-2020. According to analysis by T&E, the total number of BEV models on the market in the EU will surpass 100 in 2022 and reach 172 in 2025; see Electric surge: Carmaker's electric car plans across Europe 2019-2025, p. 9; available here: https://www.transportenvironment.org/sites/te/files/publications/2019_07_TE_electric_cars_report_final.pdf.

vehicles such as motorcycles, mopeds, quads, and minicars[24];

(ii) Buses and coaches[25]; and

(iii) Heavy-duty vehicles[26].

Without going into too much detail, to the extent public authorities are involved and can steer the deployment of recharging infrastructure for those other types of vehicles, they should aim for synergies between the different recharging solutions. This could for instance include the development of recharging hubs offering recharging solutions to different types of electric vehicles, in order to minimise grid connection costs.

1.6 Overview of coordinators, authors, core review team, stakeholders and respondents

An overview of the coordinators, authors, core review team and solicited and participating stakeholders is provided in Annex 3.

The eQuestionnaire turned 37 replies. Stakeholder representation was good and diverse, with replies from different Member States and levels of government. Figures The eQuestionnaire received 37 replies. Stakeholder representation was good and diverse, with replies from different Member States and different levels of government. Figures 1 and 2 below provide an overview of the diversity of the respondents.

Figure 1: Origin of respondents

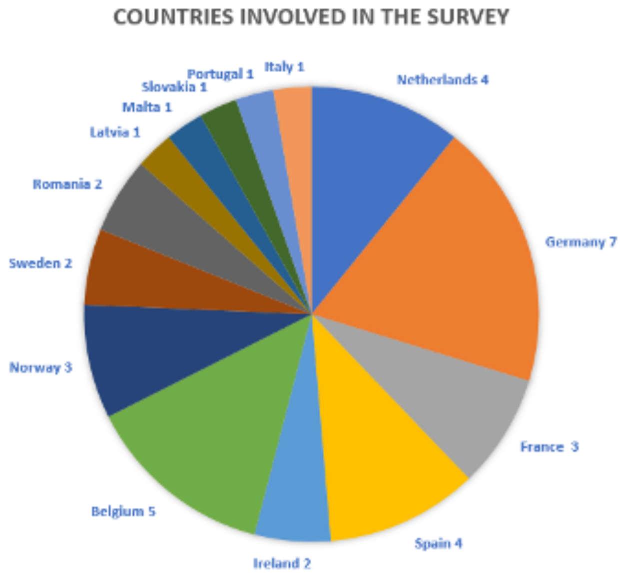
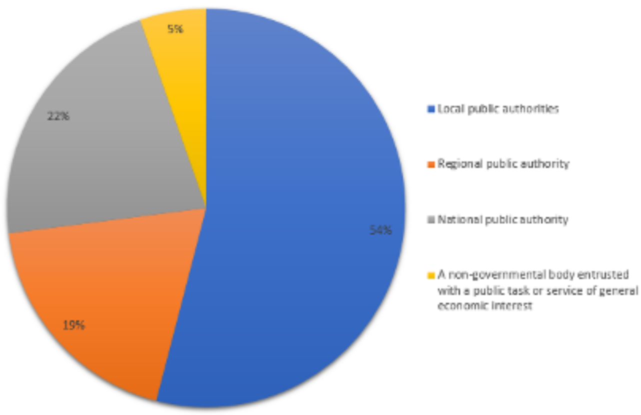


Figure 2: Levels of government represented



24 The European Commission has developed standards for recharging infrastructure for L-category vehicles: see Article 1 of Commission Delegated Regulation (EU) 2019/1745 of 13 August 2019 supplementing and amending Directive 2014/94/EU of the European Parliament and of the Council as regards recharging points for L-category motor vehicles, shore-side electricity supply for inland waterway vessels, hydrogen supply for road transport and natural gas supply for road and waterborne transport and repealing Commission Delegated Regulation (EU) 2018/674; available here: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1745&from=EN.

25 In the coming years in particular municipal bus fleets are expected to be gradually electrified as a consequence of the Member State obligations under Directive (EU) 2019/1161 of the European Parliament and of the Council of 20 June 2019 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles; available here: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L1161&from=EN. Standards for electric recharging of electric buses are currently being developed under Mandate M533; final recommendations from CEN/CENELEC are available here: https://www.cencenelec.eu/standards/Topics/eMobility/Documents/eMCG_Sec0102_INF.pdf.

26 In particular inner-city heavy-duty transport is expected to be decarbonised in the coming decade under impulse of the legally binding 30 % reduction target for the average fleet emissions of new trucks by 2030, set by Regulation (EU) 2019/1242 of the European Parliament and of the Council of 20 June 2019 setting CO2 emission performance standards for new heavy-duty vehicles and amending Regulations (EC) No 595/2009 and (EU) 2018/956 of the European Parliament and of the Council and Council Directive 96/53/EC; available here: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1242&from=EN.

2. Defining the deployment approach

As explained in section 1.1 above, recharging infrastructure will have to be deployed in all EU Member States in the coming decades to accommodate the expected rapid uptake of electric vehicles. This infrastructure will be connected to the (public) electricity network, will likely take up (public) space and will, certainly in the early stages, require public support. In order to maintain network stability, manage the public space and, as the case may be, spend public funds effectively, public authorities will have an important role in the successful deployment of recharging infrastructure.[27] This will be the case irrespective of the decision to develop the network themselves (via a public undertaking), tender it out through concessions or entirely leave its development to the market - in which case the public authority will still be able to steer its development somewhat through urban planning (e.g. permitting procedures, planning guidelines, etc.). In this chapter, we will examine a number of considerations that public authorities could and should make when defining their approach to deploying recharging infrastructure. An overview of the main features of the deployment approaches applied by the respondents to the eQuestionnaire is provided in Annex 2.

2.1 The importance of long-term mobility strategies

As a first step, it will be primordial for public authorities to develop a long-term mobility strategy - including an electrification and infrastructure strategy.

The long-term mobility strategies should include a clear vision on how the local mobility and electricity demand situation is expected to, or should develop. This requires for instance forecasting on:

- changes in urban planning, and in particular the amount and types of parking spaces (public and private);
- changes in vehicle fleets, e.g. in terms of number of vehicles overall as well as vehicle categories (light duty and heavy - duty) and drivetrain types;
- changes in traffic densities and traffic flows;
- all of the above possibly spurred by local UVARs/LEZs
- reductions in private vehicle ownership and increased use of shared, possibly electrified vehicles;
- expected modal shift, e.g. towards active mobility solutions such as walking and cycling, but also towards public transport;
- technological developments of electric vehicles (e.g. in terms of battery size, recharging capabilities, etc.) in turn affecting expected recharging needs;
- degree of electrification and resulting recharging needs of specialised and captive fleets such as taxis, (urban) logistics, etc.; and
- local energy demand developments and hosting capacity of the local electricity grid.

The insights gained from long-term mobility planning are essential to identify the needs for recharging infrastructure and, ultimately, define the best locations for that infrastructure. A good analysis of the real needs is required to prevent that short time investments in infrastructure turn out to be suboptimal, or in the worst case redundant, in the longer term. Since recharging infrastructure has an expected lifetime of at least 7 years[28] and urban mobility policies

27 APPM, 2016, Een statistisch onderzoek naar de effectiviteit van elektrisch vervoerbeleid van gemeenten 2016, iov Ministerie van Economische Zaken

28 This is the expected time period for an operator to refinance his investment in the city of Berlin. MRA-E prescribes a minimum lifetime of ten years in its tender specifications, and has not experienced any significant problems with the first recharging stations deployed on large scale since 2013. Stuttgart explains that the lifetime ranges from 8 years for some components of the recharging pole itself to 30 years for the underground power supply and

and urban planning are subject to permanent change, there is a real risk of ending up with stranded assets in the absence of a long-term vision. An example that readily springs to mind is of a street equipped with relatively new on-street recharging points that becomes car-free: in the best case, the recharging points can be re-installed elsewhere, but any corresponding investments in grid upgrades and underground cables will be lost.

A last noteworthy point is the inclusion of measurable quantitative and qualitative targets for electromobility and/or the deployment of recharging infrastructure in long-term electrification strategies. Targets are useful for two main reasons: on the one hand to keep track of progress and allow timely intervention (e.g. amendments to the relevant policy framework) if needed, and on the other hand to create a stable investment climate.

Deployment targets may either involve the setting of absolute target numbers (e.g. Brussels[29]) or relative targets, where the targets depend on factors such as the number of citizens owning an electric vehicle (e.g. the 1:10 indicative target in recital (23) of AFID). It is important that authorities do not simply aim for a fixed number of new recharging points (pure quantitative target), but also base these numbers on a proper qualitative analysis, based on the real (expected) needs of mobility users - including in terms of the quality and user-friendliness of the infrastructure deployed. This is where the Recommendations of Chapter 4 come in.

A large majority of the respondents to the eQuestionnaire (29 out of 38) indeed confirm having included measurable targets for electromobility and/or the deployment of recharging infrastructure in their long-term electrification strategies.

Recommendation

In order to plan recharging infrastructure deployment, public authorities should develop a long-term vision and strategy on how the local mobility situation should progress. Such long-term mobility strategies should include measurable quantitative and qualitative targets for electromobility and/or the deployment of recharging infrastructure, in order to monitor progress and create a stable investment climate.

2.2 The importance of cooperation

National levels of government (and some regional governments) enshrine their long-term mobility strategies, and electromobility strategies in particular, in the National Policy Frameworks adopted under AFID and, more generally, in the National Energy and Climate Plans adopted in accordance with EU Regulation on the governance of the energy union and climate action (EU)2018/1999. For municipal authorities, such long-term electrification strategies should be integrated in their Sustainable Urban Mobility Plans(SUMPs)[30 31], while often

cables.

29See Annex 5.3 of Brussels, Vision on the deployment of recharging infrastructure for electric vehicles, June 2020, available here (in French and Dutch): https://environnement.brussels/sites/default/files/user_files/note_vision_regionale_bornes_fr.pdf https://leefmilieu.brussels/sites/default/files/user_files/note_vision_regionale_bornes_nl.pdf

30https://sumps-up.eu/sump-registry/

31 In this respect, see in particular the Topic Guide: Electrification – Planning for electric road transport in the SUMP context; available here: https://www.

being complemented by their Covenant of Mayors local energy and climate action plans (SECAPs)[32]. Coherence between these (electro) mobility strategies is key to ensure that measures implemented by different governance levels, but also between different policy domains (energy, mobility, housing, etc.), reinforce and leverage impact.

It is precisely for this reason that Article 3(3) of the Alternative Fuels Infrastructure Directive requires that "National policy frameworks shall take into account, as appropriate, the interests of regional and local authorities". Since cities claim that this has often not been the case, they ask for the establishment of multi-level governance frameworks, in order to address potential local and regional infrastructure gaps and align policy measures between authorities[33]

eltis.org/sites/default/files/electrification_planning_for_electric_road_transport_in_the_sump_context.pdf.

32https://www.covenantofmayors.eu/en/

33EUROCITIES, Better alternatives for city authorities: EUROCITIES policy paper on the revision of the alternative fuels infrastructure directive, p. 6, available here: http://nws.eurocities.eu/MediaShell/media/EUROCITIES_Better_alternatives_for_city_authorities_FINAL.pdf.

Germany: cooperation between the federal level and Länder

In Germany there are bi-annual meetings with representatives of the Federal States (Bundesländer) to discuss the need and further deployment of charging infrastructure organised by the Federal Ministry of Transport in coordination with the central coordination centre (Nationale Leitstelle Ladeinfrastruktur), NOW gmbh (= National Centre for Recharging Infrastructure, see https://www.now-gmbh.de/en). Furthermore, the Federal States can use the Federal Funding Guideline for their own funding thanks to an opening clause for the Federal States ("Länderöffnungsklausel") and in order to ensure uniform minimum criteria throughout Germany. The latter allows the Federal States to implement their own funding guidelines with the same basic requirements without the need for notification.

The Leitstelle also offers consulting services for the Federal States to assist with their funding activities. A group made up of representatives of the Federal Government and the federal states meet regularly to steadily evolve the functionalities of StandortTOOL (central planning tool for alternative fuels infrastructure, incl. recharging infrastructure: see relating box in section 2.3.2.1) in cooperation with local government associations.

Dedicated electric mobility managers ensure a coordinated and effective deployment of recharging infrastructure in municipalities. Their task is to provide support and assistance to local authorities for the deployment of recharging infrastructure. This also allows the pooling of knowledge regarding approval processes and technology; the manager is responsible for transmitting relevant information and toolkits between the Federal Government, the federal states and the local authorities.

The Netherlands: cooperation between public and private stakeholders

In the Netherlands, the Dutch Ministry of Infrastructure and Water has drawn up a National Agenda charging Infrastructure to ensure that a well-functioning infrastructure for electric transport can be rolled out. The National Agenda was drawn up in collaboration with public and private stakeholders, who jointly made agreements and defined goals and actions for the deployment of charging infrastructure.

The Eurocities paper Better alternatives for city authorities, reported that members from the Netherlands highlighted the benefits of such a consultation, which was said to 'lead to improved coordination in the deployment of infrastructure, while ensuring broad multi-stakeholder buy in.[34]

34TNO, Publieke Laadinfrastructuur Elektrisch Vervoer en rol van MRA-E en G4, 2018; and EUROCITIES, Better alternatives for city authorities: EUROCITIES policy paper on the revision of the alternative fuels infrastructure directive, p. 7, available here: http://nws.eurocities.eu/MediaShell/media/EUROCITIES_Better_alternatives_for_city_authorities_FINAL.pdf.

The Netherlands: regional cooperation

A specific example of regional cooperation in the Netherlands is the Metropolitan Region Amsterdam-Electric (MRA-Electric). MRA-E was founded in 2012 to support municipalities in the three provinces of North-Holland, Flevoland and Utrecht with the development and implementation of EV-policies. Supported by a dedicated project team of electromobility experts, the municipalities share experience and knowledge, develop demonstration projects, develop standard documents/templates for use by all, and jointly procure/manage recharging infrastructure. The cooperation ensures that an interoperable recharging network is not only deployed in the main cities, but also in the surrounding municipalities (hinterland). Beginning 2020, MRA-E announced the selection of the concessionaire of the biggest EU tender for the development and operation of recharging infrastructure thus far: 20,000 new recharging points![35] More information available here: https://www.mra-e.nl/.

The same coherence is needed between long-term mobility strategies of neighbouring cities, regions or countries, where choices made by one will inevitably have impacts on the other. For instance, the European Commission's assessment of the National Policy Frameworks of 24 EU Member States in 2017[36] found that "[t]he NPFs are not coherent from an EU perspective in terms of the priorities they set and how ambitious they are with regard to different alternative fuels. Member States' ambition to change the current state of affairs varies a lot, both in terms of projected deployment of vehicles and vessels running on alternative energy and the related infrastructure. Most importantly, only a few NPFs set clear and sufficient targets and objectives and suggest support measures". This resulted in a situation where a handful of Member States spearheaded the deployment of recharging infrastructure while, at the same time, "10 Member States [did] not consider any measures to increase the number of publicly accessible recharging points". Such inconsistencies will inevitably cause problems for users, particularly when they want to travel cross-border.

Cross-border cooperation: Franco-German alignment on deployment

There are annual bilateral meetings between the Federal Ministry of Transport and Digital Infrastructure (Bundesministerium für Verkehr und digitale Infrastruktur) and the French Ministry for Ecological and Solidary Transition (Ministère de la transition écologique et solidaire) devoted to the deployment of recharging infrastructure, focussing in particular on deployment in the border regions and on connecting the largest cities.

35https://www.mra-e.nl/nieuws/20-januari-2020/

36Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'Towards the broadest use of alternative fuels -an Action Plan on Alternative Fuels Infrastructure under Article 10(6) of Directive 2014/94/EU, including the assessment of national policy frameworks under Article 10(2) of Directive 2014/94/EU', SWD(2017)365final, p.6

Sharing good practices and cross-border exchanges

Cities collaborating across borders: Interreg projects are said to increase cross-border cooperation. The city of Dortmund moreover has a visiting programme to learn and exchange best practices with other cities and private stakeholders.

Cities collaborating within national borders: Reggio Emilia and the city of Milan share information and experiences regarding the deployment of recharging infrastructure.

Collaboration between the city and lower level municipalities: London is a good example of an effective framework of collaboration between the city level and the city boroughs; see: http://lruc.content.tfl.gov.uk/london-electric-vehicle-infrastructure-taskforce-delivery-plan.pdf.

Technical and financial support provided by the EIB

The European Investment Advisory Hub (EIAH or the Hub) is a partnership between the European Investment Bank Group and the European Commission as part of the Investment Plan for Europe.

The Hub acts as a single access point for public authorities for various types of technical and financial advisory services. It supports the project life cycle in the identification, preparation and development of investment projects and programmes across the European Union.

A unique strength of the Hub is its ability to bring together EIB technical experts from across different sectors such as mobility, energy and digital to advise local authorities on their investment projects, to bring these closer to implementation. Similarly, EIB experts from other advisory divisions such as **InnovFin Advisory, EPEC or Financial Instruments Advisory**, but also external consultants where necessary, can be included in cross-sector technical and financial advisory assignments.

The Hub has been particularly active in support of local authorities for their clean bus transition investments, including related recharging infrastructure. The Hub participates in urban mobility advisory under the **Cleaner Transport Facility** and can offer support to local authorities in preparing projects. Together with urban development experts, the Hub offers support under **URBIS** for integrated urban development investment programmes which can include urban mobility investments. With respect to recharging infrastructure in particular, the Hub also provides support to promoters seeking to apply under the **CEF Blending Facility**.

The Hub's advisory services are available free of charge to public authorities and can be contacted via the online platform eiah.eib.org or by email eiah@eib.org

Other relevant EIB advisory divisions are:

The European PPP Expertise Centre (EPEC): an advisory service of the European Investment Bank with a mission to support public authorities across Europe to deliver sound public-private partnerships (PPPs), including concessions. EPEC can support public authorities by: (1) sharing experience and good practice on PPPs/concessions through its network of active members, (2) assisting the development of PPP policies and frameworks for the implementation of PPPs/concessions, and (3) providing strategic advice to procuring authorities on the preparation of individual PPP/concession projects.

Financial Instruments Advisory (FIA) provides a range of advisory support to Managing Authorities and National Promotional Banks and Institutions in relation to the design, development and implementation of financial instruments and investment platforms. The team operates EU wide and covers a range of sectors including urban development, transport and renewable energy. Typical advisory assignments include feasibility work to assess the demand and need for a new financial instrument in a given sector and/or geography and the provision of advice in relation to the design of an appropriate investment strategy and governance structure.

InnovFin Advisory (IFA) has solid experience in providing advisory services to support the development of EV charging infrastructure projects, including the assessment of project viability and bankability, review business plans and financial models and, ultimately, facilitating access to finance.[37]

In addition, pubic authorities can get assistance from the Joint Assistance to Support Projects in **European Regions (JASPERS)**. JASPERS is actively supporting sustainable urban mobility across many Member States, providing horizontal support at national, regional and local levels, in order to help prepare a robust pipeline of urban mobility investments and assisting in the preparation of Sustainable Urban Mobility Plans. More information and contact details are available on www.eib.org/jaspers.

Harmonisation and simplification of permitting procedures is another thematic area that deserves specific focus in cooperation between public authorities. The 2019 STF stakeholder consultation identified lengthy permitting procedures, involving many different administrative procedures and actors as one of the more important barriers to a quick roll-out of recharging infrastructure in the EU. Also in their contributions to these Recommendations, CPOs identified compliance with a plethora of –often very local- permitting regulations as a main barrier to quick infrastructure roll-out, and one leading to unnecessary costs – which will eventually have to be borne by consumers.

Recommendation

In order to ensure consistency, public authorities should align their recharging infrastructure deployment strategies between different levels of government and between neighbouring nations, regions and cities.

37 They published a well-received transport study in 2018. One key recommendation was that EV charging infrastructure be built-up across the EU with blending instruments used to finance this growth – a point that helped to conceive the existing Future Mobility Facility. Our follow-on report engages with private and public promoters (incl. City of Milan and Riga Transport Authority, amongst others) to propose resolutions intended to minimise financial hurdles inherent in the development of innovative transport and mobility solutions.

2.3 The building blocks of a suitable recharging network

A suitable recharging network provides enough conveniently available recharging options to (potential) users of electric vehicles, meaning that a vacant recharger with sufficient power is likely to be available at locations where users require them. At the same time the societal impact in terms of cost, use of public space and nuisance should be minimised.

Recommendation

To the extent that public authorities are involved in the planning of a recharging network in their territories, they should aim for recharging networks to cost-effectively provide sufficient availability and capacity for EV-users to recharge at their convenience. This requires taking two main aspects into account:

1. Providing flexibility for electric vehicle users by:
   a. defining the required amount of recharging points;
   b. identifying appropriate locations;
   c. ensuring geographical dispersion; and
   d. identifying appropriate power levels.
2. Reducing overall deployment costs and nuisance by:
   a. making best use of existing infrastructures to limit installation costs;
   b. limiting the use of (public) space;
   c. preventing nuisance during installation and maintenance works; and
   d. maximising the occupancy rate of recharging infrastructure (effective EV parking policy).

2.3.1 Providing flexibility for electric vehicle users

In order to stimulate the uptake of electric vehicles, a suitable recharging network is essential. A suitable recharging network that offers sufficient flexibility to EV-users in terms of the routes that they want to drive at the desired moment. For the uptake of electric vehicles, it is important that electric vehicle users feel confident that they have enough electric energy to meet their mobility demands at their disposal. This means that sufficient recharging points are available at the right locations with high enough power.[38] Realising this will be one of the major challenges for electromobility.

In order to meet this demand, the recharging infrastructure network should be configured to meet the actual and forecasted future patterns of mobility users. Therefore, account should be taken of the origins and destinations of mobility users (traffic flows) and traffic densities on the road network. These may differ for various groups of EV-users such as inhabitants, customers, commuters (inside and outside), guests and commercial transport. Recharging points should be deployed accordingly at people's homes, offices, along

38 NB: Providing flexibility to users also means that consumers have access to as many recharging points as possible: opening up the recharging network through increased transparency on the locations and prices of recharging points, interoperability between different recharging service providers (CPOs and EMSPs), etc. will be considered in more detail in chapter 4.

highways and at locations where people are typically parked for 30 minutes to a couple of hours - such as retail stores, restaurants etc.

Typically, origins and destinations of mobility users go beyond the boundaries of the geographical areas managed by a single public authority. It is therefore vital that the public authorities of adjacent regions align their electromobility strategies and recharging infrastructure networks.

2.3.1.1 Determining required amount of recharging points

The availability of a sufficient number of recharging points is essential to convince drivers of ICE-vehicles to shift to electric vehicles. As mentioned in chapter 1.1, the Green Deal expects that 1 million recharging points will be required in the EU by 2025 to facilitate the use of approximately 13 million electric vehicles.[39]

In the Alternative Fuels Infrastructure Directive (2014/94/EU), which was adopted in 2014 to ensure the deployment of alternative fuels infrastructure throughout the EU, the European Union obliged Member States to ensure the deployment of a number of recharging points commensurate to the number of electric vehicles in their territories. The Alternative Fuels Infrastructure Directive suggested that the number of recharging points should be equivalent to at least one publicly accessible recharging point per ten electric vehicles (1:10), taking into consideration the type of cars, recharging technology and available private recharging points. This number is non-binding and may not be a 'one-size-fits-all' metric. For example, the Dutch climate agreement estimates that approximately 1.7 million (semi-)public rechargers will be needed by 2030 to facilitate approximately 1.9 million electric passenger cars (or in other words, a ratio of nearly 1:1).[40] Other indications on average electric vehicle/publicly accessible recharging point ratios have been provided by the National Development and Reform Commission of China (2015) and the International Energy Agency (2017), Cooper and Schefter (2017), Wood et al. (2017) and Harrison and Thiel (2017), with values ranging from 7 to 27 EVs per public recharging point. Gnann et al. (2018) estimated that the ratio of public 'fast' recharging points (for a power level of150 kW) per EV can be similar to that applied for refuelling stations of other alternative fuels, i.e. on point for every 1000 vehicles.[41]

The amount of publicly accessible recharging points that will be required in a given area will be mainly driven by demand, which can be pretty accurately forecast taking account of the following factors:

- **The (expected) number of electric vehicles circulating in that area:** this includes residents, but also commuters from outside the area and utility vehicles of all kinds, including potential seasonal peaks: eg. increased winter and summer holiday traffic. Moreover, when forecasting traffic flows, account should be taken of

39COM(2019) 640 final, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, The European Green Deal, p. 11; available here: https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf.

40Climate Agreement (Klimaatakkoord), The Hague, 28 June 2019. The high ratio can be explained by a strong dependence on publicly accessible normal power recharging stations in the Netherlands: the Dutch National Agenda for Recharging Infrastructure, which is a constitutive part of the Climate Agreement, mentions an expected ratio between normal and high power recharging of 85%/15% in 2030.

41See JRC, The Role of Infrastructure for Electric Passenger Car Uptake in Europe, which also includes the references for the cited studies and literature. This report also provides an analysis of the expected ratio between public recharging points and EVs in EU Member States, EEA countries and the UK on the basis of the projections given in the National Policy Frameworks submitted in accordance with the Alternative Fuels Infrastructure Directive; available here: https://www.mdpi.com/1996-1073/12/22/4348.

expected developments in city planning: in certain areas public authorities may want to discourage the circulation of vehicles altogether;

- **The amount of/potential for semi-public infrastructure in that area:** although strictly speaking also publicly accessible infrastructure, specific attention is drawn to the availability of or potential for recharging infrastructure in private large parking garages, or car parks of large warehouses, convenience stores, etc. The availability or potential of such semi-public infrastructure will have an important impact on the requirements for recharging infrastructure in the public domain;
- **The amount of/potential for private infrastructure in that area:** the ratio of residents with access to a private garage or driveway (private parking) compared to those without such access. Public authorities can incentivise this for instance by mandating the erection of recharging points in certain buildings or facilitating it in multi-dwelling buildings, providing grants for the development of private recharging points.[42] This will also reduce the need for recharging infrastructure in the public domain.
- **Local electricity grid hosting capacity:** planning the deployment of recharging stations in areas where grid capacity is readily available can considerably reduce connection (one-time) and network costs (annual). Municipalities can request data on grid hosting capacity from the local grid operator and use grid-based recharging infrastructure planning tools to identify cost-optimal recharging point locations. Moreover, efficient grid planning for recharging point roll-out will become increasingly important with the rise of V2X technologies (see section 4.3.5); where public authorities want to use EVs as a means of storage of abundant renewable energy, they may want to attract those battery assets as close as possible to the renewable generation facilities to avoid network losses.
- **The power of recharging points:** the deployment of a relatively higher amount of high power recharging points means less recharging points will be needed overall. . A study undertaken by the Netherlands showed that for the establishment of each high power recharging point, 44.3 fewer normal power recharging points will be required in 2030 .[43] The choices regarding power level will be discussed in more detail later in this section.
- **Developments in battery technology:** the expected increase in power and energy density of electric vehicle batteries will likely affect the required number of publicly accessible recharging points. In particular, EV-users may decide to recharge less frequently, or only when it is really necessary - much like conventionally fuelled cars (see also section 4.3.1).
- **The advent of new technologies, such as the uptake of connected and autonomous driving.** It is expected that autonomous vehicles will be able to (dis)connect from recharging points without human intervention. This could lead to important efficiency improvements in the occupancy rate of recharging points, reducing the need for recharging points overall.

Since these characteristics differ widely depending on the area, it is not possible to make general recommendations as to the

42In this context, specific attention is drawn to the obligations in Article 8 of Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency; available here: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L0844&from=EN.

43The study of the Dutch National Service for enterprises (RVO) is available here (see page 6): https://www.rvo.nl/sites/default/files/2019/11/Geactualiseerde%20prognose%20laadinfrastructuur_20190329.pdf.

amount of recharging points required in any given area. However, a number of the above factors can be influenced by public authorities. They can accelerate the shift to electric vehicles with a range of support measures for EVs (e.g. purchase subsidies, tax reductions, toll exemptions etc.) or measures against ICEs (e.g. UVARs/diesel bans, vehicle sales bans, etc.). This will have a corresponding impact on the requirements for publicly accessible recharging infrastructure.

USER-CHI: development of a charging infrastructure planning tool

The Horizon 2020 USER-CHI project includes the development of a 'Charging Infrastructure LocatIon and HolistiC Planning Kit' (CLICK tool) that will analyse inputs on vehicle fleets, local mobility strategies, potential electricity grid impact and territory aspects to provide guidance on optimal deployment strategies. Based on a deployment tool first developed for the city of Berlin, the CLICK tool will be abstracted from Berlin's reality to fit the needs of planners in any European city. The purpose of the tool is to forecast the amounts of recharging infrastructure needed in predetermined city areas or zones, based on a list of questions for ever more detailed information on city specifics. The more detailed information a user has about his city, the more precise and targeted estimate the tool can provide. In addition to Berlin, the tool will be tested at the very minimum in Barcelona, Budapest, Murcia, Rome and Turku.]

The tool is based on an approach that takes into account different user groups, like private use, carsharing, and commercial use.

Other mobility planning tools that are widely used are the SparkCity model (https://sparkcity.org/), …

2.3.1.2 Identifying appropriate locations

As mentioned above, a suitable recharging infrastructure network is characterised by the presence of recharging points at strategic locations allowing mobility users to recharge their vehicles whenever necessary without significant detours.

There are, by and large, three main ways of selecting locations for recharging infrastructure, with a plethora of options to combine aspects of these three:

(i) modelling/forecasting of the recharging demand development;

(ii) utilising data extracted from existing recharging points[44]; and/or

(iii) responding to requests for a new recharging point from a (prospective) electric vehicle owner.

As explained in section 2.4.2.1, all of these should be mapped on pre-identified locations in the electricity grid so that existing capacity is used optimally and unnecessary upgrade costs can be avoided.

The decision and selection are then ultimately either made centrally, by public authorities or (semi-)public undertakings, or decentrally, by the market or (indirectly) by (prospective) EV-users. More information on the authority responsible for tendering is provided in section 3.1.

When public authorities centrally determine locations for recharging infrastructure, they very often base their decisions on modelling of demand development. Such forecasts should naturally follow from long-term electromobility strategies. Central planning of infrastructure is most common in the early stages of network development. It is argued to be necessary to solve the chicken-and-egg dilemma of the electromobility market: a basic network must be in place to convince even the earliest-moving consumers to buy an electric vehicle; at the same time, in that early market situation, there is often still little or no interest from the private sector to deploy any such infrastructure. In those circumstances, public authorities often find themselves in the position of having to determine the best locations for initial infrastructure deployment - a decision that they often delegate to a specialised public undertaking or to the distribution system operator (DSO)[45]. For example, in Flanders[46] (by means of tender procedures) and Luxembourg[47], the DSO was tasked to develop a basic infrastructure network, leaving a lot of discretion to the DSO to determine the sites.

There may however also be other reasons for public authorities wanting to determine at least certain locations for recharging infrastructure. For instance, public authorities may want to ensure a good geographical spread, instead of a concentration of recharging stations in the most profitable locations (see also section 2.4.1.3). Another is the objective of a socially just energy transition: when the deployment of recharging stations is driven only by (expected future) profitability, there is a real risk of a shortage of infrastructure in weaker

44J.R. Helmus,J.C. Spoelstra,N. Refa,M. Lees,R. van den Hoed, Assessment of public charging infrastructure push and pull rollout strategies: The case of the Netherlands, Energy Policy, October 2018 https://doi.org/10.1016/j.enpol.2018.06.011Helmus, J., van den Hoed, R., 2016. Key performance indicators of charging infrastructure. In: Proc. 29th Electron. Veh. Symp., pp. 1–9.

45 In principle, in accordance with Article 33 (2) of the Electricity Directive (2019/944), distribution system operators shall not own, develop, manage or operate recharging points for electric vehicles, except where distribution system operators own private recharging points solely for their own use or when a derogation of Article 33 (3) applies. In the latter case, the continued applicability of that derogation should be re-assessed every 5 years.

46Decree of the Flemish Government of 25 March 2016 (Besluit van de Vlaamse Regering tot wijziging van het Energiebesluit van 19 november 2010, wat betreft de activiteiten en openbaredienstverplichtingen van de distributienetbeheerders ter stimulering van de infrastructuur voor elektrische voertuigen).

47Article 2 of the Luxembourgish regulation regarding public electric mobility infrastructure (Règlement grand-ducal du 3 décembre 2015 relatif à l'infrastructure publique liée à la mobilité électrique).

socio-economic parts of cities, regions or countries.

A decentralised approach involves either market parties or EV-users determining or proposing the most appropriate locations.

In some cases, (prospective) EV-users without access to a private garage, can apply for the erection of a recharging point in the vicinity of their home, assuming there are none yet. This 'Amsterdam-model'[48] or 'demand-driven approach' has been applied in varying ways throughout the EU, often in combination with a centralised approach.[49] This approach has proven benefits in convincing consumers to switch to an electric vehicle. Very often this demand-driven approach is combined with a 'hierarchy of recharging', requiring that recharging takes place as much as possible on private domain (see Figure 4).

Figure 3: Rome: consolidated view of approximately 1150 demands for desired recharging point locations in dedicated web application (46% EV owners, 56% potential EV-users). Rome also forecasts demand for new recharging points on the basis of the number of employees per hectare

Source: Andrea Pasotto, Roma servizi per la mobilità, presentation at Eurocities "Electric Mobility Plan for Rome"

48 The model was applied in the earlier days of infrastructure development in Amsterdam.

49 Examples of such combined approach include Flanders and Rome (see Figure 3).

Antwerp's demand-driven approach[50]

The policy vision of the Autonomous Antwerp city Parking Agency (AAPA) is based on two principles: the 'hierarchy of recharging' and 'recharging point follows EV'.

Hierarchy of recharging

In AAPA's vision, residents and workers must recharge to a maximum degree on private property in accordance with the 'hierarchy of recharging'. The 'hierarchy of recharging' consists of three recharging solutions from the point of view of the EV-drivers. These are: (1) parking and recharging on their own domain, (2) private recharging points and publicly accessible recharging points on semi-public domain and (3) publicly accessible recharging points. [...]

Recharging point follows EV

"Recharging point follows EV" is a responsive strategy in which a recharging point is deployed in the vicinity of an EV-driver as soon as there is a certain guarantee that a resident (or company) will buy/lease an electric vehicle. [...]

It is possible to apply to the city of Antwerp via an electronic form on the city of Antwerp website. The specific target group are (potential) EV-drivers who do not have the possibility to recharge on their own premises. Further conditions for the applicant are:

- (future) possession or lease of an electric vehicle with a full electric range of 50 kilometres according to manufacturer's specifications (future EV-drivers must be able to demonstrate that they purchased/leased a vehicle on the basis of an invoice,...);
- to have their residence in the city of Antwerp or working for at least 18 hours per week in the territory of Antwerp.

50NB: the principles underpinning Antwerp's deployment approach (hierarchy of recharging and recharging point follows EV) stem from long-standing practice in the Netherlands.

Translated from Dutch: "De beleidsvisie van GAPA [Gemeentelijk Parkeer Agentschap Antwerpen] baseert zich op 2 principes: de 'ladder van laden' en 'paal volgt wagen'.

Ladder van laden

De visie van GAPA stelt dat bewoners en werknemers maximaal laden op privaat domein, en volgt hiermee de 'ladder van laden'. De ladder van laden bestaat uit drie treden voor laadoplossingen vanuit het perspectief van de e-rijder. Deze zijn: (1) parkeren en laden op eigen terrein, (2) een private laadvoorziening en publiek toegankelijke laadpunten op semipubliek domein en (3) publieke laadvoorzieningen. [...]

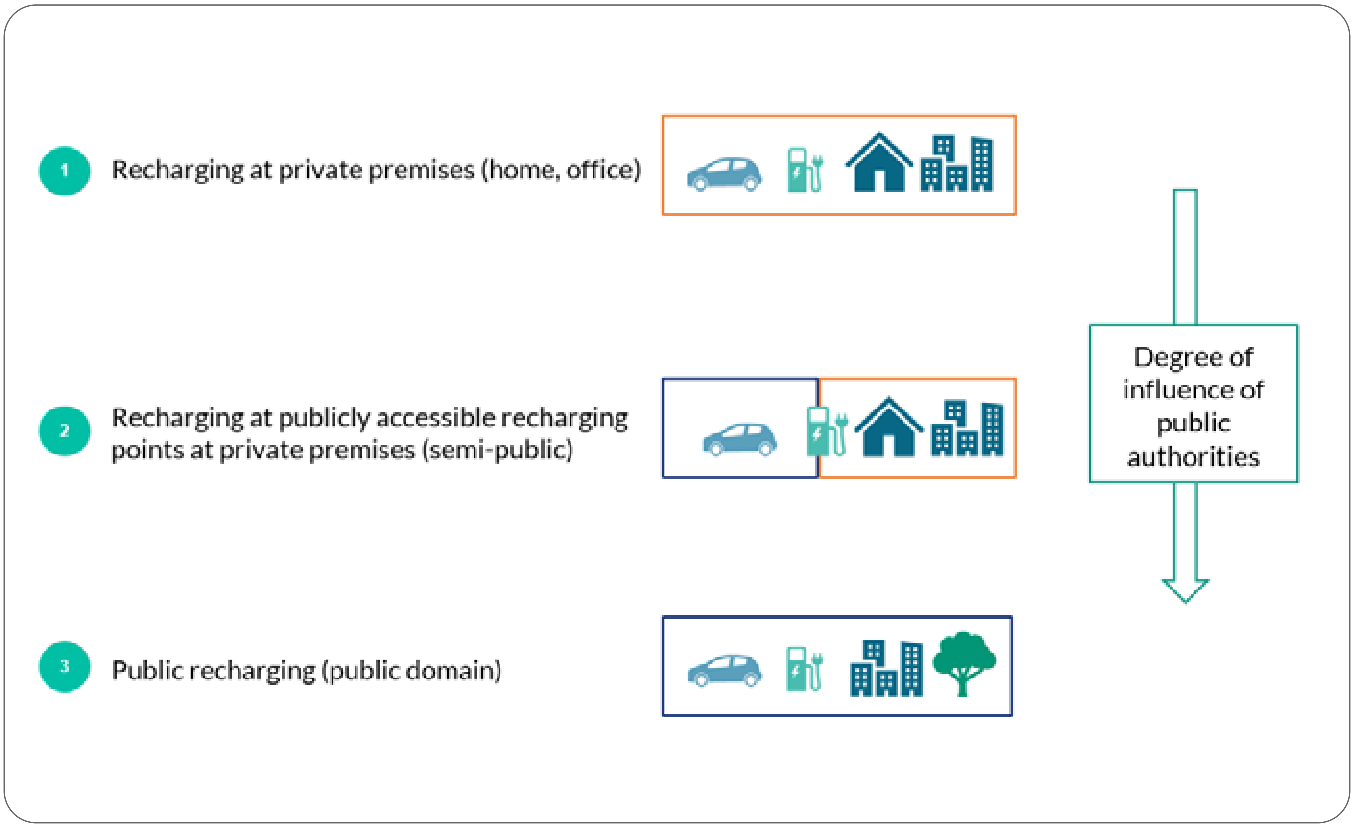
Paal volgt wagen

'Paal volgt wagen' is een reactieve strategie waarbij er een laadpunt voorzien wordt in de buurt van een e-rijder van zodra er een bepaalde garantie is dat een inwoner (of onderneming) een elektrisch voertuig zal kopen/leasen. [...]

Bij de stad Antwerpen kunnen via een elektronisch formulier op de website van de stad Antwerpen laadpunten worden aangevraagd. De specifieke doelgroep hierbij zijn de (potentiële) e-rijders die niet beschikken over een eigen terrein om op te laden. Verdere voorwaarden voor de aanvrager zijn:

- (toekomstig) bezit of lease van een elektrisch voertuig met een volledig elektrisch bereik van minimaal 50 kilometer bij fabrieksopgave (toekomstige e-rijders moeten kunnen aantonen dat ze een voertuig hebben aangekocht / geleased via een aankoopfactuur, ...);
- Woonachtig zijn in de stad Antwerpen of minimaal 18 uur per week werkzaam zijn op grondgebied Antwerpen."

Figure 4: Hierarchy of recharging



Source: Floris Jousma (Fier Automotive), "Planning the roll-out of (public) recharging infra", (with adaptations)

In cases where market parties are allowed to determine the precise locations of recharging infrastructure[51], they can either have full discretion or still be somewhat or largely constrained. Constraints on their discretion can either be set by law, urban planning requirements (e.g. predetermined zones for recharging infrastructure, time of use limitations) or in tender specifications. Tenders may for instance set deployment requirements such as distance requirements[52] or density requirements[53]. Another recurrent practice is to oblige concessionaires to build additional recharging points in a specific location if the utilisation rate of existing infrastructure passes a certain threshold. For example the city of Utrecht applies a threshold of 70% occupancy rate. Others do not set such a predetermined threshold, but generally require CPOs to transmit certain dynamic data on the recharging points to monitor their usage (cf. Madrid).

51 The city of Leuven for instance allows all interested market parties to deploy infrastructure in its territory, to the extent they meet certain minimum infrastructure requirements.

52 Although not a binding deployment requirement, the European Commission assessed infrastructure sufficiency in the Member States using a distance requirement of at least on recharging point every 60km on TEN-T Core Network: This value is derived from field test data from various EU countries and it can be reasonably assumed that it would remove range anxiety concerns. See for more details: JRC (2015) Individual mobility: From conventional to electric cars. Available at: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC97690/eur_27468_en_online_v3.pdf

53https://www.amsterdam.nl/parkeren-verkeer/amsterdam-elektrisch/flexpower-laadpaal/

Identifying new locations for recharging infrastructure: Madrid, London, Dortmund and Stuttgart

MADRID: In Madrid, city authorities use data from the concessionaire to steer network deployment. In particular, the concessionaire must "provide information concerning the parameters for the use of the recharging network, inter alia: state and maintenance of the network, recharging times, average consumption for each recharging session and user typology. Data must be transmitted in such a way that the collected information can be analysed to offer the city of Madrid a clear understanding of the development of electric mobility in its territory."[54]

LONDON: The city of London mainly takes the following elements into consideration when identifying potential new locations for the deployment of recharging infrastructure: locations of existing recharging infrastructure, current electric vehicle ownership, new licensing requirements for taxis and private hire vehicles and the expected future uptake of EVs.[55]

DORTMUND: The city of Dortmund bases its deployment strategy on a forecast of EVs, grid analyses, socio-economic data, city planning data and involves citizens in its decisions regarding locations and type of recharging points.

STUTTGART: The city of Stuttgart bases its deployment strategy on the number of inhabitants and working places in each of the 152 city districts. The required amount of new recharging points in each city district is therefore determined at macro-level. It is subsequently left to market parties to decide where exactly in each city district they want to roll-out the required amount of recharging infrastructure.

54 Translation of an excerpt from paragraph 5 of the Decree No 416 of 28 November 2018 of the Madrid Delegate for the Government Area on the Environment and Mobility, approving the procedure for granting authorisation to use recharging points for electric vehicles by means of a partnership agreement for the development of a public and universal high-speed recharging network¬in public and universal areas in the city of Madrid: "Suministrar información referente a los parámetros de uso de la red, entre otros: estado y mantenimiento de la red, tiempos de recarga, consumos medios en cada recarga y tipología de usuario; de forma que con la información extraída se puedan realizar análisis que permitan conocer el desarrollo de la movilidad eléctrica en la ciudad de Madrid. »

55 Electric vehicle charging infrastructure: Location guidance for London; available here: http://content.tfl.gov.uk/electric-vehicle-charging-infrastructure-location-guidance-for-london.pdf.

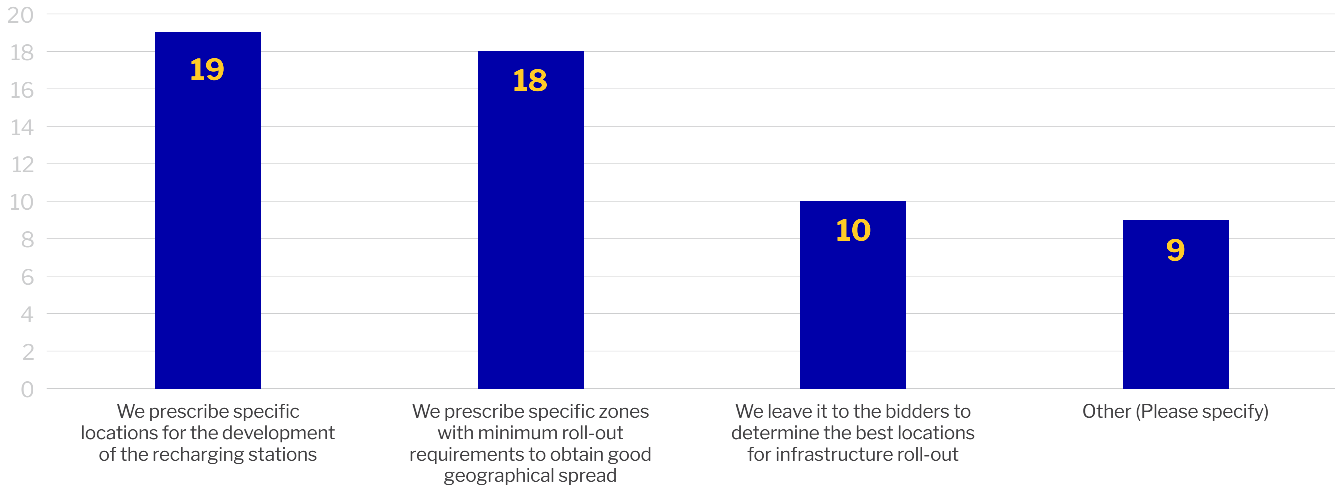


Figure 5: eQuestionnaire responses to the question: how do you choose the locations of the infrastructure (multiple answers possible)

The responses to the eQuestionnaire indicate that many cities are opting for demand-driven infrastructure development: new recharging point locations are determined on the basis of demand in any given area. The parameters to determine such demand can however differ (see Box 'Identifying new locations for recharging infrastructure: Madrid, London, Dortmund and Stuttgart'). More recently, several municipalities started using dynamic data on actual usage and consumption at the existing recharging network for future planning (see example Madrid).

Monitoring of driving behaviour via digital means, with the necessary anonymizations and all respect to privacy laws, can indeed help a more targeted roll-out of recharging infrastructure.[56]

Most of the respondents either prescribe specific locations or specific zones with minimum roll-out requirements to obtain a good geographical spread. In most cases it is a combination of both.

Some respondents indicate that the final location of the infrastructure is determined by

56 There is increasing support in literature for such approaches to identify demand, and notably demand locations, on the basis of existing, real-world mobility data of conventional vehicles. These approaches work best if real mobility data is available from a sufficiently large cohort of GIS-connected vehicle monitoring boxes, as distributed by insurance companies or digital service providers among their clients. See e.g. the following articles:

- Analysis and assessment of the electrification of urban road transport based on real-life mobility data" by M. DeGennaro, E. Paffumi, H. Scholz and G. Martini, March 2013, World Electric Vehicle Journal 6(1):100-111, DOI: 10.3390/wevj6010100;
- Assessment of the potential of electric vehicles and charging strategies to meet urban mobility requirements" by E. Paffumi, M. DeGennaro, G. Martini and H. Scholz, Transportmetrica A: Transport Science Volume 11, 2015 - Issue 1, https://doi.org/10.1080/23249935.2014.913732;
- "GIS-driven analysis of e-mobility in urban areas: An evaluation of the impact on the electric energy grid," by M. De Gennaro, E. Paffumi, H. Scholz and G.Martini, 2014, Applied Energy, Elsevier, vol. 124(C), pages 94-116, DOI: 10.1016/j.apenergy.2014.03.003; and
- "Innovative Technologies for Smart Cities: Towards Customer Driven Infrastructure Design for Large Scale Deployment of Electric Vehicles and Vehicle-to-Grid Applications" by M. DeGennaro, E. Paffumi, and G. Martini, Transportation Research Procedia, Volume 14, 2016, Pages 4505-4514, https://doi.org/10.1016/j.trpro.2016.05.373.

the concessionaires. However, in such cases municipalities often set minimum requirements or provide guidance for identifying suitable locations. A couple of respondents use several approaches or have switched approach over time from allowing concessionaires to determine the appropriate locations to a more demand-driven approach.

Almost half of the respondents indicate that they want to develop infrastructure in urban areas first. Only few respondents consider deployment in rural areas a priority. It seems that this latter group of respondents has simply shifted focus, after having already realised a considerable amount of recharging infrastructure in urban areas.

Some respondents refer to the tension between, on the one hand, facilitating electric transport and, on the other hand, ensuring a liveable public space. In particular, this seems to be a challenge for cities. Many of the respondents indicate that they develop location criteria to maintain a good balance between facilitating electric vehicles and ensuring a pleasant living environment.

Berlin explicitly indicates that it aims to develop as much recharging infrastructure as possible on privately-owned sites to reduce the use of public space. This is also a clear objective of Brussels and most cities in the Netherlands.

Where cities define a target in terms of the maximum distance between their resident's place of living to the nearest recharging point – a metric often used for demand-driven deployment, this varies strongly between cities. Some aim to have a recharging point within 200m walking distance, while in other cities this is 2km.

When identifying appropriate locations for ultra-fast chargers (150kW or more), different considerations apply. In particular, with increasing ranges of EVs, more and more EV-users will use their vehicle to travel cross-border in the EU. This will require the deployment of a minimum, continuous infrastructure network to serve Europe's major highways, the TEN-T network. Moreover, seasonal travel with EVs will lead to seasonal recharging peaks at certain locations, which may differ between summer and winter holiday periods.

In this respect, a number of respondents to the eQuestionnaire indicate to set deployment targets on highways. The maximum distance between two recharging points aimed for by respondents is between 50 km and 150 km.

Recommendation

Real 'demand' is always a good indication of where 'supply' should be. An easy means of mapping 'real' demand, is for public authorities to monitor the use of existing recharging points, e.g. by means of dynamic data on the availability of the recharging point. They could then identify locations with a high turnover and (ask to) increase the amount of infrastructure at or near those locations.

In a (peri-)urban context, several parameters are useful to forecast demand for recharging points, such as (expected) EV ownership, number of daily commuters coming to a given area, amount of transit (long-distance) traffic, amount of semi-public and private recharging infrastructure and number of lisenses for specialised fleets (such as taxis).

When identifying appropriate locations for ultra-fast chargers (150kW or more), long distance travel considerations should be borne in mind - including the occurrence of seasonal holiday recharging peaks. This issue needs to be addressed holistically, across borders, to enable uninterrupted EU-wide EV travelling.

2.3.1.3 Ensuring geographical dispersion

In the decades to come, close to all passenger cars will become net zero emitting. Electric vehicles are expected to play an important role. This means that also mobility users in areas with lower population density will require access to recharging infrastructure. Inhabitants in such areas will to a large extent have access to private electricity supply that can be used for vehicle charging. However, for visitors or households not owning private vehicles, it may still be important to have access to public recharging points. In such areas with low population density, it is especially important that the public infrastructure is deployed strategically, at locations where it is used to a maximum extent. This could for instance be at locations where people typically remain for a sufficiently long period to recharge their vehicles, such as stores or restaurants, but also different types of public access buildings (e.g. hospitals, museums, theatres, universities, stadiums, etc.) and public transport stations (e.g. airports, ports, train and bus stations).[57]

Another important argument for a good geographical dispersion of recharging points is the objective of a socially just transition. No regions should be left behind in the transition to decarbonised mobility. This risk is particularly real in weaker socio-economic parts of cities, regions or countries, where the expected uptake of emobility may be slower due to initially high costs of electric vehicles. The lack of recharging stations in such areas should not further delay EV-uptake in such regions.

2.3.1.4 Identifying appropriate power levels

Electric energy can be provided to electric vehicles at various power levels. The Alternative Fuels Infrastructure Directive distinguishes 'normal power recharging points' (P ≤ 22 kW) and 'high power recharging points' (P > 22 kW). A more enhanced categorisation was proposed by the STF in 2019: see Table 1 below. [58]

Table 1: Proposal for enhanced categorisation of recharging points

Category	Sub-category	Definition	Power
Category 1	A	Normal power recharging points single-phase (AC)	P < 7.4kW
	B	Rapid power recharging points, triple-phase (AC)	7.4 kW ≤ P ≤ 22 kW
Category 2	A	High power recharging points 1 (DC)	22 kW < P < 43 kW
	B	High power recharging points 2 (DC)	43 kW ≤ P < 150 kW
	C	Ultra-high power recharging points 1 (DC)	150 kW ≤ P < 350 kW
	D	Ultra-high power recharging points 2 (DC)	P ≥ 350 kW

Source: 2019 STF stakeholder consultation, with minor adaptations

57For a more detailed analysis of good locations for recharging infrastructure, see: JRC, "Optimal allocation of electric vehicle charging infrastructure in cities and regions" available at https://publications.jrc.ec.europa.eu/repository/bitstream/JRC101040/allocatechargingpoints_sciencepolreport_eurreport_online.pdf.

58Sustainable Transport Forum Report 'Analysis of stakeholder views on key policy needs and options for action in Alternative Fuels Infrastructure deployment and consumer services', p. 43, available here: https://ec.europa.eu/transport/sites/transport/files/2019-stf-consultation-analysis.pdf

The overview in Table 1 above also indicates that there are two categories of recharging point, depending on the type of current: direct current (DC) or alternating current (AC). The type of current has an impact on the maximum power that a recharging point can deliver, the cost of the recharging point and the type of connection needed. As indicated in the above table, AC current recharging points can only offer power up to 22 kW. They are generally cheaper to install and connect to the power grid. In addition, up to a power capacity of 7.4 kW, they can be connected to a 230V grid (recharging points with a higher power capacity must be connected to the 400V grid). AC recharging points are suitable for normal power recharging (3.7 to 7.4 kW) and semi-fast recharging (11 to 22 kW). Direct current recharging points can offer power above 22 kW but this implies higher installation, connection and operating costs and has a greater impact on the network. These recharging points are suitable for fast and ultra-fast recharging. They are generally connected to the high-voltage grid of the transmission system operator (TSO).[59]

The power, and therefore the speed with which the EV-battery can be recharged at any given recharging point determines how that recharging point will be used. Three main utility models for recharging can typically be distinguished (using the categorisation terminology of Table 1):

(i) long-time recharging or overnight recharging at normal or rapid power recharging points (P ≤ 22 kW): many vehicles are stationary for a significant part of every day when owners are at home or at work. This time can be used to recharge the vehicle's battery at relatively low power levels. This type of recharging has the advantages of causing less load on the electricity network and requiring less complex hardware. As a result, the cost of this type of recharging is lower compared to that of higher power recharging.

(ii) high power recharging (22 kW < P < 43 kW) in places where people recharge for a top-up (e.g. supermarkets, convenience stores, charging plazas, park-and-rides).

(iii) high power or ultra-high power recharging (43 kW ≤ P) for recharging 'on the go' during longer itineraries. As slow recharging will significantly lengthen the duration of the trip, a driver may prefer to recharge at higher power. This is also known as fast recharging..

High power recharging points require less time to provide an equivalent vehicle range, so can recharge more vehicles in a given timeframe than normal power recharging points. However, the cost of such recharging points is higher and they generally impose a higher burden on the electricity network.[60] Moreover, EVs are normally constrained (by the on-board converter, battery or the power inlet) in the power level at which they can recharge. Therefore, the benefits of high power or ultra-high power recharging points cannot be reaped by all passenger cars and vans on the market. Future EVs are expected to be able to cope with higher power-levels. High and ultra-high power recharging may therefore seem like an overinvestment in the short term, but are likely to be more fit-for-future.

The amount of recharging points, their locations and power outputs are intertwined. As mentioned above, relatively low power recharging points may be well suited to locations where people tend to park for longer periods of time, e.g. at home or at work. However, as vehicles recharge slower at lower power, more recharging points are needed to facilitate the vehicle users' demands - likely

59Brussels, Vision on the deployment of recharging infrastructure for electric vehicles, June 2020, available here (in French and Dutch): https://environnement.brussels/sites/default/files/user_files/note_vision_regionale_bornes_fr.pdf https://leefmilieu.brussels/sites/default/files/user_files/note_vision_regionale_bornes_nl.pdf

60NB: new solutions are being implemented to reduce that burden, e.g. the addition of batteries to recharging stations to smoothen power fluctuations.

putting more strain on the public domain. On the other hand, at times when drivers want to spend little time recharging their vehicles, they may want to use faster recharging points despite the higher cost, e.g. on long range highway drives. A higher share of high power recharging points may reduce the need for recharging points overall, depending on their locations. This was concluded in a recent study by the Dutch National Service for enterprises (RVO) in which the need for high power recharging points along the motorway network was studied. Based on the number of electric vehicles projected in the Dutch Climate Agreement for 2030, certain service areas along motorways with traffic intensities would require more than 60 high power recharging points with an average power level of 120 kW. However, doubling the power level would approximately half the number of required recharging points, significantly reducing the required space.[61]

However, the choice to develop normal or high power recharging points is also influenced by other factors. Prices for recharging at normal power recharging points ('slow recharging') are currently in many cases considerably lower than for recharging at high power recharging points ('fast recharging'), making this particularly interesting for the daily/weekly commuter's recharge.[62] Moreover, since recharging at normal power recharging points assumes that the vehicle is stationary for a longer period of time to achieve any considerable battery increase, slow recharging is particularly well-suited for electric vehicles to provide grid services, by means of smart recharging or bi-directional recharging (more in sections 4.3.4 and 4.3.5 below).

The Dutch National Agenda for Recharging Infrastructure mentions an expected ratio between normal and high power recharging of 85%/15%.[63]

2.3.2 Reducing overall deployment costs and nuisance

Developing and maintaining a network with sufficient and well-dispersed recharging points at suitable power levels requires significant investments which may be partly covered by public authorities. Moreover, the infrastructure takes up valuable public space and could potentially lead to nuisance, both during installation and operation. In order for the infrastructure to be socially accepted and sustainable in the longer term, these effects should be minimised.

2.3.2.1 Making best use of existing infrastructures to limit installation cost Grid constraints

As already mentioned in section 2.4.1.1, planning the deployment of recharging stations in areas where grid capacity is readily available can considerably reduce connection (one-time) and network costs (annual). In turn, this could result in lower recharging costs for consumers and lower electricity grid costs overall.

By contrast, uncontrolled deployment of recharging infrastructure can cause serious concerns for the electricity grid. The grid may not be able to cope with the electricity demand at certain times (e.g. during peak hours) and locations (e.g. parts of the grid in

61 Available here: https://www.rvo.nl/sites/default/files/2019/11/Geactualiseerde%20prognose%20laadinfrastructuur_20190329.pdf

62 NB: some stakeholders indicate that with an increased uptake of EVs, this could be reversed and prices could become lower at higher power recharging points.

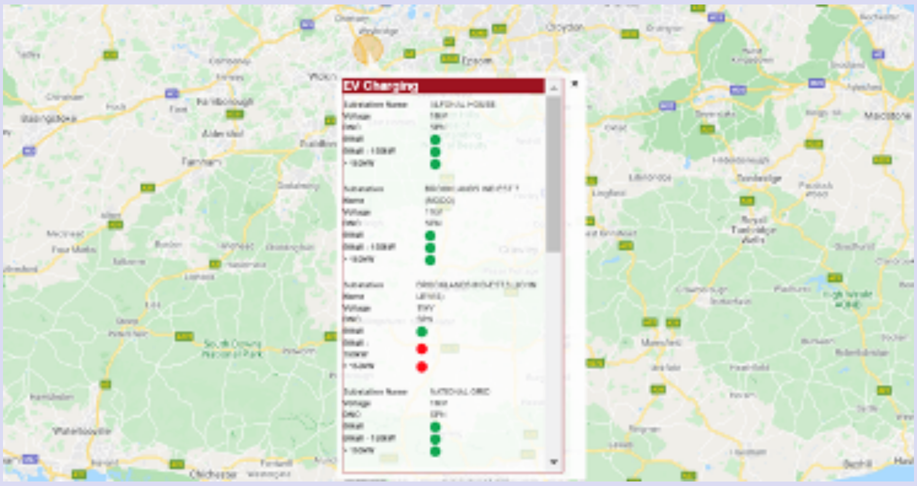
63 Nationale Agenda Laadinfrastructuur, available here (in Dutch only): https://www.klimaatakkoord.nl/documenten/publicaties/2019/06/28/achtergrondnotitie-mobiliteit-laadinfrastructuur.

remote areas may not be particularly suitable for large amounts of high power recharging infrastructure). To prevent undesirable situations such as grid congestion, account should be taken of grid capacity before deploying recharging infrastructure.

Mapping grid capacity: the UK Open Power Networks project

The UK Open Power Networks project issues maps detailing the grid's hosting capacity for recharging points with different power levels (50kW, 100kW, 150kW).

Figure 6: UK Open Power Networks project



Source: UK Power Networks, available here: https://dgmap.ukpowernetworks.co.uk/site/?q=ev_ext

Mapping recharging demand on these locations will reveal cost-optimal locations that need least public support.

Various solutions are available to mitigate potential grid capacity issues, i.e.:

- Reinforcing the grid capacity, however, this is in most cases a very costly matter.
- Installing recharging points in areas where sufficient grid capacity is available. This would require:
    - close cooperation between contracting authorities, DSO/TOSs and recharging point developers[64]; and/or
    - transparency by the DSO/TSO on its grid characteristics, so areas can be identified with sufficient capacity to speed-up the permitting procedure or application procedure (to DSO/TSO)
- Deploying recharging points with an appropriate installed capacity taking account of local grid limitations (see example Brussels);
- Directly or indirectly managing the electricity demand of vehicle owners through:
    - variable pricing: lower electricity prices at times when and locations where more grid capacity is available, to incentivise EV owners to recharge during those times or at those locations; or
    - controlled or smart recharging: actively managing the recharging process and the power supply to individual vehicles to lower the demand peak. These processes will be improved with the development of dedicated standards, and in particular the future IEC 63110 standard, that enables a reliable demand-side-management of notably, slow - to medium fast AC-chargers over big cohorts of recharging points (see also section 4.2.2.3). This standard is expected to also include an "emergency break" feature, against grid-overload in acute peak demand periods.

Another option to avoid excessive grid reinforcement costs, particularly in the first phase of deployment and specifically for ultra-high power recharging points, is to require that at least one recharging point of a larger recharging station can deliver maximum power at all times (with a cost supplement for users if needed) on a first come, first served basis, while letting the other recharging points be dynamically throttled, with an absolute minimum of 50kW being provided at all times.

64 Hildermeier J. Building a market for EV charging infrastructure: A clear path for policymakers and planners. June 2020

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Brussels Capital Region: normal power recharging is the norm[65]

Urban electricity grids are often still powered by 230V. This is also the case in Brussels, where about 86% of the network is 230V. As network upgrades would result in prohibitively high costs and would have a major impact in terms of road works, the Brussels Capital Region of Belgium generally recommends the deployment of ‘normal power’ recharging points (P <= 7.4kW). This allows for the recharging of the average Brussels residents’ daily mileage, i.e. 30 km, in about 1 hour while allowing a full recharge overnight. Recharging at higher power levels (11kW or higher) is reserved for commercial hubs, off-street public parkings or other suitable locations close to the 2,500 “400V ready” electrical cabins dispersed over the Region. While existing conventional refuelling stations are identified as most suitable locations for the deployment of fast charging infrastructure (defined as 50kW or higher).

Germany: grid transparency through StandortTOOL

The German federal government created an online tool for the planning of recharging infrastructure called the “StandortTOOL”. This StandortTOOL provides a map of Germany, divided up into small rectangular zones with different colours. The colours, ranging from dark green to pink, indicate, for each rectangular zone whether there is a low or high need for additional recharging infrastructure (dark green indicating the lowest need). In order to make this assessment as accurate as possible for the different zones, the StandortTOOL combines data on the existing vehicle fleet, the existing recharging infrastructure stock as well as the mobility patterns of German drivers. For each zone, the StandortTOOL also provides information on the possibilities to connect to the medium voltage grid (see graph below). In doing so, potential investors can get a first idea of the possible costs for connecting a recharging station to the grid at a given location. Interestingly, the StandortTOOL not only provides data on the current need for additional recharging infrastructure, but also makes projections for the future (time horizon 2022 and 2030), so that the deployment of recharging infrastructure can keep pace with the expected demand.

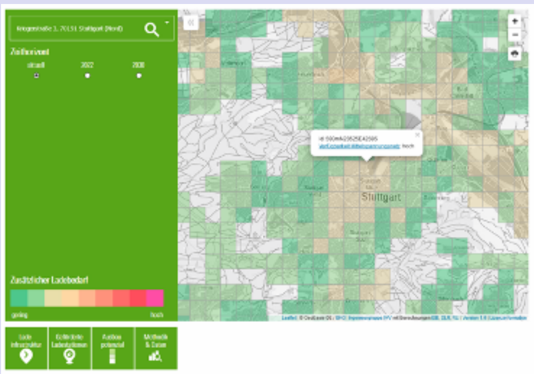


Figure 7: StandortTool

Source: https://www.standorttool.de/

65 See: Brussels, Vision on the deployment of recharging infrastructure for electric vehicles, June 2020, available here (in French and Dutch): https://environnement.brussels/sites/default/files/user_files/note_vision_regionale_bornes_fr.pdf and https://leefmilieu.brussels/sites/default/files/user_files/note_vision_regionale_bornes_nl.pdf.

Figure 8: integration of recharging solution in a lamp post (left) and telecom distribution box (right)

Source: Ubitricity (left) and Deutsche Telekom (right)

But existing structures can also bring opportunities. Integrating recharging solutions in existing electrified structures, such as lamp posts or on-road telecom distribution boxes, could be an efficient, low-cost and fast way to roll-out (slow-charging) recharging options in cities. Moreover, by avoiding the need to install new infrastructure on the streets, public authorities can limit the use of public space. Cities that have integrated recharging points in lamp posts include Berlin and London, while Deutsche Telekom has announced that it will integrate recharging points into telecom distribution boxes all over Germany.

Recommendation

When identifying appropriate locations for infrastructure deployment, public authorities should optimally exploit existing grid capacity and make efficient use of existing infrastructures (e.g. buildings and roads) to reduce cost of grid connection and use.

At the same time, they should seek to exploit the presence of existing electrified on-street structures to accelerate roll-out at limited cost.

2.3.2.2 Limiting the use of (public) space

Public spaces are places that are publicly owned or of public use, accessible and enjoyable by all for free and without a profit motive (UN-HABITAT, 2015). A recent study indicated that public spaces make up 2% to 15% of land in city centres in Europe[66]. Moreover, this study concludes that most European cities will increase in area size, and they will have to increasingly recognise the importance of optimising how their public space is both designed and used. This also includes the integration of recharging infrastructure. Therefore, the amount and locations of recharging points in city centres

66 The Future of Cities – Opportunities, challenges and the way forward. Executive Summary, EUR 29752 EN, Publications Office, Luxembourg, 2019, ISBN 978-92-76-05443-6, doi:10.2760/089751, JRC116711>

should be chosen such that electric vehicle users are sufficiently facilitated but users of the public space are minimally impacted - in terms of visual pollution for instance. This is discussed in more detail in section 4.1.1 below.

2.3.2.3 Preventing nuisance during installation and maintenance works

In view of the large amount of recharging points that will have to be erected to meet demand from EVs, it is expected that many roads and pavements will have to be opened up potentially several times in the decades to come. Limiting the nuisance from these building works requires good planning. This means that a long-term roll-out strategy should also take account of potential future road works (for purposes other than installing recharging points), such as road renewal works, maintenance of cables or sewers or the installation of parking meters or lamp posts. Identifying such synergies may not only limit nuisance but also lower installation costs.

For example, in the Metropolitan region of Amsterdam the erection and installation of recharging points would typically take multiple days in which multiple companies would do parts of the installation works. This resulted in a relatively high number of worker's vans to and from the installation locations. Based on this experience, MRA-E now requires, but also facilitates, that the erection and installation is performed by one, single team in one day. This requires good cooperation with the DSO and concessionaire.

In Stuttgart, whenever road works are performed, a number of additional empty tubes are dug in, which can be used later for new underground cables. These tubes can be used later once the amount, type and precise locations of recharging points have been decided upon, without the need for additional digging works.

Recommendation

When identifying appropriate locations for infrastructure deployment, public authorities should aim to limit the use of (public) space and prevent nuisance during installation and maintenance works. For this reason, many public authorities apply a 'hierarchy of recharging', requiring that recharging takes place as much as possible on private domain.

2.3.2.4 Maximising the occupancy rate of recharging infrastructure (effective EV parking policy)

As mentioned in the previous section a higher occupancy rate leads to less required recharging points and therefore to lower investment and maintenance costs, as well as reduced occupancy of (public) space and reduced nuisance. An occupancy rate is defined as the share of time during which vehicles are effectively recharging at a recharging point. Vehicles that are connected overnight may only be recharging a limited amount of the time they are actually connected to the recharging point. Even though the recharging point is occupied all night, the occupancy rate in these cases may be low. Therefore, for cost-efficiency reasons, a high overall occupancy rate should be pursued by public authorities and Charge Point Operators alike.[67]

Installing the right amount of recharging points and selecting the most suitable locations and power levels increases the chances of achieving a higher occupancy rate. There are however two important additional

67 NB: with the increased deployment of (sufficient/excess) recharging infrastructure and the advent of V2G technologies, it may become more interesting to ensure that vehicles are connected to recharging points as much as possible, to add flexibility to the energy system.

parking-related policies that public authorities can apply to influence the occupancy rate:

(i) the application of restrictions on the use of EV-enabled parking lots by non-EVs; and

(ii) the application of different parking rates for EV-enabled parking lots.

Restrictions on the use of EV-enabled parking lots by non-EVs

Recharging at normal power recharging points can take hours and therefore such recharging points are usually installed at parking lots where EVs are stationary for longer periods. Since these parking lots are especially equipped for EV recharging, they are also known as EV-enabled parking lots (EVPLs). While EVPLs are still relatively scarce, and also for general cost-efficiency reasons as explained above, public authorities should maximise the occupancy rate of EVPLs. To this end, they could apply three different types of parking policies to restrict the use of such EVPLs, namely:

(i) Recharging-exclusive parking: EV-enabled parking lots can only be used by electric vehicles while they are recharging their vehicle;

(ii) Electric Vehicle Exclusive parking: EV-enabled parking lots can only be used by electric vehicles regardless of whether the EV is actively recharging or not. In such cases, an additional requirement (for monitoring purposes) may be that the EV is at all times connected to the recharging point;

(iii) Dynamic Parking Policy: parking for non-EVs on the EVPL is allowed only in certain situations, for instance when (almost) no other parking lots are vacant.

A study that evaluated these three different types of parking policies[68] concluded that 'recharging-exclusive parking' is a particularly suitable policy in those cases where less recharging points are available than are required to meet the needs of EV-drivers. 'Electric vehicle exclusive parking' is the preferable parking policy in case there is a slight overcapacity of recharging points, as this increases the occupancy of parking lots. The 'Dynamic Parking Policy' only becomes relevant when a substantial number of recharging points are available and an advanced IT infrastructure is deployed to continuously assess the number of vacant parking lots nearby. Under these conditions, applying this parking policy will result in the highest occupancy rate, while sufficient recharging options remain available for EV-drivers.

Different parking rates for EV-enabled parking lots

Besides parking restrictions, the rates for parking at an EVPL can also differ from those applied to regular parking lots. Three possible parking rate policies for EVPLs are:

(i) **Free parking:** only electricity consumed for recharging is charged to the EV-driver (NB: in certain cases, to stimulate the uptake of EVs, the electricity for recharging is also provided for free);

(ii) **Regular parking rates:** the costs for the electricity consumed are charged to the EV-driver while regular parking rates also apply;

(iii) **Progressive parking rates:** besides the costs for the electricity consumed, parking rates increase with the duration of the parking session.

Free parking for electric vehicles is a way to promote electric driving, especially in places where parking rates are substantial. Providing this privilege to EV-users however decreases the parking revenues collected by public authorities. This parking rate policy can be combined with either 'recharging-exclusive parking' or 'electric vehicle exclusive parking', to ensure that only electric vehicles park at these EVPLs. A downside to free parking

68 Babic, Jurica; Carvalho, Arhtur; Ketter, Wolfgang; Podobnik, Vedran. Evaluating Policies for Parking Lots Handling Electric Vehicles. IEEE Access. (2017), 6; 944-961. http://dx.doi.org/10.1109/ACCESS.2017.2777098

policies for EVs is that the EVPLs may be occupied by EVs because they want to avoid parking fees, not because they need to recharge. This may result in ineffective use of recharging stations.

When applying regular parking rates, the use of EVs is not incentivised and there is no loss of parking revenues. In addition, this parking rate policy can be combined with either 'recharging-exclusive parking' or 'electric vehicle exclusive parking' policies.

Progressive parking rates for EVPLs can be a means to limit the use of these parking lots by vehicles that are not recharging. Rates that increase with the parking duration will encourage EV-users to move their vehicles to a regular parking lot as soon as they have been fully or sufficiently recharged. Such a policy will increase the average amount of electricity recharged during a parking session compared to the two other parking rate policies, thereby increasing the occupancy rate.

As a result, less EVPLs will have to be installed, limiting costs. Such parking rate policies are particularly suitable for EVPLs with a high turnover rate (e.g. in city centres, along highways, etc.), but much less so for parking lots that are typically used for overnight recharging, where it will considerably hamper the convenience for EV-users.

However, this could be overcome by combining progressive parking rates for EVPLs during the day with free or regular parking rates overnight. This could in turn however result in more complex parking rates, making prices less transparent.

e-Parking policy in the City of Amsterdam

The city of Amsterdam allowed free parking for electric vehicles at EVPLs for a short while to encourage the uptake of EVs. This was gradually replaced by regular parking rates. However, EV owners living in the city of Amsterdam can apply for a special e-parking licence. With very limited new parking licences being granted, applications for e-parking licences get priority, and are usually issued within weeks. For regular combustion engine vehicles these waiting times can run to several years in certain parts of the city.

Moreover, the Dutch national government has recently adopted a new legal framework of parking policy, allowing cities and regions to differentiate parking rates between zero-emission vehicles and regular combustion engine vehicles. The city of Amsterdam will consider applying such differentiated parking policy.

Recommendation

To reduce the need for additional recharging infrastructure, public authorities should maximise the occupancy rate of recharging infrastructure as much as possible. EV parking policies can be an effective means to that end. Parking places that are equipped with a recharging point (EVPL) should be reserved for EVs when recharging infrastructure is still scarce. Progressive parking rates can be effective to limit the use of EVPL by (plug-in hybrid) electric vehicles that are not recharging.

3. Organising tender procedure

The deployment of new recharging infrastructure consists of several phases: from the initiative to develop new infrastructure to the actual implementation and operation.

In this chapter we examine three topics that are important in the initiation phase; (1) identification of the responsible authority, (2) the selection of the operator and (3) the policy instruments that can be used to roll-out infrastructure.

3.1 Identification of responsible authority and cooperation

3.1.1 Identification of responsible authority

Different levels of government are involved in the deployment of recharging infrastructure. The approach differs from country to country. For example, a small country such as Malta has opted for a centralised approach in which the national government also organises the tender procedure. Germany and Italy, like many other European countries, have national guidelines for rolling-out infrastructure. Local authorities tender the projects and ensure that the call for tenders is in line with the conditions set by the central government.[69]

The location can also determine the authority responsible for the tendering procedure. For example, municipalities will often organise the tender of infrastructure in towns and villages, whereas infrastructure on provincial roads and motorways is often handled by the province or national government.

In Belgium, the Flemish Region organises an annual concession tender for and on behalf of interested municipalities. The network operator is responsible for organising the tender. The aim of the regional concession is to ensure that the infrastructure meets the same requirements (harmonisation) and to prevent the creation of small closed networks (interoperability). Participation is voluntary: larger cities like Leuven, Ghent and Antwerp have chosen to organise their own tenders.

3.1.2 Cooperation and joint procurement

Authorities can also decide to cooperate and organise tender procedures jointly. This increases buying power through economies of scale. Moreover, it allows several authorities to group knowledge and resources to limit costs, while maximising benefits.

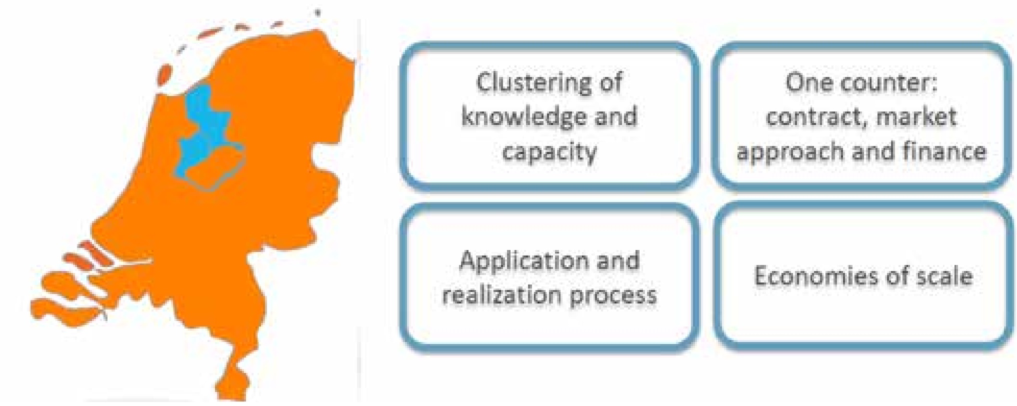
In the Netherlands, the government has set up a national knowledge platform for recharging infrastructure (Nationaal Kennisplatform Laadinfastructuur, in short ‘NKL’), where all information regarding recharging infrastructure is gathered, stored and exchanged between public authorities of different levels. The knowledge platform includes a section dedicated to public procurement, concession awards or government support, including tender specifications.[70]

Under the auspices of NKL, municipal governments and market parties have jointly developed a Standard Set of recommended requirements for recharging stations or recharging plazas (hubs). The Standard Set in other words contains a number of requirements for public authorities to include in their tender specifications regarding recharging infrastructure.

69 The municipality of Reggio Emilia refers to the National charging infrastructure Plan in their communal guidelines for deploying infrastructure.

70 Available here (in Dutch only): https://www.nkl-kennisloket.nl/02-documentatie-aanbestedingen-plaatsing-laadinfrastructuur/

Figure 9: four advantages to regional procurement (Netherlands)

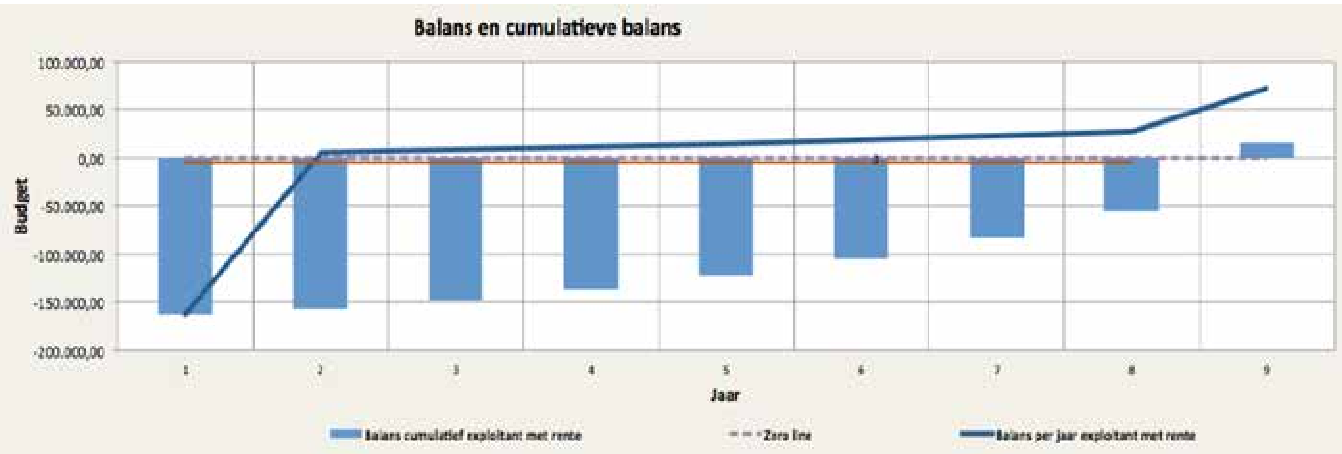


Source: Tim van Beek (EVConsult), Joint regional procurement in the Netherlands, CIVITAS Electromobility workshop, 2016, Rotterdam

Moreover, a couple of provinces and large cities have set up a network to coordinate project and policy approaches. The best known examples are MRA-E (Metropoolregio Amsterdam-Elektrisch or Metropolitan Region Amsterdam-Electric) and MRDH (Metropoolregio Rotterdam Den Haag or Metropolitan Region Rotterdam The Hague). The aim of the collaboration is to research and coordinate different policy choices and ensure a dynamic market with sufficient market players and transparent entry criteria.

Moreover, they have jointly selected a tender procedure and drawn up a programme of requirements to achieve public policy objectives - such as sustainability, maintenance and availability and accessibility of recharging points. This cooperation has been very successful in terms of achieving the objectives listed in Figure 9 above and in particular, has significantly brought down procurement costs (Figure 10) due to economies of scale.

Figure 10: 7 years plan of bringing down costs through regional procurement (Netherlands)



Source: Tim van Beek (EVConsult), Joint regional procurement in the Netherlands, CIVITAS Electromobility workshop, 2016, Rotterdam

Recommendation

Public authorities should consider what is the most appropriate level of government to deploy/support the deployment of recharging infrastructure, and in which locations.

Regardless of which public authority is charged with this task, there must be sufficient coordination with other levels of government and surrounding municipalities and regions to prevent the creation of island networks.

Cooperating with other public authorities in the field of procurement can be an advantage. They can benefit from the experience gained and possibly also reduce costs by jointly organising the procurement process.

3.2 Selection of entities to develop and operate infrastructure

A first key question competent authorities will have to answer when setting out their deployment strategies, is who will develop and own publicly accessible recharging infrastructure. This could be a public authority, a private company, user-owned, or a combination of two or all three. Different aspects could influence the answer to this question - most notably the expected costs of deploying and operating such a network and its expected profitability, the degree of control public authorities want to maintain over infrastructure deployment in their territories and the (lack of) interest of the private sector. As these aspects change over time, depending on the state of development of the recharging market, public authorities should regularly re-assess this question.

The development of infrastructure goes through different phases, from initiative, to development, to construction and operation. In each of these phases, different steps must be taken by the competent public authorities. In the initiative and development phase, the competent public authority must develop a clear picture of the objectives it wants to achieve and the possible limitations of the project. An important element at this stage is the identification of risks. Once the authority has identified the project risks, it should start allocating those risks between the private sector and the public sector, based on an assessment of which party can best manage that risk. The results of this risk analysis can be used to choose a contract model (see section 3.3). The risk assessment will also contribute to mitigating those risks (for example by ensuring permits or granting subsidies).

Another central question at this stage is which party/parties can best attain the objectives as formulated by the public authority. High goals and quality demands impact the business case. A cost-benefit analysis will also be necessary to understand the feasibility of the project. In particular, if the model involves public money or other public support (i.e. public contract and concession with or without subsidies, see also section 3.3.2), the authority needs to make an assessment as to whether the envisioned project and corresponding contract model represents the best use of public money/support, based on a set of qualitative and quantitative criteria. The chosen model can then be tested in a market consultation (see section 3.3.3).

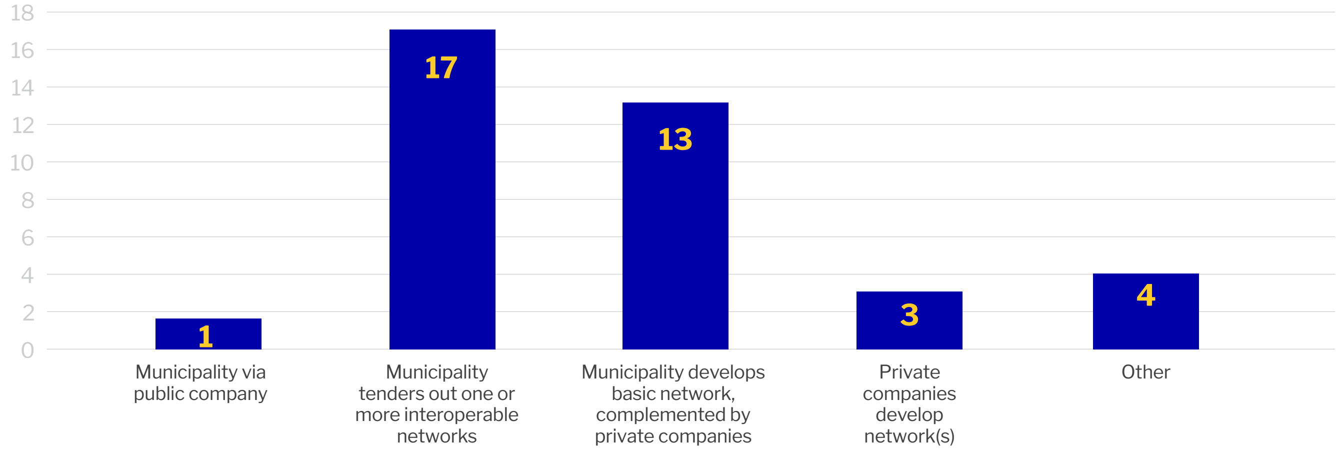
The responses to the eQuestionnaire show that different cities and regions choose different ownership structures. For example, the city of Gothenburg has chosen to develop the infrastructure itself (via a public company). Rolling-out a public network contributes to the visibility of electric transport, according to the city, and the market for infrastructure in Gothenburg is not yet sufficiently developed for private parties to make a sound business case. Developing recharging infrastructure, for them, is a temporary solution until the market is attractive for private market players. Barcelona also indicates that due to a lack of private investors, the city has chosen to build its own infrastructure.

Over a third of the respondents indicated that they tender the development and operation of one or more networks. Close to the same number of respondents indicate that they (often municipalities) develop the basic infrastructure and allow this to be complemented with infrastructure developed by private companies. While the level of cooperation varies between the respondents, many indicate that this strategy allows them to ensure that the likely less profitable areas (less used infrastructure) are still served while at the same time making optimal use of the technical and more business-minded expertise of the private sector.

Lisbon also mentions the risk that a private party will withdraw or default on its contract with the city. In such cases, the city believes it is essential to at least have a basic publicly owned infrastructure.

The municipality of Rotterdam, for example, chose to tender out the development and operation of the recharging network on its territory, but maintained its ownership. The City of Paris currently still considers the development of infrastructure to be (financially) risky. For this reason, they prefer to work with concessions, allowing them to retain control and benefit from the royalties paid by the concessionaire while outsourcing the most important operational risks to the concessionaire.

Figure 11: Responses to the eQuestionnaire question: What is in your view the best approach to achieve a comprehensive publicly accessible recharging network at municipal level?



Source: Tim van Beek (EVConsult), Joint regional procurement in the Netherlands, CIVITAS Electromobility workshop, 2016, Rotterdam

At the end of the day, the project risks have to be borne by either the private or public party. A project that carries too many risks will not be attractive for a private party. It is unlikely that the private sector is better at mitigating financial risk.

The City of Oslo develops its own basic public network. In addition, it works with a joint-venture structure with private actors to develop high power recharging infrastructure chargers in the public domain.

At the other end of the spectrum are public authorities that leave as much as possible to the private sector. This is primarily to avoid (financial) risks. The Ministry of Economy of Slovakia, for example, indicates that it sees no role for municipalities in the deployment of infrastructure, as it considers this too challenging for them, both financially and in terms of human resources. Private parties offer sufficient expertise. Other municipalities or regions, such as the Vestland county in Norway, have already invested significantly in the initial phase of recharging infrastructure deployment and therefore choose to leave further development to the market.

Recommendation

The development of recharging infrastructure consists of several phases. In the initiative and development phase, public authorities formulate objectives and assess the risks. Mapping the objectives and risks helps to determine who should own and operate the infrastructure. It is moreover essential to determine what is the best contract model/policy instrument to attain those objectives and distribute risks accordingly. Finally, the publicly accessible recharging network serves a number of public interests: public authorities should consider how these public interests are best ensured when choosing a particular contract model/policy instrument.

3.3 Selection of contract models and policy instrument

In order to realise recharging infrastructure, the (local) government can make use of various contract-models and policy instruments. Public authorities may have multiple contracts managing multiple contractors, all managing different parts of the network or involved in different stages of network deployment.

3.3.1 Contract models

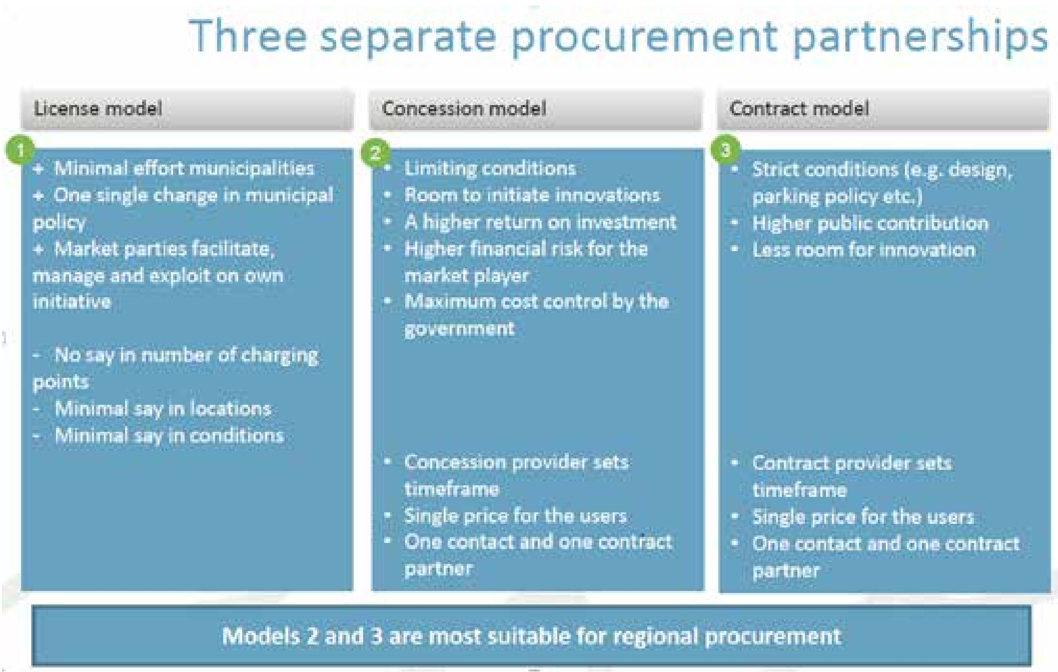
Cities and regions explore different contract models. Respondents to the eQuestionnaire generally identify three main models: the licence model, concession model and (public) contract model, as portrayed in Figure 12. The models are used by public authorities to distinguish the risks and costs associated with the different options.

The European Investment Bank distinguishes five main contractual models that can be used to roll-out infrastructure, namely:

i. **The public contracting model:** the public authority keeps control over the infrastructure and retains most of the project risks and, from construction to exploitation. The public authority finances the expenditure (capital and maintenance) and collects the revenues from the consumer.

ii. **The joint-venture model:** the public and the private sector share the overall control of the infrastructure. In this model, the project risks are not allocated to a specific party but instead are shared between public authority and private sector based on their stake in the joint-

Figure 12: main characterizations of the different models, according to CIVITAS Electromobility initiative



Source: Tim van Beek (EVConsult), Joint regional procurement in the Netherlands, CIVITAS Electromobility workshop, 2016, Rotterdam

venture. The model remains flexible on financing of the expenditure.

iii. **The concession model**: In the concession model a private party is given the concession to run and exploit (and build) a certain work or service. The (financial) risks lie with the concessionaire.[71] In contrast to the licensing model, this and other models allow the public authority to make more demands on where and what kind of infrastructure will be rolled out. After all, there is an obligation for the concessionaire or contractor to act in accordance with the contract. This enables the public authority to ensure, for example, that infrastructure will be rolled out at less favourable locations. This is also confirmed by the respondents to the eQuestionnaire. They indicate that the tendering a concession or a public contract gives them the opportunity to impose higher demands and choose the desired location. The private sector finances the expenditure (with or without subsidies from the public authority), and collects the revenues from the consumer (with or without sharing with the public authority). This category covers many different sub-models because there are many aspects of the concession model that can be tailored to suit the public authority's objectives and constraints.[72]

iv. **The availability-based model:** As with the concession, the public sector allocates the project risks between the public and the private sector, but in this model, the public sector collects the revenues from the consumer and therefore retains the demand risk of the project (more precisely the revenue risk). The private sector finances the expenditure and is paid back by the public authority over the duration of the contract, but if (and only if) the infrastructure is available for the intended use.

v. **The licence model:** This model allows the authorities to permit an activity or act that is not permitted without this official permission. This means that a party that complies with the policy rules drawn up by a municipality can be given permission to erect, manage and operate recharging points in the public space. The licence can include constraints over what the private sector can do. Some municipalities choose to give any party that complies with the rules a licence, other municipalities choose to permit a limited number of applicants, to avoid creating a local monopoly. In this model the private sector keeps control over the infrastructure and retains most of the project risks, from construction to operation. The private sector finances the expenditures and collects the revenues from the consumer. The disadvantage of a license model is that it is less suitable for achieving desired deployment levels of recharging points. Through licences it is possible to limit numbers, but erection at less favourable locations cannot be enforced. Recharging points will then be located where market parties wish to install them.[73] It should be noted that where there is a limited number of licences or even just one licence, transparency obligations can apply when granting the licence. Meaning that an appropriate degree of publicity must be guaranteed to

71 See recital (18) of Directive 2014/23/EU of the European Parliament and of the Council of 26 February 2014 on the award of concession contracts: "The main feature of a concession, the right to exploit the works or services, always implies the transfer to the concessionaire of an operating risk of economic nature involving the possibility that it will not recoup the investments made and the costs incurred in operating the works or services awarded under normal operating conditions even if a part of the risk remains with the contracting authority or contracting entity."

72 The concession model and the availability-based model, will be further explored in a paper currently developed by EPEC (European PPP Expertise Centre)

73 TNO-rapport TNO 2018 R10769 |Publieke Laadinfrastructuur EV en rol van MRA-E en G4

each potential bidder, so that the granting of the licence is open to competition.[74]

Each model can be tailored in order to match the public sector objectives and constraints. Different models can coexist. For example, there are municipalities that organise part of the infrastructure by means of licensing and realise other locations by means of a public contract. For each of the models, public authorities must respect the applicable transparency and procurement rules.

Recommendation

Public authorities must always consider possible obligations in terms of public procurement legislation and State aid rules, whatever form of contract is chosen (a public company, a joint venture (public -private partnership), a public contract or a concession). In particular, bearing in mind that the recharging market should develop as a competitive market, public authorities should always consider the possibility that several parties may be interested in developing and operating the recharging infrastructure.

3.3.2 Subsidy[75]

The licence, concession or public contract is often combined with a subsidy, as in many places the deployment of recharging infrastructure is not yet a sufficiently profitable business. Also, when granting subsidies, public authorities can impose requirements on the infrastructure and services to be provided.

Several countries have national subsidy schemes. Some countries choose to pay the subsidy directly to the project developer and/ or operator (such as Germany). Other countries (such as the Netherlands) distribute the subsidy among the provinces and municipalities responsible for the deployment of infrastructure, who in turn organise tenders to select project developers and or operators.

In both example countries (Germany and the Netherlands), the subsidy is used to set minimum requirements to ensure quality. Germany also uses the grant to avoid uncontrolled deployment across the territory.

3.3.3 Market consultation

In the initial development phase the authority can also determine whether there is a need for market consultation. Preliminary market consultations can also help contracting authorities in preparing the procurement. Preliminary market consultations can also help contracting authorities in preparing the procurement. The consultation will provide public authorities with knowledge about different options and offers available on the market, and can help to identify the best solutions for a particular situation.[76] A market consultation, however, does not replace a competitive tendering procedure, but can be used in its preparation.

Public authorities often choose a combination of instruments. The choice of instrument depends in the first place on the goal that the public authority wants to achieve. In addition, there are a number of variables that play an essential role in choosing the most suitable

74 HvJ EU 3 juni 2010, nr. C-203/08, A. Drahmann, Uitdijing van de werking van het transparantiebeginsel: van concessies naar vergunningen? Een beschouwing naar aanleiding van het Betfair-arrest' in NTB 2012/25

75 The recommendations made in this document are without prejudice to State aid rules.

76 Directive 2014/24/EU

instrument/model. Figure 14 shows the most important variables for Leuven (and other public authorities), namely: the costs of the process and the ability of the public authorities to influence the roll-out. Another important criterion is the market structure: what effect does the chosen model have on competition and the reliability and affordability of recharging infrastructure.

According to the graph by Leuven, a licence-based system is the least expensive, whereas a public contract, in which the public authority carries most of the financial costs, is the most costly model for public authorities. Whether or not this is true depends to a large extent on the current market in the area and the type of licence/ contract that will be issued and the requirements made.

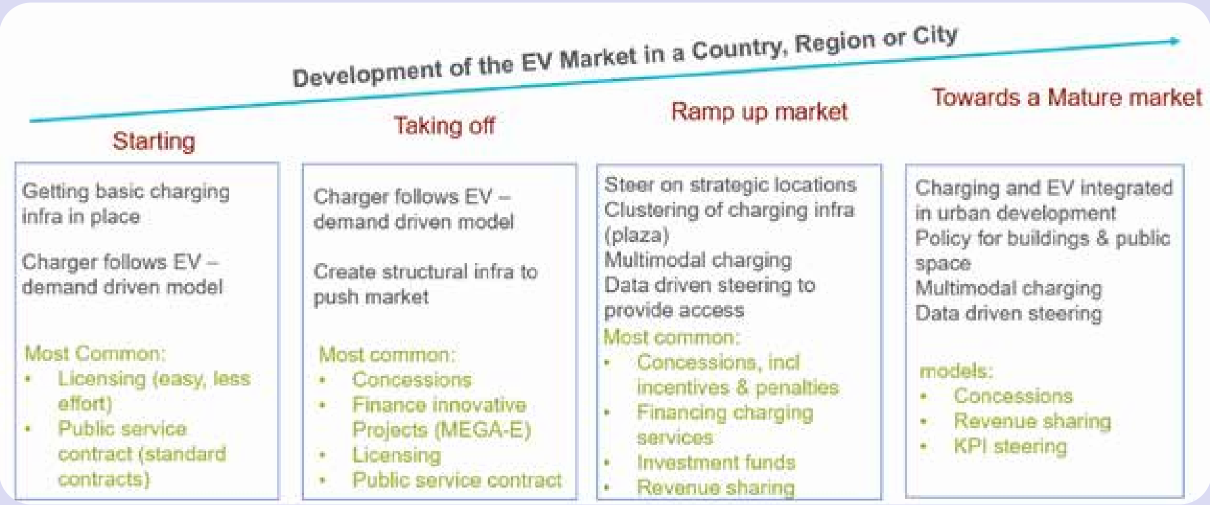
Furthermore, the figure only shows the costs on the side of the public authority and not the costs paid by the end-users. It is possible that for example a public contract ultimately leads to significant savings for the users.

Allego's experience: different policy instruments and contracting models depending on market development

Experience by Allego indicates that national, regional and local governments use different policy instruments depending on the market maturity in the area concerned. Berlin is an example of a city that is changing its policy from a grant-awarding to a concession-based model.

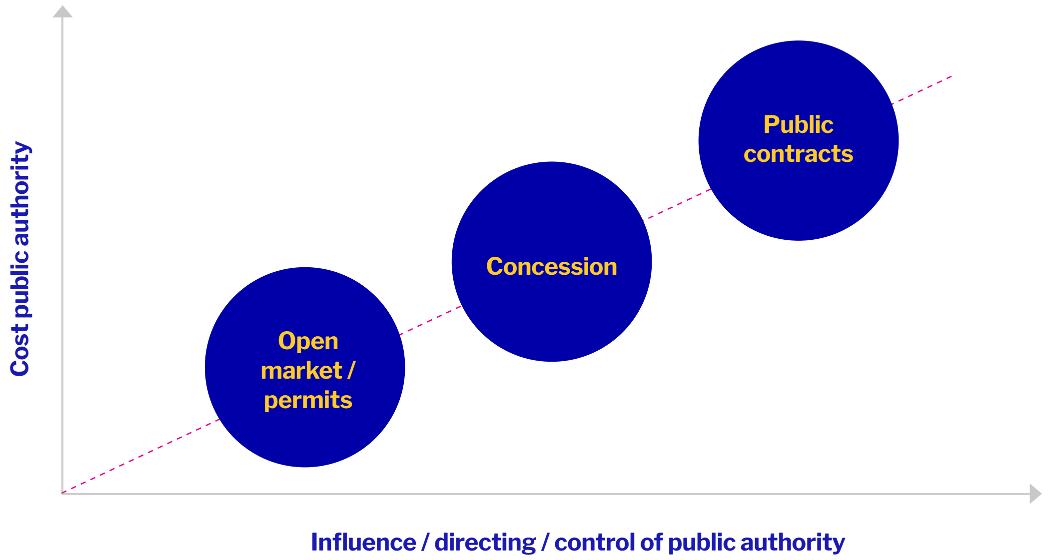
In an infant ('starting') market, they see that the licence model and public service contracts are widely used to deploy recharging infrastructure. When the market is taking off, authorities use concessions, licences and public procurement procedures. In more mature markets, concessions are predominantly used.

Figure 13: Allego's experience: different policy instruments depending on market development



Source: Allego, presentation Harold Langenberg, Managing Director Benelux

Figure 14: factors influencing choice of most appropriate policy instrument



Source: City of Leuven. Integrated vision for the role out of charging infrastructure. Clean vehicles working group POLIS - 26 September 2019 – Bilbao.

Recommendation

The development of recharging infrastructure consists of several phases. In the initiative and development phase, public authorities formulate objectives and assess the risks. Mapping the objectives and risks helps to determine who should own and operate the infrastructure. It is moreover essential to determine what is the best contract model/policy instrument to attain those objectives and distribute risks accordingly. Finally, the publicly accessible recharging network serves a number of public interests: public authorities should consider how these public interests are best ensured when choosing a particular contract model/policy instrument.

3.4 Measures to support competition in the market

According to recital (30) of the Alternative Fuels Infrastructure Directive (2014/94/EU), “[t]he establishment and operation of recharging points for electric vehicles should be developed as a competitive market with open access to all parties interested in rolling-out or operating recharging infrastructures”.

Public authorities procuring, awarding concessions or granting government support for the establishment and operation of recharging points have an eminent role to play in ensuring just such a competitive market - first and foremost by designing the contract award procedure appropriately.

3.4.1 Competitive tender procedures and market access

Competitive tenders make it possible for parties to get a fair chance to compete for what is called a scarce right or exclusive right, whether it is a public contract, concession or even a limited licence. The tender procedure ensures that everyone has been able to take note of the possibility to compete and that a choice has been made for a party in a transparent and fair manner.

A potential weakness of the procurement model is that it can restrict the free market access of non-selected operators and can therefore unintentionally impede innovation and eventually lead to higher costs for end-consumers. After all, in the concession-model parties compete for (a piece of) the market, but market competition is usually limited to the concession award procedure itself. Often the winning concessionaire obtains an exclusive right to develop and/or operate recharging infrastructure in a given area. This disadvantage can be limited by tendering several smaller lots instead of one large concession. Concomitantly, the division into smaller lots also supports the entry into the market of new, smaller, market parties.[77] Malta, Slovakia and Germany for example split up lots to allow different operators to co-exist. The municipality of Reggio Emilia limits applications for the development of recharging stations by private companies: “Every request by a private company must not exceed 60 recharging points. After 3 months another request can be submitted.” Stuttgart has used the smallest possible lots (one location, two recharging points), in order to make the market as accessible as possible, in particular to smaller players (there are currently 4 investors, one of them a smaller market party). Leuven allows all interested CPO’s to develop and operate infrastructure on its territory on the sole condition that they comply with a list of basic requirements. The city of Stockholm uses a ‘first come, first served’ (licence) model, that allows different parties to co-exist.

Stockholm’s first come-first served model

The city of Stockholm has mapped possible locations for on-street recharging points on a publicly accessible on-line map https://tillstand.stockholm/tillstand-regler-och-tillsyn/parkering/ansok-om-att-etablera-nya-laddplatser-for-elbil/.

Interested project developers and operators may apply for a location on a first-come-first-served basis, following a predetermined applications process:

https://tillstand.stockholm/tillstand-regler-och-tillsyn/parkering/ansok-om-att-etablera-nya-laddplatser-for-elbil/anmal-intresse-for-att-satta-upp-nya-laddare/#step-1.

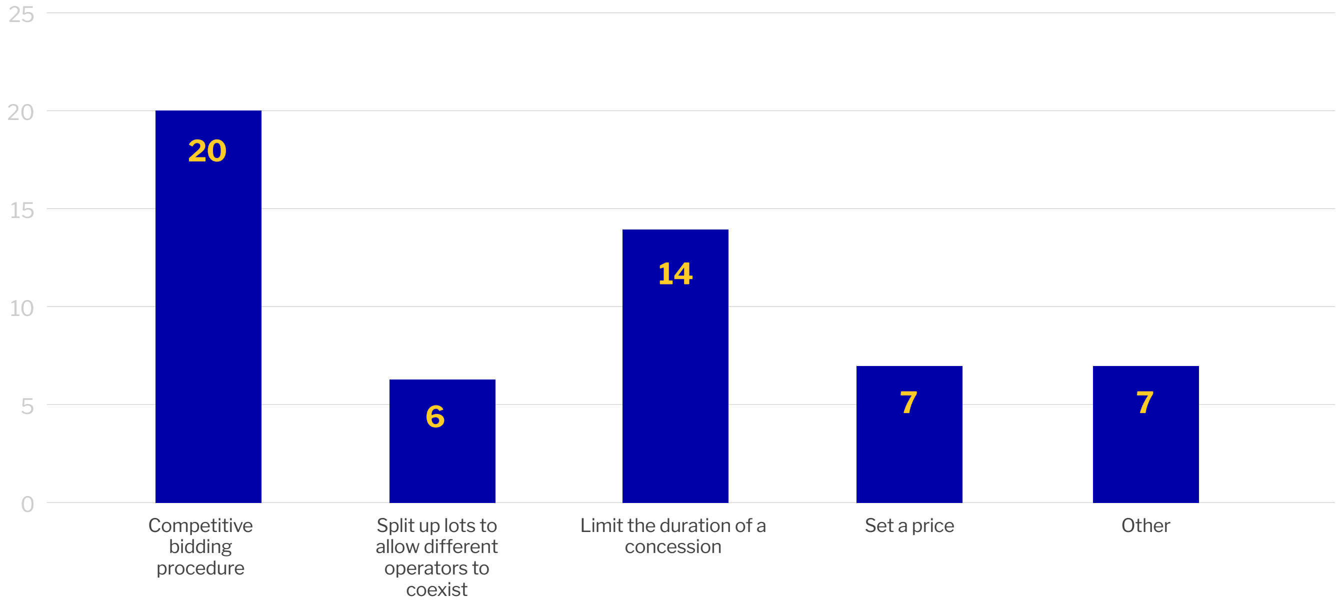
In order to ensure competition, the city applies a limitation to the number of applications that can be made by the same party (maximum 30 applications/locations). Some streets have been or will be pre-cabled by the DSO and are identified as “orange” locations on the map. Any applicant may only apply for a maximum of 4 orange locations.

If an applicant is successful, the city enters into an ‘access agreement’ (19 year agreements that get prolonged 5 years at a time) with that operator setting the basic requirements for operating recharging infrastructure in the public domain.

This process has resulted in the conclusion of access agreements with 4 different operators, with a couple more pending conclusion.

77 Analysis of the SMEs’ participation in public procurement and the measures to support it - 697/PP/GRO/IMA/18/ 1131/10226, Final report, October 2019, p. 59-64

Figure 15: eQuestionnaire responses to the question: "Did you apply any of the following measures to foster competition in the market (multiple answers possible)?



The addressees of the eQuestionnaire were asked if they applied any of the following measures to foster competition in the market: 1) competitive tenders, 2) splitting up lots, 3) limit the duration of the concession, 4) set a price cap[78], and 5) other. An overview of answers is provided in Figure 15.

Limiting the duration of the concession can be a measure to prevent parties from developing an undesirable dominant market position (but must be balanced against other considerations: see section 4.7.1 below). The extent to which existing long-term contracts can limit market developments is discussed in section 3.4.2 below.

3.4.2 Existing concessions

Existing concessions, which are often infinite or run over very long periods of time, may also limit access to new market parties. An example of concessions that have impeded market entry for recharging service providers are highway concessions for conventional refuelling stations (petrol stations).

In the Netherlands, the petrol station owners claimed the exclusive right to sell energy on the highway based on everlasting concessions.[79]In other words, they argued to have exclusive

78 NB: it is acknowledged that this is not a means to foster competition, but rather a means to protect consumers against a lack of competition in the market.

79 Wet tot veiling van bepaalde verkooppunten van motorbrandstoffen (translated: Law on the auctioning of certain motor fuel sales points) or read (only in Dutch): Ecorys, Tweede evaluatie benzineveilingen, Eindrapportage, Opdrachtgever: Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, Rotterdam, 14 november 2014, p. 9.

rights to develop recharging infrastructure in the domain of their concession. However, contrary to government objectives, they did not develop this recharging infrastructure. The national government then decided to give new parties the opportunity to build charging infrastructure next to the petrol stations. Eventually this led to a lawsuit. The government was vindicated: the sale of electricity was considered a new service not covered by the initial concession, as electricity did not constitute a 'fuel' in the strict sense. The example shows that it is sometimes necessary to reconsider existing concession agreements that stand in the way of the emergence of a new market. There are often possibilities to modify or open-up existing agreements - particularly those with an infinite duration. Moreover, the extension of existing concessions without organising an open, competitive award procedure may raise State aid concerns or other competition concerns regarding the granting of exclusive rights.

3.4.3 Auctioning recharging lots

An essential network/ infrastructure is a prerequisite for the development of a well-functioning competitive market. As explained in chapter 2 above, many (local) public authorities see it as their task to deploy a basic infrastructure network, either themselves or together- or by commissioning a private party, to break through the chicken-and-egg dilemma that electric vehicles can only become interesting to consumers once there is a minimum recharging network in place.

The Regulatory Assistance Project (RAP) published a paper in June 2020 with policy recommendations for developing the recharging market as a competitive market. The report recommends among other things that 'Member States require, by way of a binding target in a directive or as a regulation, to define an "essential [re]charging network" with the objective of providing a minimum coverage of [re]charging points, including hard-to-serve areas.[80]

The policy instruments and various contract models discussed in the previous section also influence the creation of a well-functioning market.

For example, a market consultation can provide the authorities with knowledge about different options and offers available in the market. Especially when including functional specification, meaning that the municipality specifies what has to be achieved, rather than how it should be achieved. In this way, the market gets the opportunity to come up with its own innovative solutions, which can be incorporated in the final tender.

In order to deploy a basic infrastructure network at the lowest possible cost, the Regulatory Assistance Project (RAP) proposes to auction recharging point locations, similar to auctions for offshore renewable energy generation sites in some EU Member States.[81] This instrument could help to reveal the economic value or cost of each recharging point. Companies can bid for the lowest price or lowest subsidy. Depending on the location, additional subsidies might be needed.[82] The choice of auctionable locations can be based on existing grid capacity mapping, to further reduce cost. Another advantage is that it can increasingly become income-neutral for governments: as forecasts for EV uptake improve, recharging point developers will take more risks to get concessions for specific locations, reducing and gradually eliminating

80 Building a market for EV charging infrastructure: A clear path for policymakers and planners, J. Hildermeier, RAP, June 2020. Online version can be found here: https://www.raponline.org/knowledge-center/building-market-for-ev-charging-infrastructure/.

81 Cf. example scheme

82 Building a market for EV charging infrastructure: A clear path for policymakers and planners, J. Hildermeier, RAP, June 2020, p. 11

the need for subsidies. Moreover, if authorities batch locations with a high expected turnover with locations with a lower expected turnover, payments for profitable locations can cover for non-profitable ones, as the market develops (see section 3.4.4 below).

A properly designed competitive allocation process minimises the costs for the deployment of recharging infrastructure, as long as the design of the bidding process ensures competitive pressure and prevents the exercise of market power.[83] Properly designed tender specifications, including well-designed award criteria, will however be essential to ensure that low price does not equal low quality.

In particular for public support schemes, it is essential to capture fast-evolving market economics. Experience with funding schemes in Norway confirms that, where EV-usage goes up, subsidies for recharging infrastructure go down – sometimes drastically in short periods of time. Today, many recharging stations in Norway, mostly around cities and highways, are built without subsidies. It shows that these areas are increasingly interesting for commercial parties.[84]

A rigid funding scheme, that provides fixed remuneration for recharging points over a longer time period, cannot capture fast-evolving changes in the EV-fleet and corresponding changes in funding needs. In case the fixed subsidy offered for the construction of recharging stations is lower than the real subsidy needs, the subsidy scheme will not provide adequate incentives for investments and will thus be ineffective. By contrast, if the fixed subsidy offered is too high (or more likely, becomes too high over time), the subsidy scheme will not deliver value for money and result in overcompensation for the beneficiaries, possibly distorting the recharging market.

3.4.4 Batching locations

Moreover, another risk with badly designed subsidy schemes (e.g. fixed rates irrespective of the locations) is that investments focus in those areas with the highest expectations of profitability.

Public authorities will want to ensure that investments into infrastructure are not only directed to the most profitable locations (with most expected usage, due to high traffic flows only. Locations which can be expected to be equipped by private parties in any case at a given moment in the future). They will also want to equip potentially less profitable locations (with less expected usage), to have a widespread infrastructure network.

An instrument suggested by the Regulatory Assistance Project (RAP) to tackle this problem, is to 'batch' different locations. To equip very remote areas, like the northern part of Norway, authorities could combine commercially interesting (densely populated) areas with remote areas in a tender. The profitable locations can than cross-finance the non-profitable locations.[85] This is especially interesting for fast-charging nationwide infrastructure. Regional cooperation in procurement between dense urban areas and rural areas can also support affordable infrastructure in the entire region.

83 See also Commission Staff Working Document Accompanying the document Report from the Commission: Final Report of the Sector Inquiry on Capacity Mechanisms, SWD/2016/0385 final, section 5.3.4.1: Competitive allocation processes are better at revealing the real value of capacity, available here: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016SC0385&from=EN

84 Building a market for EV charging infrastructure: A clear path for policymakers and planners, J. Hildermeier, RAP, June 2020, p. 10. NB: Experience from Norway also demonstrates that, for the areas that are sparsely populated and hence have a low share of EVs and/or less traffic (e.g. rural areas and the main roads in the northern part of Norway), government support remains necessary to incentivize the development of recharging points, despite increasing EV uptake nationwide.

85 RAP, 2020, p. 11

Where public authorities decide to 'batch' different locations, they should ensure that the batches are not so large as to preclude the participation of smaller players in the bidding process.

Example Switzerland: Batching locations

The Swiss Federal Roads Office (FEDRO)[86] organised a tender for 100 high power recharging stations along Swiss highways. To avoid 'cherry picking' FEDRO made several batches of locations that are on average comparable in commercial attractiveness.

The tender allocated 100 locations in 5 packages of 20 sites. These 20 locations are a mix of very high traffic roads near densely populated areas and more rural roads. However, the party that wins the batch, must build high power recharging stations on all 20 locations.

3.4.5 Increasing competition in the tender by reducing risks for bidders

Another way to increase the number of participants in a competitive tender procedure is by lowering financial risks for the bidders. FEDRO, The Swiss Federal Roads Office, tendered locations that would be equipped with a sufficiently large grid connection. In other words, the contracting authority promised to pre-finance and pre-install a suitably large grid connection, while the bidder would only be required to install the recharging points and operate them. The public authority would become the owner of the grid connection and sell or lease it to the operator, and any following operator of the recharging stations. This allowed the (often high) cost for the grid connection to be equally shared over subsequent recharging station concessionaires, without one having to bear all those costs upfront. Preparing the grid connection can be a large financial burden for the first operator. By taking away this cost and risk, the competitive tender will become more attractive, not only for the large, well-capitalised recharging point developers/operators, but also for smaller competitors and entrants, thus increasing competition and potentially lowering the cost for the recharging service itself.

Another way to make the tender more attractive is to simply identify clear locations in advance - so called certain to get locations. This enables bidders to better estimate the value of the specific locations being tendered, in particular in cases where the public authorities have already performed a pre-assessment regarding the possibilities to obtain (construction/environmental) permits for those locations.

3.4.6 Price cap

Many recommendations in this paper are aimed at making recharging as convenient as possible for consumers. Another objective for public authorities may be to make it as or more attractive than petrol and diesel, or in other words cheap for users, and avoid high prices.[87]

Public authorities can design their award

86 FEDRO: federal authority responsible for road infrastructure and private road transport in Switzerland.

87 See for instance the claim that fast-charging became more expensive than refuelling a petrol care in certain cases: https://thedriven.io/2020/01/20/norway-horrified-as-new-rates-make-ev-charging-prices-higher-than-petrol/

procedure in such a way that they can contribute to fair and reasonable prices. This could for instance be done by making bidders compete on the maximum prices to be charged to consumers, and including this as an award criterion in tenders.

Many of the respondents to the eQuestionnaire confirm that the price paid by end-users plays a role in selecting the party that will ultimately be contracted.

Some respondents indicate to determine a maximum price themselves (see also section 4.4.5 below), while others encourage market players to come up with lower prices, by selecting the bidder that can offer the best price to the end user. The region of Vestland, for example, includes price requirements in its tender. Rotterdam demands a maximum price of 26 cent ex VAT per kWh for the consumer. Others demand a maximum ad hoc price.

Germany grants government support to the bidder who can offer the lowest cost in terms of €/kW capacity.[88] In this case it is not a price cap for what the users pay, but a cost cap for what investors pay.

NB: some public authorities indicate it may also be necessary to set minimum prices: in particular, this could be necessary to incentivise private recharging and reduce demand for public recharging (and therefore the need for additional publicly accessible recharging points).

Recommendation

Public authorities should look into which policy instrument and contractual models support the development of a competitive market of recharging infrastructure and services. Combinations of instruments and contracts can also be used for this purpose.

Public authorities should ensure sufficient market competition, in order to guarantee a qualitative (innovative) and affordable infrastructure in the longer run. It is therefore important that multiple parties have access to the market. There are various measures that contribute to this, such as: limiting contract terms, investigating whether existing long/perpetual concessions can be broken up, splitting up lots and ensuring that tenders are set-up in such a way that new parties also get the chance to compete.

In order to gain more insight into what market parties can offer, a market consultation can be an interesting instrument. By means of a market consultation, public authorities can get more insight into what innovations and prices the market can offer.

Public authorities should investigate which financial and project (process management, permits etc.) risks they can reduce or take over, so that private parties can offer more competitive prices. One example is to auction locations which are already equipped with a grid connection, another is to auction locations that are sure to get support from the competent authorities for permitting purposes.

In order to deploy a basic infrastructure network at the lowest possible cost, public authorities should consider organising competitive auctions for (potential) recharging locations, similar to the auctions for renewables. In this way, they can reveal the real economic value of certain lots, avoiding overcompensation.

88 German Federal Ministry for Infrastructure and Mobility, first federal funding guideline 13/02/2017 (foerderrichlinie ladeinfrastruktur), p. 6

At the same time, public authorities can ‘batch’ or group different lots, with more and less expected turnover, in their competitive auctions. In this way, they can ensure that investments are not only focused on the most profitable locations, while also reducing the need for subsidies for the least profitable locations through cross-subsidies. Where they decide to do so, public authorities should ensure that the batches are not so large as to preclude the participation of smaller players in the bidding process.

Public authorities should ensure that not only the costs incurred by the government play a decisive role in the choice of the instrument, but also the price ultimately paid by the end consumer. This could for instance be done by making bidders compete on the maximum prices to be charged to consumers, and including this as an award criterion in tenders.

4. Specific tender requirements

Good quality recharging infrastructure is important for the uptake of electric vehicles. Especially while recharging infrastructure is still scarce, quality is of the essence. Whatever the form of contract or policy instrument chosen, public authorities can and should use it to realise a high quality publicly accessible recharging infrastructure network.

The factors determining whether recharging infrastructure is of good quality include most notably:

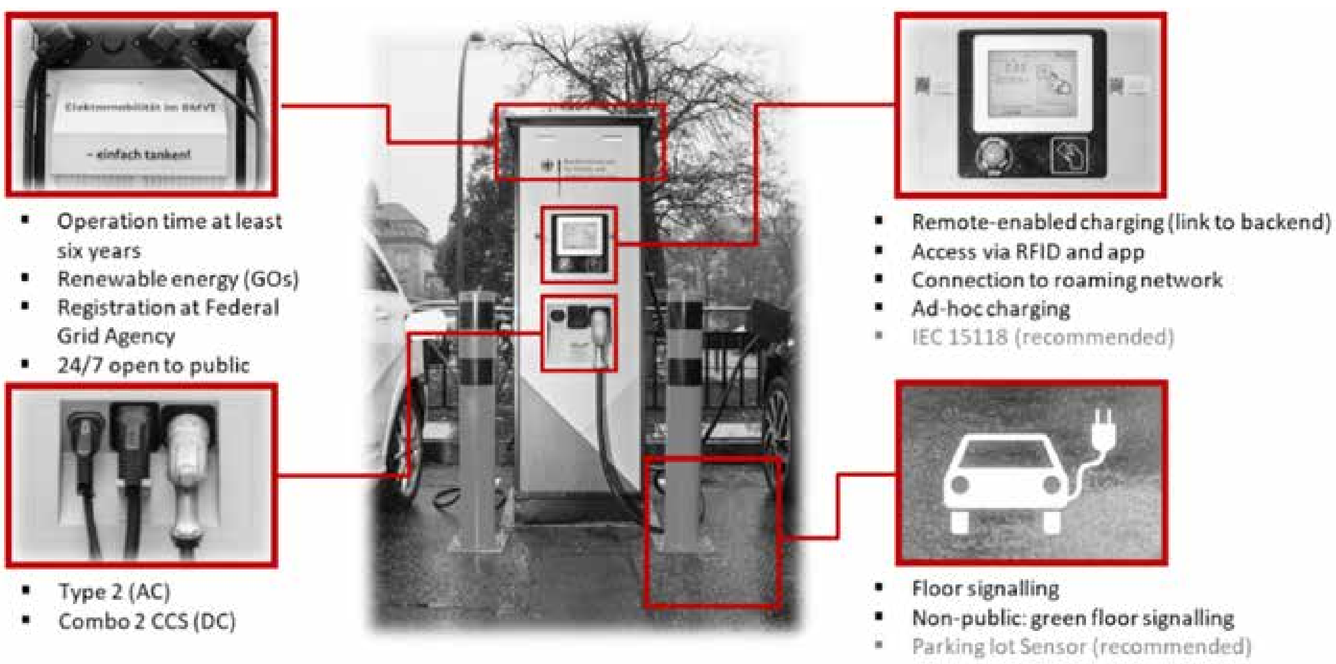
- the suitability of design and positioning of the infrastructure (section 4.1);
- the measure of interoperability of the infrastructure, both in terms of hardware (connector fits vehicle) and software (infrastructure can communicate and interact) (section 4.2)
- whether or not the infrastructure is future-proof (section 4.3);
- whether or not it is easy to find and use, and functions properly (section 4.4); and
- whether or not it is (cyber-)secure (section 4.5).

These elements, and in particular the recommended tender specifications relating to them, are discussed in more detail in the respective sections of this chapter.

Besides setting requirements regarding the quality of infrastructure, public authorities should make sure these can be enforced (section 4.6).

Lastly, public authorities should consider including in their tender specifications provisions in anticipation of the end of the concession (section 4.7).

Figure 16: Germany: visual overview of requirements for funding (2018)



Source: NOW gmbh

4.1 Requirements regarding the recharging station and design of the recharging pole

4.1.1 Requirements relation to the recharging station/location

4.1.1.1 Access requirements

Opening hours

Users of electric vehicles rely on recharging infrastructure to use their vehicles when and where they need to. This means that the existing rechargers should be publicly accessible as much as possible. They should be open for service to the public a large share of the day, preferably 24 hours a day, 7 days a week.

Moreover, there should not be access restrictions based on requirements to pre-register or obtain a dedicated access card. Additionally, as required by Article 2(7) of the Alternative Fuels Infrastructure Directive, public authorities should ensure that publicly accessible recharging infrastructure offers non-discriminatory access for all EV-users. In other words, it is not desirable to have privileged access for any specific infrastructure users.

City of Leuven: accessibility 24/7

The recharging infrastructure shall be publicly accessible 24 hours a day, 7 days a week, in the sense that it can be used by everyone to recharge their electric vehicle. The operator provides users with as much up-to-date information as possible on the presence and availability of the recharging point, through generally available channels as is common in the market for public charging services.

Germany: funding based on accessibility

Publicly accessible: some funding schemes link funding to opening hours, e.g. Germany's fifth funding call (Förderaufruf-ladeinfrastruktur-2020-04-14):

"Funding under this call for funding is only possible if the charging infrastructure is publicly accessible. A recharging point is open to the public if it is either in the public highway or on private land, provided that the parking space forming part of the recharging point can actually be used by an indeterminate group of persons or can only be determined according to general characteristics (§ 2 No 9 LSV).

If public accessibility is to be guaranteed without limitation in time, the maximum funding rates and amounts referred to in points 4.1 to 4.4 shall apply.

If public accessibility is not to be guaranteed without limitation in time, but at least on working days (Monday to Saturday) for 12 hours each, these maximum funding rates and amounts will be reduced by half in each case.

In the event of shorter or non-existent public accessibility, no support may be granted."

Recommendation

At least recharging points in the public domain should be publicly accessible 24 hours a day, 7 days a week, meaning that they can be used by everyone to smart recharge their electric vehicle at any time.

Public authorities should moreover require that no access restrictions apply to publicly accessible recharging points, and that there is non-discriminatory access for all EV-users (as required by AFID 2014/94/EU).

Physical access

As a result of the expected uptake of zero-emission passenger cars, more and more people will have to be able to use the vehicles and the recharging infrastructure. Therefore, in the first place, public authorities should ensure that in principle the location of all recharging points is designed in such a way that the recharging points can be used by as much of the public as possible, in particular taking into consideration the specific needs of older persons, persons with reduced mobility and persons with disabilities.[89] In particular, the recharging location must in principle be accessible for persons with disabilities. Practically, this means for instance that there should be sufficient space around the parking lot, the recharging pole is not installed on a kerbed higher surface, etc. But the recharging pole itself should in principle also be accessible: the connector should be at an appropriate height and the weight of the recharging cables should be such that the general public can handle them with ease. Furthermore the screen / user interface should be accessible: for example the size of the letters or volume of speakers should be adaptable; if a screen is used, good contrast is required, etc. In some cases, deviations from the general rule are possible and a balance needs to be struck between conflicting interests between accessibility and other requirements such as limited space available.

Public authorities should be aware that certain minimum accessibility requirements apply, stemming from the European Accessibility Act.[90] This Act sets accessibility requirements for products and services so that persons with disabilities can use them on equal basis with others. These include for example requirements in relation to payment terminals and certain transport services and infrastructure.[91] The European Accessibility Act also interacts with the Public Procurement Directives: for products and services within the scope of the Accessibility Act, the inclusion of accessibility requirements in public procurement is compulsory.

89 The UN Convention on the Rights of Persons with disabilities provides in its article 1 that 'persons with disabilities' include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others.

90 OJ L 151, 7.6.2019, p. 70–115, Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services, available here: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0882.

91 In addition to the accessibility requirements of the European Accessibility Act in relation to user interfaces, the provision of information and the built environment, the following European standards and draft standards, resulting from European Commission Mandates, contain very relevant information:

- Mandate 376 on accessibility requirements for public procurement of products and services in the ICT domain; available here: https://ec.europa.eu/

To facilitate the use of recharging infrastructure for persons with disabilities, in compliance with the Public Procurement directives[92] [93], the tender specifications should require that all recharging points are accessible unless duly justified. But even when derogations can be justified due to conflicting interests, the tender requirements should seek to maximise accessibility, by setting minimum requirements, e.g. that a minimum number of fully accessible recharging points is deployed within a predetermined radius (e.g. at least one fully accessible recharging point/location in any 1km radius). In those cases, accessible recharging points should be shown with a distinctive indicator in a digital application and be bookable with priority by persons with disabilities.

Sweden: accessible recharging points

The Swedish National Board of Housing, Building and Planning's regulations and general advice on equipment for the recharging of electric vehicles contains the following advice regarding the accessibility of recharging points: Any collision protection or similar equipment should be designed so that it is possible to access the recharging point from an electric wheelchair for limited outdoor use (smaller outdoor wheelchair). Obstacles in the form of kerbstones and level differences should be avoided.

Any signage should be easy to read, have a good brightness contrast, not cause reflections and be placed at a suitable height to be readable by both people in wheelchairs and people who are standing.

Recommendation

Public authorities should ensure that in principle the location of all recharging points as well as the recharging poles themselves are designed in such a way that they can be used by as much of the public as possible - in particular taking into consideration the specific needs of older persons, persons with reduced mobility and persons with disabilities. In particular, they must in principle be accessible for persons with disabilities. This means for instance sufficient space around the parking lot, the recharging pole is not installed on a kerbed surface, the buttons / screen of the recharging point are at an appropriate height and the weight of the recharging cables is such that the general public can handle

growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=333#.

- Mandate 554 on the accessibility of the websites and mobile applications of public sector bodies; available here: https://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=577.
- Mandate 420 on accessibility requirements for public procurement in the Built Environment (including transport infrastructures) prEN 17210; available here: https://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=392.
- Mandate 473 to include accessibility following "Design For All" in relevant standardization activities EN 17161; available here: https://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=461.

92 Article 42 of the Public Procurement Directive states: 'technical specifications shall, except in duly justified cases, be drawn up so as to take into account accessibility criteria for persons with disabilities or design for all users.'

93 Directive 2014/23/EU of the European Parliament and of the Council on the award of concession contracts ('the Concessions Directive'); Directive 2014/24/EU of the European Parliament and of the Council on public procurement and repealing Directive 2004/18/EC ('the Public Procurement Directive'); and Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sector and repealing Directive 2004/17/EC ('the Utilities Directive'). Although these Recommendations refer primarily to the Public Procurement Directive, most of the same obligations for pursuing socially responsible public procurement also exist under the other two directives.

them with ease. In cases where it can be justified that certain recharging locations or recharging poles cannot be configured to make them fully accessible, the tender requirements should seek to maximise accessibility. They could for instance require that, as an absolute minimum, at least one fully accessible recharging point is deployed within a predetermined radius (e.g. at least one fully accessible recharging point/location in any 1km radius).

4.1.1.2 Dedicated parking

In section 2.3.2, possible parking policies for facilitating recharging infrastructure were discussed. The tender requirements should be defined in such a way that it aligns with the authority's parking policy. This means the infrastructure should be realised at appropriate parking lots.

More than 68% of respondents to the questionnaire have indicated that in their tender specifications they always demand at least one dedicated parking space adjacent to every recharging point. 34% of the respondents indicate that they have means to ensure those dedicated parking lots are reserved for electric vehicles. In most cases this comes down to a marking on the ground with a dedicated road sign. This is then enforced in the same way as non EV-enabled parking lots (fines for incorrect parking, possible towing of incorrectly parked cars).

Recommendation

Public authorities should ensure that every recharging point is served by at least one adjacent parking lot that may only be used by EV-users. Obligations to this end could be imposed on concessionaires.

4.1.2 Design of the recharging pole

Design elements of the infrastructure to take account of in tendering recharging infrastructure are characteristics related to:

- fitting with the surroundings: size, positioning, safety and outer-appearance;
- the recharging infrastructure lifecycle: sustainability, durability, modularity and repairability;
- safety of the design: no sharp ends, no pieces sticking out, location of cables
- user-friendliness of the design: e.g. clearly visible when in use/out of order, easy accessibility to people with reduced mobility.

4.1.2.1 Fit with the surroundings: size, safety, positioning and outer-appearance

Public space is scarce due to the presence of elements such as (parked) cars, mopeds and bicycles, traffic lights, parking meters, trash cans, bus stops and so on. As it is expected that a significant amount of recharging points will be required in the coming decades, even more elements will be added to the already crowded public space. In certain areas it will therefore be vital to limit the use of scarce public space and visual pollution. Design factors to take into account are therefore size, positioning, safety and outer-appearance.

As already mentioned in section 2.3.2, public space is valuable and therefore the space taken up by rechargers should be kept to a minimum. Possible ways to achieve this are:

- installing compact recharging points;
- deploying recharging poles with multiple connectors, allowing multiple vehicles to be charged simultaneously;
- combining multiple services in one device, e.g. lamp posts, telecom boxes, etc.

In certain countries, the DSO prescribes the use of a smart meter on recharging points. As these meters are relatively large in size, this significantly affects the dimensions of the recharging points. Cooperation of the various stakeholders involved (such as DSO and CPO) may in such cases be required to find innovative solutions to reduce spatial impact.

Another important feature is the safety of the recharging points. Since many recharging points will be in public spaces, many adults, children, elderly, and also pets and other animals will come across them. In order to avoid injuries, it is vital that the rechargers are designed in such a way that they pose no health hazards. This means that they should not have sharp ends, no elements sticking out and the cables and connectors should be stored in such a way that the risk of tripping over them, or getting exposed to the electrical components, is limited. Also, while in use, the infrastructure should be safe, limiting in particular the risk of electroshock.

More than half of the respondents to the eQuestionnaire indicate that they include safety specifications in their tender requirements. In some cases the authorities include case specific safety requirements, but in most cases they refer to health and safety legislation, regulations, standards and/or codes of practice. In many cases these are general laws on electrical installations, not specifically applied to recharging infrastructure.

The use of public space and the safety of recharging points are both affected by their exact positioning. A well-chosen position limits the interference with users of public space, thereby also limiting safety risks. Figure 17 illustrates two examples of differently positioned recharging points. One is positioned on the sidewalk and fairly large. It takes up a large amount of public space, close to pedestrians, increasing the risk of bumping into the recharger or tripping over the cable. In the situation on the right, the recharging point is located just off the side walk, leaving more space to pedestrians and limiting safety risks. By contrast, it is at a higher risk of getting damaged by parking cars. Being significantly smaller in size, however it has the advantage of resulting in less visual pollution. Visual pollution can be caused by different elements of recharging points, such as their shape, size but also colour. Those elements should be considered in the tendering specifications (see example Leuven).

Figure 3: Examples of positions of recharging infrastructure (left: Budapest, right: Ljubljana)

Source: Kerényi László Sándorz

Leuven: requirements for positioning recharging infrastructure

The city of Leuven includes the following requires in tendering charging infrastructure:

- the passage for other traffic (bicycle, pedestrian, wheelchair, ...) remains guaranteed (cf. to comply with the guidelines as included in the Vademecum Public Accessible Domain);
- there are no obstacles with respect to other street furniture or (public) greenery; and
- the recharging infrastructure fits in with the streetscape. The recharging point has RAL color anthracite grey (RAL 7016). Desired means of advertising or communication may only be used with the permission of the city of Leuven.

Leuven: design of the recharging infrastructure

- The minimum height of the recharging infrastructure from ground level is 800 mm and the maximum height of the recharging infrastructure from ground level is 1,500 mm. Further agreements will have to be made about the maximum space requirements: 90,000 mm2.
- The recharging infrastructure is a freestanding uniform column or pedestal (with the exception of wall boxes that are attached to a wall)
- The recharging infrastructure has a high quality finish without sharp points, pronounced cavities or curves
- The recharging infrastructure has a slanted top, to ensure no items will be put on top of the infrastructure
- - The recharging infrastructure, including housing exposed to the outside air parts, are made of corrosion-resistant materials, such as stainless steel, aluminum or high quality impact resistant plastic material that does not suffer from aging, by for example UV radiation;
- The maximum depth of the foundation is 600mm - ground level
- The recharging infrastructure will indicate at least the following statuses per outlet: Charging, available (plugged in or recently accepted), Out of order, charging pass refused. When this is done with LEDs, the following colors shall be used:
    - Blue: charging
    - Green: newly accepted or plugged in
    - Red: in malfunction
    - Red (flashing): charging pass refused.

Additional colours are possible for additional functionalities.

Recommendation

The design of the recharging infrastructure should take account of the surroundings (size, positioning, safety, outer-appearance, potential generation of light pollution, ...), the recharging point's lifecycle (sustainability, durability, modularity and repairability), safety of the design (no sharp ends, no pieces sticking out, location of cables) and user-friendliness (clearly visible when in use/out of order, easy accessibility to people with reduced mobility).

4.1.2.2 *Recharging infrastructure lifecycle: sustainability, robustness, modularity and repairability*

Because of the sheer amount of recharging infrastructure that is expected to be deployed in the coming decades, it is important to limit their lifecycle cost and environmental impact. This requires the recharging infrastructure to be robust, sustainably produced, modular and repairable as much as possible.

Sustainability

One of the ambitions mentioned in the European Green Deal is mobilising the industry for a clean and circular economy. This means that the environmental impact of industry should be diminished. This holds not only for the production processes, but also during their lifetime and at end-of-life.

The European Commission has developed a handbook[94] designed to help public authorities successfully plan and implement 'Green Public Procurement'. This handbook explains the possibilities offered by European Union law in a practical way, including the 2014 Procurement Directives[95] that enable public authorities to take elements related to sustainability into account in their tendering procedures. Moreover, the handbook describes simple and effective ways of greening contracts.

For recharging points specifically, public authorities could think of several requirements aimed at improving their energy-efficiency.

For DC-recharging points specifically, a first important aspect would be their ability to convert AC-grid power in the most energy-efficient way, limiting energy losses in the conversion process. The systemic electric energy-efficiency of medium- to high power DC recharging points depends primarily on four factors:

1. The principle efficiency level of the power electronics in the rectification modules, and for ultra-high power recharging points (P>150kW) also the efficiency of upstream transformers if required in function of middle-tension-grid- or low-tension-grid-connection concepts;
2. How efficiently the DC recharging point

94 Buying green! A handbook on green public procurement 3rd Edition. ISBN: 978-92-79-56848-0 doi: 10.2779/246106. European Union, 2016

95 Directive 2014/23/EU of the European Parliament and of the Council on the award of concession contracts ('the Concessions Directive'); Directive 2014/24/EU of the European Parliament and of the Council on public procurement and repealing Directive 2004/18/EC ('the Public Sector Directive'); and Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sector and repealing Directive 2004/17/EC ('the Utilities Directive').

steers its modules to adapt to various DC-power levels demanded in any single recharging session, while able to respond to the differing demands from the large majority of EVs expected to recharge at the recharging point;

3. How efficiently the DC recharging point can adapt to the various voltage levels demanded by the large majority of EVs expected to recharge at the recharging point; and
4. The energy-efficiency of all accessorial components of the DC recharging point, notably regarding:
   a. its internal cooling and/or winter heating systems (including the sub-system providing fluid-cooling to the recharging cable and plugs in case of ultra-high power recharging points); and
   b. other accessorial loads like the display, communication devices, etc.

While the most effective incentive for CPOs to deploy energy-efficient infrastructure would likely follow from stricter rules on pricing and billing (i.e. allowing CPOs to only charge the amount of kilowatt-hours effectively delivered to the electric vehicle), public authorities should, both for ecological and economic reasons, also set certain requirements in their tender specifications. To this end, they could for instance require that the typical efficiencies of a DC-recharging point at different load conditions are transparently communicated by prospective developers of recharging infrastructure in their bids, for easy tender comparison. Currently, the following full-system's electric energy efficiency levels should be, as a minimum, attainable by DC-recharging points under typical application conditions (i.e. climate, etc.):

Efficiency	Load
95%	Nominal load
93.5%	50% of nominal load
92%	25% of nominal load

Moreover, with an increasing number of recharging points being deployed throughout the EU, the stand-by power consumption of both AC- and DC-recharging points is equally becoming significant from an energy-efficiency point of view. A simple calculus illustrates this: if a public authority supports the deployment of 500 AC-chargers with a stand-by consumption that is 20 Watts above today's best available technology, and assuming these AC-recharging points are available 24/7, this would result in an additional electricity consumption (and related costs) of approximately 88MWh/year.

As an indication, today modern Mode 3 AC-recharging points of up to 22kW (3phase) should easily achieve stand-by powers clearly below 10W, and should optimise accessorial elements like e.g. own lighting elements, if necessary at all, with power-saving coloured LEDs. Many Mode 2 AC-recharging points have been found to remain well under 6W of standby power consumption today. In both cases, a few Watts should be added to these indicative stand-by power consumption levels, to allow the recharging point to keep up a communication connection to a back-end system (although state of the art infrastructure communication systems can turn to a hibernate mode to minimise power consumption). In view of the above, public authorities should require in their tender specifications that the stand-by power consumption of recharging points under typical application conditions is minimal, and that it is transparently communicated in the tender bids for easy comparison.

Moreover, procuring sustainable and circular products may include setting requirements in terms of robustness, modularity and repairability of infrastructure (see below). But it could also require anticipating discontinued manufacture of spare parts and resulting maintenance support at product end of life/obsolescence. Such anticipation could include requiring the contractor to upgrade components at regular intervals or require the maintenance of a suitable stock of the most important spare parts.

Robustness

As the recharging infrastructure will stand out in the open for many years, subject to various weather conditions and possible vandalism, it is important that it is robust and durable. Such requirements can be included in the tender specifications in multiple ways, such as:

- by demanding maintenance throughout the concession period (see section 4.4.2.1);
- a warranty for the concession period or longer (see section 4.6);
- by demanding well-functioning infrastructure at the end of the concession period (see section 4.7); and/or
- the use of a deposit, that will only be returned in the case that the infrastructure in in good order at the end of concession (see section 4.7).

Amsterdam: requirements on durability, modularity, and open interfaces

Best practice of Amsterdam suggests including the following specific requirements:

- • Durability: set quality requirements e.g. relating to use of non-corrosive materials and the protection of electrical parts (waterproof).
- • Modularity: require a modular set-up of the recharging point, so all components and systems (e.g. RFID reader and controller) can be easily replaced.
- • Mandate the use of open (hard- and software) interface standards between components and systems, so components and systems are interoperable and can be easily upgraded or transferred to a new operator.

Modularity

An increased lifetime of products usually reduces overall costs and emissions, except when an updated product is so much more energy efficient, that the emissions due to the production of a new product are more than balanced out by the lower lifetime cost and emissions. With modular products, it is possible to replace old hardware for new whenever it is broken or needs to be updated. This means that the lifetime of products can be increased, while at the same time upgraded parts can be replaced to ensure that the product and its energy efficiency remain state of the art. The tender requirements could therefore mention that efficient exchange of components should be possible. As an example, the Metropolitan Region Amsterdam (MRA-E) included in their tender requirements that “the recharging pole shall be modular and the various components and systems (such as RFID reader and controller) should be easy to replace and/or upgrade”.

Repairability

As mentioned above, increased lifetime of products usually reduces overall costs and emissions. Products that can be easily repaired are therefore generally less costly and have lower emissions over their lifetime. A possible way to take this into account in the tender requirements is by demanding transparency regarding specifications of individual elements, e.g. dimensions and materials used.

Recommendation

In their tender specifications, public authorities should require that recharging infrastructure is circular in design, sustainable, robust, modular (components can be easily taken out and replaced) and easily repairable.

4.1.2.3 The recharging cable: fixed or not?

Currently, most DC recharging points come with a fixed recharging cable, while AC recharging points are not usually equipped with one - meaning EV-drivers must bring their own cable in order to be able to initiate a recharging session. This has allowed older EVs with a Type 1 inlet to recharge at any publicly accessible Type 2 AC recharging point, using the cable as an adapter (type 2 > type 1). While most EV- drivers have at their disposal the cable to recharge at an AC recharging station, the bring-your-own-cable solution is not very user-friendly or efficient. As Type 2 inlets have become standard in the EU, public authorities could require the installation of a fixed type 2-connector recharging cable onto the recharging point (as is the case for DC high power recharging points). This is certainly more convenient for EV-drivers, who now have to always remember to bring a recharging cable with them, failing which they cannot recharge at certain AC publicly accessible recharging stations.

Public authorities should however be aware that adding a fixed recharging cable will have an extra cost, and that such cables need to be maintained and possibly replaced in case of damage or wear and tear. Besides the cost issue, (fixed) cables have the risk of not being long enough to be used with every vehicle, as the position of the inlet in cars is not yet standardised. By contrast, if sufficiently long cables are provided at the recharging point, they may pose a safety hazard if not properly re-attached to the recharging point by EV-users. Several solutions exist to avoid cables lingering around in the public space: for instance, recharging points could be equipped with a system to automatically roll-up the fixed cables after use or recharging points could be equipped with helical cables (see Figure 18).

Figure 18: recharging point equipped with helical cable

Source: Orgalim

Recommendation

Public authorities should require that every DC recharging point is equipped with a fixed recharging cable, that is at least compliant with the standards set in Annex II of Directive 2014/94/EU. They should consider requiring companies that deploy AC recharging stations to equip these with a fixed cable, since this is more convenient to EV-drivers. In these cases, the cables should have sufficient length to recharge most vehicles and an appropriate cable management system should allow easy and safe handling of the cable and connectors (e.g. by the automatic roll-up and storing of the cable in the recharging pole or by using a helical cable).

4.1.3 Requirements relating to metering

Users of recharging infrastructure should feel confident that they pay only for the electricity actually off-taken. This requires that the electricity off-taken during a recharging session is accurately metered.

All electricity grid off-take points in all Member States need to be equipped with an electricity (DSO) meter that is certified by a national authority for compliance with the Measuring Instruments Directive (2014/32/EU, in short 'MID').[96] This certification assures highly accurate measurement and according billing as well as safe operation of the electrical equipment. Every recharging station normally has at least one certified MID meter, which measures the electricity off-taken by the CPO at the electricity grid off-take point of that recharging station.

Moreover, every recharging point within that recharging station normally disposes of a meter for measuring the electricity recharged by EV-users for every single recharging session; however, these meters are not subject to the requirements of the MID directive.

Some Member States have however introduced strict accuracy requirements also for meters installed in the recharging points. For example, the German Weights and Measures Law (Eichrecht)[97] provides a framework for accurate calibrations and measurements that are required for very precisely charging and invoicing EV-users.

In the past, this has caused some headaches for CPOs in particular in relation to DC metering. [98]

Currently not all Member States have such accuracy requirements and relating certification procedures in place. If there are such national requirements, this should be reflected in the tender specifications.

Recommendation

EV-users should be confident that the invoice for recharging correctly reflects the actual amount of electricity recharged. Recharging points should be equipped with a certified meter for highly accurate kWh metering and where needed a data storage device as well as the possibility to check the historical measurement data, for billing purposes.

4.1.4 Requirements relating to the grid connection

In section 2.4.2.1 it was already stated that account should be taken of the existing electricity grid when installing new recharging points.

In many cases public authorities may want the successful concessionaire or beneficiary to develop recharging points with a specified minimum installed capacity. In order to ensure that every vehicle recharging at such a recharging point is actually able to use the full nameplate power, contracting authorities should ensure that the successful concessionaire or beneficiary also develops a

96 OJ L 96, 29.3.2014, p. 149–250, Directive 2014/32/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments (recast) ('MID Directive'), available here: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0032&from=EN.

97 It should be noted that, in addition to regulating metering accuracy, the Eichrecht also sets rules on data handling, trust mechanisms, verifiability of bills and receipts, and even physical protection of equipment against manipulation, dust, the elements, etc.

98 See for instance this report ordered by the Ministry of Foreign Affairs of the Netherlands: https://www.rvo.nl/sites/default/files/2019/04/German%20charging%20infrastructure%20regulations%20report%20march%202019_0.pdf.

sufficiently large grid connection to support the recharging points. This is necessary to avoid that the total nameplate power offered at a recharging point is reduced in reality when multiple vehicles recharge at the recharging station simultaneously.

A similar issue occurs when a recharging pole comes with more than one connector, which can be used simultaneously. In such cases, public authorities should require that the recharging infrastructure distributes the electricity from the grid in an efficient and intelligent way over the number of vehicles that can be connected to the recharging pole simultaneously.

This could for instance mean that vehicles receive more power at the beginning of a recharging session than towards the end, or that priority is given to vehicles with a more depleted battery.

In any case, CPOs should be required to clearly communicate to EV-users, in advance of the recharging session, the estimated time to recharge the vehicle to a desired battery level, while equally informing them of whether the estimated duration is possibly subject to change –and to what extent- in case a simultaneous recharging session is initiated at the same recharging pole. If such an event subsequently occurs, CPOs should inform all affected users, providing an updated estimated duration for the recharging session.

Finally, the grid connection should be ready for future expansion of the infrastructure network. This can also be requested in the tender specifications.

The city of Amsterdam for instance requires that the Primary Charging Object is connected to the electricity grid and is suitable for connecting 1 or 2 secondary Charging Objects to enable a future recharging plaza.[99]

Recommendation

Public authorities should, if possible, set suitable requirements regarding the capacity of the grid connection, in order to ensure that recharging points can recharge EVs at full power.

Where recharging poles are equipped with two or more connectors for simultaneous recharging, the recharging point must be able to distribute the electricity in an efficient and intelligent way over the number of vehicles connected. The same applies for recharging stations offering two or more recharging points.

Grid connections should be future fit and upgradable, to anticipate extensions of the recharging station.

4.2 Interoperable infrastructure

One of the most frequent criticisms in relation to recharging infrastructure is the ‘lack of interoperability’. But what does this actually mean?

According to the Cambridge dictionary, interoperability is “the degree to which two products, programmes, etc. can be used together, or the quality of being able to be used together”. As part of its task under the European Commission Mandate M/490, the CEN-CENELEC-ETSI Smart Grid Coordination Group defined interoperability as “[t]he ability of two or more networks, systems, devices, applications, or components to interwork, to exchange and use information in order to perform required functions”.[100]

99 Gemeente Amsterdam. Programma van Eisen. AI 2015-093 Laadobjecten elektrisch vervoer. Versie 11 september 2015

100 CEN-CENELEC-ETSI Report ‘SG-CG/M490/I Smart Grid Interoperability - Methodologies to facilitate Smart Grid system interoperability through

Applied to recharging infrastructure, this essentially translates to the ability of all electric vehicles to recharge at any recharging point. This has a number of desired outcomes:

1. it reduces the consumption of (public) space by reducing the need for (parallel) infrastructure overall;
2. it helps to create a healthy competitive and open market, avoiding technical operator lock-in; and
3. it gives EV-drivers access to an increased amount of recharging points through a single subscription.

By and large, two main strands of interoperability can be identified:

i. Hardware interoperability or compatibility, understood as the interoperability between the electric vehicle's battery and inlet, on the one hand, and the recharging point's connector and plug, on the other hand. From the perspective of the driver of an electric vehicle, hardware interoperability is necessary to be able to use all relevant recharging infrastructure: similar to petrol and diesel nozzles, electric vehicles' plugs should be interoperable with all electric vehicles on the road. Most of these elements are covered one way or another by existing standards or by standards currently under development; some of these are mandatory by law, as explained in section 4.2.1 below.

ii. Software interoperability, or interoperability between the software systems in recharging points, on the one hand, with the software systems in electric vehicles or of different Charge Point Operators, e-mobility service providers and roaming platforms. Software interoperability is necessary to allow seamless contract-based authentication and payment options, including through roaming arrangements. Lack of such software interoperability between a specific electric vehicle and the recharging points of a specific Charge Point Operator, will mean that the electric vehicle can only recharge at those recharging points on an 'ad hoc' basis. Moreover, software interoperability between a specific recharging point and a CPO's back-end is important to enable contract-based recharging and billing. Furthermore, software interoperability between that same recharging point and the software systems of a competing CPO, EMSP or roaming platform will enable the latter to integrate new recharging points in their portfolio's at a reasonable cost, which helps to open the market, avoid operator lock-in and –most importantly- gives EV-drivers access to an increased amount of recharging points through a single subscription. Different options exist to achieve software interoperability, usually requiring some form of standardisation of one or more, or a set of different communication protocols. These include e.g. communications from vehicle to recharging point, from vehicle to DSO, from recharging point to CPO, from recharging point to recharging point, from CPO to roaming platform, etc. These options are discussed in section 4.2.2.3 below.

4.2.1 Hardware interoperability

The Alternative Fuels Infrastructure Directive 2019/94/EU ("AFID") currently requires that all recharging points are, for interoperability purposes, equipped at least with socket outlets or vehicle connectors of Type 2 (for AC normal and high power recharging points) and connectors of the combined charging system,

standardization, system design and testing', recital (324); available here: ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/HotTopics/SmartGrids/SGCG_Interoperability_Report.pdf

Figure 19: mandatory recharging connectors in EU

Source:

CharIN, https://www.charinev.org/ccs-at-a-glance/ccs-implementation-guideline/

CCS/Combo 2 (for DC high power recharging points).[101] Figure 19 provides a graphical overview of these requirements.

At the same time, AFID does not prohibit the addition of other connectors to a recharging point. While prior to the adoption of AFID, a number of recharging points with AC connectors other than Type 2 were deployed in the EU, the prescription of the Type 2 standard through the Directive put an end to this. By contrast, while it has been a requirement for all DC high power recharging points constructed after the entry into effect of the Directive to be equipped with at least CCS/Combo2 connectors, it has become market practice to equip in particular 50kW recharging points with an additional CHAdeMO connector. CHAdeMO is a connector standard developed in Japan and so far needed to recharge Japanese vehicle brands and also some models of certain European brands, such as certain Citroëns and Peugeots. Recently, these two European brands offer CCS inlets on their cars destined for the European market; Nissan however has not taken any decisive decision regarding the choice of DC inlets for future vehicles, with the exception of one model now offered with CCS.[102] As a result, more and more providers of high power recharging points choose to equip their stations with CCS/Combo 2 connectors only. Although equipping DC high power recharging points with just one type of connector will clearly have cost advantages, it may be at the expense of certain older EV models or certain foreign EV models which will not be able to recharge at that recharging point.

Recommendation

In their tender specifications, public authorities should require that all recharging points comply at least with the technical specifications set out in point 1.1 or point 1.2 of Annex II of the Alternative Fuels Infrastructure Directive or, more precisely, the national transposition of those standards. Tender specifications should require that:

i. Alternating current (AC) recharging points shall be equipped at least with socket outlets or vehicle connectors of Type 2 as described in standard EN 62196-2.

ii. Direct current (DC) recharging points shall be equipped at least with connectors of the combined charging system 'Combo 2' as described in standard EN 62196-3.

while leaving it to the market to decide whether or not to add other connectors.

101 Art. 4(4) of the Alternative Fuels Infrastructure Directive (2014/94/EU) in conjunction with points 1.1 and 1.2 respectively of Annex II to that Directive.

102 Tesla already late 2018 confirmed that its European version of the Model S would be equipped with a CCS inlet, and gradually started retrofitting its proprietary recharging network to come with CCS connectors: https://electrek.co/2018/11/14/tesla-model-3-ccs-2-plug-europe-adapter-model-s-model-x/

4.2.2 Software interoperability

Software interoperability is only relevant to allow seamless contract-based authentication, payment and related services. Where user-friendly ad-hoc charging options are available[103], software interoperability is not strictly required to offer a seamless recharging experience to the EV driver.

It is therefore important to understand the difference between ad hoc and contract-based recharging.

The Alternative Fuels Infrastructure Directive in Art. 4(9) requires that "[a]ll recharging points accessible to the public shall also provide for the possibility for electric vehicle users to recharge on an ad hoc basis without entering into a contract with the electricity supplier or operator concerned". It is intended as an easy means for EV-drivers to recharge at any recharging point in the EU, without being a customer of the operator of the recharging point in question.

By contrast, the Directive also refers to the possibility of CPOs/EMSPs to offer contract-based recharging services. Article 4(8), second sentence, explicitly recognises the right of Charge Point Operators "to provide electric vehicle charging services to customers on a contractual basis, including in the name and on behalf of other service providers".

Such contracts allow CPOs to offer preferential recharging services to their customers and allow for more customer-friendly billing methods, e.g. monthly billing. Such contracts can also help circumvent allegedly high bank transaction costs for allegedly low turnovers per charging session, for which reason they are promoted by CPOs and EMSPs.

Unlike the ad hoc payments for recharging, contract-based recharging requires:

i. A contractual relationship between the EV-user and EMSP that is usually concluded before the user arrives at the recharging station for an individual recharge and does not end 'on the spot', i.e. after the recharging transaction is terminated. This makes it possible to send a single bill to the customer for the settlement of all payable recharging sessions in any given month at the end of that month; and

ii. Identification and authorisation of the user by the CPO and EMSP for each individual recharging transaction 'on the spot' to link the specific user to the right contract.

In order to offer contract-based recharging, a recharging point must be accessible from a distance. In the absence of such (direct or indirect, through the CPO) connection, an EMSP cannot obtain the data of a recharging session (identification of customer, kWh charged, time spent) it needs for billing purposes. When an EMSP also acts as CPO and owns/operates his own infrastructure, this is relatively easy to establish between his own recharging points and back office. It however becomes more complicated in the case that his customers recharge at a recharging point owned/operated by another CPO. This is where software interoperability comes into play: it allows the two (or more) software systems to communicate and exchange the necessary data (referred to as roaming, either peer-to-peer or via a roaming platform). The easiest way of enabling such communications, is to ensure that two software systems speak (different versions of) the same language; in other words, ensuring that they use the same protocols for communications.

103 Some suggestions to make ad hoc recharging convenient for EV-users are provided in section 4.4.4 below.

4.2.2.1 *Digitally connected infrastructure*

Quite obviously, digital connectivity is a precondition for any kind of software interactions –and thus data exchanges– be it between the electric vehicle and the recharging point, or the recharging point and back-end. In the absence of a digital connection, a CPO will not be able to know if any of his recharging points are technically (un)available, in use, etc. This also means such information will not be available to consumers, who may want to know which recharging points are available at what price, or city planners, who may use such data to determine where additional recharging points are needed (see section 2.4.1.2). Also, it will not be possible to offer contract-based charging in relation to such non-smart recharging points, as it will be impossible for the CPO to register the data of a recharging session from a distance. Likewise, it will be technically unfeasible to offer features like smart and bidirectional recharging on such non-connected recharging points.

In particular, within the EV recharging ecosystem digitally connected recharging infrastructure comprises a set of physical attributes and technical specifications that are necessary to:

1) Send and receive static and dynamic data in real time, enabling the flow of information between market actors that are dependent on these data for fully developing the recharging experience, including among them CPOs, EMSPs, roaming platforms, DSOs, National Access Points and ultimately the end consumers.
2) 2)Connect recharging points to different EMSPs and third party service providers, allowing the possibility to carry out contract-based payment solutions and to provide other types of customer services.
3) Support API integration and cloud services.

For this purpose, recharging stations would need to be equipped with an ethernet port or a SIM card. This would allow the recharging station to connect to the internet via a wireless connection with GPRS or wired connection with a local network. The software and the overall IT system of the recharging station would moreover need to support the required standards and protocols for the transmission of any data that may be relevant for enabling an adequate recharging process.

The lack of harmonisation between these fundamental technical requirements for ensuring a digital connection of recharging infrastructure could result in the imposition of different requirements for different recharging operators, leading to the creation of de facto island networks, with certain infrastructure incapable of delivering the services expected by end consumers.

In conclusion, digital connectivity of recharging points is important, if not essential, to enable proper planning of infrastructure, geolocation and, in general, ensuring infrastructure is consumer-friendly and well-integrated into the electricity grid.

Unsurprisingly, many respondents to the eQuestionnaire already explicitly require in their tender specifications that recharging infrastructure is digitally connected. Examples include: AMB Barcelona, Amsterdam, Region Auvergne-Rhône-Alpes, Dortmund, Latvia, Malta, MRA-E (Metropolitan Region of Amsterdam), Munich, Norway and Stuttgart. Others include this requirement implicitly, for example by imposing the use of certain communication protocols (e.g. Rotterdam and Oslo) or by requiring the availability of contract -based charging for users (e.g. Toulouse).

Some respondents explicitly mention their reasons for requiring such digital connection, for example: it is needed to allow EV-users to find any station by using a third party software or navigation system (Dortmund), to monitor the technical operation of the recharging point thus reducing maintenance costs and increasing up time (Latvia), or simply to offer a basic service to consumers, in particular occasional users (Region Auvergne Rhône-Alpes).

Interestingly, a number of respondents set additional requirements to the digital connection, for instance:

- The city of Amsterdam and MRA-E require 99% uptime of any data connection
- AMB Barcelona requires the presence of a SIM card in each recharging point
- Munich requires recharging stations to be connected using a GPRS 'line'
- Madrid requires Ethernet and 3G, adapted for equipment control and monitoring remotely, for high power recharging infrastructure

Recommendation

Public authorities should require that all publicly accessible recharging infrastructure is digitally connected. This implies the installation of the necessary software, standards, protocols and overall IT systems required to ensure the infrastructure is able to send and receive static and dynamic data in real time, as well as to connect the different market actors that are dependent on these data for enabling the recharging process. It is essential to ensure an adequate network connection: in this respect, best practice is to set minimum connection uptime requirements, irrespective of the chosen technology.

4.2.2.2 Access and authentication

First and foremost, in order to offer contract-based recharging services, recharging points and CPO/EMSP back-ends must be able to uniquely identify and authenticate EV-users at the recharging station. Different technical solutions exist, but a distinction can be made between the two main authentication systems:

i. 'manual' authentication systems, where the user has to take some action to authenticate himself at the recharging point (e.g. swiping of a customer card at an RFID reader, entry of a password at a recharging point, etc.); and

ii. 'automatic' authentication systems, where the mere plugging of the recharging connector into the vehicle inlet performs the authentication function.

Current contract-based charging is predominantly dependent on the use of RFID cards for authentication purposes. The individual and uncoordinated development of RFID cards by different CPOs and EMSPs has led to a proliferation of such cards. It is not uncommon that an EV-user needs multiple RFID cards to be able to recharge since different cities often have different recharging network operators who all have their own RFID card.

The responses to the eQuestionnaire indicate that a number of public authorities[104] require in their tender specifications that recharging station concessionaires make an RFID card available to any interested EV-driver at no cost.[105]

104 Examples include Amsterdam, Germany, Madrid and Slovakia.

105 For example Amsterdam requires the provision of the recharging card and a dedicated app at no cost to any interested EV user.

[RFID requirements: eViolin Code of Conduct

In the Netherlands, tender specifications generally refer to the eViolin Code of Conduct106 when setting requirements for RFID cards. In this respect the eViolin Code of Conduct provides:

"When authentication of an EV-driver at the recharging point is done, this is at least possible via access system based on NFC (Near Field Communication) with radio frequency of 13,56 MHz and NFC Tag 1-functionality according to ISO/IEC 14443A.

CPOs accept NFC Mifare Classic 7 byte charge tokens. [E]MSPs only distribute 7 byte tokens."

Although still in its development phase in Europe, there seems to be a growing interest in the potential of automatic authentication technologies among different market parties. These are technologies that allow EV-users to recharge their vehicle by simply plugging the recharging connector into the vehicle without any further administrative or other requirements on the EV user. The vehicle simply communicates automatically with the recharging point and the underlying communication protocols do the rest: authenticating the vehicle, possibly its state of charge and requested recharge, logging the amount of electricity effectively recharged and possibly the time for recharging (in case of time-based fees) and transfer all these data to the CPO and eventually EMSP back-end for billing purposes.[107]

Different solutions to enable such 'automatic' authentication and recharge exist (Tesla for instance uses a proprietary technology to enable it) or are being developed, but the most prominent development in this area is the ISO/IEC 15118-20 standard.[108]

The 2019 STF stakeholder consultation found however that this standard is not fully ready yet, and is subject to some competition concerns in particular regarding lock-in effects and free choice of EMSP for consumers – a concern reiterated by some CPO's contributing to these Recommendations[109] (on communication standards, see also section 4.2.2.3 below).

Nevertheless, public authorities should keep an eye on the market uptake of the ISO 15118-20 "Plug and Charge" authentication feature, and possibly require recharging infrastructure to be easily upgradable to accommodate it in the future.

106 eViolin is an association of charging station operators and service providers that pursues national roaming with international connection, using open standards. Any CPO or EMSP that wants to become a member of eViolin has to accept the Code of Conduct, setting a number of minimum conditions for interoperable and user-friendly recharging. The latest version of the Code of Conduct is available here (Dutch and English): http://www.eviolin.nl/wp-content/uploads/2019/11/Code-of-Conduct-_-minimale-set-afspraken-EVIOLIN_3_1-incl-signing-request.pdf

107 Some stakeholders point to the following weakness of automatic authentication technologies like Plug'n'Charge: the recharging point identifies the vehicle and not the user. This may not be particularly suitable for increased shared car use, as the individual users will not be able to choose their own EMSP.

108 ISO 15118-20 (under development) is part of the existing and widely used ISO 15118 standard, a protocol for communications between the electric vehicle and recharging point. ISO 15118-20 will introduce a number of new features, summarised as follows:
(i) Energy management: earlier version of the standard allows smart recharging while version -20 will allow bi-directional recharging;
(ii) Some value added services, including internet access while being connected to a recharging point;
(iii) Plug'n'Charge: automatic vehicle recognition when plugged-in to initiate a charging session, allow billing etc.

For these features to work in a cybersecure way, both recharging points and electric vehicles need to be uniquely identifiable. To enable this, stakeholder are currently working on a framework for and the development of one or more Public Key Infrastructures (PKIs), which are systems for managing digital certificates that are used for securing digital communication. Within the PKI, a trusted authority called Certification Authority (CA) –or Root Certification Authority (Root CA) in case of larger PKIs– issues certificates, which contain information on the owner of a specific key, the validity period of that key, who issued it and the digital signature of the CA to authenticate the key. The keys are subsequently used to encrypt and decode messages between market parties, providing the required security for their communication.

109 Similar concerns were voiced by Eurelectric, see: https://www.eurelectric.org/media/4563/20200709_eurelectric_features_and_implementation_of_iso15118_final-2020-030-0464-01-e-h-330B2A5B.pdf.

Recommendation

As most EV-drivers today already have RFID cards, public authorities should consider to at least require the integration of an RFID card reader or NFC reader capable of reading RFID cards, in the recharging point. Several public authorities require that such a NFC / RFID card reader communicates at a radio frequency of 13,56 MHz and applies NFC Tag 1-functionality according to ISO/IEC 14443A. Since standards for automatic authentication are either proprietary solutions or not yet fully developed, public authorities should not, at this stage, mandate automatic authentication on recharging points. They should however keep an eye on market developments regarding the ISO 15118-20 "Plug and Charge" authentication possibilities.

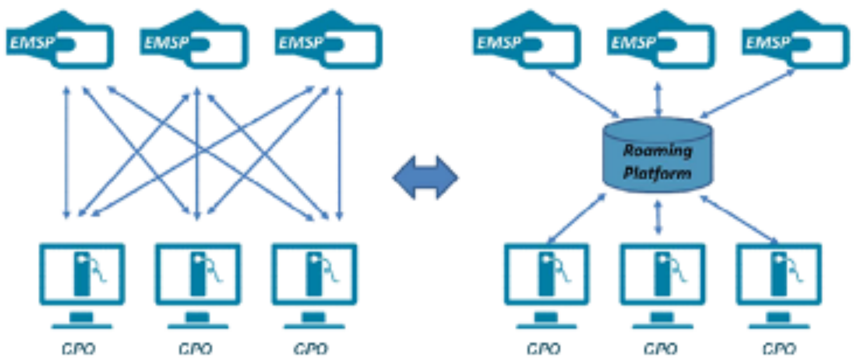
Figure 20: what happens if each city offers its own recharging card?

Source: NOW GmbH

Irrespective of the choice for manual or automatic authentication technologies, in order to allow customers to recharge using their e-mobility contract anywhere, the technology applied by one recharging infrastructure provider must be interoperable with that applied by others. In the absence of such interoperability, islands of connectivity will emerge. This refers to a situation where each CPO/EMSP offers its own RFID card, granting access for its customers to all the recharging points it operates, but not to those operated by others. In order to recharge at the recharging stations of other CPO/EMSPs, the customer will either have to conclude another contract to obtain yet another RFID card (resulting in the accumulation of RFID cards), or charge ad hoc. The latter option is not problematic per se, if ad hoc recharging is made fully convenient for consumers (more on this in section 4.4.4 below) and ad hoc pricing is not discriminatory compared to contract-based pricing (more on this in section 4.4.5 below).

Another means of establishing interoperability, is for one or more CPOs and EMSPs to agree on the use of common standards and communication protocols to facilitate interoperability between their respective software systems. Such interoperability agreements can either be made bilaterally (Peer-to-Peer) or facilitated through intermediary roaming platforms (see Figure 21 below).

Figure 21: peer-to-peer roaming (left) versus roaming via a platform (right)



Source: Province of North-Brabant

4.2.2.3 Communication standards and protocols

Communication protocols

As mentioned above, the easiest way to allow different software systems of different players in the EV charging ecosystem to exchange information, share files and enable mutually supported services –in other words to establish interoperability– is to make them speak the same language.

Currently different standards and communication protocols exist and are used indistinctly in the electromobility market. They cover different functions, from authentication, reservation, billing, roaming, capacity forecasting or smart recharging to the provision of data on recharging points (location, availability, price, etc.) to EMSPs, which ultimately display this information to the user.

Currently, electromobility has entered a new market phase in which the functionalities provided by existing standards and open protocols are expected to converge into official international standards with aggregated features. Today, the following communication domains can be distinguished within the EV charging ecosystem, which are subject to standardisation work:

(i) EV – Recharging point

(ii) Recharging point - Back-end/network management system

(iii) Roaming

(iv) Distributed energy resources

An overview of the most common standards and protocols used for communication exchange between the different ecosystem domains is provided in Table X below.

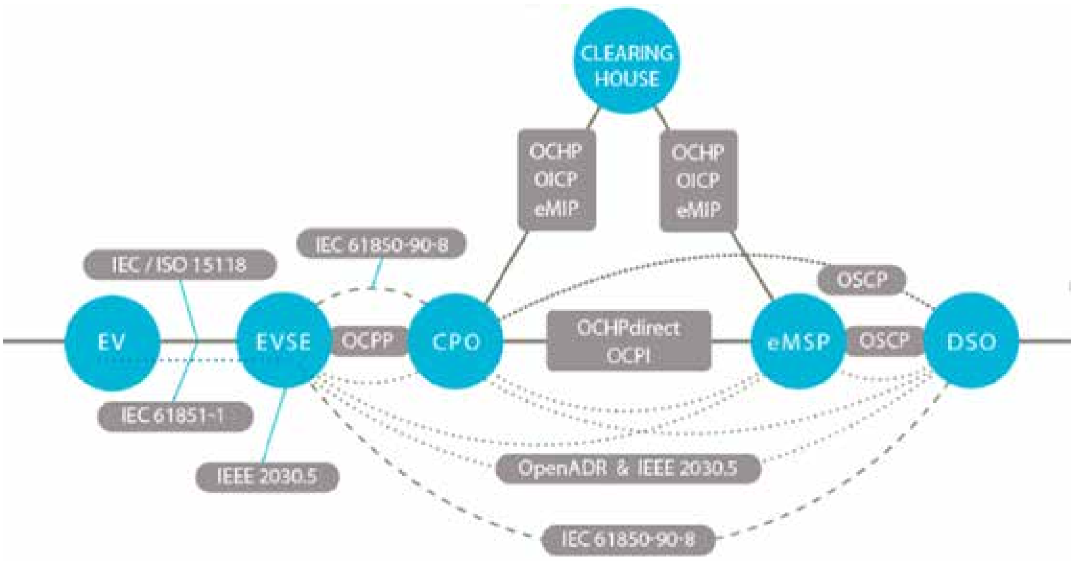
An overview of the most common standards and protocols used for communication exchange between the different ecosystem domains is provided in Table 2 below.

Table 2: Overview of main EV communication domains and relevant protocols/standards

Communication domain	Overview - Use cases of current protocols/standards	
EV – Recharging point	IEC 61851-24	Digital communication between a DC EV recharging station and an electric vehicle for control of DC charging
	ISO 15118	Communication between EV and CPO, authorise charging session, reservation, smart recharging (V2G - future version)
Recharging point - Back-end/ network management system	OCPP	Authorise recharging session, reservation, billing, CPO management, smart recharging
Roaming	OCPI	Authorise recharging session, reservation, billing, roaming, provision of CPO information
	OICP	Authorise recharging session, reservation, billing, roaming, provision of CPO information
	OCHPdirect	Roaming, peer communication between market parties
	eMIP	Authorise recharging session, reservation, billing, roaming, provision of CPO information
Distributed energy resources	OSCP	Smart recharging, grid management, capacity forecast
	OpenADR	Smart recharging, demand response, price and load control
	IEC 61850-90-8	Object models for EVs, smart recharging, integration with other DER types like PV, wind, etc.
	IEEE 2030.5	EV-home energy management system, demand response, exchange of metering data, usage and billing information

An overview of the most common protocols used for communications between the different e-mobility actors is provided in Figure 22 below.

Figure 22: schematic overview of most common emobility communications protocols



Source: ELAAD, EV related protocol study, original study report version 1.1 (2016), available here: https://www.elaad.nl/uploads/files/EV_related_protocol_study_v1.1.pdf.

The overview in Figure 22 dates from 2016 but is still largely relevant.[110] All standards and protocols mentioned in it, are still in use. The market is however converging on the use of certain protocols for certain communications, while certain protocols are increasingly applied also for other communication domains (such as OCPI for CPO to roaming platform communications).

The 2019 STF stakeholder consultation found that an absolute majority of respondents identified ISO 15118, IEC 61851, IEC 63110, OCPP, OCPI and OpenADR in high need for harmonisation within the EV recharging ecosystem. As part of the current work undertaken by international standardisation organizations (ISO, IEC, CEN-CENELEC) a new simplified outlook will be shaped. Based on this work, the following table shows the expected predominant harmonised standards for each of the four main communication domains in the EV charging ecosystem.

110 NB: stakeholders point out the reference to IEC 61851-1 is incorrect and should refer to IEC 61851-24: Standard for digital communication between a DC EV recharging station and an electric vehicle for control of DC charging.

Table 3: Overview of main EV communication domains and possible future harmonisation

Possible Future Harmonized Scenario		
Communication domain	**Standards**	
EV – Recharging point	ISO 15118-20	Vehicle-to-grid communication interface
Recharging point - Back-end/ network management system	IEC 63110	Management of EVs recharging and discharging infrastructures
Roaming	IEC 63119	Governing of information exchange of EV roaming services
Distributed energy resources	IEC 61850	Exchange of information with distributed energy resources

For EV to recharging points communications, only two public authorities responding to the eQuestionnaire explicitly require recharging points to comply with a standard, namely with IEC 61851 (MRA-E and Latvia). As already briefly mentioned in section 4.2.2.2 above, respondents did not require ISO 15118 at this stage: none currently prescribes its use for EV to recharging point communications. This is not surprising as the standard (or at least version '-20') is not yet finalised. The city of Paris however requires that new recharging infrastructure is 'ISO 15118-ready' and can be easily upgraded to this standard, if and when it becomes needed. Also, the German Federal government explicitly recommends its use in its funding calls for a number of reasons[111], with a view to making it a requirement at a later stage. By contrast, MRA-E (Metropolitan Region of Amsterdam) is undecided about ISO 15118, and waiting for clarity on what 'ISO15118 ready' actually encompasses, its use case (will it be supported by all vehicles?) and protection from abuse/lock-in (see the discussion at section 4.2.2.2 above). It is indeed recommended that public authorities keep an eye on developments around ISO 15118; an overview of the current state of progress regarding the different elements of the standard is given in Figure 23.

111 Germany argues that, as an extension of CCS, the ISO 15118-20 standard can be regarded as the prevalent and most advanced standard of its kind in Europe; the power line communications (PLC) this standard offers is a lot more secure than existing RFID cards and the communication via the protocols that are currently in use (including the current version of ISO 15118); this standard offers the user-friendly Plug&Charge function without having to resort to several proprietary systems; the standard offers smart recharging and vehicle-to-grid functionalities that will become necessary in the future; unlike other communication protocols (e.g. CPO to EMSP) it was developed in the process of an international standardisation organisation that was (at least initially) open to every industry player.

Figure 23: Status of adoption of ISO 15118 standard (red is not yet adopted)

ISO 15118	Road vehicles - Vehicle-to-grid communication interface	Adoption
ISO 15118-1:2013 ED1	Part 1: General information and use-case definition	2013-04
ISO 15118-1:2019 ED2	Part 1: General information and use-case definition	2019-06
ISO 15118-2:2014 ED1	Part 2: Network and application protocol requirements	2014-04
ISO 15118-3:2015 ED1	Part 3: Physical and data link layer requirements	2015-03
ISO 15118-4:2018 ED1	Part 4: Network and application protocol conformance test	2018-05
ISO 15118-4 ED2	Part 4: Network and application protocol conformance test	2021-11
ISO 15118-5:2018 ED1	Part 5: Physical and data link layer conformance tests	2018-05
ISO 15118-6:2016 ED1	Part 6: General information and use-case definition for wireless communication	2016-10
ISO 15118-7 ED1	Part 7: Network and application protocol requirements for wireless communication	Unknown
ISO 15118-8 ED2	Part 8: Physical layer and data link layer requirements for wireless communication	2020-12
ISO 15118-8:2018 ED1	Part 8: Physical layer and data link layer requirements for wireless communication	2018-05
ISO 15118-9 ED1	Part 9: Physical and data link layer conformance test for wireless communication	2021-07
ISO 15118-20 ED1	Part 20: Network and application protocol requirements	2H 2021

In-Tech proposed technical requirements for "ISO 15118-ready"

'ISO 15118-ready':

- ISO 15118-3 is fully available – demonstrable by a successful setup of the Powerline Communication connection via SLAC;
- Processor and Memory of the charge controller have sufficient reserves to handle ISO 15118-2 / -20; and
- Hardware Acceleration for Cryptographic Operations needed in ISO 15118 is available
- Integration of a Hardware Security Module (HSM) capable of generating and storing ISO 15118 certificates and keys

For the other protocols, the practice of public authorities is in line with the 2019 STF stakeholder consultation findings, where the imposition of certain protocols tends to favour open, non-proprietary protocols. In some cases this prescription is broad, requiring the mere use of open, non-proprietary protocols. In other cases, public authorities prescribe the use of a specific protocol for certain data communications.

This is certainly the case for recharging point to CPO communications - arguably the most relevant communication domain for contracting authorities - as they may want to ensure that future concessionaires can take over and operate the existing infrastructure without too much cost and hassle. A wide variety of respondents from different cities and regions in Europe currently prescribe OCPP for recharging point to CPO communications, making this communication protocol the de facto standard for recharging point to CPO communications.[112] It is important to note however that, at this stage, market actors indicate that OCPI version 1.6 is a reliable standard, while version OCPP 2.0 is not usable and version v2.0.1 is at this moment only used by a few CPOs, so it may be too early to prescribe its use.

If and when public authorities explicitly prescribe a standard for CPO to EMSP or CPO/EMSP to roaming platform communications, they require the use of OCPI. The number of respondents explicitly requiring the use of OCPI in their tender specifications is however much less significant than for OCPP: only AMB Barcelona, MRA-E and Rotterdam explicitly prescribe it at this moment (while a few others, like Leuven and Amsterdam, require the use of an open protocol for such communications, suggesting the use of OCPI). It can therefore not be concluded, at least not on this basis, that this is becoming a de facto standard for the aforementioned communication domains. An overview of the most commonly used communication protocols for roaming, including their characteristics, is provided in Figure 24 below.

Figure 24: overview of most commonly used communication protocols for roaming

	OCHP	OICP	eMIP	OCPI
Governance	By a non-commercial roaming hub operator	By a commercial roaming hub operator	By a commercial roaming hub operator	By knowledge platform, to be moved to independent board
Accordance to WTO criteria for open standards	Medium-high	Medium	Medium-low	Current: Medium-high Future: High
Supported business models	Both P2P (OCHPdirect) and (any) roaming hub	Only via Hubject roaming hub[24]	Only via GIREVE roaming hub[24]	Both P2P and (any) roaming hub
Other functionalities	To a high degree similar			
Supported Charge Pint information fields	To a high degree similar			

Source: van der Kam M., Bekkers R., Comparative analysis of standardized protocols for EV roaming - Report D6.1 for the evRoaming4EU project, Eindhoven University of Technology, May, 2020[113]

112 This is the case for Antwerp, AMB Barcelona, Dutch cities, Flanders Region, Latvia, Malta, Oslo, Paris and Toulouse.

113 Available here: https://evroaming.org/app/uploads/2020/06/D6.1-Comparative-analysis-of-standardized-protocols-for-EV-roaming.pdf; for a summary see: https://evroaming.org/the-ideal-ev-roaming-protocol/

One respondent argues that the choice of the protocol to enable roaming services should be left to the market parties and provides a number of reasons for this, namely:

(i) Mandating the use of a specific communication protocol for roaming is not advisable, as all are developed by parties with vested interests and none of the protocols have been developed in a process that is truly open to any organisation. While all of them are open in the sense that they are public, their licences state that in order to use the services they have to be used in a certain manner or that additional services at a cost may be added at a later stage.

(ii) Mandating the use of certain P2P protocols (such as OCPI) risks benefitting large market actors with powerful IT and back office capacities to the detriment of competition in the market. Prices for roaming peer-2-peer are not transparent to market actors. Smaller parties might be dissuaded from deploying recharging infrastructure, which may in turn lead to oligopolistic market structures and higher prices for consumers.

A good compromise solution could be to ask for the implementation of 'at least' one specific protocol for roaming communications. Such a requirement would have the benefit of ensuring that all recharging stations use at least one common communication protocol to facilitate roaming agreements, while not precluding the use of additional communication protocols. For these benefits to materialise, public authorities should prescribe the use of a roaming protocol that is not linked to any specific commercial roaming platform, so that it is available to all market players without being obliged to sign up to any specific roaming platform. Moreover, the protocol should ideally support both Peer-2-Peer and platform roaming solutions. Protocols from commercial roaming platforms do not provide this option, leading to a form of lock-in, or at least a bias towards a specific business model, restricting the possibilities for CPOs to connect directly Peer-2-Peer. These were the considerations of the Californian (US) regulator when obliging Charge Point Operators to implement the OCPI communication protocol on their infrastructure.[114]

California: At least one common roaming protocol to facilitate roaming agreements

No later than July 1, 2021, the [CPO] shall meet, at a minimum, and maintain the "California Open Recharging Point Interface Interim Test Procedures for Networked Electric Vehicle Supply Equipment for Level 2 and Direct Current Fast Charge Classes"[115], adopted April 15, 2020, and incorporated by reference herein, for each applicable EVSE. This does not preclude the additional use of other communication protocols.

When respondents indicate to ask for the implementation of a specific standard in their tender specifications, it is not uncommon either to ask for the 'latest version' of such a standard to be implemented, or to require that future updates of the standard are implemented at no additional cost within a maximum period (e.g. one year) from their adoption.

114 See§ 2360.3. Facilitating Roaming Agreements, implemented in the California Code of Regulations on 29 May 2020, with effective date 1 July 2020, see: https://ww2.arb.ca.gov/rulemaking/2019/evse2019

115 Available here: https://ww3.arb.ca.gov/regact/2019/evse2019/appb.pdf

Recommendation

Public authorities must ensure that the communication standards and protocols covering the four main communication domains of the EV recharging ecosystem are interoperable. To achieve this, public authorities will have to closely follow developments regarding the adoption of new standards. Tender specifications should include a requirement that the concessionaire implements the 'latest version' of a standard, or that future updates of a standard are implemented at no additional cost within a maximum period (e.g. one year) from their adoption. For each respective communication domain, the following considerations should be made:

1) **EV – Recharging point**

   While the IEC 61851 standard is currently being mandated in certain tenders, others are gradually moving towards the ISO 15118 standard. It is recommended that public authorities ensure that recharging infrastructure is future-proof and thus require that it contains the necessary hardware and software elements to support an upgrade to ISO 15118, at no extra cost to the contracting authority, when the different parts of the standard are both completed and suitable to the specific recharging use-case.

2) **Recharging point - Back-end/network management system**

   Currently, OCPP is the dominant protocol for this communication domain. Standardisation work is ongoing at IEC level to transpose and harmonise the OCPP and its functionalities into a de iure international standard, IEC 63110, which should be backwards-compatible with OCPP. This convergence process may still take a couple of years. At least until a final, OCPP backwards- compatible version of IEC 63110 becomes available, the use of OCPP should be encouraged for recharging point to back-end communications in upcoming public tenders.

3) **Roaming**

   For communications between CPO to EMSP and CPO/EMSP to roaming platforms, public authorities are strongly encouraged to require the use of open, platform-independent, non-proprietary protocols, that are free to use. Imposing a requirement on CPOs to implement at least one specific protocol for roaming communications - ideally one that is not linked to any specific commercial roaming platform - would have the benefit of ensuring that all recharging stations use at least one common communication protocol to facilitate roaming agreements, while not precluding the use of additional communication protocols. In the future, it is expected that IEC 63119 will harmonise the roaming communication domain - including the interaction between CPOs and EMSPs. On this basis, to avoid costly retrofits in the future, public authorities should ensure that any protocol they choose to prescribe, is upward-compatible with IEC 63119.

4) **Distributed energy resources**

   The communication between CPOs, EMSPs, grid operators, grid users and facility managers is expected to be harmonized under IEC 61850. It is important to note that IEC 61850 works as a data model where different open protocols can be used. This approach differs from common standard conception and responds to the communication needs of power systems.[116] Currently the IEC working group responsible for this standard has finalised and

116 NB: Stakeholders point out that further clarification is needed regarding the interfaces of IEC61850 with other standards as the domain of DER and integration with the power system is quite broad, and thus multiple standards apply.

made available data models for EVs and supply equipment, where others functionalities are under development (distributed energy resources object model, including grid connection function modelling, microgrids, thermal energy). Future tenders should require the use of IEC 61850, and consequently, allow the use of open data models according to the needs of CPOS and DSOs.

In conclusion, it is important to remark that the predominant protocols proposed in these Recommendations correspond to a possible future harmonised scenario over the next 3 to 5 years, as shown in Table 3 above. These scenarios take into account current standardisation works carried out by international standardisation organisations. Until their work is complete and an advanced ecosystem is built up, public authorities should cover the various communication domains with those standards and protocols that best facilitate an open and resilient environment enabling a smooth digital interaction between vehicle, services and customers. The use of open, non-proprietary protocols, that are free to use, fosters the development of the recharging services market as an open and competitive market, with non-discriminatory access to new entrants.

4.2.2.4 E-roaming requirements

Standardising communications between the software systems of the different market actors active in the electromobility market facilitates transactions between them. It does not, however, guarantee their cooperation. Public authorities have come up with a number of further-reaching obligations to overcome this. These can all be categorised as forms of roaming requirements, assuming roaming covers both bilateral (Peer-to-Peer) connections and those established through intermediary clearing houses, commonly referred to as roaming platforms.

In particular, a number of public authorities prescribe either of the following, or a combination of both:

(i) an obligation on CPOs to establish connections with any EMSP who wants to connect to the CPO network;

(ii) an obligation on CPOs to establish a minimum amount of roaming connections (via a clearing house or Peer-to-Peer).

Amsterdam and MRA-E (Metropolitan Region Amsterdam-Electric) require a combination of both in their tender specifications. In particular, the CPO-concessionaire must allow third party (EMSPs) access to recharging points, to provide services on the recharging points (start/stop a session, financial transaction, smart recharging), using a commonly used protocol e.g. OCPI. Similarly, in Berlin every CPO operating a recharging point in the public domain must register it in a central authentication platform managed by the city, offering access to the customers of each EMSP under comparable conditions.

As examples of the latter approach, the following respondents to the eQuestionnaire prescribe a minimum amount of roaming connections: Arnhem, Berlin, Dortmund, Germany, Latvia, Malta, MRA-E, Oslo, Rotterdam, Slovakia, Stuttgart and Toulouse.

E-roaming requirements in Slovakia and Oslo

Slovakia: Within three months of the commissioning of the recharging points, they must be connected to any roaming platforms that connect more than 80 operators.

Oslo: the City has an open policy for sharing with third parties. Roaming companies must however cover the actual cost for connecting.

Their reasons include ensuring that consumers are able to recharge in other networks than those of his CPO/EMSP, ensuring that consumers can recharge anywhere (in the same city) using the same card, opening the network of recharging infrastructure to as many consumers as possible and attracting foreign customers. It should be mentioned that a number of CPOs/EMSPs contributing to these Recommendations equally support that public tendering specifications require a minimum level of roaming with market players, without, however, mandating the way in which roaming is implemented (Peer-to-Peer or via a clearing house).

Recommendation

Public authorities should require that the CPO-concessionaire allows non-discriminatory third party (EMSPs) access to its recharging points, so third party-EMSPs can offer their customers services on these recharging points (start/stop a session, financial transaction, smart recharging). Moreover, this requirement should be complemented by an obligation on the CPO-concessionaire to establish a minimum amount of roaming connections, without, however, mandating the way in which roaming is implemented (Peer-to-Peer or via a clearing house).

4.3 Future-proof infrastructure

As electric vehicles and the required recharging infrastructure are relatively new technologies, a lot of development is likely to happen in the decades to come. Since recharging points are made to last a decade or longer, the recharging points that public authorities choose to install should be future-proof. This requires not only that recharging points are state-of-art today, but also that they can be easily configured to future standards, should these arise.

Some potential future developments that public authorities should consider are:

- higher power levels of recharging points and higher energy-capacity vehicles;
- hardware updates, e.g. to enable higher power levels (especially for high power recharging points);
- software updates;
- the development of DC ‘normal power’ recharging solutions;
- ‘smart’ recharging (commonly referred to as smart charging) and V2G;
- inductive recharging; and
- in-motion recharging or electric road systems.

Some of these future technologies or capabilities are still in a test phase and should not necessarily be required in large-scale tenders, as they could drastically increase costs and thereby slow down infrastructure deployment. An option could be to organise smaller scale demonstration projects through separate tenders.

4.3.1 Higher power levels of recharging points and higher energy-capacity vehicles

As already discussed in section 2.3.1.4, electricity can be provided to EVs at various power levels. In view of the fast increasing power levels of what is now defined as ‘high power recharging points’ under the Alternative Fuels Infrastructure Directive (P >= 22kW), a reorganisation of the categories of recharging points is being suggested, with the introduction of several new categories (see Table 1 in section 2.3.1.4). For example, different CPOs are currently deploying recharging points with an installed capacity of 350 kW. Furthermore, tests are already being carried out with even higher capacities of up to 1 MW. Such power levels will likely enable electric trucks to opportunity-recharge on their trajectories: by way of example, a truck could recharge about 300 km of range at a 1 MW recharging point in about half an hour.

At the same time, batteries are becoming increasingly powerful, energy-dense and energy-efficient. According to Bloomberg, new EV battery chemistries are being adopted faster than in the past. Around 2023, lithium nickel manganese cobalt aluminum oxide (NMCA) will start to enter the EV market: this provides higher energy densities and a longer cycle life than the equivalent NMC or NCA material.[117] Taken together with the falling costs of the batteries and better (battery and vehicle) design approaches, electric vehicles can be expected to have increasingly longer ranges, reducing the need for regular recharges.

These fast - evolving technological developments will have significant impacts on the recharging needs and behaviour of EV-users. With more performant batteries offering longer range and higher power recharging infrastructure available, it is not unthinkable that the recharging behaviour of EV-users will increasingly replicate the refuelling behaviour of conventional ICE-drivers.

4.3.2 Smart (re)charging

In most cases, electric vehicles are recharged from the moment they are connected to the recharging point. This means that there is a large peak in demand when many vehicles are connected to the electricity network more or less at the same time. As the current electricity grid is in many cases not capable of meeting such high demands, it would eventually have to be reinforced in many locations. This leads to higher system costs. Moreover, it may potentially result in a less sustainable energy supply as energy supply from solar and wind does not necessarily peak at the same moment as demand, resulting in the need to generate electricity in more conventional ways, with nuclear, gas or even coal power plants. In many cases cars are parked longer than the minimum time required to recharge sufficient electricity for the future trip. In those cases, it would not be necessary to recharge the vehicle imminently, but it is good enough if, for example, the vehicle is fully recharged the next morning. This offers flexibility to the recharging process, which can be used to limit peak demand for instance around the time when people come home from work by deferring recharging to a period with less electricity demand. Such spreading of electricity demand over a longer period of time will ultimately reduce the need for an enforced electricity grid and potentially increase the use of sustainably generated electricity, by allowing to better align electricity demand with supply.

'Smart (re)charging' (or controlled recharging) is a term used for techniques that manage the energy supply to recharge electric appliances and vehicles in such a way that the peaks in network load are reduced and possibly the best use is made of available sustainably generated electricity (see schematic example in Figure 25). This can be done in different ways and with different degrees of complexity. In a simple form, this means that the recharging session of certain coupled vehicles is temporarily postponed, interrupted or the power level altered - for instance driven by electricity market price signals.

Smart (re)charging can be managed manually by customers or through different degrees of automated control by optimisation platforms

117 Bloomberg Electric Vehicle Outlook 2020, available here: https://about.bnef.com/electric-vehicle-outlook/

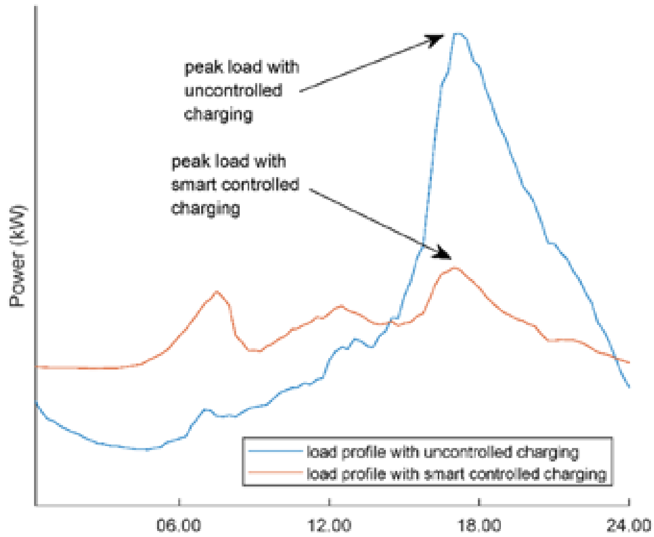


Figure 25: Schematic outline of daily load profiles with and without shifting EV charging load in time. The arrows point out peak loads. The difference between the pointed out peak loads is the amount of peak power reduced.

Source: Reza Fachrizal and Joakim Munkhammar, Improved Photovoltaic Self-Consumption in Residential Buildings with Distributed and Centralized Smart Charging of Electric Vehicles, Energies 2020, 13(5), 1153; https://doi.org/10.3390/en13051153

/ aggregators. The use of interactive technology increases consumer savings, for example by recharging EVs at cheaper hours. A key condition however is that time-varying price signals - reflecting availability of cheaper energy and/or spare capacity on the grid - arrive at the recharging point to encourage customers to adapt their recharging behaviour. As a consequence, recharging infrastructure needs to be able to accurately measure and communicate the EVs' consumption.

In a more complex form, the vehicle battery can be used as a buffer in the energy system, which can be recharged when there is excess (renewable) electricity and discharged when more electricity is needed than is generated in other parts of the electricity network (referred to below as Vehicle-to-Grid, V2G).

Smart (re)charging requires the inclusion of a smart controller in the recharging point and back office with power steering algorithms, which must be standardised. Moreover, it requires compatibility and communication between recharging points, the electricity grid and the vehicles. In order for this communication to work effectively - independent of the specific CPO, vehicle manufacturer or recharging infrastructure developer - standards are required. Such standards should allow for an effective integration of EVs into the smart grid and should prevent any vendor lock-in by proprietary solutions.[118] Currently, international standards and communication protocols for smart recharging have not yet been fully developed. However some applicable standards are already available and more are in late stages of development (see also Table 4 below and section 4.2.2.3).

118 Electric vehicle smart charging: The key to a renewable and stable grid. ECOS. March 2020; available here: https://ecostandard.org/wp-content/uploads/2020/04/ECOS-BRIEFING-SMART-CHARGING-HR.pdf

Table 4: overview of smart (re)charging standards and current status

Code	Title	Application	Development
IEC 61851	Electric Vehicle Conductive Charging System	Safety requirements for charging with plugs and cables (AC or DC) and the basic communication between the charging station and the EV	Published
ISO 15118-2	Road vehicles — Vehicle-to- grid communication interface	Detailed communication between an EV (battery EV or a plug-in hybrid EV) and a charging station	Currently under review
ISO 15118-20	Road vehicles — Vehicle-to-grid communication interface – Part 20 : 2nd generation network and application protocol requirements	High-level communication between a charging station and an EV for the control of charging services	To be published at the end of 2020[119]
IEC 61851-23/24	Electric vehicle conductive charging system - Part 24: Digital communication between a DC EV charging station and an electric vehicle for control of DC charging	High-level communication between a charging station and an EV for the DC smart (re)charging services IEC61851-1 : AC smart (re)charging	Currently under review and to be published in mid- 2021, The CHAdeMO protocol based on which Ed2 discusses V2X was already published in 2014
EC 63110	Management of Electric Vehicles charging and discharging infrastructures	Remote management of charging stations by charging station operators and their integration with energy management systems	To be published in mid-2021
IEC 63119	Charging Service Providers	Roaming and payment in the context of EV charging services	To be published in 2022
EN 50549	Requirements for generating plants to be connected in parallel with distribution networks	Definition of technical requirements for the protection functions and the operational capabilities for generating plants	Published
EN 50491-12-2	Smart Grid interface and framework for Customer Energy Management	Management of power flows inside buildings, including exchanges with EV charging	To be published in 2021

Source: ECOS, Electric vehicle smart charging: The key to a renewable and stable grid, p. 7; IEC 61851-23/24 standard added at request of Eurelectric

119 This timeline is expected to be delayed at least until mid 2021.

Most respondents to the eQuestionnaire indicate that they require in their tender specifications that the recharging infrastructure is 'smart-charging ready', without however, defining this requirement at great length. According to MRA-E (Metropolitan Region Amsterdam-Electric) the basics would be: a smart meter and a controller that communicates using OCPP 1.6 (or a more recent version of that standard). In this respect, in the UK the 'Automated and electric vehicles (AEV) act 2018' gives government the powers to mandate, through secondary legislation, that all recharging points sold or installed in the UK must have smart functionality. The adoption of such secondary legislation is currently being prepared.[120]

4.3.3 Vehicle2Grid

Renewable energy sources such as wind and solar are less 'manageable' than fossil fuels in terms of where and when electricity is generated. This may lead to imbalances in supply and demand of energy. Storing electric energy in batteries at times when more is generated than required and using the stored energy when the situation is the other way around, could be (part of) the solution to this challenge. Car batteries could be used for this purpose at the time that they are connected to an energy generating or energy demanding unit.[121] This principle is also referred to as 'Vehicle-2-Everyting' or V2X. V2X is a collective name for the following technologies:

- Vehicle-to-Grid (V2G): Using an electric vehicle (EV) battery to interact with the electricity grid, both in charging and discharging modes. This is different from smart recharging (only) approaches and includes bidding electricity to ancillary service markets to make the grid stable and participating in the energy market, where possible;
- Vehicle-to-Building (V2B): Using EV batteries to optimise local building energy consumption and generation;
- Vehicle-to-Home (V2H): Optimising home energy consumption and generation or using EVs as emergency back-up power; and
- Vehicle-to-Load (V2L): Any other instance of an EV battery providing energy to a load.[122]

Potentially, large-scale use of this technology - for example by aggregating many EV batteries and managing their discharging - can reduce the burden on the electricity network, which leads to lower network reinforcement costs, better exploiting of existing grid capacities and reduced system costs overall, in particular by providing local flexibility. This is especially suitable for fleets, including public service fleets, to optimise the energy use without overloading the grid while helping to support the integration of renewable energy sources (RES) in the grid, which can potentially lead to financial rewards to compensate the more expensive initial investments in the DC bi-directional recharging points. Currently, recharging points offering V2G possibilities are still relatively costly compared to their benefits, in particular due to the limited volume. With mass-uptake of EVs, the benefits of such technologies may however become larger.

Some respondents to the eQuestionnaire indicate that they require in their tender specifications that the recharging infrastructure is V2G- or 'bi- directional-recharging ready', again however, without providing much detail on the specifics of this requirement. ELAAD is currently developing a paper in conjunction with interested stakeholders to flesh these out.

120 See: https://www.gov.uk/government/consultations/electric-vehicle-smart-charging/public-feedback/electric-vehicle-smart-charging-consultation-summary-of-responses

121 See for instance: B. De Brey, Smart Solar Charging: Bi-Directional AC Charging (V2G) in the Netherlands, available here: http://www.davidpublisher.org/Public/uploads/Contribute/597afe6907a12.pdf.

122 Thompson, A. W. (2018, August 31). Economic implications of lithium ion battery degradation for Vehicle-to-Grid (V2X) services. Journal of Power Sources. Elsevier. https://doi.org/10.1016/j.jpowsour.2018.06.053.

ELAAD: ISO 15118 V2G-ready

ELAAD's set of standard tender specifications for Dutch municipalities and regions includes the following requirement:

"At the latest one year after at least 2 car brands support vehicle-to-grid via ISO 15118 in vehicles that are commercially available in the Netherlands, the aforementioned standard shall be implemented [in the recharging stations of the concessionaire] and smart recharging/vehicle-to-grid shall be available via this protocol and associated hardware." [123]

4.3.4 Inductive recharging

Currently, most EVs must be physically connected to recharging infrastructure to recharge. Such connection can be made using electricity cables or pantographs. However, some electric vehicles can already be recharged wireless or inductively.[124] In this case, the recharging system is installed under or just above ground and the electrical energy is supplied to the vehicle via induction. This does not require a physical connection such as a cable. Inductive recharging therefore has a number of advantages - in particular in an urban context - mainly the limited visual pollution and occupancy of public space. Moreover, inductive recharging could be perceived as more user-friendly, as the EV-user would have to engage in fewer operations to recharge (no need to connect and disconnect the vehicle).

Although inductive recharging is already commercially available, the technology is certainly not yet ready to replace the known recharging poles. Reasons for this are:

- higher costs (investment and maintenance);
- higher energy losses with inductive charging;
- lack of standardisation/interoperability between cars and recharging systems;
- complexity and costs for installing underground infrastructure.

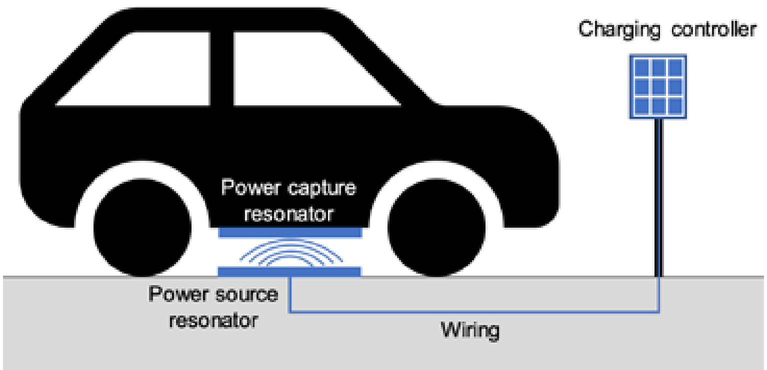


Figure 26: Schematic overview of an inductive recharging system

123 Translated from Dutch: "Maximaal één jaar nadat tenminste 2 automerken vehicle-to-grid via ISO 15118 ondersteunen middels voertuigen die commercieel beschikbaar zijn in Nederland dient ISO15118 geïmplementeerd te zijn en Smart Charging/vehicle-to-grid via dit protocol en bijbehorende hardware toegepast kunnen worden."

124 See for instance: https://www.press.bmwgroup.com/global/article/detail/T0281369EN/charging-even-easier-than-refuelling?language=en.

Inductive recharging can be used both to recharge stationary vehicles (see Figure 26 above) or for vehicles in motion (see section 4.3.3 below).

Few respondents to the eQuestionnaire indicate that they have organised tenders for wireless recharging infrastructure. This is currently only for small-scale roll-out/demonstration projects, for innovation purposes or for specific applications. For instance, the city of Oslo tendered wireless or inductive recharging infrastructure for taxis.

4.3.5 In-motion recharging or electric road systems

There are three primary solutions that are theoretically possible with respect to electric road system, namely:

(i) Overhead conductive technology (catenary system): catenaries hanging over a lane of a road and connecting to vehicles via a pantograph installed on the vehicle;

(ii) Dynamic on-road conductive technology (CPT): contact rail is built into road's surface, providing power via physical pick-up;

(iii) Inductive power transfer (IPT): wireless power transfer from coils built into the road to a pick-up point in the vehicle.[125]

The most important advantages of in-motion recharging are that:

- vehicles can be configured with a much smaller battery, which leads to lower costs, lower energy consumption, less weight (due to the high weight of batteries) and less space than (large) batteries within the vehicle;
- vehicles do not lose time being stationary to recharge; and
- electricity can be provided to vehicles gradually, at lower power levels, avoiding the deployment of costly ultra-high power recharging infrastructure (P >= 1 MW) and decentralised high peak demands from such infrastructure.

Since loss of time and vehicle weight and space are especially costly for commercial vehicles, and ultra-high power recharging infrastructure (P >= 1 MW) would be deployed solely to recharge long-distance heavy-duty vehicles, these in-motion recharging systems are particularly interesting for those types of vehicles. However, even though the primary use case would be for heavy-duty vehicles, both conductive and inductive electric road systems could gradually also become used by passenger cars and vans.

In-motion recharging is not a new technology. For instance, trolleybuses have been operating for decades in a number of European cities. These buses are supplied with electrical energy via overhead wires while in motion. Currently, new types of in-motion recharging systems are being tested throughout Europe. In May 2019 a stretch of road was opened in Germany on the A5 motorway south of Frankfurt, the right-hand lane of which is equipped with an overhead line over a length of ten kilometres: the eHighway. Trucks can drive up to 90 km/h under the lines to recharge their batteries. The capacity with which the vehicles are charged is 200 kW.

Secondly a trial is currently being carried out in Sweden in which the road between Arlanda

125 Ricardo 'Zero Emission HGV Infrastructure Requirements', ref. Ricardo/ED12387/Final Report/Issue Number 5, section 2.4, page 21; available here: https://d423d1558e1d71897434.b-cdn.net/wp-content/uploads/2019/05/Zero-Emission-HGV-Infrastructure-Requirements-Ricardo-Energy-and-Environment.pdf

near Stockholm and a two-kilometre-long freight centre is equipped with an electric rail. This has been incorporated into the road. On this road a converted truck will drive with a towing contact underneath the vehicle. Also in this system the vehicles will be provided with 200 kW power while driving.

Figure 27: eRoadArlanda in Sweden (left) eHighway in Germany (right)

Source: www.eroadarlanda.com (left) and eHighwayInnovative electric road freight transport (www.siemens.com/mobility) (right)

Recommendation

TAs electric vehicles and the required recharging infrastructure are relatively new technologies, a lot of (technological) developments will likely take place in the decades to come. Since recharging points are made to last a decade or longer, publicly accessible recharging points should be future-proof. This requires not only that they are state-of-art today, but also that they can be easily configured to future standards, should these arise.

The most important technological developments to keep an eye on are:

(i) higher power levels and more energy-dense batteries: ever faster recharging times and ever higher energy-dense batteries could have significant impacts on the recharging needs and behaviour of EV-users, potentially increasingly replicating the refuelling patterns of conventional ICE-vehicles;

(ii) ‘smart’ recharging (commonly referred to as smart charging) and V2G: smart (re)charging’ (or controlled recharging) is a term used for techniques that manage the energy supply to recharge electric appliances and vehicles in such a way that the peaks in network load are reduced and possibly the best use is made of available sustainably generated electricity (see schematic example in Figure 25). In a simple form, this means that the recharging session of certain coupled vehicles is temporarily postponed, interrupted or the power level altered - for instance driven by electricity market price signals. In a more complex form, the vehicle battery can be used as a buffer in the energy system, which can be recharged when there is excess (renewable) electricity and discharged when more electricity is needed than is generated in other parts of the electricity network (referred to as Vehicle-to-Grid or V2G). Public authorities should require that all publicly accessible recharging points are at least 'smart charging ready'. This requires the inclusion of a smart controller in the recharging point and back office with power steering algorithms (which must still be harmonised).

(iii) inductive or wireless recharging: while currently most EVs must be physically connected to recharging infrastructure to recharge, some electric vehicles can already be recharged wireless or inductively. In this case, the recharging system is installed under or just above ground and the electrical energy is supplied to the vehicle via induction. In an urban context, this could have major advantages in limiting visual pollution and occupancy of public space. Moreover, inductive recharging could be perceived as more user-friendly, as the EV-user would have to engage in fewer operations to recharge (no need to connect and disconnect the vehicle).

4.4 User-friendly infrastructure

4.4.1 Finding infrastructure

4.4.1.1 Collecting and providing static and dynamic data

The Alternative Fuels Infrastructure Directive provides in Article 7(7) that, "Member States shall ensure that, when available, the data indicating the geographic location of the [publicly accessible alternative fuels] refuelling and recharging points […] are accessible on an open and non-discriminatory basis to all users. For recharging points, such data, when available, may include information on real time accessibility as well as historical and real time charging information."

This provision is complemented by the provisions of the Intelligent Transport Systems (ITS) Delegated Regulation (EU) 2015/962 on Real Time Traffic Information Services[126] and ITS Delegated Regulation (EU) 2017 on Multimodal Travel Information Services, both adopted under the ITS Directive (Directive 2010/40/EU). The ITS Directive and these Delegated Regulations contain some minimum requirements regarding the sharing of certain static and dynamic road and traffic data, including some static and dynamic data regarding alternative fuels infrastructure.[127] They for instance require that certain static and dynamic data regarding alternative fuels infrastructure must be made accessible in Datex II (CEN/TS 16157) format (or relevant upgrades of that standard) online, at least through the relevant National Access Point.[128]

The Commission is supporting Member State implementation of the ITS Directive and its

126 The Commission is currently examining whether this Delegate Regulation should be clarified or complemented, in particular to make it easier for consumers to find alternative fuels infrastructure, and to use it more efficiently.

127 For the purposes of this chapter static and dynamic data have the meaning given to them in the ITS Directive, namely 'static data' means data that do not change at all or do not change often, such as location data, whereas 'dynamic data' are data that change often or on a regular basis, such as availability data.

128 An overview of national access points is available here: https://ec.europa.eu/transport/sites/transport/files/its-national-access-points.pdf

Delegated Regulations in the field of alternative fuels infrastructure through a CEF Programme Support Action (PSA) entitled “Data collection related to recharging/refuelling points for alternative fuels and the unique identification codes related to e-Mobility actors”. This PSA firstly supports Member States in collecting and making available – through national or common access points – static and dynamic data regarding alternative fuels recharging / refuelling infrastructure. Secondly, it helps Member States in setting up an effective, EU-wide system based on mutual recognition to assign unique identification codes to recharging points, CPOs and EMSPs.

In the context of this PSA, several Member States have started developing legislation obliging CPOs to provide certain static and dynamic data to their National Access Points.

Contracting authorities are in a perfect position to facilitate this process bottom-up: they can require the provision of the aforementioned static and dynamic data as part of their tender specifications.

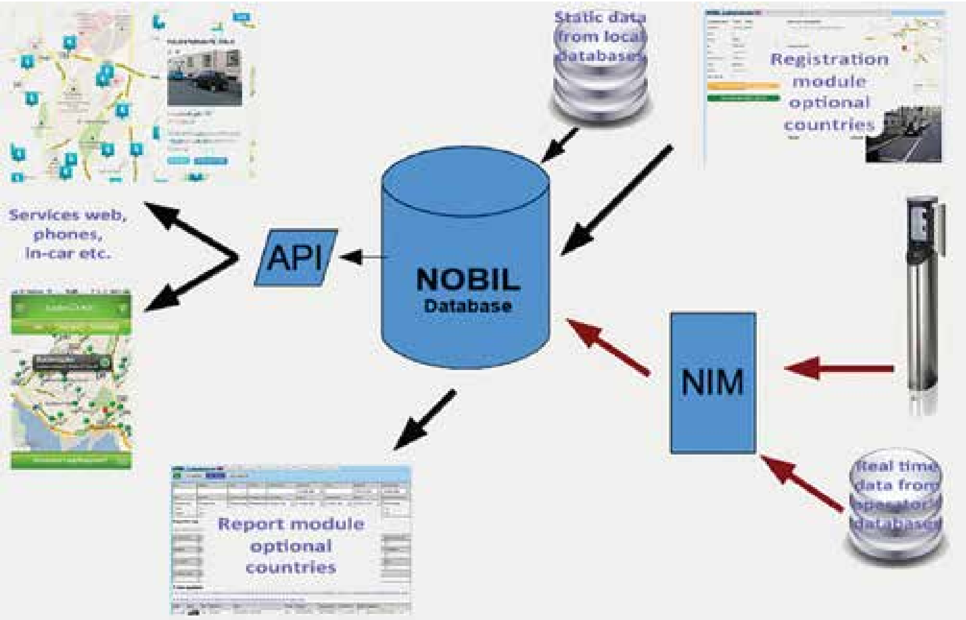
Now why is this important? Range anxiety (the fear of not being able to drive long distances, e.g. for holiday travel, with an electric vehicle) and charge anxiety (the fear of not finding a recharging point) are consistently named in the top three reasons for consumers to not buy an electric vehicle - behind the price of such a car compared to an ICE vehicle.[129] In particular in the transition phase, it is crucial to demonstrate that sufficient recharging infrastructure is available to convince consumers to buy an electric vehicle. Digital maps that display all the recharging points available to EV-users can help to build that confidence. Besides, such maps are quintessential for EV-drivers to find recharging infrastructure when needed. This is true in not only the early stages of market development, when recharging infrastructure is still relatively scarce, but also later, taking account of the recent tendencies of urban planners to confine recharging infrastructure to off-street locations, which cannot readily be found without routing. Also, navigation services can help to plan routes for electric vehicles efficiently, taking into account the availability of recharging infrastructure towards the destination.

In both cases, the comprehensiveness and quality (up-to-date) of the recharging maps and supporting data will be key. The more infrastructure is displayed on the maps, the greater confidence will be inspired in potential EV-consumers and the more options existing EV-drivers will have to recharge their vehicle. The latter is also a matter of competition policy: it is still common practice for CPOs/ EMSPs to provide their own smartphone recharging application to their consumers, with an integrated recharging map. Such maps very often only display the recharging stations operated by that CPO/EMSP or operated by other CPOs/EMSPs with whom the CPO/ EMSP providing the app has a contractual agreement in place. This gives those CPOs/ EMSPs - and in particular larger CPOs/EMSPs with a large consumer base - strong bargaining power compared to smaller CPOs who want to see their recharging points integrated in the map offered by the competing CPO/ EMSP. Similar concerns exist in relation to on-board navigation systems, which now also integrate recharging points and plan journeys according to their availability. Questions arise as to the comprehensiveness of such maps (do they include all recharging points or exclude competitors?) as well as the choices made by their underlying algorithms in terms of journey planning (do they have preferential partners/ routing?). These risks of market power and anti-competitive behaviour can however be avoided to a large extent, by means of an obligation on all Charge Point Operators to make their data public. In this case, public

129 See for instance: Joint Research Centre (JRC) 2017 Report ‘Quantifying the factors influencing people’s car type choices in Europe’, p. 14; available here: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC109452/kjna28975enn.pdf

authorities consolidate all recharging point data and make it available freely to all interested parties for re-use. This is exactly the choice Norway made when it set up the NOBIL database, managed by the Norwegian EV-drivers association.[130] NOBIL only collects and reports recharging point data, but is in no way active in the recharging services market (e.g. it does not offer booking and payment services): in other words, it has no conflict of interest. Some EU cities have equally set up such an independent data platform (see example Berlin).

Figure 28: functioning of the NOBIL database



Source: NOBIL (https://info.nobil.no/eng)

Data communication obligations: Germany

In Germany, CPOs are generally obliged to transmit certain static data to the regulator (Federal Grid Agency, Bundesnetzagentur) electronically or in writing at least four weeks before deploying any recharging infrastructure. The regulator then makes the data available on its webpage in the form of xlsx and csv-files and offers a publicly available recharging infrastructure map.

The city of Berlin has set up a CPO independent information platform, operated by the city, with static and dynamic information on recharging infrastructure in Berlin.

130 https://info.nobil.no/eng

To be sure: the location of recharging points (GNSS coordinates, address) is not the only static data (i.e. data that does not change after being recorded) that is important to EV-drivers. Other important static data include:

- opening hours
- maximum power offered (AC/DC, kW, voltage range, maximum current)
- available connectors (plugs, sockets, induction plate, battery swapping)
- available authentication and payment methods
- identification of the owner/operator
- possibly: roaming options
- possibly: source of electricity offered (renewable or not)
- target groups (at least 6 categories based on UNECE standards):
  - Cars and vans (M1 + N1),
  - Buses (M2 + M3),
  - Trucks (N2 + N3),
  - Light electric vehicles (L)
  - Agricultural and forestry vehicles (T)
  - Other

Moreover, particularly in the early market phase when infrastructure is not abundant, EV-drivers will want to know whether a recharging point is actually technically available (i.e. not out of order). And at the same time, they will want to know whether it is not already in use, in particular in the case of normal power (slow) recharging infrastructure. The provision of those types of dynamic data (i.e. data that may change after it is recorded, and has to be continually updated) to EV-drivers is therefore particularly important in urban areas, where most infrastructure is normal power recharging infrastructure. The importance of finding infrastructure that is actually available, will moreover only grow as the amount of EVs on the EU's roads increases.

Besides (technical) availability, there is another set of dynamic data that is important for EV-drivers: data on pricing. This can encompass both the ad hoc price payable at a given recharging station, or the contract price payable at the same (in the latter case, such data can only be provided by the EV-driver's EMSP of choice). The provision to consumers of data on recharging prices can be compared in importance for the development of the recharging market as a competitive market, with the provision of data on recharging point locations. If an EV-user does not know what he will actually pay at any given recharging point before he actually drives to it, he cannot make an informed decision about his next recharge. In other words, his choice will be based on factors other than price, such as the vicinity of the recharging point, recharging speed, etc. – assuming those data are indeed available. This lack of price transparency is one of the most frequent complaints of EV-drivers (more on this in section 4.4.6 below).[131]

However, the solution is simple: an obligation on all Charge Point Operators to make their ad hoc prices publicly available.

Moreover, in this fast-evolving market environment, public authorities should leave sufficient flexibility to revise, at regular intervals, the types of static and dynamic data CPOs should make available to them, to satisfy user needs. As an example of such changing user needs, there is an increasing demand to know the source (renewable or not) of the electricity provided at recharging points.

The next challenge is to ensure that all those data are communicated to all consumers equally, thereby laying the foundations for a competitive electromobility market, with

131 See for instance this ADAC (DE) study: https://www.adac.de/rund-ums-fahrzeug/tests/elektromobilitaet/e-ladesaeulen/ or this AFIREV (FR) study:

an equal level-playing field for all market actors. In this respect, there could be a role for the public sector to consolidate such data and make it available freely to all interested parties for re-use. Failing such common data layer, companies that act as gatekeepers to the consumers (such as digital map providers) could selectively display certain data while leaving out others, thereby limiting consumer choice and effectively foreclosing the market to certain market actors.

Malta: detailed requirements for Network Management System (NMS)

The provider of the software should provide customised smart phone applications for users to have everything they need to find, book, and unlock a recharging station suitable for their vehicle. All data on infrastructure and pricing offers that the operator inserts in his back office should be available in real time in the user interface and vice versa; all data or bookings entered by the users are automatically transmitted to the operator's backend system.

Responses to the eQuestionnaire indicate that a large majority of respondents do indeed require the transmission of (some or all) of the above static data in their tender specifications.[132] Although less than for static data, a majority of respondents to the eQuestionnaire also include provisions in their tender specifications requiring CPOs to transmit dynamic recharging data to them.[133] Reasons for requiring the transmission of dynamic data include network planning (see sections 2.4.1.1 and 2.4.1.2 above), network uptime and maintenance monitoring (see section 4.4.2.1 below) and, as suggested here above, adequately informing consumers. Requirements on the frequency of static data transmission range from once a day to once a year; only Germany indicated to have a general obligation in place for CPOs to transmit certain static data on publicly accessible recharging points to the Regulator before being allowed to operate such infrastructure (see box data communication obligations in Germany). For the transmission of dynamic data, the requirement is either to transmit it in real time, or in (monthly/quarterly) reports. It is not uncommon for public authorities to explicitly specify in their tender specifications that they have and retain ownership of the data generated by the tendered recharging infrastructure at all times. This allows them to store the data on a platform managed in-house and to use it at will.

At which interval should the data be transmitted?

- Amsterdam wants visibility (in XML, SOAP, HTTPS and TCP/IP format) on availability of all recharging points individually, with max 30seconds delay (from real time)
- Norway requires real time connection and reporting to the public recharging point database NOBIL
- Madrid asks CPOs to provide information on the situation of the recharging infrastructure in real time, to adequately meet demand and to allow optimum use of the grid.

http://www.avere-france.org/Site/Article/?article_id=7741.

132 This is the case for 26 out of 30 useful responses to this question, or 86% of respondents.

133 This is the case for 18 out of 27 useful responses to this question, or 67% of respondents.

As to the type of data that should be transmitted to the contracting authority, the detail of requirements in Dutch tender specifications (e.g. Amsterdam, Rotterdam and Arnhem) is noteworthy, and goes much beyond the above list of static data. It additionally includes, for instance: type of recharging location (charging hub, off-street, ...), detailed recharging session data (e.g. maximum charging rate during the session), accessibility (public, semi-public, private), type of parking lot (horizontal/vertical to road, ...), smart (re)charging enabled, etc.

Moreover, besides certain Dutch public authorities (Amsterdam and Rotterdam), only Madrid indicated to require the transmission of ad hoc price data. This may however be a consequence of many public authorities setting a fixed ad hoc price in their tender requirements (more on this in section 3.4.6 above).

More detailed information on the tender requirements in terms of data rights and ownership is provided in section 4.5 below.

Recommendation

Public authorities should include in their tender specifications an obligation on CPOs to transmit at least the following static and dynamic data to them, in real time (only in case of changes for static data):

- location (address, GNSS coordinates)
- opening hours
- maximum power offered (AC/DC, kW, voltage range, maximum current)
- available connectors (plugs, sockets, induction plate, battery swapping)
- available authentication and payment methods
- identification of the owner/operator
- technical availability (in service/out of order)
- occupation status (occupied/available)
- price for recharging (ad hoc price)

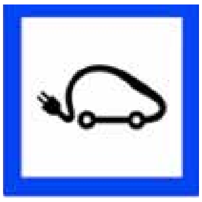
Moreover, public authorities should require strict compliance with the requirements of Directive 2010/40/EU on Intelligent Transport Systems and subsequent delegated and implementing acts - in particular Commission delegated Regulation (EU) 2015/962 and delegated Commission Regulation (EU) 2017/1926/EU. This includes the requirement that certain static and dynamic data regarding recharging points are made accessible in Datex II (CEN/TS 16157) format (or relevant upgrades of that standard) online, at least through the relevant National Access Point.

4.4.1.2 Road signs and graphical displays

Another way to facilitate the finding of recharging points, is to equip roads with clearly visible and easily recognisable signposting towards recharging points. Such signposting may make use of graphical displays, as shown on the examples below:

Germany

France



Denmark

Slovenia

But also, clearly visible and easily recognisable road markings and signposts at the recharging location may be appropriate to identify parking lots that are reserved for recharging electric vehicles, as shown in the examples below:

Barcelona

City of Ghent (off-street parking sign)

City of Antwerp (on-street parking sign)

The Netherlands

Public authorities can require that these road markings and signpostings are supplied by the concessionaire. Arnhem for example, requires the equipment of each recharging location with at least one signpost - if possible attached to existing street infrastructure such as lighting posts - as a precondition to start operating the recharging points of the respective location.

Recommendation
Public authorities should equip roads with clearly visible and easily recognisable signposting towards recharging points. Similarly, they should clearly mark parking lots that are reserved for recharging electric vehicles. Obligations could be imposed on concessionaires.

4.4.2 Performance requirements

Even if users are in the best case informed in advance about the technical downtime of recharging points, public authorities may want to avoid such downtime altogether. This is particularly true in areas where recharging infrastructure is still scarce, and users have little alternatives to recharging points that are out of order.

There are two types of maintenance: preventive maintenance (ex ante) and corrective maintenance (ex post). Proper preventive maintenance by the Charge Point Operators can reduce the need for corrective maintenance/repairs to a minimum.

Amsterdam: full cycle of quality of equipment testing/maintenance

- **General quality requirements:** recharging point including its base is designed for low maintenance erection in outdoor space during 10 years.
- **Testing of equipment:** factory acceptance test (by independent third party) + site acceptance test
- **Uptime requirements:** 99% uptime on monthly basis; with max 3 failures per month
- **Support service requirements:** 24h support service + failures must be corrected within 24h, with two exceptions:
  - It must be possible to stop a recharging session and uncouple the plug from a distance (so immediately when the user calls)
  - failures where a user cannot connect or disconnect his vehicle or where there is a risk to safety, must be solved within 2h of notification
- **Preventive maintenance requirements:** minimum every 6 months

4.4.2.1 Preventive maintenance and minimum uptime

As it is difficult for public authorities to determine the appropriate preventive maintenance requirements, let alone to monitor them, a results-based objective may be a suitable means to incentivise the concession holder to perform the required preventive maintenance. This could take the form of minimum uptime requirements: a minimum amount of time the recharging infrastructure must be technically available.

Such minimum uptime requirements are indeed applied by 26 out of the 28 public authorities answering the corresponding question in the eQuestionnaire.[134]

A closer look at the replies indicates that a number of respondents have set general maintenance obligations (e.g. 24/7 availability), but no real, measurable minimum uptime requirements. Thirteen respondents however did, including targets that range from 90% in Flanders, to 99.5% in Latvia. In some cases, the uptime requirement is measured on the entirety of the infrastructure, while in others it has to be demonstrated for recharging points individually.

A 'middle way' proposed by a CPO contributor, is to set a high minimum uptime requirement for each recharging station (the proposal is 99%) but not for each individual recharging point, to ensure that even when some recharging points may be down, there are others available at the same location; the contributor argues that this is, in the end, what counts for users.

Authorities should however balance such considerations against the risk of reduced maintenance on individual recharging points - in particular towards the end of the contract/concession period. This could for instance be tackled by combining a high overall station uptime requirement with lower individual recharging point uptime requirements.

Few respondents have set penalties for non-compliance with uptime requirements. And even when they did, some respondents indicate to apply these leniently and only if repairs of recharging points are really lagging (e.g. more than a week) or if there are repeated issues.

Monitoring is performed either in real time (on the basis of dynamic data transmission: see section 4.4.1.1) or on the basis of ex post reporting (e.g. quarterly in Berlin or bi-annually for Germany). One respondent indicates that, although previous tenders did include uptime requirements, newer tenders left these out as downtime has not been an issue in the past.

Yet another respondent illustrates quite another problem: there is a general maintenance obligation, but no penalties attached to this, nor any real control, highlighting that recharging points "have to face and solve too many problems on a daily basis: vandalism, communication between the charger and the back [end] service, etc." This could be tackled by including a 'force majeure' provision, excluding penalties for the reasonable duration infrastructure is out of order as a result of certain well-defined circumstances (e.g. power cuts, vandalism) that are not attributable to the operator.

Malta: interface requirements for monitoring purposes

In order to offer maximum adaptability to changing operational conditions (O&M organisation and mode of operation),

134 Arnhem, Paris, MRA-Electric, AMB Barcelona, Ireland (Dept. of Transport + Sustainable Energy Authority), Toulouse, Oslo, Vestland, Stockholm, Région Auvergne-Rhône-Alpes, Berlin, Stuttgart, Latvia, Brussels, Germany, Amsterdam, Madrid, Antwerp, Norway, Flanders Region, Malta, Gothenburg, Reggio Emilia, Rotterdam, Leuven. Some respondents indicate they are still in the process of developing their detailed tender requirements, but intend to include minimum uptime requirements.

all man/machine interfacing (MMI) for supervisory and control purposes shall be implemented as web applications, i.e. applications that can be operated through standard web browsers. The applications shall be accessible from any operator terminal connected to the data communication network, subject only to adequate access rights being granted by a system administrator.

Ensuring continuous maintenance by means of an appropriate deterrent may be less important at the beginning of a concession agreement, when the infrastructure is still new and the concession holder still has an interest in keeping it in good condition while he is operating the concession. It becomes ever more important towards the end of the concession period, in particular in a set-up in which the concession holder only manages and operates the infrastructure on behalf of the public authority, having to hand it back over to that authority when the concession ends. In those cases, well-defined uptime requirements with according penalties can be key to ensuring that the infrastructure is in good condition once transferred back to the public authority (see also section 4.4.2.1 above).

Recommendation

In order to offer the best possible service to EV-drivers on the one hand, and to get the best value for money on the other hand, public authorities should set minimum uptime requirements for infrastructure. Monitoring is best performed in real time, or at least on the basis of real time data. Financial penalties could be considered as a deterrent to ensure that maintenance is taken sufficiently seriously by the contractor - including towards the end of the concession period.

4.4.2.2 Support service: minimum response times, availability of support staff

Even with the best possible maintenance and minimum uptime requirements in the concession agreement, technical issues with the recharging equipment cannot be excluded. In case they do arise, it will be key to ensure that the infrastructure is repaired as soon as possible, so the recharging point is again made available for use by EV-drivers. To this end, a large majority of public authorities responding to the eQuestionnaire indicate setting minimum support requirements. Best practice examples include clear minimum response times in their tender specifications. These are obligations on the operator to repair infrastructure within a given timeframe, either from a distance (e.g. a software issue) or, if needed, on site.

For EV-drivers, arriving at a recharging point with a depleted battery to find it 'out of order' may be frustrating enough, worse still is when the recharging point malfunctions during use - for example making it impossible for the EV-driver to disconnect his recharging cable from the recharging point. Some respondents have set clear intervention requirements for such problems: 24/7 phone assistance, in the local language, and maximum time limits for on-site intervention where needed (see e.g. box on Arnhem). Public authorities should be aware that phone assistance offered in the local language only, may be of little help to foreign visitors. Support in at least one common European language other than the native tongue of the country/region in which the infrastructure is located should be provided; this could be achieved by hiring bilingual operators, where one could already be sufficient for each call centre.

Arnhem: service level agreement

The concession must provide a first line fault service (at a distance) with a free emergency failure number in the Dutch language, which can be reached 24/7. Direct assistance is provided (by phone) 24/7 through remote management. In case the fault/malfunction cannot be solved from a distance, the fault report is immediately transmitted to the second-line failure service, as indicated below. The concession holder shall provide for a second line failure service (on site) which shall follow-up fault reports and resolve them within the specified time limits set out in these tender requirements.

Urgent malfunctions (recharging point is dysfunctional and there is no alternative recharging point within a 1 km radius, connector is stuck and/or other unsafe situations) are solved within 2 hours (24/7, both working and festive and weekend days). If a failure notification in relation to a stuck connector cannot be remedied in a timely manner (within 2 hours) and it is not possible for the EV-driver to disconnect his recharging cable from the recharging point, the concession holder shall ensure that recharging cable is returned to the EV-driver at any address of his choice within 8 hours.

In case of unsafe situations/serious damage, the concession holder must also inform/enable (depending on the situation) the relevant distribution system operator. All other/non-urgent malfunctions (offline, software issues, minor damage) must be solved/remedied within 24 hours (work and weekend days). Cleaning of the recharging point shall take place within 5 working days of detection or notification of graffiti or other contaminants.[135]

Recommendation

Public authorities should include minimum support requirements in their tender specifications, such as obligations on the operator to repair infrastructure within a given timeframe, either from a distance (e.g. a software issue) or, if needed, on site. 24/7 phone assistance should be provided as a minimum. Support in at least one common European language other than the native tongue of the country/region in which the infrastructure is located, is advised. The phone number of the call centre should be clearly displayed on each recharging point.

135 Tender Specifications Overijssel and Gelderland, Programma van Eisen ref. 20171024, point 1.1 Service-level agreement (SLA), translated from Dutch:

"Concessiehouder voorziet in een eerstelijns storingsdienst (op afstand) met een gratis storingsnummer in de Nederlandse taal (evenals al het overige klantcontact), dat 24/7 bereikbaar is. Er wordt (telefonisch) 24/7 direct hulp geboden middels beheer op afstand. Indien op afstand de storing niet kan worden opgelost, wordt de storingsmelding direct doorgezet naar de tweedelijns storingsdienst en geldt eis 3.

Concessiehouder voorziet in een tweedelijns storingsdienst (op locatie) die storingsmeldingen aanneemt en binnen de gestelde termijnen uit dit programma van eisen oplost.

Urgente storingen (laadpaal functioneert niet en er is geen alternatieve laadmogelijkheid in een straal van 1 km, stekker vast en/of onveilige situaties) worden binnen 2 uur opgelost (24/7, zowel werk- als feest- en weekenddagen).

Indien een storingsmelding m.b.t. stekker vast niet tijdig (binnen 2 uur) opgelost kan worden en het door de e-rijder niet mogelijk is zijn laadkabel los te koppelen van de laadpaal, zorgt de Concessiehouder dat de e-rijder binnen 8 uur op elk gewenst adres zijn laadkabel geretourneerd krijgt.

Bij onveilige situaties/ernstige schades dient ook de betreffende netbeheerder te worden geïnformeerd/ingeschakeld (afhankelijk van de situatie).

Alle overige-/niet urgente storingen (offline, softwarematige issues, lichte schade) worden binnen 24 uur opgelost (zowel werk- als weekenddagen). Reiniging van de laadpaal vindt plaats binnen 5 werkdagen na constatering of melding van graffiti of andere verontreinigingen."

4.4.2.3 *Starting a recharging session*

In order to ensure that the processing systems of recharging points are of sufficient quality, some authorities have set specific time limits within which a user should be logged out or logged on to a recharging point, in order to initiate a contract-based recharging session.

Amsterdam and Arnhem: requirements for starting-up a recharging session

Both Amsterdam and Arnhem set time limits for starting a recharging session at a recharging point:

- within 8 seconds of identification of user, recharging session should start;
- within 2 mins from disconnection of user, new user should be able to start new session

4.4.3 Easy to use display and instructions for use

There are a large number of EV recharging infrastructure equipment manufacturers, each offering their own recharging point design. Some recharging points come with a display, while others are very basic recharging poles with little or no added features. All these different designs make every recharging experience a challenge, especially for new EV-drivers.

Figure 29: Comparison of an Alfen-Allego recharging point (left), a Vattenfal- EV-Box recharging point (middle) and three different Fastned-ABB recharging points

Source: **Allego** (left), **EVBox** (middle) and **Fastned** (right)

In those circumstances, the provision of instructions for use, in the local language and possible also other languages such as English, French and German for visitors, is certainly not an unnecessary luxury. Just over half of respondents to the eQuestionnaire indeed ask concessionaires to provide clear instructions for use to EV-drivers. Requirements range from ‘brief and clear instructions’ (icons and text) to detailed step-by-step instructions displayed on the screen. As to the available languages for those instructions, only a few respondents explicitly indicate that they ask for instructions in another language other than the local language. AMB Barcelona, Madrid and Toulouse all require instructions to also be provided in English; Oslo has 24/7 callcentres serving in Nordic languages and English. Paris by contrast admits to only require instructions to be provided in French.

Figure 30: Recharging point in Ljubljana: instructions in Slovenian and English

Source: Elektro Ljubljana

City of Leuven: easy to find support services

The recharging point must clearly mention following data: telephone number for fault notifications and support service, unique recharging point number and a reference to the terms of use.[136]

4.4.4 User-friendly ad hoc payment

Article 4(9) of the Alternative Fuels Infrastructure Directive requires that all electric vehicle users can recharge at any publicly accessible recharging point “without entering into a contract with the electricity supplier or operator concerned”. The ad hoc charging requirement has been included in the Alternative Fuels Infrastructure Directive to ensure that any EV-driver can recharge at any recharging point in the EU, without necessarily being a customer of the operator of the recharging point in question. In other words, if an EV-driver turned up at a recharging point operated by a CPO with whom he (or his EMSP) did not have any contractual relationship, he could still be certain that he could recharge his EV at that recharging point. In that sense, it was supposed to be the easiest way of ensuring access for EV-drivers to all recharging networks in the EU, without being dependent on underlying contractual agreements between CPOs, EMSPs and roaming platforms, nor on interoperability of their infrastructure.

The Commission has however been alerted by consumers and their representations alike, that the ad hoc requirement has been implemented in very diverse ways by CPOs throughout the EU, sometimes even within Member States – if at all.

136 Translated from Dutch: “Op de oplaadinfrastructuur worden de volgende gegevens duidelijk vermeld: telefoonnummer voor storingsmelding en overige dienstverlening, uniek objectnummer en een verwijzing naar gebruiksvoorwaarden”

According to the European Consumer Organisation (BEUC):

“Many [C]harg[e] [P]oint [O]perators do not provide this possibility (ad hoc charging, Ed.) to EVdrivers. Very often, to be able to use a publicly accessible [re]charging station, an EV driver must sign up for a contract with its operator.”

In a test of 53 recharging points in different German Länder, published in May 2018, the German automotive club ADAC found that ad hoc charging was simply not possible in 23% of the cases.[137] Stakeholders responding to the 2019 STF stakeholder consultation pointed to similar problems across major cities in the EU.

While the absence of an ad hoc recharging option at a recharging station is clearly contrary to law, this is prima facie less evident for the user-unfriendly ad hoc recharging solutions offered by certain CPOs. Though while the ad hoc requirement in the Alternative Fuels Infrastructure Directive is not spelled out in much detail, it clearly prohibits CPOs from requiring non-customers to register on their website before being able to pay ad hoc – a practice that is all too often applied.

A user-friendly interpretation of the ad hoc charging requirement in the Alternative Fuels Infrastructure Directive entails:

(i) a one-off contract, that is concluded when the EV-user connects the recharging connector to his EV to initiate the recharging session and ends with payment for that recharging session, without there being any longer-lasting mutual obligations;

(ii) no need for any written agreement;

(iii) no need for the EV user to identify or register himself in any way; and

(iv) easy payment, on the spot.

Hence, payment for ad hoc charging would require e.g. cash or bank wiring or similar transactions that end “the customer to service provider relationship” at payment (on the spot), which is currently the standard for refuelling conventional vehicles.

The European Commission’s clarification of the ad hoc recharging requirement, as part of the FAQ for CEF Blending calls

Question: Relating to Article 4(9) of directive 2014/94/EU: In the Eligibility Checklist for Alternative Fuels, it states that ‘EV-users should be able to recharge on an ad hoc basis without entering into a contract with the electricity supplier or operator concerned.’ At the same time, the promoter must confirm that the EV user does not need to identify or register himself in any way. On an ad hoc basis, payment would most likely be done by bank/credit card or mobile phone, which could leave a trace that makes it possible to identify the EV user. Is this permitted?

Answer: The requirement that an EV user does not need to identify or register himself in any way is intended to preclude the situation where an EV user needs to fill in an online form or download a specific application provided by the Charge Point Operator or an affiliated organisation, where he needs to identify himself directly to the Charge Point Operator or its affiliate. Payment via bank/credit card or third party payment services application (e.g. iWallet or an application provided by their bank), where identification is only indirect and the user does not need to register beforehand, is therefore permitted.[138]

137 Available here (in German only): https://presse.adac.de/meldungen/adac-ev/tests/e-laden-noch-zu-wenig-kundenservice.html

138 NB: in all cases, Charge Point Operators should ensure that ad hoc payment options offered are generally available and used by the public in the country in which the recharging point is installed. Limiting ad hoc to one proprietary payment service application, which is dependent on the ownership of a specific smartphone (such as iWallet) would not be in compliance with the requirements of the Alternative Fuels Infrastructure Directive.

Surprisingly, not all respondents to the eQuestionnaire explicitly prescribe the availability of ad hoc payment options.[139] In fact, one respondent indicated that it does prescribe the use of certain user identification technologies, such as RFID card/NFC reader, automatic authentication possibility, etc., thereby enabling contract-based recharging, while not requiring the availability of an ad hoc payment solution.[140] Three more were certain to require the former but uncertain about the latter.[141] The decision not to include an explicit ad hoc payment option in tender specifications may be based on the assumption that it is a legal obligation anyway. However, the diverse and not always very user-friendly implementation of this obligation by CPOs in practice, as explained here above, merits the setting of detailed requirements in tender specifications. These are important to ensure that visitors who do not necessarily possess the specific, local charge card, can easily and seemingly recharge at their travel destinations.

ELAAD: ad hoc requirements

The operator must offer at least one common and widely supported method to be able to recharge and pay without a recharging card. Recharging and payment must also be possible and available to foreign EV-drivers. It must be clear to EV-drivers who want to use this method at the recharging station how to use it.

Amsterdam: contactless ad hoc payment

Already as early as 2015, Amsterdam's tender specifications asked for the provision of contactless NFC payment via bank/credit card.

Recommendation

Public authorities should require in their tender specifications that any EV-user is able to recharge on an ad hoc basis at any publicly accessible recharging point:

(i) with a one-off agreement, that is concluded when the user starts charging the vehicle and ends with payment for that recharging session, without there being any longer-lasting mutual obligations;

(ii) without any need to enter into any written agreement with the Charge Point Operator or owner;

(iii) without any need to download a dedicated smartphone application (e.g. from the Charge Point Operator);

(iv) without any need to identify or register himself; and

(v) offering an easy payment option on the spot, that shall as a minimum allow for payment by debit or credit card (e.g. contactless payment via NFC reader) or other direct bank payment through widely supported digital means.

4.4.5 Ensuring fair and reasonable prices

Article 4(10) of the Alternative Fuels Infrastructure Directive requires inter alia that "prices charged by the operators of recharging points accessible to the public are reasonable [...] and non-discriminatory".

Although traditional economics theory assumes that market forces will result in near-perfect price formation in a market-economy (law of supply and demand), it also accepts that

139 Only 24 out of 31 respondents to this question do, or 77%.

140 Castilla y Léon

141 Göteborg, Region Auvergne-Rhône-Alpes and Stockholm

public intervention (e.g. by setting maximum prices) may be needed in the absence of a well-functioning, competitive market. In the current state of the electromobility market, EV-drivers often have imperfect price information, as a good overview of the recharging options in a given area - including the prices charged - is rarely available (see section 4.4.1.1 above). They are therefore all too often condemned to the prices charged by the CPO of the recharging point they are lucky to find on their way – in some cases even without knowing how much that CPO will charge in advance of their recharging session (see section 4.4.6 below).

Moreover, the market for recharging infrastructure and related services shows certain features of network industries. This is particularly true for highway and urban on-street infrastructure that is installed on the public domain on the basis of concessions. Such concessions often grant a degree of exclusivity for the CPO, in terms of geography (e.g. in the case of a concession for developing/operating infrastructure in a given area) and/or time (e.g. in the case of a concession to operate recharging infrastructure on a highway rest area for a given period of time). Moreover, recharging infrastructure has certain features of a natural monopoly: high sunk costs (mainly in the case of fast and ultra-fast chargers) and, most notably, non-duplicability. With this in mind, it is essential for public authorities to avoid abuse by the operators of such infrastructure of their quasi-dominant or exclusive position, e.g. in the form of excessive prices for consumers or bad service. A number of recommendations have been made here above to address the latter; public authorities can also help to avoid the former in a number of ways.

Firstly, as explained in section 3.4.6 above, public authorities can design their award procedure in such a way as to ensure reasonable prices. The most obvious is to include a maximum price for recharging (a price cap) as an award criterion: the bidder who sets the lowest maximum price for recharging obtains the highest amount of points.

Antwerp: price as an award criterion[142]

First award criterion: pricing for (potential) EV-users (40 points)

The Autonomous Antwerp city Parking Agency (AAPA) assumes an operational model in which the concessionaire can deliver the full scope of services without any financial contribution of AAPA or other public authorities. In this context, the candidate should indicate in his proposal a maximum price payable by (potential) EV-drivers at its recharging points. In his bid, the candidate must specify a maximum price (per kWh) for each of the following two payment methods:

- •The maximum price per kWh [payable for contract-based recharging] (e.g. via a charging card, app,...) (15 points);
- The maximum price per kWh for ad-hoc payments by SMS (price including cost for sending SMS) (cf. 15 points);
- Rotation rate per 15 minutes (day) (10 points).

142 Translated from Dutch: “[eerste toewijzingscriterium:] prijszetting ten aanzien van de (potentiële) e-rijders (40 punten)

GAPA [Gemeentelijk Autonoom Parkeer- en mobiliteitsbedrijf Antwerpen] gaat uit van een exploitatiemodel, waarbij de concessiehouder het geheel van de diensten kan leveren zonder bijdrage van GAPA of andere overheden. In het kader hiervan dient de kandidaat in zijn voorstel een prijszetting op te geven die de (potentiële) e-rijder maximaal zal betalen aan de laadpunten. De kandidaat dient zijn prijs (per kWh) op te delen volgens twee betaalmethoden:

- De maximale prijs per kWh (bijvoorbeeld via een laadpas, app, …) (15 punten);
- De maximale prijs per kWh via SMS-betaling (prijs inclusief SMS-betaling) (cfr. ad hoc betaalwijze) (15 punten);
- Rotatietarief per 15 minuten (overdag) (10 punten).”

But public authorities can also simply set a maximum price (price cap) themselves, for instance based on a market analysis (e.g. comparison with average recharging prices elsewhere) or simply based on an objective to foster electromobility (e.g. ensuring electric recharging is always cheaper than refuelling an internal combustion equivalent). In its price clause, the city of Amsterdam for instance clearly refers to this ambition (see example box Amsterdam below).

To avoid any misunderstanding, these maximum prices should not function as fixed prices, but as a cap on prices. Different price caps could be foreseen for different time horizons, to foster smart recharging (e.g. higher prices during peak hours 18:00-20:00 and lower prices at night). Also, a clear price indexation or price review mechanism could be included in concession agreements, to take account of demonstrable and objective changes to price elements (e.g. in electricity prices) over time. In case of a price review mechanism, public authorities should clearly and unambiguously specify the circumstances (e.g. 'consistent rise in average wholesale electricity prices of at least [X]% for a continuous period of [Y] months') that could trigger the price review, and make the price review subject to their agreement (see example box Amsterdam below).

Last but not least, pricing can also be used as a very powerful instrument to influence when and where EV-users recharge their vehicles. It is likely that EV-users will recharge their vehicles at the lowest possible price at any convenient location and time. In other words, it is very likely that EV-users will change their recharging behaviour as a result of price incentives. It could be imaginable for public authorities to set on-street recharging prices slightly higher to incentivise EV-users to recharge their vehicles as much as possible at private recharging points, such as at home or at the office, or at so-called semi-public off-street recharging points (e.g. at supermarkets or large parking garages).

Recommendation

Public authorities should require in their tender specifications that bidders specify a maximum B2B (contract-based) and ad hoc price in their bids – these maximum prices serve as a cap on the prices charged to users throughout the duration of the contract/concession (with the exception of contractually agreed price indexation or price review provisions).

Amsterdam: non-discriminatory maximum price and price changes

The concessionaire shall charge a maximum price of EUR X per kWh (excl. VAT) to EMSPs and end consumers alike. The level and structure of the price for recharging services have not yet been developed in detail. Price developments should in any case be balanced with the city of Amsterdam's interest to stimulate electric mobility. Price changes or changes in price structure (e.g. time-based charge, higher price for faster charging, higher price during peak hours 18:00-20:00 and lower price at night) are possible during the contract, in agreement with and after consent from the awarding authority.[143]

143 Translated from Dutch: "Opdrachtnemer verrekent laadtransacties met laaddienstverleners en pashouders van de Opdrachtnemer voor een maximumprijs van € X per kWh ex BTW. De hoogte en structuur van tarieven voor laaddienstverlening zijn nog niet uitontwikkeld. De prijsontwikkeling moet in evenwicht zijn met het belang van Amsterdam om elektrisch vervoer te stimuleren. Wijzigingen in de hoogte van het tarief of de tariefstructuur

Another price safeguard is to set requirements in terms of non-discrimination between the price offered by CPOs to B2B customers (EMSPs) and the price offered to B2C customers (i.e. the ad hoc price charged to EV-drivers). Recently implemented price differentials raised worries that certain market players are steering customers into e-mobility service contracts.[144] The question is whether large price differences between the ad hoc price (basically the price paid by non-customers, more on this in section 4.4.4 above) and the contract-based price (price for –indirect– customers) can be explained other than as a desire by CPOs to tie customers to them. Even when this is considered a valid business objective, the question arises as to whether public authorities co-financing (and possibly owning) recharging infrastructure should not exclude such discriminatory price-setting altogether, with a view to offering equal access to the infrastructure to all interested EV-users. Moreover, this is arguably even mandated by Article 4(10) AFID, which requires recharging prices to be reasonable and non-discriminatory. The European Commission is considering including a non-discrimination clause prohibiting a non-justifiable differentiation between the ad hoc and B2B price offered, in its future conditions for CEF funding.

Another option for public authorities to enable fair and reasonable prices, is to set requirements that foster price transparency. This is arguably the most market-based solution to ensure reasonable prices: if consumers have full price information and can easily compare prices, then they can choose the services that best fit their needs at the lowest price. More information on this matter is provided in the next section 4.4.6.

Recommendation

Public authorities should require in their tender specifications that there is no discrimination between the prices charged by CPOs to B2B customers (EMSPs) and the prices charged to B2C customers (i.e. the ad hoc price charged to EV-drivers). For example, public authorities could require that the difference between the price charged by a CPO to a third party-EMSP for a recharge at his stations or the price charged directly to an EV-driver recharging at his stations ad hoc, shall never exceed [X]%.

4.4.6 Price transparency

Article 4(10) of the Alternative Fuels Infrastructure Directive also requires that “prices charged by the operators of recharging points accessible to the public are [...] easily and clearly comparable [and] transparent”.

This is a lex specialis of the more general price transparency obligations contained in Directive 2005/29/EC on unfair business-to-consumer commercial practices. This Directive, which applies to the sale of both goods and services, contains the main general EU legislation for business-to-consumer commercial practices, including price information. It is designed to complement other, more specific EU legislation applicable to commercial practices, and provides a safety net that ensures a high common

gedurende de looptijd (bijv. tijdsgebonden tarief, hoger tarief voor sneller laden, hoger tarief gedurende piek 18:00 - 20:00 en lager tarief ‘s nachts) zijn mogelijk in overleg met en na goedkeuring van de Opdrachtgever.”

144 See for instance: https://chargedevs.com/newswire/is-ionitys-prodigious-price-increase-designed-to-steer-customers-to-mobility-services/

level of consumer protection against unfair commercial practices in all sectors. It generally prohibits the misleading of consumers and requires that prices:

- are transparent from the advertising stage throughout the transaction; and
- include all applicable fees and charges before the transaction (no drip-pricing).

Moreover, if prices are subject to rapid change because of the dynamic nature of the market, traders must make this clear to consumers.

Despite these legal requirements, almost four out of five respondents to the 2019 STF stakeholder consultation believed that consumers never or rarely have full information about all the different components of the total price for recharging at publicly accessible recharging points. They were joined by about 70% of CPOs, EMSPs and roaming platforms responding to this question. Only one respondent (a public authority) believed that consumers always have full information of the different components that will constitute the final price.

Respondents to that same stakeholder consultation generally felt that a lot of confusion around prices is caused by the distinction between ad hoc and contract-based prices. In particular, CPOs indignantly pointed to the fact that the issue is not so much that prices are not displayed at the station, but that prices on the bills may differ from those prices advertised due to different contractually agreed prices and the addition of non-transparent roaming costs. In other words, in reality the EMSP often determines the final price for the charging service, not the CPO, notably in the case of contract-based charging. This leads to the confusing situation where the consumer is not invoiced according to the price that he sees on the station and assumes to be his agreed transaction price, but according to a price that he agreed to when he concluded his EMSP contract. Some EMSPs by contrast complained that they cannot display their prices on stations that they do not own or operate. It was also argued that the application by CPOs of a variety of tariff structures (time-based, kWh-based, flat rates, start-up costs, etc.) combined with variable costs such as EMSP transaction costs and additional roaming fees, makes it hard to offer a one-size-fits-all solution for charging. Moreover, EMSPs complained that the specific CPO tariffs are not always known by EMSPs in advance which makes it hard for them to properly inform consumers ahead of a recharging session.

A proper understanding of the distinction between contract-based and ad hoc prices is indeed essential to fully grasp the difficulty of enabling price transparency in the electromobility sector. While contracting authorities can use tender procedures to set conditions for contract-based prices of the local EMSP[145] (i.e. for recharges made using their specific RFID card), including conditions on transparency of prices, they can hardly influence the contract-based prices offered by other EMSPs – even when the customers of those other EMSPs recharge at the recharging points on their territory. Moreover, they can have no influence on the roaming costs that would apply in such cases, let alone on the way they are communicated to consumers. Nevertheless, strictly in relation to the contract-price for recharges made with the local recharging card, authorities can set a number of transparency requirements in their tender specifications, e.g. that those prices are available in the local recharging smartphone application, or on the local recharging website. It must however be stressed that such

145 NB: this assumes that the scope of the services procured by the public authority not merely cover the deployment (and possibly minimum operations such as maintenance) of infrastructure, but also the provision of certain e-mobility services.

requirements, useful as they may be, only benefit residents or regulars who possess the local recharging card (and, if applicable, smartphone application).

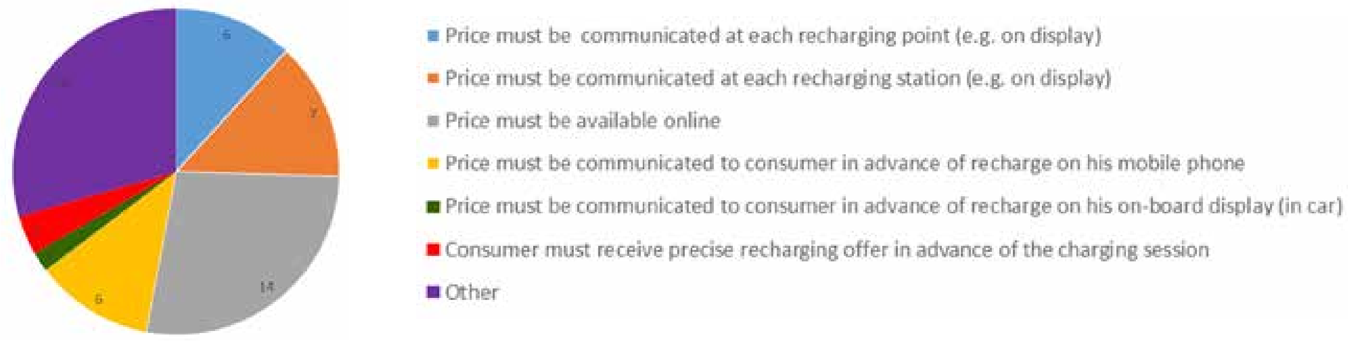
Whilst the scope for public authorities to influence the transparency of contract-based prices for recharging is limited, they have more leverage regarding the ad hoc price (the price charged by the CPO-concessionaire to end consumers). And it can be argued that the transparency of the ad hoc price is more important than the transparency of the contract-based price. First of all, any EV-driver can benefit from this ad hoc price, regardless of the subscriptions he has made. The transparency of this ad hoc price is therefore particularly relevant for visitors who will often not have downloaded the local recharging services smartphone application or visited the local recharging services website prior to their recharge. Secondly, EV-drivers subscribing to a specific contract can be expected to have somewhat informed themselves about the terms of that contract, including the applicable prices. If they are unhappy about the price transparency offered by their EMSP, they can switch to another EMSP. They are in any case not obliged to charge under a contract, as they can always recharge ad hoc. And this reconfirms the importance of a transparent, but also reasonable and user-friendly ad hoc recharging option.

Price transparency can be facilitated by public authorities in two ways: by setting requirements on traders in terms of communicating the price to consumers, or by setting requirements on the price structure itself.

With respect to the former, a distinction can be made between the traditional ways of informing consumers at the recharging station, similar to the way consumers are informed about prices at conventional refuelling stations, and more sophisticated means of informing consumers, such as on their smartphones and on-board car displays, all conditional upon underlying data streams. There are a number of advantages to the latter form of communicating prices. Firstly, it increases competition, as consumers can choose their recharging point based on prior information on the price (see section 4.4.1.1 above). Secondly, it is possibly more adapted to fast-changing dynamic recharging prices, required to incentivise smart recharging and V2G. And thirdly, an EMSP-offered smartphone application can provide transparency not only on the ad hoc price for a recharging session, but also on the contract-based price since the EMSP should dispose of the required information to provide both. The disadvantages are that it presupposes a perfectly connected ecosystem where data is shared freely between interoperable systems, which is currently not the reality. Moreover, it also presupposes that all EV-drivers dispose of the required technology that enables such price communication: a smartphone, an on-board display in the vehicle etc. Eurostat data show that in 2018, on average around 70% of the EU population used a portable device to access the internet away from home – in two EU countries, it was less than 50% (Italy and Poland). This creates a risk that users that do not possess the required digital devices or who are less familiar with digital technologies, are left behind if prices are only communicated via digital means. Therefore, while digital price communication may be the most appropriate way going forward, the traditional communication of prices at the recharging station are a cheap, easily and quickly implementable first step in providing more price transparency for EV-drivers. About 67.5% of respondents to the 2019 STF stakeholder consultation, and also two thirds of CPOs among these, agreed that prices should be displayed at the recharging station, either via a display (which allows dynamic pricing) or at least a sticker (in case of fixed prices).

Since the scope for public authorities to influence the communication of contract-based prices for recharging through tender specifications is limited, as argued here above, the eQuestionnaire asked public authorities about the requirements they set in relation to ad hoc price transparency. Seventeen public authorities responding to this question indicate that they include specific price transparency requirements in their tender specifications (see Figure 31).[146]

Figure 31: Price transparency requirements of eQuestionnaire respondents (multiple answers were possible)[147]



Germany 5th funding call: ad hoc price transparency requirements

In order to ensure price transparency for users of recharging points, it is necessary to specify the price of ad hoc recharging on the recharging device. If the price is made up of several components (e.g. start-up fee, labour price, etc.), these must be shown separately. It is not permitted to transmit the ad hoc recharging conditions exclusively through a smartphone app.[148]

ELAAD: Price transparency requirements

The concessionaire must ensure that the charging station clearly communicates which costs will be charged. This means:

- the rates for using the recharging point and the electricity price if the default supplier is used, or if another supplier is used.
- the costs charged for a recharging session without a recharging card (ad hoc)

All rates/costs must be shown inclusive of VAT. In the event of changes in legislation and regulations, the operator must ensure that these are complied with.

146 Castilla y León provides recharging for free at this stage so does not include price transparency requirements yet, while Ireland is still designing its tender specifications and indicates it will include price transparency requirements in these.

147 While the question asked respondents about the ad hoc price transparency, it is unclear whether all respondents understood it in this way. This is particularlty the case for those replying “other”, where certain replies seem to relate rather to contract-based price transparency requirements.

148 Translated from German: “Um für Benutzer von Ladepunkten Preistransparenz zu gewährleisten, muss der Preis für das adhoc-Laden an der Ladeeinrichtung angegeben werden. Setzt sich der Preis aus mehreren Bestandteilen zusammen (z. B. Startgebühr, Arbeitspreis etc.), sind diese separat auszuweisen. Das Ausweisen der ad-hoc-Ladekonditionen ausschließlich über eine Smartphone-App ist nicht zulässig.”

The second means for public authorities to facilitate price transparency is by setting requirements that simplify prices overall, so that they can be compared more easily. This could for instance involve a harmonisation of the price structure, the prohibition of certain price elements, etc. A large majority of respondents (five out of six) to the 2019 STF stakeholder consultation believed that a further harmonisation of ad hoc price information would be beneficial for consumers; of those respondents, no less than 90% were in favour of harmonising the price components.[149] The most concrete proposal was tabled by AFIREV, who recommend that a price for recharging should consist of at most three parameters (NB: their recommendation relates to B2B prices[150]):

Price = p1 + p2 x (time of connection) + p3 x (energy delivered)

In that sum, the predominant, but not sole, element should be 'p3', or the €/kWh price EV-drivers pay for the electricity received. Additional €/minute payments ('p2') can be applied to maximise the occupancy rate by dissuading unnecessarily long occupation of EV-enabled parking spots (see section 2.3.2.4). 'p1' is supposed to be the service fee.

The predominance of the electricity price is particularly important to support smart recharging or V2G, by means of dynamic pricing. In those cases, intraday price changes should be accurately reflected in the costs charged to the EV-user.

Although the eQuestionnaire did not specifically ask public authorities about their requirements in relation to the price structure, the tender specifications provided by public authorities reveal that some do set such requirements (see for instance Reggio Emilia).

Reggio Emilia: price transparency and price structure requirements

In case the recharging service is provided by a company in return for a fee, the service provider should adopt a consumption-based price model, based on the kWh of energy consumed and time passed during the recharging session, so as to discourage prolonged recharging sessions beyond the maximum allowed recharging time[151], to allow as many as possible EV-drivers to recharge.

The applicable prices must be communicated in a clear and transparent manner to all users prior to recharging. Failure, even partial, to comply with the provisions of this point [...] will entail the forfeiture of the concession and the obligation to restore the premises at the expense of the concessionaire, in addition to the right of the municipality to claim damages.[152]

149 In this context, price components was defined as referring to the different components of the final price, such as a kWh based fee, a time-based fee, etc.

150 AFIREV, Livret Qualité, 15 November 2019, available here (in FR): https://www.afirev.fr/wp-content/uploads/2019/11/Livret-Reco-Qualit%C3%A9-2019-11-15.pdf.

151 Reggio Emilia sets maximum time limits for recharging in particular at publicly ocpp high power recharging points (maximum one hour between 8h and 20h).

152 Translated from Italian: "Nel caso il servizio di ricarica sia fornito da un società che prevede il pagamento di una tariffa per l'erogazione del servizio, dovrà essere introdotta l'adozione di un modello di pagamento a consumo, basato sui kWh di energia e sul tempo utilizzati dall'utente nel corso della propria ricarica, finalizzato anche a disincentivare soste per la ricarica prolungate oltre il tempo massimo consentito, in modo da garantire l'opportunità di ricarica a più utenti. Le tariffe applicate devono essere comunicate in maniera chiara e trasparente a tutti gli utenti prima dell'effettuazione della ricarica. Il mancato rispetto, anche parziale, di quanto indicato al presente punto [...] implicherà la decadenza della concessione e l'obbligo di ripristino dei luoghi a spese del concessionario, oltre alla facoltà del Comune di richiedere il risarcimento dei danni."

Recommendation
Public authorities should require that (all elements of) the ad hoc price are displayed at any publicly accessible recharging point in a visible, transparent and unambiguous manner. Moreover, in order to ensure fair, transparent and easy-to-compare pricing, they should mandate that the ad hoc price and contract-based price offered by the successful concessionaire are based mainly on electricity consumed (i.e. a kWh based price), possibly complemented by a time-based fee (to dissuade unnecessarily long occupation of the dedicated parking space). In case of dynamic prices, the intraday price changes should be accurately reflected in the costs charged to the EV-users, and ultimately in the invoice.

4.4.7 Electricity supply requirements

4.4.7.1 Renewable electricity

Requirements can also be made with regard to the electricity supplied at the recharging station. Although not strictly a legal requirement, a number of public authorities require the supply of only green electricity. One of the main arguments is that decarbonisation is a major objective to switch to alternative fuels, and by demanding green energy public authorities make sure that they support this objective.

According to the last years STF consultation, the respondents believe that the origin of the electricity, and in particular whether it is renewable or not, should be mandatory to display at the recharging station.

An example of a country that requires the supply of green electricity is Germany. The German Ministry of Transport and Digital Infrastructure requires: using guarantees of origin via a declaration and a submitted contract that is sent to the Federal Agency for administrative services (Bundesanstalt für Verwaltungsdienstleistungen, BAV).

Recommendation
In order to support the green image of electromobility, public authorities should consider requiring that only renewable electricity is offered for electric vehicle recharging.

4.4.7.2 Free choice of electricity supplier

It follows from Article 4(8), first sentence of the Alternative Fuels Infrastructure Directive that CPOs are to be considered final customers in the meaning of the Electricity Directive (2019/944).

In other words, from the perspective of the Electricity Directive, CPOs need to select and contract the suppliers of electricity at their recharging stations. They do not sell the electricity to EV-drivers as such, but rather sell a recharging service.

Nevertheless, respondents to the STF 2019 stakeholder consultation pointed to experiments in the Netherlands (most notably the Province of North-Brabant) to allow consumers to choose their supplier at the recharging point, and ultimately use their own home-produced (solar) energy, though it was acknowledged that these projects were in a research phase and required changes to the existing electricity market design.

Germany's energy regulator BNetzA is currently publicly consulting on a similar concept, and in particular on the legal and administrative framework required to allow this Europe-wide.[153]

North-Brabant: preparing the ground for "free choice of energy supplier"

This concession seeks to enable the implementation of free choice of energy supplier and recharging with auto-produced renewable electricity (see also "Innovations"). To make this possible, we ask the Tenderer to provide the following fees separately:

1. the fee for the management and operation of the recharging points (the installation fee); and
2. the all-inclusive electricity fee for the electricity provided by the Tenderer when acting as default energy supplier.[154]

In particular, there are certain legal and technical limitations to EV-users choosing their own electricity supplier at any recharging station, or recharging their own PV-produced electricity 'on the road' (as certain Dutch regions, such as North-Brabant, are examining).

The issue is linked to the technical constraint that the production and consumption of electricity must at all times be 'in balance'; in other words: the consumption of electricity must at any given moment correspond to the production of electricity. In case this balance cannot be maintained (nor restored within certain period of time), it will be impossible to maintain the frequency of the grid and there will be a blackout. To avoid this, balancing responsible parties are appointed for each grid injection and offtake point.

These balancing parties 'balance' all different injection and offtake points in their portfolio, meaning that for every offtake point they will be responsible that the required electricity demand is supplied/generated. If their portfolio is not in balance, they will be subject to penalties. In practice, it is therefore common that the supplier of electricity at a certain offtake point, is also the balancing responsible party for that point.

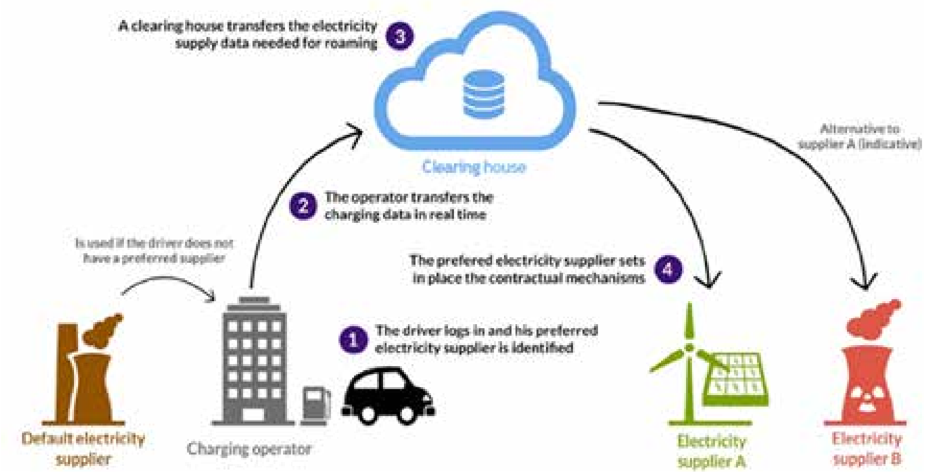
This allows that the supplier can make certain predictions regarding the offtake at a certain point, e.g. based on historical customer consumption models, so that he can produce or procure sufficient electricity to supply the expected energy offtake.

In principle, it would however be possible for different suppliers to supply electricity ad hoc at a certain electricity offtake point. This would require the development of financial clearing mechanisms separate from the actual electricity market, to balance electricity supply portfolio's (see Figure 32). Such mechanisms may be very costly to set up and it is difficult to see, at this stage, how the benefits can outweigh the costs. Local experiments, such as those undertaken in the Netherlands but also in Portugal, can shed some light on this.

153 See: https://www.bundesnetzagentur.de/DE/Service-Funktionen/Beschlusskammern/1_GZ/BK6-GZ/2020/BK6-20-160/BK6-20-160_eroeffnung_festlegungsverfahren.html?nn=869698

154 Translated from Dutch: "In deze concessie wordt gestreefd naar de mogelijkheid en toepassing van vrije keuze van energieleverancier (VKE) en het laden op zelf opgewekte duurzame energie (zie ook 'Innovaties'). Om dit mogelijk te maken vragen we de Inschrijver om de volgende tarieven los van elkaar aan te leveren:
1. Het tarief voor het beheer en de exploitatie van de laadpalen (de installatievergoeding); en
2. Het all-in stroomtarief van de stroom die de inschrijver als default-energieleverancier op de laadpaal levert."

Figure 32: central electricity clearing house enabling free choice of supplier at recharging points



Source: ITEMS International - 2016

Elaad: free choice of supplier[155]

ELAAD proposes that public authorities require in their tender specifications that CPOs conclude an agreement with a so-called default supplier, but at the same time allow users to purchase energy and services from other parties. This is also called the concept of ‘free choice of supplier’.

The proposed requirements are as follows:

“Concessionaire (operator) is responsible for the default energy supply. The operator supplies ‘green electricity’ from wind and/or solar power from the Netherlands. The supply of green electricity (from the Netherlands) is demonstrated annually by the submission of Guarantees of Origin (GvO) certificates by the Operator.[156]

In addition to that, the operator is obliged to allow “free choice of energy suppliers” and to cooperate to the extent necessary to enable this.”[157] Allowing different electricity suppliers to supply electricity to the same off-take point, will require some sort of methodology to allocate the electricity and imbalance responsibilities between them. For this purpose, ELAAD proposes the following methodology:

“The electricity actually supplied to the recharging point is allocated per clock synchronous quarter (i.e. the imbalance settlement period or ISP), on the basis of the data from the client meter on the recharging point, to the responsible supplier (using the link between the Identifier/

155 ELAAD, Bijlage 7 Programma van Eisen bij Europese aanbesteding v 1.0, paragraph 6, p. 29-30.

156 Ibid, Requirement 128, translated from Dutch: “Concessiehouder is verantwoordelijk voor de default energielevering. Daar waar Concessiehouder verantwoordelijk is voor de inkoop van de elektriciteit, levert Concessiehouder ‘groene stroom’ van wind en/of zon uit Nederland. De levering van groene stroom wordt jaarlijks door het overleggen van Garantie van Oorsprong (GvO) certificaten door Concessiehouder aangetoond.”

157 Ibid, Requirement 130, translated from Dutch: “Concessiehouder is verplicht om “vrije keuze energieleveranciers” toe te staan en voor zover nodig mee samen te werken.”

eMobility Service Provider/supplier). This data is stored in a database (blockchain) developed in collaboration with Enexis (the DSO);

By means of the allocation data included in the blockchain, Enexis will summarize the allocation from the customer meters per PTE and assign it to a virtual EAN[158] code belonging to the responsible supplier/program responsible combination in the regular allocation. In addition, the operator/default energy supplier will receive an opposite corrective allocation in the regular allocation. The used method of summation and allocation is similar to the method for individual smart meter allocation.

The operator/default energy supplier is responsible for forecasting, purchasing and maintaining the balance of the electricity allocated to it per ISP. The allocated electricity consists of the final allocation provided by Enexis, consisting of the smart meter allocation and the totalled corrective allocation of the recharging points."[159]

This means that the default supplier will only bear the balance responsibility for the ISPs allocated to it. When an EV-driver however chooses another electricity supplier, that chosen supplier will be the balance responsible party for the ISPs corresponding to that recharging session.

158 European article numbering

159 ELAAD, Bijlage 7 Programma van Eisen bij Europese aanbesteding v 1.0, paragraph 6, p. 29-30, Requirement 134, sub a and b, translated from Dutch: "a. Op basis van de allocatie uit de klantmeters van de laadpalen wordt de werkelijk geleverde elektriciteit per klok synchrone kwartier (programmatijdseenheid (PTE)) toegewezen aan de verantwoordelijke leverancier (doormiddel van de koppeling van de Identifier/e-Mobility Service Provider/leverancier). Deze data wordt opgeslagen in een mede door Enexis ontwikkelde database (blockchain);

b. Middels de in de blockchain opgenomen allocatie data zal Enexis de allocatie uit de klantmeters per PTE sommeren en toewijzen aan een virtuele EAN-code behorende bij de verantwoordelijke leverancier/programmaverantwoordelijke combinatie in de reguliere allocatie. Tevens krijgt de Concessiehouder/default energieleverancier een tegengestelde correctieve allocatie in de reguliere allocatie. De gebruikte methodiek van sommatie en toewijzing is vergelijkbaar aan de methodiek voor individuele slimme meter allocatie."

4.5 Data and cybersecurity

4.5.1 Data ownership

Recharging points can potentially generate a lot of data, for instance regarding periods that vehicles are connected, amount of power supplied, number of unique users, battery size of the vehicle recharging, number of recharging sessions per vehicle and more. Such data can be used to inform potential users of the recharging points of their current status: active/out-of-order or occupied/vacant (see section 4.4.1.1).

A second valuable use case for these data is for (public) authorities making new or adapting current policies. Data can be gathered as part of a continuous monitoring process. Since these data are up-to-date and representative of the local situation, they are a valuable input for an assessment of the situation. This assessment forms the basis for policy development or policy adaptation. Continuous monitoring and evaluation of the situation after implementation of the new or amended policy, provides insights into its true effects. Subsequently, these insights can serve as important input to assess the situation and adapt the policy if necessary. This loop can be a continuous process in which data plays a vital role.

Figure 33: The closed learning cycle enables public authorities to shape and amend their policies

In order to make this process work, the tender requirements should clearly mention all the data that the operator of the recharging infrastructure should gather and provide to the public authority. Moreover the tender requirements should unambiguously state that the public authority owns all such data. Lastly, the public authority should be allowed to use and also share (parts) of these data with third parties, for example for analyses and research purposes, but also more widely to provide better information to consumers (see section 4.4.1.1) or to support the development of smart (re)charging or V2G services.

In simple licence or concession procedures, where public authorities in principle do not own the recharging infrastructure or do not act as the contracting authority towards the operator of the infrastructure, and only for those data that CPOs are not already legally obliged to share with them, public authorities should take due care to:

- obtain the explicit consent of business data generators for the collection of data generated by their business, for the storage, use (including further processing and aggregation) and re-use of such data over time. The language used in legal agreements to obtain the consent of data generators should be clear, simple and precise. The aspects of data processing should be transparent to boost trust and mitigate concerns about data misappropriation.
- • give generators of business data access to the data they generate, whether in raw or processed format, even if it is stored at a platform owned by the public authority. It is essential to preserve data security when data is being exchanged. Access controls throughout data value chains, in adherence to strict security standards, will be key to fostering data sharing among different actors across data ecosystems.

Gathering and sharing data with third parties should be in line with the EU general data protection regulation ((EU) 2016/679). The twofold aim of the Regulation is to enhance the data protection rights of individuals and to improve business opportunities by facilitating the free flow of personal data in the digital single market[160]. The GDPR strengthens existing rights, provides for new rights and gives citizens more control over their personal data[161]. These include:

- easier access to their data: including providing more information on how that data is processed and ensuring that the
- information is available in a clear and understandable way;
- a new right to data portability: making it easier to transmit personal data between service providers;
- a clearer right to erasure ('right to be forgotten') — when an individual no longer wants their data processed and there is no legitimate reason to keep it, the data will be deleted;
- right to know when their personal data has been hacked — companies and organisations will have to inform individuals promptly of serious data breaches. They will also have to notify the relevant data protection supervisory authority.

Amsterdam and Rotterdam: data requirements[162]

The cities of Amsterdam and Rotterdam have, in collaboration with the University of Applied Sciences of Amsterdam, developed standard tender requirements regarding data generated during the deployment and operation of recharging infrastructure. The University of Applied Sciences of Amsterdam then uses this data for research. The programme of requirements consists of the following elements:

- transaction reports, containing the session values. This must be shared in real time.
- metering values; real time
- grid capacity; weekly
- characteristics of the recharging locations; monthly
- user research; the contractor agrees to cooperate in user research
- future generated data; the same conditions apply to data that may be generated in the future when new techniques are brought into use.

For each section, the programme describes the frequency with which the data must be delivered to the municipality. The programme also describes the delivery method and delivery channel

Paris: central database

The concessionaire must transmit all data to the city of Paris, which is the owner and which decides, in compliance with the rules of confidentiality, on their use (open data, etc.). The City has a platform capable of storing and processing large data flows.

160 Brussels, 19 December 2019. (OR. en) 14994/1/19. REV 1

161 Summary of: Regulation (EU) 2016/679 — protection of natural persons with regard to the processing of personal data and the free movement of such data

162 Gemeente Amsterdam, Bijlage PE-5 Eisen aan data AI 2015-093 Laadobjecten elektrisch vervoer and Gemeente Rotterdam, Bijlage PvE-2 Eisen data HvA

Approximately 35% of respondents to the eQuestionnaire include provisions on the ownership and use of EV-user data in their tender specifications.

Recommendation

Public authorities should clearly specify in the tender specifications the data that the infrastructure operator should gather for and provide to them. Depending on the contractual set-up, but certainly in cases where the public authorities own or co-fund the infrastructure, they should require ownership of the data generated by the infrastructure, allowing them to collect and consolidate these data on an independent data platform and use them as they deem fit - including by making them freely available to all interested parties for re-use.

4.5.2 Cyber-security

Another important topic to address in tender requirements is cyber security. Recharging infrastructure is an essential and critical infrastructure and must therefore be adequately protected. Cyber-attacks on recharging infrastructure could potentially lead to blackouts, thereby paralysing entire energy systems and economies. As concessions may run for a long period of time, the contracting authority would do well to formulate tender specifications in such a way that they can, if necessary in the future, be adjusted to the desired level of cyber security. Moreover, public authorities can include requirements regarding the processing of data with respect to privacy and security. Authorities can require secure processing of (personal) data. This can be enforced, for example, by means of mandatory reporting.

In the future, CPOs will need to work more closely with distributions system operators, roaming platforms and service providers to prepare, respond and recover from cyberattacks in a joint manner, learning to limit the effects of a security incident in the EV recharging ecosystem. Consequently, the different players will need to overcome the current security disparity, establishing a homogeneous security level through enhanced protocols and internal processes that promote incident reporting and foster information sharing among the different players in the ecosystem to avoid threat propagation.

ElaadNL has published three reports on data and cyber security of recharging infrastructure[163,164,165]. One of these documents describes security requirements for EV recharging systems. This includes, for example, requirements regarding the functionality needed to set up secure operational processes and secure communications between the Charge Point Operator (CPO) and Distribution System Operator (DSO).

ElaadNL: excerpt from Security Requirements of EV Charging Systems

- **SFR.01 Future-Proof Design:** The Device SHALL have sufficient reserves in memory and computing power to allow updates to security functions that security experts anticipate are necessary during the Device's lifecycle
- **SFR.02 Hardware Design:** The RFID

163 European Network for Cyber Security Commissioned by ElaadNL EV Charging Systems Security Requirements. Version 1.01 - August 2017

164 Security architecture for electric vehicle charging infrastructure. Version 1.0. 24 December 2019. EV-201-2019

165 Security test plan for EV charging stations. Version 1.0. 24 December 2019. EV-401-2019.

reader of the Device SHALL be easily and fully replaceable in case new standards require changes of this part

- **SFR.03 Remote Firmware Updates:** The Device SHALL support updating all security functions through remote firmware updates.
- **SPR.03 Key Management:**
  - The Device MUST support remote updates of all credentials and cryptographic keys.
  - The Device MUST support limiting the duration of a session to a time length that is configurable by the purchaser
- **SCR.05 Message Authentication:** The Device SHALL be able to determine that the source of a message is a specific host in the EV Charging system.
- **SCR.06 Non-Repudiation:** The Device SHALL support non-repudiation for firmware: when it installs firmware, it SHALL be able to prove that the firmware came from the Vendor
- **SHR.04 Security-enhancing features:** The Device SHOULD deploy security-enhancing features of the underlying platform, implementation language and tool chain when it enhances the Device security
- **SHR.05 Protection against Physical Manipulations:**
  - Physical manipulations of the recharging point SHALL be recognisable.
  - The recharging point door SHALL provide sufficient protection against physical manipulations.
  - The opening of the recharging point door SHALL be recognised using suitable means such as sensors. Any opening of the recharging point door SHALL generate an event in the security log.
  - The removal of any part of recharging point SHALL generate an event in the security log

Recommendation

Since recharging infrastructure is an essential and critical infrastructure, tender specifications should set requirements for electric recharging infrastructure in terms of cyber security. In particular, public authorities should try to minimise security disparities, by including in their tenders requirements for incident reporting and promoting an information-sharing culture among the different players in the EV-ecosystem, reducing the risk of threat propagation. Finally, as concessions may run for a long period of time, public authorities should require in their tender specifications that they can, if necessary in the future, require the upgrading of infrastructure to the desired level of cyber security.

4.6 Guarantees and enforcement mechanisms

In the above sections, we have described and suggested a number of requirements for inclusion by public authorities in their tender specifications. In order to avoid that these requirements remain hollow phrases, public authorities often require guarantees from bidders or include enforcement mechanisms in their tender specifications. As an example of those, in section 4.4.2.1 above we have already discussed penalties for failure to meet uptime requirements.

87% of respondents to the respective question in the eQuestionnaire (or 21 out of 24 respondents) indicate that they have included in their tender specifications one or more enforcement mechanisms to verify that the tender requirements they impose are respected. These range from the standard provision of references to be qualified to provide the services (e.g. Dortmund), over financial guarantees (e.g. Reggio Emilia), linking subsidies to progress reporting (e.g. Flanders, Slovakia, Ireland), retaining the right to claim back payments (e.g. Vestland, Germany), to direct penalties (e.g. Antwerp).

Reggio Emilia: guarantees and insurance[166]

Following approval of the projects, the operator will have to:

(i) take out a surety policy, guaranteeing the operator's failure to act, repair damage to the recharging points caused by third parties or natural disasters, the maintenance thereof, and the possible restoration of the condition of the site; the surety policy shall be released at the end of the concession or shall be forfeited in the event of failure to restore the premises; the value of the surety policy shall be EUR 1,500 for any normal power recharging infrastructure and EUR 5,000 for high power recharging infrastructure;

(ii) enter into an appropriate third party liability insurance for the activity subject of the concession with a maximum ceiling of no less than EUR 3,000,000 (including amongst the third parties the municipality of Reggio Emilia); the policies must be maintained throughout the period of the concession and the parts not covered by the insurance and any excesses and/or overdrafts will be borne by the operator.

Antwerp: enforcement mechanisms and practical limits to contractual penalties[167]

There are 2 kind of 'direct' penalties:

- when the charging infrastructure exceeds the accepted amount of down time
- when the charging station is not installed within the time frame agreed upon in the contract.

Another enforcement mechanism is limited validity of the contract: one year, with possibility to extend maximum twice for another year, on condition that the yearly evaluation is positive. This is indended to encourage the CPO to comply with all the requirements stated in the agreement.

However, due to a lack of human resources and the fact that it takes a lot of effort to tender a new agreement, the city authorities always gave a positive evaluation of the CPO, even if they weren't entirely satisfied with the quality delivered by the CPO and not all contractual requirements were met. By way of example: the city authorities waited three years (and thus the

166 Translated from Italian: "A seguito dell'approvazione dei progetti, prima dell'inizio dei lavori, l'operatore dovrà:

i. stipulare una polizza fidejussoria, a garanzia della inadempienza dell'operatore, della riparazione dei danni alle colonnine causati da terzi o da eventi calamitosi, della manutenzione delle stesse, nonché dell'eventuale ripristino dello stato dei luoghi; la polizza fidejussoria sarà svincolata alla scadenza della concessione oppure escussa in caso di mancato ripristino dello stato dei luoghi; il valore della polizza fidejussoria dovrà essere pari a € 1.500,00 per ogni infrastruttura quick charging e a € 5.000,00 per ogni infrastruttura fast charging;

ii. stipulare un'adeguata polizza RCT che preveda l'attività oggetto della concessione con un massimale non inferiore ad euro 3.000.000 (incluso fra i terzi il comune di Reggio Emilia); le polizze dovranno essere mantenute per tutta la durata della concessione e le parti non coperte dall'assicurazione ed eventuali franchigie e/o scoperti di polizza saranno comunque a carico dell'operatore

167 City of Antwerp, Model van de concessieovereenkomst, page 11, article 9.4 (duration of concession) and page 13, article 11 (evaluation).

entire duration of the agreement) for the CPO to provide the contractually required data into the city's data platform.

Additionally, a lot of problems were encountered that were not subject to penalisation with a monetary punishment under the contract: e.g. the premature installation of recharging infrastructure (i.e. before there was an official decision by the City College of Mayor and Aldermen), or the installation of recharging infrastructure in the wrong locations.

Linking subsidies to progress reporting

ENOVA SF Norway: final and periodic report (5 years)

Flanders: service levels are defined and monitored by the DSO, including the possibility for penalties in case service levels are not met.

Slovak Ministry: Subsidy for the construction of a recharging station is paid in the form of a refund upon submission of the final Financial and Technical report. In case of failure to meet any of the conditions, the subsidy is not paid.

SEAI (Irelan): grants are not paid if any Terms of Reference provisions are infringed

Recommendation

In order to avoid that the tender requirements remain hollow phrases, public authorities should require appropriate guarantees from their concessionaires and/or include appropriate enforcement mechanisms (e.g. penalty mechanisms) in their tender specifications. These must at the same time be sufficiently high to have a deterrent effect during execution of the contract, while not being so high as to deter bidders from participating in a tender altogether.

4.7 End of the concession, public contract, licence

4.7.1 Duration

A concession, public contract or licence is limited in time. The lifetime of the infrastructure might however be (much) longer than the duration of the concession, public contract or licence. That means that at the end of the contracting period, the contracted party will lose the rights as laid down in the agreement, while the infrastructure may still be in place.

Moreover, public authorities often separate the works for the deployment of the infrastructure (possibly linked to ownership) and the operation and maintenance of that infrastructure. Therefore, they often make a distinction between the period for deployment of the recharging infrastructure (the deployment period), and the period for the operation and maintenance of the infrastructure (the operation or service period).

To determine the appropriate duration of a concession, public contract or licence for deploying and/or operating recharging infrastructure, public authorities should take a number of elements into consideration.

First and foremost, the appropriate duration of a contract will depend on the chosen ownership model and related division of costs and risks between the contracting authority and contractor.

In the case of a public contract, the property (and the related financial risks) of the infrastructure will often lie with the contracting authority. It should be noted that the concession may also include requirements regarding ownership of the infrastructure.

However, when a model has been chosen in which the operator has to build and operate the infrastructure at its own expense and risks, a longer payback period will be expected compared to a situation in which the property and risks lie with the public authority.

Developing infrastructure, such as recharging points, often means large investments. A contractor that also develops the recharging infrastructure, will require a contract duration that allows it to recoup its investment while gaining a reasonable return on that investment. At the same time, a longer contract period will allow the concessionaire to amortise its investment over a longer duration, possibly resulting in lower prices for consumers. The direct relation between the contract period and the B2B/final consumer prices is particularly important if the public authority asks bidders to offer a maximum B2B/consumer price and assesses this as an award criterion or if the public authority itself sets a maximum B2B/consumer price. If the duration is (too) short, in the former case it will lead to higher B2B/consumer prices, while in the latter case it could lead to the receipt of few or no offers.

In this respect, Directive 2014/23/EU on the award of concession contracts is instructive.[168] The directive does not generally fix a maximum number of years that a concession may last, but does say that concessions which last more than 5 years, must not exceed the time in which a concessionaire could reasonably expect to recoup its investment together with a return on invested capital under normal operating conditions, taking into account specific contractual objectives undertaken by the concessionaire in order to deliver requirements relating to, for example, quality or price for users.[169] In doing so, the directive tries to strike a balance between the legitimate interests of the investor to recoup his investment with a reasonable return on investment, and the public interest of not restricting free market access and competition for an unnecessarily long period. Indeed, as explained in the directive, concessions of a very long duration are likely to result in the foreclosure of the market, and may thereby hinder the free movement of services and the freedom of establishment. This is true not only for concessions, but also for public contracts and licences - in particular when they grant exclusive rights to the contractor.

168 OJ L 94, 28.3.2014, p. 1–64, Directive 2014/23/EU of the European Parliament and of the Council of 26 February 2014 on the award of concession contracts, available here: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32014L0023

169 Recital (52) and Article 18, Directive 2014/23/EU of the European Parliament and of the Council of 26 February 2014 on the award of concession contracts; available here: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0023&from=en.

Looking at the responses to the eQuestionnaire, the duration of the contract between the public authority and the operator varies per municipality/ region/Member State and also per type of contract (concession, public contract, licence, joint venture, etc.). Some public authorities prefer long-term contracts while others opt for short-term arrangements. Both have advantages and disadvantages, as explained above.

Antwerp: considerations for determining the duration of the concession

The city of Antwerp prefers, what it calls, short-term concessions, that allow it to be more flexible and enable it to keep up with new innovations. The deployment period is limited to 1 year with the possibility to extend twice by one year. The operating period, by contrast, lasts 9 years, with the possibility to extend twice by one year.

Recommendation

To determine the appropriate duration of a concession, public contract or licence for deploying and/or operating recharging infrastructure, public authorities should strike a balance between a number of considerations. As a general principle, the duration of the contract will depend on the chosen ownership model and related division of costs and risks between the contracting authority and contractor.

For contracts where the contractor invests in the infrastructure, the duration should not exceed the time in which he can reasonably be expected to recoup his investment together with a reasonable return on it, as mandated – at least for concessions – by Directive 2014/23/EU. Moreover, in those cases the amortisation period will be directly proportional to the contract period, which may in turn impact the final prices for consumers.

The legitimate interests of investors to recoup their investment and considerations regarding the amortisation period and its impact on the final prices paid by consumers should be balanced against the public interest of limiting the duration of contracts, and in particular those that grant exclusive rights, as they restrict free market access and competition.

4.7.2 Property

With respect to the end of the concession period, many respondents choose one (or a combination) of the following 3 options:

(i) the public authority demands that the concessionaire partially or completely removes the infrastructure;

(ii) the public authority demands that the ownership of the infrastructure will be handed over to the public authority; or

(iii) the infrastructure is transferred to a new party.

An example of a city that demands that it becomes the owner of the infrastructure is Paris. The Antwerp concession agreement, on the other hand, specifies that the concessionaire has full ownership of the recharging infrastructure during the concession. The authorities waive their public rights of accession (as the recharging stations are on public ground). At the end of the concession period, the concessionaire must remove all infrastructure at the request of the contracting authority. The concessionaire must also restore the public domain to its former state free of charge, including restoring all the pavements to their original state.[170] Brussels and Munich also demand that the operator removes the infrastructure at the end of the concession.

The third option mentioned above is to transfer the infrastructure to the new concessionaire. The majority of respondents to the eQuestionnaire indicated that they do require the operator of the recharging infrastructure to hand it over to the new concessionnaire at the end of the contract period.

In Stuttgart, a clear distinction is made between the surface part (recharging pole, display, fuses, meters etc.), which must be removed after 8 years or handed over to a new party, and the underground part (power supply, cable), which must not be removed. The city is currently assessing whether this approach works over a long period of time.

Making requirements on removing (and moving) charging stations is also recommended by Elaad.

ELAAD: Recommendations on transfer of property

The programme of requirements developed by Elaad includes the following requirements concerning the transfer of infrastructure:

- Concessionaire is responsible for transferring the recharging station after the operating period to the concession provider or a new party free of charge.
- New parties must be able to carry out tests to check the quality of the infrastructure
- the concessionaire removes the infrastructure at the request of the concession provider, if required
- the charging stations meet the minimum requirements as set out in the programme of requirements and thus meet current standards
- Concessionaire commits to train the new party and to hand over all relevant documents for the management of the charging stations

Another condition included by ELAAD in its programme of requirements that is relevant to the transfer of the infrastructure, is that the infrastructure will be build modular (see also section 4.1.2.2 above). The aim is to make sure that open (hard- and software) interface standards are used, guaranteeing interchangeability with future components and systems. The used standards are shared with the concession provider (public authority). Such a requirement can contribute to a better understanding of the quality and value of the infrastructure by the new owner, and ensures that the infrastructure will stay up to date and be future-proof.

A few operators indicated that they would like to own the infrastructure and receive compensation for transferring any infrastructure at the end of the concession period. They propose that non-movable

170 Bijlage 2 Model van concessieovereenkomst; Model van concessie overeenkomst voor het leveren, plaatsen en exploiteren van laadinfrastructuur in de stad Antwerpen

infrastructure can be transferred against a (predetermined) fee, while retaining the possibility to resell the movable infrastructure. Where operators had to invest in (upgrading) the grid connection, they require that this should be considered as an investment and an asset owned by the operator that can be amortised over 10 years or more and open for compensation by the next operator in case of changes (e.g. concessionaire change).

Requirements at end of contract

To ensure that the infrastructure is maintained during the end of the concession period, the municipality of Reggio Emilia demands that the operator pay a deposit. The deposit shall be paid back at the end of the contract period, provided that the operator has complied with the maintenance obligations.

Another way to secure that the infrastructure can be re-used after the end of the contract is by demanding that the infrastructure is open standards. The Amsterdam municipality, for example, requires: The recharging point (hardware) and all systems (software) must be free from IPR and based on open standards, so they can be transferred freely at end of concession.

Another requirement is that all data, including all historical data of recharging sessions, must be easily transferable to third parties. In this respect, Arnhem sets the following requirements:

After the concession period the publicly accessible recharging points are to be transferred to the city or another party without additional costs

The contractor is obliged to cooperate in the transfer at the end of the concession agreement

Suppliers of the recharging infrastructure are to provide maintenance for a minimum of 3 years after termination of the concession agreement

Recharging objects and related systems (such as software) are free of any property rights and should operate according to the OCPP 1.5 protocol

All complementary documentation is provided by the contractor at termination of the concession agreement

Ultimately, a balance will have to be struck between, on the one hand, the requirements of public authorities and, on the other hand, the objective of keeping infrastructure affordable.

Recommendation

Public authorities should include rules on who owns and is responsible for the infrastructure after the contract term.

5. Recommendations

5.1 Deployment approach

5.1.1 The importance of long-term mobility strategies

In order to plan recharging infrastructure deployment, public authorities should develop a long-term vision and strategy on how the local mobility situation should progress. Such a long-term mobility strategy should include quantitative and qualitative measurable targets for electromobility and/or the deployment of recharging infrastructure, in order to monitor progress and create a stable investment climate.

5.1.2 The importance of cooperation

In order to ensure consistency, public authorities should align their recharging infrastructure deployment strategies between different levels of government and between neighbouring nations, regions and cities.

5.1.3 The building blocks of a suitable recharging network

To the extent that public authorities are involved in the planning of a recharging network in their territories, they should aim for recharging networks to cost-effectively provide sufficient availability and capacity for EV-users to recharge at their convenience. This requires taking account of two main aspects:

1. Providing flexibility for electric vehicle users by:

   a. defining the required amount of recharging points;

   b. identifying appropriate locations;

   c. ensuring geographical dispersion; and

   d. identifying appropriate power levels.

2. Reducing overall deployment costs and nuisance by:

   a. making best use of existing infrastructures to limit installation costs;

   b. limiting the use of (public) space;

   c. preventing nuisance during installation and maintenance works; and

   d. maximising the occupancy rate of recharging infrastructure (effective EV parking policy).

5.1.4 Identifying appropriate locations

Real 'demand' is always a good indication of where 'supply' should be. An easy means of mapping 'real' demand, is for public authorities to monitor the use of existing recharging points, e.g. by means of dynamic data on the availability of the recharging point. They could then identify locations with a high turnover and (ask to) increase the amount of infrastructure at or near those locations.

In a (peri-)urban context, several parameters are useful to forecast demand for recharging points, such as (expected) EV ownership, number of daily commuters coming to a given area, amount of transit (long-distance) traffic, amount of semi-public and private recharging infrastructure and number of licences for specialised fleets (such as taxis).

When identifying appropriate locations for ultra-fast chargers (150kW or more), long distance travel considerations should be borne in mind, including the occurrence of seasonal holiday recharging peaks. This issue needs to be addressed holistically, across borders, to enable uninterrupted EU-wide EV travelling.

When identifying appropriate locations for infrastructure deployment, public authorities should optimally exploit existing grid capacity and make efficient use of existing infrastructures (e.g. buildings and roads) to reduce cost of grid connection and use. At the same time, they should seek to exploit the presence of existing electrified on-street structures to accelerate roll-out at limited cost.

When identifying appropriate locations for infrastructure deployment, public authorities should aim to limit the use of (public) space and prevent nuisance during installation and maintenance works. For this reason, many public authorities apply a 'hierarchy of recharging', requiring that recharging takes place as much as possible on private domain.

To reduce the need for additional recharging infrastructure, public authorities should maximise the occupancy rate of recharging infrastructure as much as possible. EV parking policies can be an effective means to that end. Parking places that are equipped with a recharging point (EVPL) should be reserved for EVs when recharging infrastructure is still scarce. Progressive parking rates can be effective to limit the use of EVPL by (plug-in hybrid) electric vehicles that are not recharging.

5.2 Organising the tender procedure

5.2.1 Identification of responsible authority and cooperation

Public authorities should consider what is the most appropriate level of government to deploy/support the deployment of recharging infrastructure, and in which locations.

Regardless which public authority is charged with this task, there must be sufficient coordination with other levels of government and surrounding municipalities and regions to prevent the creation of island networks.

Cooperating with other public authorities in the field of procurement can be an advantage. They can benefit from the experience gained and possibly also reduce costs by jointly organising the procurement process.

5.2.2 Selection of entities to develop and operate infrastructure

The development of recharging infrastructure consists of several phases. In the initiative and development phase, public authorities formulate objectives and assess the risks. Mapping the objectives and risks helps to determine who should own and operate the infrastructure.

It is moreover essential to determine what is the best contract model/policy instrument to attain those objectives and distribute these risks accordingly. Finally, the publicly accessible recharging network serves a number of public interests: public authorities should consider how these public interests are best ensured when choosing a particular contract model/policy instrument.

5.2.3 Selection of contract models and policy instruments

Public authorities must always consider possible obligations in terms of public procurement legislation and State aid rules, whatever form of contract is chosen (a public company, a joint venture (public -private partnership), a public contract or a concession). In particular, bearing in mind that the recharging market should develop as a competitive market, public authorities should always consider the possibility that several parties may be interested in developing and operating the recharging infrastructure.

Public authorities should assess which contract model and policy instrument are most suitable to achieve their objectives, taking due account of the costs of the different options. This should include a proper analysis of the costs and risks borne by and benefits for the different players affected, including the final users of the infrastructure.

5.2.4 Support competition in the market

Public authorities should look into which policy instrument and contractual models support the development of a competitive market of recharging infrastructure and services. Combinations of instruments and contracts can also be used for this purpose.

Public authorities should ensure sufficient market competition, in order to guarantee a qualitative (innovative) and affordable infrastructure in the longer run. It is therefore important that multiple parties have access to the market. There are various measures that contribute to this, such as: limiting contract terms, investigating whether existing long/perpetual concessions can be broken up, splitting up lots and ensuring that tenders are set up in such a way that new parties also get the chance to compete.

In order to gain more insight into what market parties can offer, a market consultation can be an interesting instrument. By means of a market consultation, public authorities can get more insight into what innovations and prices the market can offer.

Public authorities should investigate which financial and project (process management, permits etc.) risks they can reduce or take over, so that private parties can offer more competitive prices. One example is to auction locations which are already equipped with a grid connection, another is to auction locations that are sure to get support from the competent authorities for permitting purposes.

In order to deploy a basic infrastructure network at the lowest possible cost, public authorities should consider organising competitive auctions for (potential) recharging locations, similar to the auctions for renewables. In this way, they can reveal the real economic value of certain lots, avoiding overcompensation.

At the same time, in their competitive auctions, public authorities can 'batch' or group different lots, with more and less expected turnover. In this way, they can ensure that investments are not only focused on the most profitable locations, while also reducing the need for subsidies for the least profitable locations through cross-subsidies. Where they decide to do so, public authorities should ensure that the batches are not so large as to preclude the participation of smaller players in the bidding process.

Public authorities should ensure that not only the costs incurred by the government play a decisive role in the choice of the instrument, but also the price ultimately paid by the end consumer. This could for instance be done by making bidders compete on the maximum prices to be charged to consumers, and including this as an award criterion in tenders.

5.3 Specific tender requirements

5.3.1 Requirements regarding the recharging station

5.3.1.1 Access requirements

Recharging points in the public domain should be publicly accessible 24 hours a day, 7 days a week - meaning they can be used by everyone to smart recharge their electric vehicle at any time.

Public authorities should moreover require that no access restrictions apply to publicly accessible recharging points, and that there is non-discriminatory access for all EV-users (as required by AFID 2014/94/EU).

Public authorities should ensure that in principle the location of all recharging points, as well as the recharging poles themselves, are designed in such a way that they can be used by as many of the public as possible - in particular taking into consideration the specific needs of older persons, persons with reduced mobility and persons with disabilities. In particular, they must in principle be accessible for persons with disabilities. This means for instance, sufficient space around the parking lot, the recharging pole is not installed on a kerbed surface, the buttons / screen of the recharging point are at an appropriate height and the weight of the recharging cables is such that the general public can handle them with ease. In cases where it can be justified that certain recharging locations or recharging poles cannot be configured to make them fully accessible, the tender requirements should seek to maximise accessibility. They could, for instance, require that as an absolute minimum at least one, fully accessible recharging point is deployed within a predetermined radius (e.g. at least one fully accessible recharging point/location in any 1km radius.

5.3.1.2 Dedicated parking

Public authorities should ensure that every recharging point is served by at least one adjacent parking lot that may only be used by EV users. Obligations to this end could be imposed on concessionaires.

5.3.2 Design of the recharging pole

5.3.2.1 Fit with the surroundings: size, safety, positioning and outer-appearance

The design of the recharging infrastructure should take account of the surroundings (size, positioning, safety, outer-appearance, potential generation of light pollution, …), the recharging point's lifecycle (sustainability, durability, modularity and repairability), safety of the design (no sharp ends, no pieces sticking out, location of cables) and user-friendliness (clearly visible when in use/out of order, easy accessibility to people with reduced mobility).

5.3.2.2 Recharging infrastructure lifecycle: sustainability, robustness, modularity and repairability

In their tender specifications, public authorities should require that recharging infrastructure is circular in design, sustainable, robust, modular (components can be easily taken out and replaced) and easily repairable.

5.3.2.3 Recharging cable: fixed or not?

Public authorities should require that every DC recharging point is equipped with a fixed recharging cable, that is at least compliant with the standards set in Annex II of Directive 2014/94/EU. They should consider requiring companies that deploy AC recharging stations to equip these with a fixed cable, since this is more convenient to EV-drivers. In these cases, the cables should have sufficient length to recharge most vehicles and an appropriate cable management system should allow easy and safe handling of the cable and connectors (e.g. by automatic roll-up and storing of the cable in the recharging pole or by using a helical cable).

5.3.3 Requirements relating to metering

EV-users should be confident that the invoice for recharging correctly reflects the actual amount of electricity recharged. Recharging points should be equipped with a certified meter for highly accurate kWh metering and, where needed, a data storage device as well as the possibility to check the historical measurement data, for billing purposes.

5.3.4 Requirements relating to the grid connection

Public authorities should, if possible, set suitable requirements regarding the capacity of the grid connection, in order to ensure that recharging points can recharge EVs at full power.

Where recharging poles are equipped with two or more connectors for simultaneous recharging, the recharging point must be able to distribute the electricity in an efficient and intelligent way over the number of vehicles connected. The same applies for recharging stations offering two or more recharging points.

Grid connections should be future fit and upgradable, to anticipate extensions of the recharging station.

5.3.5 Interoperability

5.3.5.1 Hardware interoperability:

In their tender specifications, public authorities should require that all recharging points comply at least with the technical specifications set out in point 1.1 or point 1.2 of Annex II of the Alternative Fuels Infrastructure Directive or, more precisely, the national transposition of those standards. Tender specifications should require that:

- Alternating current (AC) recharging points shall be equipped at least with socket outlets or vehicle connectors of Type 2 as described in standard EN 62196-2.
- Direct current (DC) recharging points shall be equipped at least with connectors of the combined charging system 'Combo 2' as described in standard EN 62196-3. while leaving it to the market to decide whether or not to add other connectors.

5.3.5.2 Software interoperability

Digitally connected

Public authorities should require that all publicly accessible recharging infrastructure is digitally connected. This implies the installation of the necessary software, standards, protocols and overall IT systems required to ensure the infrastructure is able to send and receive static and dynamic data in real time - as well as to connect the different market actors that are dependent on these data for enabling the recharging process. It is essential to ensure an adequate network connection: in this respect, best practice is to set minimum connection uptime requirements, irrespective of the chosen technology.

Access and authentication

As most EV-drivers today already have RFID cards, public authorities should consider to at least require the integration in the recharging point of an RFID card reader or NFC reader capable of reading RFID cards. Several public authorities require that such an NFC / RFID card reader communicates at a radio frequency of 13,56 Mhz and applies NFC Tag 1-functionality according to ISO/IEC 14443A.

Since standards for automatic authentication are either proprietary solutions or not yet fully developed, public authorities should not, at this stage, mandate automatic authentication on recharging points. They should however keep an eye on the market developments regarding the ISO 15118-20 "Plug and Charge" authentication possibilities.

Communication standards and protocols

Public authorities must ensure that the communication standards and protocols covering the four main communication domains of the EV recharging ecosystem are interoperable. To achieve this, public authorities will have to closely follow developments regarding the adoption of new standards. Tender specifications should include a requirement that the concessionaire implements the 'latest version' of a standard, or that future updates of a standard are implemented at no additional cost within a maximum period (e.g. one year) from their adoption. For each respective communication domain, the following considerations should be made:

1) **EV – Recharging point**

While the IEC 61851 standard is currently being mandated in certain tenders, others are gradually moving towards the ISO 15118 standard. It is recommended that public authorities ensure that recharging infrastructure is future-proof and thus require that it contains the necessary hardware and software elements to support an upgrade to ISO 15118, at no extra cost to the contracting authority, when the different parts of the standard are both completed and suitable to the specific recharging use-case.

2) **Recharging point - Back-end/network management system**

OCPP is the current dominant protocol for this communication domain. Standardisation work is ongoing at IEC level to transpose and harmonise the OCPP and its functionalities into a de iure international standard - IEC 63110 - which should be backwards-compatible with OCPP. This convergence process may still take a couple of years. At least until a final, OCPP backwards- compatible version of IEC 63110 becomes available, the use of OCPP should be encouraged for recharging point to back-end communications in upcoming public tenders.

3) **Roaming**

For communications between CPO to EMSP and CPO/EMSP to roaming platforms, public authorities are strongly encouraged to require the use of open, platform-independent, non-proprietary protocols, that are free to use. Imposing a requirement on CPOs to implement at least one, specific protocol for roaming communications - ideally one that is not linked to any specific commercial roaming platform - would have the benefit of ensuring that all recharging stations use at least one common communication protocol to facilitate roaming agreements, while not precluding the use of additional communication protocols. In the future, it is expected that IEC 63119 will harmonise the roaming communication domain, including the interaction between CPOs and EMSPs. On this basis, to avoid costly retrofits in the future, public authorities should ensure that any protocol they choose to prescribe is upward-compatible with IEC 63119.

4) **Distributed energy resources**

The communication between CPOs, EMSPs, grid operators, grid users and facility managers is expected to be harmonised under IEC 61850. It is important to note that IEC 61850 works as a data model where different open protocols can be used. This approach differs from common standard conception and responds to the communication needs of power systems. Currently, the IEC working group responsible for this standard has finalised and made available data models for EVs and supply equipment, where others functionalities are under development (distributed energy resources object model, including grid connection function modelling, microgrids, thermal energy). Future tenders should require the use of IEC 61850, and consequently, allow the use of open data models according to the needs of CPOs and DSOs.

In conclusion, it is important to remark that the predominant protocols proposed in these Recommendations correspond to a possible future harmonised scenario over the next 2 to 5 years, as shown in Table 5 below. These scenarios take into account current standardisation works carried out by international standardisation organizations. Until their work is complete and an advanced ecosystem is built up, public authorities should cover the various communication domains with those standards and protocols that best facilitate an open and resilient environment enabling a smooth, digital interaction between vehicle, services and customers. The use of open, non-proprietary protocols, that are free to use, fosters the development of the recharging services market as an open and competitive market, with non-discriminatory access for new entrants.

Table 5: Overview of main EV communication domains and possible future harmonisation

Possible Future Harmonised Scenario		
Communication domain	**Standards**	
EV – Recharging point	ISO 15118	Vehicle-to-grid communication interface
Recharging point - Back-end/ network management system	IEC 63110	Management of EVs recharging and discharging infrastructures
Roaming	IEC 63119	Governing of information exchange of EV roaming services
Distributed energy resources	IEC 61850	Exchange of information with distributed energy resources

E-roaming requirements

Public authorities should require that the CPO-concessionaire allows non-discriminatory third party (EMSPs) access to its recharging points, so third party-EMSPs can offer services on these recharging points (start/ stop a session, financial transaction, smart recharging) to their customers. Moreover, this requirement should be complemented by an obligation on the CPO-concessionaire to establish a minimum amount of roaming connections, without, however, mandating the way roaming is implemented (Peer-to-Peer or via a clearing house).

5.3.6 Future-proof infrastructure

As electric vehicles and the required recharging infrastructure are relatively new technologies, a lot of (technological) developments will likely take place in the decades to come. Since recharging points are made to last a decade or longer, publicly accessible recharging points should be future-proof. This requires not only that they are state-of-art today, but also that they can be easily configured to future standards, should these arise.

The most important technological developments to keep an eye on are:

(i) **higher power levels and more energy-dense batteries:** ever faster recharging times and ever higher energy-dense batteries could have significant impacts on the recharging needs and behaviour of EV-users, potentially increasingly replicating the refuelling patterns of conventional ICE-vehicles;

(ii) **'smart' recharging (commonly referred to as smart charging) and V2G:** smart (re)charging' (or controlled recharging) is a term used for techniques that manage the energy supply to recharge electric appliances and vehicles in such a way that the peaks in network load are reduced and possibly the best use made of available, sustainably generated electricity (see schematic example in Figure 25). In a simple form, this means that the recharging session of certain coupled vehicles is temporarily postponed, interrupted or the power level altered - for instance, driven by electricity market price signals. In a more complex form, the vehicle battery can be used as a buffer in the energy system, which can be recharged when there is excess (renewable) electricity and discharged when more electricity is needed than is generated in other parts of the electricity network (referred to as Vehicle-to-Grid or V2G). Public authorities should require that all publicly accessible recharging points are at least **'smart charging ready'**. This requires the inclusion of a smart controller in the recharging point and back office with power steering algorithms (which must still be harmonised).

(iii) inductive or wireless recharging: while currently most EVs must be physically connected to recharging infrastructure to recharge, some electric vehicles can already be recharged wireless or inductively. In this case, the recharging system is installed under or just above ground and the electrical energy is supplied to the vehicle via induction. In an urban context, this could have major advantages in limiting visual pollution and occupancy of public space. Moreover, inductive recharging could be perceived as more user-friendly, as the EV-user would have to engage in fewer operations to recharge (no need to connect and disconnect the vehicle).

5.3.7 User-friendly infrastructure

5.3.7.1 Finding infrastructure

Static and dynamic data collection and provision

Public authorities should include in their tender specifications an obligation on CPOs to transmit at least the following static and dynamic data to them, in real time (only in case of changes for static data):

- location (address, GNSS coordinates)
- opening hours
- maximum power offered (AC/DC, kW, voltage range, maximum current)
- available connectors (plugs, sockets, induction plate, battery swapping)
- available authentication and payment methods
- identification of the owner/operator
- technical availability (in service/out of order)
- occupation status (occupied/available)
- price for recharging (ad hoc price)

Moreover, public authorities should require strict compliance with the requirements of Directive (EU) No 40/2010 on Intelligent Transport Systems and subsequent delegated and implementing acts, in particular Commission delegated Regulation (EU) No 962/2015 and delegated Commission Regulation (EU) No 1926/2017. This includes the requirement that certain static and dynamic data regarding recharging points are made accessible in Datex II (CEN/TS 16157) format (or relevant upgrades of that standard) online, at least through the relevant National Access Point.

Road signs and graphical displays

Public authorities should equip roads with clearly visible and easily recognisable signposting towards recharging points. Similarly, they should clearly mark lots that are reserved for recharging electric vehicles. Obligations could be imposed on concessionaires.

5.3.7.2 Performance requirements

In order to offer the best possible service to EV-drivers on the one hand, and to get the best value for money on the other hand, public authorities should set minimum uptime requirements for infrastructure. Monitoring is best performed in real time, or at least on the basis of real time data. Financial penalties could be considered as a deterrent to ensure that maintenance is taken sufficiently seriously by the contractor, also towards the end of the concession period.

Public authorities should include minimum support requirements in their tender specifications, such as obligations on the operator to repair infrastructure within a given timeframe, either from a distance (e.g. a software issue) or, if needed, on site. 24/7 phone assistance should be provided as a minimum.

Support in at least one, common European language other than the native tongue of the country/region in which the infrastructure is located, is advised. The phone number of the call centre should be clearly displayed on each recharging point.

5.3.7.3 User-friendly ad hoc payment

Public authorities should require in their tender specifications that any EV-user is able to recharge on an ad hoc basis at any publicly accessible recharging point, namely:

- with a one-off agreement, that is concluded when the user starts charging the vehicle and ends with payment for that recharging session, without there being any longer-lasting mutual obligations;
- without any need to enter into any written agreement with the Charge Point Operator or owner;
- without any need to download a dedicated smartphone application (e.g. from the Charge Point Operator);
- without any need to identify or register himself; and
- offering an easy payment option on the spot, that shall as a minimum allow for payment by debit or credit card (e.g. contactless payment via NFC reader), or other direct bank payment through widely supported digital means.

5.3.7.4 Ensuring fair and reasonable prices

Public authorities should require in their tender specifications that bidders specify a maximum B2B (contract-based) and ad hoc price in their bids – these maximum prices serve as a cap on the prices charged to users throughout the duration of the contract/concession (with the exception of contractually agreed price indexation or price review provisions).

Public authorities should require in their tender specifications that there is no discrimination between the prices charged by CPOs to B2B customers (EMSPs) and the prices charged to B2C customers (i.e. the ad hoc price charged to EV-drivers). For example, public authorities could require that the difference between the price charged by a CPO to a third party-EMSP for a recharge at his stations or the price charged directly to an EV-driver recharging at his stations ad hoc, shall never exceed [X]%.

5.3.7.5 Price transparency

Public authorities should require that (all elements of) the ad hoc price are displayed at any publicly accessible recharging point in a visible, transparent and unambiguous manner. Moreover, in order to ensure fair, transparent and easy-to-compare pricing, they should mandate that the ad hoc price and contract-based price offered by the successful concessionaire are based mainly on electricity consumed (i.e. a kWh based price), possibly complemented by a time-based fee (to dissuade unnecessary long occupation of the dedicated parking space). In case of dynamic prices, the intraday price changes should be accurately reflected in the costs charged to the EV-users, and ultimately in the invoice.

5.3.7.6 Electricity supply requirements

In order to support the green image of electromobility, public authorities should consider requiring that only renewable electricity is offered for electric vehicle recharging.

5.3.8 Data and cyber security

Public authorities should clearly specify in the tender specifications the data that the infrastructure operator should gather for and provide to them. Depending on the contractual set-up, but certainly in cases where the public authorities own or co-fund the infrastructure, they should require ownership of the data generated by the infrastructure, allowing them to collect and consolidate these data on an independent data platform and use them as they deem fit - including by making them available freely to all interested parties for re-use.

Since recharging infrastructure is an essential and critical infrastructure, tender specifications should set requirements for electric recharging infrastructure in terms of cyber security. In particular, public authorities should try to minimise security disparities, by including in their tender requirements for incident reporting and promoting and information-sharing culture among the different players in the EV-ecosystem reducing the risk of threat propagation. Finally, as concessions may run for a long period of time, public authorities should require in their tender specifications that they can, if necessary in the future, require the upgrading of infrastructure to the desired level of cyber security.

5.3.9 Guarantees and enforcement mechanisms

In order to avoid that the tender requirements remain hollow phrases, public authorities should require appropriate guarantees from their concessionaires and/or include appropriate enforcement mechanisms (e.g. penalty mechanisms) in their tender specifications. These must at the same time be sufficiently high to have a deterring effect during execution of the contract, while not being so high as to deter bidders from participating in a tender altogether.

5.3.10 End of concession, licence, public contract

Public authorities need to balance the contract term with the obligations and costs that the operator receives and incurs.

Public authorities should include rules on who owns and is responsible for the infrastructure after the contract term.

Annex 1:
Glossary

2019 STF stakeholder consultation	The stakeholder consultation on key policy needs and options for action in Alternative Fuels Infrastructure deployment and consumer services conducted by the Sustainable Transport Forum ("STF") in 2019. The findings of this consultation were recorded in the Sustainable Transport Forum Report 'Analysis of stakeholder views on key policy needs and options for action in Alternative Fuels Infrastructure deployment and consumer services', available here: https://ec.europa.eu/transport/sites/transport/files/2019-stf-consultation-analysis.pdf
AFID - Alternative Fuels Infrastructure Directive	OJ L 307, 28.10.2014, p. 1–20, Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure.
Alternative fuels	Meaning fuels or power sources which serve, at least partly, as a substitute for fossil oil sources in the energy supply to transport and which have the potential to contribute to its decarbonisation and enhance the environmental performance of the transport sector. They include, inter alia — electricity, — hydrogen, — biofuels as defined in point (i) of Article 2 of Directive 2009/28/EC, — synthetic and paraffinic fuels, — natural gas, including biomethane, in gaseous form (compressed natural gas (CNG)) and liquefied form (liquefied natural gas (LNG)), and — liquefied petroleum gas (LPG).
BEV - Battery Electric Vehicle	Also known as an all-electric vehicle, a BEV has all its power from its battery packs and thus has no internal combustion engine, fuel cell, or fuel tank.
CCS - Combined Charging System (Combo 2)	CCS (Combo 2) is the connector standard for DC recharging in the EU.
CHAdeMO	"CHArge de MOve" Charging System/ Trade name of a quick charging for battery electric vehicles delivering up to 62.5 kW of high-voltage direct current via a special electrical connector. It is proposed as a global industry standard by an association of the same name.
Connector	A connector is the physical interface between the recharging point and the electric vehicle through which the electric energy is exchanged.
CPO Backend	Backend, administrative systems of the CPO, as opposed to frontend, on-site systems that communicate directly with EV's.
CPO - Charge Point Operator	Entity responsible for the management, operation and maintenance of one or more recharging points. The role of a CPO can include both the administrative operation (e.g. access, roaming, billing to EMSP etc.) and technical maintenance of recharging points.
DR - Demand Response	The act of changing the energy consumption of an end-user in reaction(response) to a request (demand) from service providers such as the energy provider, DSO, and flexibility operator. The request may explicitly state the requested change, or implicitly stimulate change (by price signals).

DSO - Distribution System Operator	The organisation that designs, operates and maintains the public distribution grid through which electricity is supplied to recharging points. The recharging points are connected to the DSO grid through a delivery point.
Dynamic Data	Data that changes frequently over time, such as data on the availability of a recharging station.
Electricity Clearing House	Clearing house responsible for energy demand and response clearing and enabling energy services.
Electricity supplier	Supplier of electricity to the recharging station according to a contract with a CPO.
eMobility/ Electromobility	eMobility refers to road transportation based on plug-in electric powertrains. To enable eMobility, EV recharging infrastructure must be deployed to enable EVs to recharge ubiquitously.
EMSP - Electromobility Service Provider	An entity offering eMobility services to end customers (services offered may include recharging, search & find, routing and other services).
eQuestionnaire	Survey distributed to public authorities in Europe (European Member States, EEA countries and the UK, but also European cities and regions) for the purposes of these Recommendations, to gather input and learn from the experiences of Europe's cities, regions and Member States in relation to concessions, procurement and subsidy schemes for alternative fuels infrastructure. The eQuestionnaire is attached as Annex 4.
EV Service	EV Services are all the services related to Electromobility.
EV - Electric vehicle	Meaning a motor vehicle equipped with a powertrain containing at least one non-peripheral electric machine as energy converter with an electric rechargeable energy storage system, which can be recharged externally.
EV-driver	Human driving an electric vehicle.
EV-enabled parking lots (EVPLs)	Parking lots especially equipped for EV recharging.
EV-user	Human using an electric vehicle.
Grid Operator (GOP)	The term Grid Operator refers to a Transmission System Operator, a Distribution System Operator or a local grid operator (e.g. CEMS).
High power recharging point	Means a recharging point that allows for the transfer of electricity to an electric vehicle with a power of more than 22 kW.
ICE	Internal Combustion Engine: an engine which generates motive power by the burning of petrol, oil, or other fuel with air inside the engine, the hot gases produced being used to drive a piston or do other work as they expand.
Interoperability	The ability of two or more networks, systems, devices, applications, or components to interwork, to exchange and use information in order to perform required functions.
kWh - Kilowatt hour	Measure Unit of energy equal to 1,000 watt-hours, or 3.6 megajoules. The kilowatt-hour is commonly used as a billing unit for energy delivered to consumers by electric utilities.
MID Directive - Measuring Instruments Directive (2014/32/EU)	OJ L 96, 29.3.2014, p. 149–250, Directive 2014/32/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments.
NFC - Near Field Communication	A set of standards specifying uni- and bi-directional messaging between devices using radio communication over small distances. It is used for access, authorisation and billing purposes, typically using a NFC-enabled smart card or smart phone.

Normal power recharging point	Means a recharging point that allows for the transfer of electricity to an electric vehicle with a power less than or equal to 22 kW, excluding devices with a power less than or equal to 3,7 kW, which are installed in private households or the primary purpose of which is not recharging electric vehicles, and which are not accessible to the public.
NPFs	National Policy Frameworks adopted under the AFID. In accordance with Article 3 of AFID, Member States were obliged to adopt National Policy Frameworks and report them to the European Commission by 18 November 2016. NPFs should include national targets for the deployment of alternative fuels infrastructure in the respective Member State.
OEM	Original Equipment Manufacturers, in this context referring to automotive manufacturers.
PHEV - Plug-in hybrid electric vehicle	A PHEV shares the characteristics of both a conventional hybrid electric vehicle - having an electric motor and an internal combustion engine (ICE), and of an all-electric vehicle, having a plug to connect to the electrical grid.
PLC - Power Line Communications	A mechanism of transferring data over an electric conductor that is simultaneously being used to transfer power.
RFID - Radio Frequency Identification	Automatic identification technology which uses radio-frequency electromagnetic fields to identify objects carrying tags (usually RFID cards) when they come close to a reader.
Recharging location	A location (public or private) where one or more recharging points are erected.
Recharging network	Recharging points are frequently operated and managed as a collection of distributed devices in a branded network. These networks have relationships with the site owners on which recharging points are deployed, and work on behalf of the site owners to manage delivery of EV recharging and other services. In some instances, EV recharging networks may own the EV recharging equipment and may have rights to the property on which the equipment resides. EV recharging networks may also have relationships with the EV-drivers and may provide consolidated account management and billing of services rendered. Services to EV-drivers may be rendered not only “in-network”, but also on “off-network”. In short, EV recharging networks help bridge the gap between entities wishing to offer EV recharging (i.e., supply-side) and EV-drivers wishing to use EV recharging (i.e. demand-side).
Recharging point accessible to the public, public recharging point or publicly accessible recharging point	Meaning a recharging point which provides Union-wide non-discriminatory access to users. Non-discriminatory access may include different terms of authentication, use and payment.
Recharging point	Meaning an interface that is capable of recharging one electric vehicle at a time or exchanging a battery of one electric vehicle at a time.
Recharging pole	A physical object with one or more recharging points, sharing a common user identification interface.
Recharging service provider	Depending on the context, can refer to a CPO or EMSP, or to both.
Recharging Session	A recharging session is a unit of recharging service consumption. It starts when the EV is connected to the EVSE (and if required, authorised). It ends when the EV is disconnected, or by some other well-defined event (different providers may select different terminating conditions, depending upon whether they bill consumers for parking without charging). During the recharging session, the EV consumes different services, including energy and parking/occupancy. The EV-user may be billed by session, or by the consumption of energy/occupancy that took place during the session, or some other mechanism.
Recharging Station	A location which groups more than one recharging point for EV recharging.

RES	Renewable energy sources or Energy from renewable sources or renewable energy: means energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas.
Roaming Platform or Roaming Clearing House	A central organization connecting multiple electromobility market players. They are responsible for contractual clearing and enabling electromobility services between the connected actors and end consumers.
Roaming, e-roaming or EV roaming	Roaming of EV related services will occur when a service is contracted between consumer A and provider B, but is delivered to consumer A by provider C, based on a contract between provider B and provider C.
SECAPs	Sustainable Energy and Climate Action Plans, adopted by cities under the auspices of the Covenant of Mayors. See: https://www.covenantofmayors.eu/en/
Semi-public recharging points	Publicly accessible recharging points erected on private domain, subject to specific, though non-discriminatory, access restrictions, e.g. in terms of opening hours or use, such as the requirement to make use of the associated facilities. Examples include recharging points in car parks of large warehouses or convenience stores, underground car parks, at hotel and catering establishments, etc.
Smart (re-)charging	Smart (re)charging (or controlled recharging) is a term used for techniques that manage the energy supply to recharge electric appliances and vehicles in such a way that the peaks in network load are reduced and possibly the best use is made of available sustainably generated electricity. This can be done in different ways and with different degrees of complexity. In a simple form, this means that the recharging session of certain coupled vehicles is temporarily postponed, interrupted or the power level altered, for instance driven by electricity market price signals.
Static Data	Data that does not vary with time, such as the geographic location of a recharging station.
SUMPs	A Sustainable Urban Mobility Plan (SUMP) is a strategic plan designed to satisfy the mobility needs of people and businesses in cities and their surroundings for a better quality of life. It builds on existing planning practices and takes due consideration of integration, participation, and evaluation principles.
STF - Sustainable Transport Forum	Following the adoption of Directive 2014/94/EU on the deployment of alternative fuels infrastructure the European Commission decided to create the Sustainable Transport Forum (STF). The STF should help the Commission to advance the application of the Clean Power for Transport strategy and facilitate the implementation of Directive 2014/94/EU. It shall assist the Commission in implementing the Union's activities and programmes aimed at fostering the deployment of alternative fuels infrastructure to contribute to the European Union energy and climate goals.
Third Party Service Provider	An actor which provides access to third party data.

TSO - Transmission System Operator	A TSO is responsible for a stable power system operation (including the organisation of physical balance) through a transmission grid in a geographical area (his control area). The System Operator will also determine and be responsible for cross border capacity and exchanges. If necessary, he may reduce allocated capacity to ensure operational stability. Transmission as mentioned above means "the transport of electricity on the extra high or high voltage network with a view to its delivery to final customers or to distributors. Operation of transmission includes, as well the tasks of system operation concerning its management of energy flows, reliability of the system and availability of all necessary system services". (definition taken from the ENTSO-E RGCE Operation handbook Glossary).
Type-2 AC - Type 2 AC Connector Charging System	The IEC 62196 Type 2 connector (Also known as Mennekes) is used for recharging electric cars, the connector is circular in shape, with a flattened top edge and capable of recharging battery electric vehicles at 3–70 kilowatts.
UVARs	Urban vehicle access regulations (UVARs) is a form of traffic management that regulates access in specific urban locations according to vehicle type, age, emissions category – or other factors such as time of day, or day of the week. UVARs can include Low Emission Zones (LEZs) and/ or Congestion Charging and involve a wide range of considerations in implementation.
Vehicle To Grid (V2G)	Vehicle-to-grid-technology enables electric vehicles to function as demand response parties in the electricity system, by feeding electricity stored in the EV battery back into the grid.

Sources for glossary:

http://emi3group.com/wp-content/uploads/sites/5/2018/12/eMI3-standard-TermsAndDefinitions-v1.0.pdf

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0094&from=en

https://www.eafo.eu/knowledge-center/glossary

https://www.rvo.nl/sites/default/files/2019/01/Electric%20Vehicle%20Charging%20-%20Definitions%20and%20Explanation%20-%20january%202019_0.pdf

https://www.eltis.org/

https://languages.oup.com/ (Oxford Dictionary)

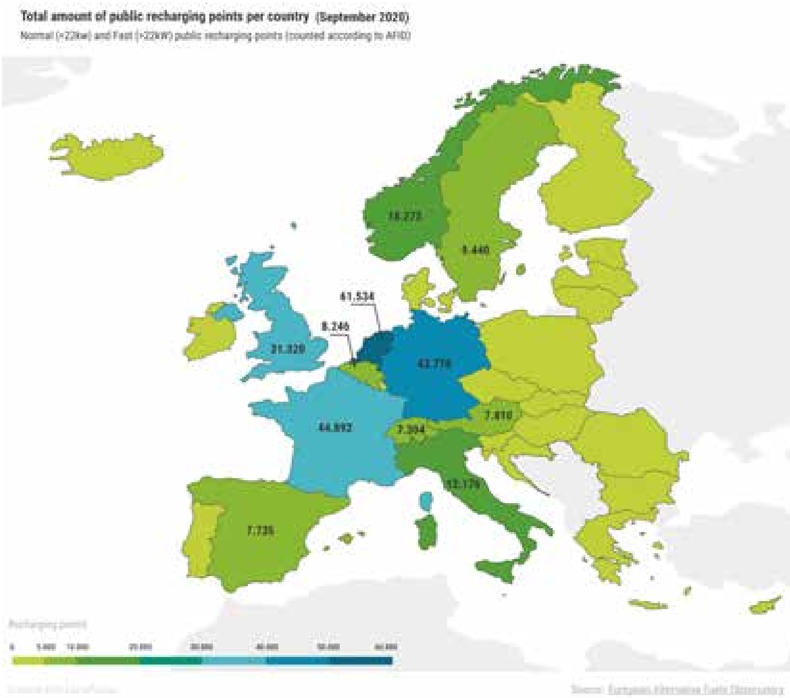
Annex 2: Overview of deployment approaches

A2.1 Differing levels of experience

There are currently almost 200,000 publicly accessible recharging points in the EU. These are very unevenly dispersed across the EU Member States. Also, within Member States, differences between regions are significant. This implies that certain cities, regions and Member States have significantly more experience in organising tenders for the deployment and operation of recharging infrastructure than others.

This also follows from the responses to the eQuestionnaire. More than one third of the respondents (14) indicated that they had a lot of experience, a similar share (15) indicated that they are somewhat experienced, and a small group of respondents indicated (8) that they had little or no experience.

Figure 34: Map indicating the number of recharging points per country (EU+UK+EFTA)



Source: European Alternative Fuels Observatory (www.eafo.eu)

A2.2 Electromobility and infrastructure plans

Most of the respondents indicate that they have a separate plan for electromobility and the deployment of infrastructure. Just over half the respondents have developed a Sustainable Urban Mobility Plan (SUMP). Only three of the respondents included a deployment strategy for recharging infrastructure. Most of the respondents that have developed a SUMP indicate that they have a separate plan or strategy for recharging infrastructure.

A2.3 Targets

The majority of respondents indicate to have measurable targets, a quarter of the respondents have indicated that the authority that they represent has not developed measurable targets for electromobility or the deployment of recharging infrastructure.

The responses show that municipalities, regions/ provinces and Member States have diverse ambitions for electromobility and or deployment of recharging infrastructure. Many of the respondents formulate targets regarding the number of installed recharging points (Arnhem, Ghent, Bilbao, Madrid, Stockholm, Stuttgart, the Flemish government, Vestland region (Norway). Norway, for example, has installed a minimum of two recharging points in every municipality and, in the first phase of its national deployment scheme (2015-2016), had the ambition to have a nationwide network of publicly accessible recharging points on all main routes with a minimum of one high power recharging point (P ≥ 50kW) per 50 km by 2021. More recently, in view of the increased power of recharging points and increased range of EV batteries, the ambition has been slightly revised to have at least one ultra-high power recharging point (P ≥ 150kW) on the main routes every 50-100 km.

Other municipalities set targets in terms of electric vehicle uptake rather than recharging point roll-out. The City of Gothenburg for instance has the ambition to have a fully electric car fleet by 2023. The number of recharging points will be determined by customer demand and behaviour.

A number of municipalities and regions describe the measures they are taking to implement these ambitions (deployment strategy), for example through building regulations that impose obligations on new urban developments (Paris).

It is notable that a number of respondents indicate that they only formulate ambitions with regard to publicly accessible recharging infrastructure (on public land), because they have limited powers on private land or with regard to private recharging infrastructure. In that case, incentives are mainly provided e.g. through subsidies (Berlin, Stockholm).

Responding Member States refer to their National Policy Frameworks for the market development of alternative fuels and infrastructure, with clear targets that also cover various geographical areas in the country.[171]

171 The National Policy Frameworks as well as the 2019 National Implementation Reports of all Member States have been published on the Member State pages of the European Alternative Fuels Observatory (www.eafo.eu).

A2.4 Overall deployment approaches

The Norwegian government argues that the infrastructure should increasingly be built and operated without state intervention.[172] The Norwegian county Vestland indicates that the county will contribute to the development of an adequate high power recharging network in specific areas only. This example shows that authorities choose to allocate the responsibility for the development of recharging infrastructure between different levels of government.

Many cities are opting for demand-driven infrastructure development; the poles are installed on the basis of demand in a given area. Nowadays there are also several municipalities that deploy infrastructure on the basis of usage and consumption data generated by existing recharging infrastructure. Examples include the city of Rotterdam and the Metropolitan Region of Amsterdam. Dortmund uses grid analyses, socio-economic data, city planning data, but also involves citizens in choosing the final recharging station locations.

172 As mentioned in the Norwegian government's Action plan for alternative fuels infrastructure in transport: "[T]he development of infrastructure for alternative fuels must be market-driven and take place at the earliest possible stadium without support". For background reading, see the Norwegian National Transport Plan (in English): https://www.regjeringen.no/en/dokumenter/meld.-st.-33-20162017/id2546287/ or the Norwegian government's Action plan for alternative fuels infrastructure in transport (in Norwegian only): https://www.regjeringen.no/no/dokumenter/handlingsplan-for-infrastruktur-for-alternative-drivstoff-i-transport/id2662448/.

Annex 3: Overview of coordinators, authors, core review team, stakeholders and respondents

A1.1 Coordinators/Authors

Name Coordinator/ Author	Organisation	Description of the organisation
Alexander Verduyn	DG MOVE, European Commission	
Maarten Verbeek Eva Winters	TNO	TNO is an independent Dutch research organisation with a mission to connect people and knowledge to create innovations that sustainably strengthen the competitiveness of businesses and the well-being of society. It focuses on innovative research in 9 principal domains, including sustainable transport policy.
Gabriela Barrera Sabina Asanova	POLIS	POLIS (www.polisnetwork.eu) represents around 80 cities, regions and transport operators from all over Europe. POLIS' objective is to support European cities and regions to improve the quality of life of their citizens through innovative measures for sustainable urban transport. The Network facilitates access to European initiatives and research programmes for its members, looking into solutions for urban and regional mobility, in the field of health and environment, traffic management and intelligent transport systems, road safety, and social and economic aspects of transport.

A1.2 Core Reviewers

Expert organisations

Name Reviewer	Organisation	Description of the organisation
Pieter Looiestijn	MRA-E	MRA-Electric is a cooperation on stimulating electromobility for 70+ local and 4 regional governments in the three provinces tot the north-west of the Netherlands. They were founded, by amongst others, the city of Amsterdam. An important part of MRA-E's work is developing a network of public recharging stations through joint procurement, piloting, network management, monitoring, etc. On behalf of the provinces of North-Holland, Flevoland and Utrecht, MRA-E launched and successfully concluded the biggest tender for publicly accessible recharging infrastructure thus far in the EU (20,000 recharging points).
Baerte De Brey	ElaadNL	ElaadNL is a Dutch consortium of 5 DSOs set up to foster the deployment of electromobility in the Netherlands. ElaadNL assists public authorities in their roll-out of large-scale recharging infrastructure by means of tenders. To this end, ELAAD has drawn up a 'program of requirements' which is used in various tendering procedures by Dutch public authorities. See also: Map containing all recharging points in the Netherlands per city district Charge Management of electric vehicles at home (2020) Electric Vehicle Symposium (EVS33) Portland, Oregon, June 14 -17, 2020 Different phases for EV Power Quality; a business case Electric Vehicle Symposium (EVS33) Portland, Oregon, June 14-17, 2020 A Public Key Infrastructure for Smart Charging VEHICLE-2-GRID READY When the car becomes part of the energy system, charging infrastructure should be ready to support CHARGING STATIONS (2020) Requirements for bidirectional systems (2020) Specific tender documents available on request to ELAAD. Contact info@elaad.nl (more information available here (NL): https://www.elaad.nl/services/aanbestedingsondersteuning/)
Philippe Damien	European Investment Bank (EIB)	The European Investment Bank is the lending arm of the European Union. They are the biggest multilateral financial institution in the world and one of the largest providers of climate finance.

Thomas Wilson	Eurocities	Eurocities is the network of 190 cities in 39 countries, representing 130 million people. Through joint work, knowledge-sharing and coordinated Europe-wide activity, we ensure that cities and their people are heard in Europe. See also: EUROCITIES policy paper on the revision of the alternative fuels infrastructure directive
Roland Ferwerda Robbie Blok	Nationaal Kennisplatform Laadinfrastructuur Nederland (NKL)	Founded in 2014 to improve cooperation between policy makers, knowledge institutions, network operators and market players active in electromobility, the independent Netherlands Knowledge Platform for Recharging Infrastructure (in short NKL) gathers, stores and exchanges all kind of information regarding recharging infrastructure. The knowledge platform includes a section dedicated to public procurement, concession awards or government support, including tender specifications. Under the auspices of NKL, municipal governments and market parties in the Netherlands have jointly developed a Standard Set of recommended requirements for charging stations or plazas. The Standard Set in other words contains a number of requirements for public authorities to include in their tender specifications regarding recharging infrastructure. See also: Uniform standards for charging stations (2018) Standard Set Charging Plazas Electric vehicle charging - Definitions and explanation (2019) Overview current tenders and relevant documentation (in Dutch)
Julia Hildermeier	The Regulatory Assistance Project (RAP)	The Regulatory Assistance Project (RAP) is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future. It's expertise lies in particular in all aspects related to the power sector. See also: Building a market for EV charging infrastructure: A clear path for policymakers and planners, J. Hildermeier, RAP, June 2020
Harm Weken Bert Witkamp Floris Jousma Edwin Bestebreurtje	Fier Automotive	FIER Automotive was founded at the Erasmus University in Rotterdam to facilitate innovative and economic research in the automotive industry. In 1994 FIER Automotive became an independent company. Since end 2017, Fier Automotive leads the consortium managing the European Alternative Fuels Observatory (www.eafo.eu) on a contract with the European Commission.

Cities

Name Reviewers	City
Norman Doege	City of Berlin
Katrien Vadenhecke	City of Ghent
Eva Sunnerstedt	City of Stockholm
Michael Hagel	City of Stuttgart

A1.3 Overview of respondents to eQuestionnaire

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
1	City of Arnhem (Netherlands)	Local public authority	The New energy made in Arnhem 2020-2030 programme set the goals for the further rollout of electric recharging infrastructure in the city: 1,000 publicly accessible recharging points by 2023 and 6,000 by 2030. The city of Arnhem tenders out the development and operation of their public recharging infrastructure, so they decide on the developments in the public space and the prices. With a concession they own the recharging infrastructure and let the market operate it. In this way they also determine the type and location of the infrastructure (i.e. recharging plazas), taking also advantage of installation of fast rechargers in highways and provincial roads.	Publieke oplaadinfrastructuur voor elektrische voertuigen ten behoeve van gemeenten binnen Flevoland, Noord-Holland en Utrecht Kenmerk: 1185846/118586 PVE – Openbare laadninfra, concessie 2020 Other relevant documents New energy made in Arnhem Programma 2020-2030
2	City of Dortmund (Germany)	Local public authority	The city of Dortmund bases its deployment strategy on a forecast of EVs, grid analyses, socio-economic data, city planning data and involves citizens in its decisions regarding on locations and type of recharging points. The city tenders out the development and operation of one or more interoperable networks. Their main investments are rather related to their own fleet operation and consider that third parties, preferably from the energy or utility industry, should respond to the tenders to install, according to the guidelines defined by the municipality, and operate the charging infrastructure for a long-term period (> 10 years).	

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
3	City of Paris (France)	Local public authority	The city of Paris considers that private companies are best placed to develop the recharging infrastructure network, since it is not the role of a public authority to 'sell' a 'fuel' and a private entity can have a greater flexibility to adapt to new innovations.	
4	Metropolitan Region of Amsterdam (MRA-E) (Netherlands)	A non-governmental body entrusted with a public task or service of general economic interest	MRA-Electric is a cooperation stimulating electromobility for 70+ local and 4 regional governments in the three provinces to the north-west of the Netherlands. They were founded by, amongst others, the city of Amsterdam. An important part of MRA-E's work is to develop a network of public recharging stations through joint procurement, piloting, network management, monitoring, etc. On behalf of the provinces of North-Holland, Flevoland and Utrecht, MRA-E launched and successfully concluded the biggest tender for publicly accessible recharging infrastructure thus far in the EU (20,000 recharging points). The approach chosen by their municipalities is: • Municipality is responsible for public space • Municipality has public goals for CO2 reductions and clean air • Energy transition needs to be socially fair; the municipality can maximise pricing and develop an accessible network. • The approach avoids (local) monopolies • The approach develops a competitive market • Once EV picks up, the infrastructure becomes an asset for the government with which the initial investment can be earned back.	Bijlage 4: Programma van Eisen; VERSIE 2 incl. NvI aanpassingen en alle bijlagen Publieke oplaadinfrastructuur voor elektrische voertuigen ten behoeve van gemeenten binnen Flevoland, Noord-Holland en Utrecht. Kenmerk: 1185846/1185862

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
5	Ente Regional de la Energías de Castilla y León (Spain)	Regional public authority	The Regional Public Administration tendered the development of a network of 58 recharging points. For them interoperability is key to be able to provide a service to all electric vehicle users.	
6	Area Metropolitana de Barcelona (AMB) (Spain)	Local public authority	Due to the lack of investment from private companies, AMB (as a metropolitan authority) and the Barcelona municipality decided to put in place a basic charging network for electric vehicles, acting as EMSP and CPO. At this moment, this network remains the most relevant public network in the area and currently plans for its expansion are under preparation.	Local Urban Mobility Plan http://www.amb.cat/web/mobilitat/pla-metropolita-de-mobilitat-urbana-amb
7	Government of Ireland (Ireland)	National public authority	Until the implementation of an electric vehicle recharging network becomes profitable (i.e. the percentage of the fleet made up of electric vehicles increases beyond a certain point), it is important that the government assists, through funding or other means, with the establishment of a basic network. This should encourage increased uptake of EVs by the public, which in turn should result in private companies seeking to garner a share of the recharging market.	
8	Toulouse Metropole (France)	Local public authority	Toulouse Métropole deploys the REVEO network in a logic of equity and territorial coverage (does not necessarily seek the best spots). At the same time, Tisséo-Collectivités (AOM) is launching a call for private initiative to equip the 4 relay parks at the head of the metro IRVE. Private companies also deploy infrastructure offering the IRVE points open to the public. Toulouse Métropole was also a winner of the VILAGIL project (National Future Investment Program), so a project company will deploy IRVEs in the Toulouse Métropole area to complement the REVEO network (i.e. interoperability).	

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
9	City of Ghent (Belgium)	Local public authority	According to the targets set by the Flemish government in 2016. The city of Ghent needs to have 162 publicly accessible recharging points by 2020. In their view a local authority should not be an energy provider but should play a role in the development of publicly accessible charging points while tendering its deployment and operation to private companies.	
10	City of Oslo (Norway)	Local public authority	Oslo will only allow zero-emission taxis from 2024 and plans to ban the sale of all diesel and gasoline passenger vehicles from 2025. It also aims to have zero-emission Public Transportation by 2028. The city of Oslo develops its own basis public network. In addition, it works with a joint-venture structure with private actors to develop high power recharging infrastructure chargers in the public domain. The municipality also gives a subsidy of 25% for charging infrastructure on private ground, especially for housing Associations/ Cooperatives.	
11	Bilbao City Council (Spain)	Local public authority	Through a tendering process the city of Bilbao has the objective of having 20% of the fleet in circulation by 2030 made up of electric vehicles. This represents 36,000 EVs for the year 2030 and more than 15,000 EVs for the year 2025. By the year 2030, 30 fast charging station are expected to be installed in the city; the municipal off-street parkings should offer at least 1 parking lot with charging infrastructure for every 40 lots (ideally 10%).	SUMP = Strategies and proposals – Actions. Environment

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
12	Vestland City Council (Norway)	Regional public authority	The region has contributed to the development of a fast charging network since 2012. At with a collaboration with fast charging operators (CPOs) at project Level. Since then, the region has gradually retreated from this role, and instead contributed financially. In that way, the process has become less bureaucratic and the risk has moved to private companies (CPOs). The region set up tenders to: (1) test the markets willingness to invest and (2) find the Level of public support necessary for the investment to occur.	
13	City of Stockholm (Sweden)	Local public authority	The city of Stockholm has mapped possible locations for on-street recharging point on a publicly accessible on-line map Interested project developers and operators may apply for a location on a first come-first served basis, following a predetermined applications process. To ensure competition, the city applies a limitation in the number of applications that can be made by the same party. If an applicant is successful, the city enters into an 'access agreement' (19 year agreements that get prolonged 5 years at the time) with that operator setting the basic requirements for operating recharging infrastructure in the public domain. The City has set up specific goals for public recharging: -Short term: 4,000 public recharging points by 2022. (2,000 in public parking garages and 2,000 on-street). -Long term goal: Access to public recharging infrastructure should not constitute an obstacle to the conversion to a fossil-free vehicle fleet. As for many cities one of the most important aspects for the development of infrastructure is "home charging".	https://tillstand.stockholm/tillstand-regler-och-tillsyn/parkering/ansok-om-att-etablera-nya-laddplatser-for-elbil/. https://tillstand.stockholm/tillstand-regler-och-tillsyn/parkering/ansok-om-att-etablera-nya-laddplatser-for-elbil/anmal-intresse-for-att-satta-upp-nya-laddare/#step-1 Experiences from setting up public charging facilities for electric vehicles in Stockholm (2016) Information on private charging is available at: www.fixaladdplats.se

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
14	Auvergne-Rhône-Alpes Region (France)	Regional public authority	For the Region it is important to develop the network together with private companies to make sure private locations (parking in buildings, commercial or office zones) are covered and to ensure the profitability of the infrastructure	
15	Ministry of Economy, Energy and Business Environment (Romania)	National public authority	The ministry prescribes specific zones with minimum roll-out requirements to obtain good geographical spread. The bidders determine the best locations for infrastructure roll-out. According to the objective established in the National Policy Framework, recharging stations will be distributed in such a way as to ensure the autonomy of alternative fuels on a radius of at least 10 km in selected urban areas by the end of 2020 and at least 150 km in the extra-urban environment for national roads, as well as at least 70 km for the TEN-T network, before end 2025. In the case of bypasses of cities with more than one hundred thousand inhabitants, sufficient loading points will be provided, positioned at reasonable distances, preferably of a maximum of 50 km.	
16	City of Berlin (Germany)	Local public authority	The local authority has developed the 'Berlin Model' which regulates the implementation and operation of recharging infrastructure on public ground. Within this framework, it is possible for private operators to erect infrastructure if they have signed a specific contract with the municipality. This allows them to install public recharging points in coordination with the different city districts. On public ground the operator needs to grant without discrimination free access for customers of every mobility provider. This to improve the user-friendliness and maximize. interoperability.	

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
			The authorization of customers takes place through a platform, operated by the municipality. The now existing public network is a first basis. In future accessible infrastructure on private ground should be of more importance.	
17	City of Stuttgart (Germany)	Local public authority	The local authority has developed the 'Berlin Model' which regulates the implementation and operation of recharging infrastructure on public ground. Within this framework, it is possible for private operators to erect infrastructure if they have signed a specific contract with the municipality. This allows them to install public recharging points in coordination with the different city districts. On public ground the operator needs to grant non-discriminatory access for customers of every mobility provider. This to improve the user-friendliness and maximise interoperability. The now existing public network is a first basis. In future, accessible infrastructure on private domain should become more important.Moreover, the public transport authority is currently working on a revision of the public recharging strategy as well as on a revision of the 'Berlin Model'. In future, the recharging requirements of light commercial transport vehicles will also be part of this strategy.	
18	Ministry of Transport of the Republic of Latvia (Latvia)	National public authority	There are other recharging networks available, but the national recharging network is comprehensive and covers the whole territory of Latvia. The target is to give the possibility of using electric cars throughout country. Public authorities develop the basic network, but this is complemented by infrastructure developed by private companies. The development of electromobility is still hindered by several specific factors, i.e. - part of inhabitants is mostly living in multi-dwelling houses, urbanized environment is not only in Riga, but also in other development centers of national and regional significance where currently there is no EV recharging infrastructure. Therefore, the availability even for slow charging is still crucial.	https://likumi.lv/ta/id/277693-darbibas-programmas-izaugsme-un-nodarbinatiba-4-4-1-specifiska-atbalsta-merka-attistit-etl-uzlades-infrastrukturu-latvija-isten...

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
19	Thüringer Ministerium für Energie, Umwelt und Naturschutz (Germany)	Regional public authority	The Region develops the basic network but this is complemented by infrastructure developed by private companies. Bidders determine the best locations for infrastructure roll-out.	
20	City of Munich (Germany)	Local public authority	The municipality tenders out the development and operation of one or more interoperable networks. Public space is scarce and shall be used also for recharging stations, but 'not exclusively'. Recharging is to become a business model and should not be continuously subsidized. Various private companies that use public space but are a CPO on private property (i.e. grocery store), may be also able to offer a good service to the public.	
21	Brussels Environment Administration (Belgium)	Regional public authority	The Brussels Capital Region has chosen to tender out the installation and operation of public recharging points through a concession. In the vision for the further roll-out, a new concession will be set up, with the possibility for the distribution network operator to fill in the spots for which no private operator is willing to answer the call. Brussels prescribes specific zones with minimum roll-out requirements to obtain good geographical spread. As Brussels' electricity grid is mainly powered by 230V and network upgrades would result in prohibitively high costs, the Brussels Capital Region of Belgium generally recommends the deployment of 'normal power' recharging points (P <= 7.4kW). Recharging at higher power levels (11kW or higher) is reserved for commercial hubs, off-street public parkings or other suitable locations close to the 2,500 "400V ready" electrical cabins dispersed over the Region.	https://environnement.brussels/sites/default/files/user_files/note_vision_regionale_bornes_fr.pdf https://leefmilieu.brussels/sites/default/files/user_files/note_vision_regionale_bornes_nl.pdf

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
22	Federal Ministry of Transport and Digital Infrastructure (Germany)	National public authority	In Germany the Federal Ministry of Transport and the central coordination centre (Nationale Leitstelle Ladeinfrastruktur), NOW gmbh organise bi-annual meetings with representatives of the Federal States (Bundesländer) to discuss the need and further deployment of recharging infrastructure. Furthermore, Federal States can participate to the Federal funding scheme through an 'opening clause', which is meant to ensure uniform minimum criteria throughout Germany. Germany has also developed a central planning tool for recharging infrastructure, to indicate where investments should best take place: the StandortTOOL. The current targets are included in the "Masterplan on Recharging Infrastructure" of 18 November 2019, which states a target of one million publicly accessible recharging points by 2030.	(1) Fünfter Aufruf zur Antragseinreichung Vom 29.04.2020 gemäß der Förderrichtlinie Ladeinfrastruktur für Elektrofahrzeuge in Deutschland des Bundesministeriums für Verkehr und digitale Infrastruktur vom 13.02.2017; (2) Vierter Aufruf zur Antragseinreichung vom 19.08.2019 gemäß der Förderrichtlinie Ladeinfrastruktur für Elektrofahrzeuge in Deutschland des Bundesministeriums für Verkehr und digitale Infrastruktur vom 13.02.2017; (3) Dritter Aufruf zur Antragseinreichung vom 19.11.2018 gemäß der Förderrichtlinie Ladeinfrastruktur für Elektrofahrzeuge in Deutschland des Bundesministeriums für Verkehr und digitale Infrastruktur vom 13.02.2017; (4) Förderrichtlinie Ladeinfrastruktur für Elektrofahrzeuge in Deutschland; (5) Datenabfrage Halbjahresberichte

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
23	City of Amsterdam (Netherlands)	Local public authority	The city of Amsterdam has been one of early movers in terms of the deployment of recharging infrastructure. With more than 3,500 publicly accessible recharging points on its territory, it is one of the frontrunners in terms of electric mobility in Europe. Amsterdam tenders out the development and operation of one or more interoperable networks to increase competitiveness and cost efficiency. In response to current and forecasted EV traffic, The Municipality of Amsterdam has set out its 'Strategic Plan for Charging Infrastructure 2020-2030' aiming to expand its charging offering from 8,000 to 80,000 charging points.	Bijlage PE-1 Uitbreiding- en realisatieproces, Concept Overeenkomst , BijlagePE-3 Managementra-pportages en beheergegevens; Programma van Eisen, Bijlage PE-5 Eisen aan data: Versie 2015 Other relevant documents https://www.amsterdam.nl/parkeren-verkeer/amsterdam-elektrisch/ The Electric city Plan Amsterdam 2018 The Clean Air Action Plan Strategisch plan Laadinfrastructuur 2020-2030
24	Madrid City Council (Spain)	Local public authority	The strategy to promote a publicly accessible recharging network in the city of Madrid is developed on several levels. The city has created a basic recharging network on public roads, owned by the municipality, which covers the central districts of the city. The municipal public transport company complements this municipally-owned network by creating spaces for recharging in strategic locations in the city: parking lots, low emission zones, etc. This basic network is also complemented by a publicly accessible recharging network in privately owned spaces, through the signing of agreements with private land owners.	PLIEGO DE PRESCRIPCIONES TÉCNICAS PARTICULARES DEL SUMINISTRO DE EQUIPOS DE RECARGA DE VEHÍCULOS ELÉCTRICOS TIPO SAVE (2 LOTES) Número de expediente 300/2019/01206; BASES QUE RIGEN EL OTORGAMIENTO DE AUTORIZACIÓN DE USO DE PUNTOS DE RECARGA RÁPIDA PARA VEHÍCULOS ELECTRICOS Other relevant documents Plan de calidad de aire de la Ciudad de Madrid y Cambio climatico (2017) EN version El despegue ultrarrápido de la electromovilidad llegará a Madrid en 2021

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
25	City of Antwerp (Belgium)	Local public authority	The policy vision of the Autonomous Antwerp city Parking Agency (AAPA) is that residents and workers must recharge to a maximum degree on private property in accordance with the 'hierarchy of recharging'. The city of Antwerp prefers, what they call, short-term concessions, that allows them to be more flexible and enables them to keep up with new innovations. The deployment period is limited to 1 year with the possibility to extend twice by one year. The operating period, by contrast, lasts 9 years, with the possibility to extend twice by one year.	Oproep tot kandidaten voor concessie van openbare dienst met als voorwerp het leveren, plaatsen en exploiteren van laadinfrastructuur in de stad Antwerpen, 2016-03-18
26	Enova SF (Norway)	National public authority	The overall target is that infrastructure should be built and operated without state intervention. For now, they launched a competitive bidding procedure for government support which is open for both private and public companies/entities. With the idea that public - private collaboration would promote the most efficient development. The Norwegian overall target is that all new private vehicles and lightweight utility vehicles (vans) are zero-emission by 2025. At municipal level the infrastructure should be developed based on a cooperation between the local authority and private companies.	
27	Botosani City Hall (Romania)	Local public authority	The municipality is developing a basic network which is complemented by infrastructure developed by private companies They prescribe specific locations for the development of recharging stations based on proximity to the electricity grid, population density, and in proximity to shopping areas.	

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
28	Flanders Region (Belgium)	Regional public authority	In Flanders Region, a long-term plan to roll-out 5.000 publicly accessible recharging points was adopted in 2016. The Flemish DSO (Fluvius) is responsible for organizing annual tenders for a specific number of recharging points. Each municipality can participate in this tender. The requirements are set at Regional level to avoid stranded investments and closed local networks. In addition to the deployment of this Regional basic network, private companies can deploy additional (semi-) public recharging points. The Region prescribes specific zones with minimum roll-out requirements to obtain good geographical spread.	
29	Transport Malta (Malta)	National public authority	The 2020 target is to have 318 normal plus 44 high power publicly accessible recharging points. As Malta is relatively small, they have a centralized approach at national level. The authority procures the infrastructure and distributes the recharging points across the municipalities whilst consulting with them on their final location of installation. This approach may change in the future.	
30	Ministry of Economy of the Slovak Republic (Slovakia)	National public authority	For the Ministry of Economy of Slovakia, there is currently no role for municipalities in the deployment of recharging infrastructure, as it considers this too challenging for them, both financially and in terms of human resources. Private companies provide the necessary experience in this regard.	Výzva na predkladanie žiadostí o poskytnutie dotácie na podporu budovania verejne prístupných elektrických nabíjacích staníc

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
31	Sustainable Energy Authority of Ireland (SEAI) (Ireland)	National public authority	In Ireland, municipalities can promote the deployment of recharging infrastructure in less profitable locations such as residential areas with on street or car parking facilities under public ownership. There may be tradeoffs between them and private operators who are seeking to place high powered recharging points in profitable areas. Councils can give access to public lands in exchange for assistance with less profitable areas. Most people in Ireland live in houses rather than apartments. The councils will receive public funds to put recharging points in place but will need the expertise of private operators to choose the best recharging equipment, IT, maintenance, and assistance to ensure that a reliable, interoperable service is provided.	NATIONAL POLICYFRAMEWORK ALTERNATIVE FUELS INFRASTRUCTUREFOR TRANSPORT IN IRELAND2017 to 2030
32	Ministry for Climate Protection, the Environment, Mobility and Urban Development, Bremen (Germany)	Regional public authority	According to Bremen, private companies are best placed to develop the network(s). CPO´s should take the lead and bear the financial risk. Public bodies like municipalities often do not have the financial capacity to cover financial loss from underutilized recharging infrastructure. The best locations for infrastructure roll-out are also determined by the bidders.	
33	City of Lisbon (Portugal)	Local public authority	In accordance with Lisbon, the municipality, as the urban mobility manager, should guarantee the best recharging network possible. It should set criteria in terms of type and location of recharging infrastructure. The city should always assume the role of licensing the installation and operation of the equipment. Assuming the public sector sets the right conditions for investments in the city, and quality of service and reasonable prices can be guaranteed, then the private sector should invest as per priority.	

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
			Nevertheless, the city should also develop a basic infrastructure that guarantees that, in case the private sector retreats, a default network will still be in place.	
34	Gothenburg City Parking (Sweden)	A non-governmental body entrusted with a public task or service of general economic interest	The city aims to focus on the need and follow the behavior of our users and they invest in line with the projections. The municipality needs to kick-start a network. The first deployment of infrastructure needs to be visible and functioning for people to be able to buy their electric cars. When a larger fleet of electric cars is present, private investors can make a more reasonable business case on investments in infrastructure.	
35	Municipality of Reggio Emilia (Italy)	Local public authority	The municipality has set the main rules to achieve a comprehensive publicly accessible recharging network at municipal level, but private companies have to pay for the full installation of the network. In case the recharging service is provided by a company in return of a fee, the service provider should adopt a consumption-based price model, based on the kWh of energy consumed and time passed during the recharging session, so as to discourage prolonged recharging sessions beyond the maximum allowed recharging time.	Linee di indirizzo tecniche e gestionali per l'installazione di punti di ricarica per i veicoli elettrici sul territorio comunale SUMP (in Italian)
36	City of Rotterdam (Netherlands)	Local public authority	The municipality of Rotterdam, chose to tender out the development and operation of the recharging network on its territory, but maintained its ownership. The market can supply the infrastructure, but the city has specific requirements such as rate and service. The bidder also proposes a location, and the city evaluates this according to their recharging policy.	https://www.rotterdam.nl/wonen-leven/elektrisch-rijden/ https://www.rotterdam.nl/wonen-leven/elektrisch-rijden/Laadkader-2020.pdf

Nr.	Respondent	Type of respondent	Vision and approach	Documents provided
37	City of Leuven (Belgium)	Local public authority	In Leuven the strategy for the development of recharging infrastructure depends on the locations: • strategic locations: assigned through a tender; • locations with clear demand for recharging: development by private players; and • semi-public: assigned through a tender. The city prescribes specific zones with minimum roll-out requirements to obtain good geographical spread. It allows all interested CPO's to develop and operate infrastructure on its territory on the sole condition that they comply with a list of basic requirements, including that the recharging infrastructure shall be publicly accessible	Algemene vergunningsvoorwaarden voor oplaadinfrastructuur van elektrische voertuigen in de stad Leuven https://www.leuven.be/laadpunten-voor-elektrische-autos

Annex 4:
eQuestionnaire sent to public authorities

Questionnaire
Recommendations for procuring, awarding concessions and granting aid for alternative fuels infrastructure

Introduction

The European Commission is supporting the preparation of a Guidance document by the Sustainable Transport Forum to help public authorities with the roll-out of **publicly accessible electricity recharging infrastructure for passenger cars and vans** in their territory.

The Guidance document is intended as a toolkit for authorities that are either looking to procure recharging infrastructure or to award concessions for their roll-out and/or operation, possibly linked to the granting of State aid.

Last year, the Sustainable Transport Forum conducted a targeted stakeholder analysis to identify problems and possible solutions related to the deployment of publicly accessible alternative fuels infrastructure. The findings of this exercise were published on our website: https://ec.europa.eu/transport/sites/transport/files/2019-stf-consultation-analysis.pdf
The Sustainable Transport Forum has decided that these findings should be translated into recommendations for public authorities, for example to raise awareness about issues frequently experienced by users of recharging infrastructure. This questionnaire has been set up accordingly to collect information and opinions from public authorities in this regard. This exercise is not linked to any ongoing formal process of evaluating or assessing relevant European law and does not represent a formal public consultation run by the European Commission. It will help the Sustainable Transport Forum of the European Commission to further develop suitable recommendations for public authorities on key issues, ranging from finding infrastructure, getting access to and actually using infrastructure, technical downtime of infrastructure, problems with payments, etc. Those issues can be addressed through better procurement of infrastructure, by setting minimum requirements for the infrastructure.

This exercise is focused on issues regarding electric recharging points. This focus is due to the particular specifics of rolling-out electric recharging infrastructure for vehicles compared to the specifics of e.g. rolling-out infrastructure for refuelling alternative fuels vehicles with natural gas or hydrogen. An electric recharging infrastructure that will serve millions of electric vehicles will need way more single recharging points, leading to a much more widespread, dense network. For example, the Green Deal of the Commission expects that a possible fleet of up to 13 million electric vehicles needs at least 1 million publicly accessible recharging points. For that reason, it can be reasonably expected that all public authorities will at some point have to make choices regarding the deployment of a widespread infrastructure. They will have to address issues around planning (where best to install recharging points) and technical choices (what type of rechargers are wanted by the market, or needed, what should they offer to users).

To support a seamless mobility between cities and regions, interoperability of infrastructure throughout the EU is needed. Decisions taken by public authorities, in concession award procedures, public procurement procedures or state aid procedures, will inevitably shape market developments in this area. Sharing experience and building common recommendations can help to support a coherent network of infrastructure that supports its easy and seamless use and thereby help to accelerate the ramp up of vehicles.

Should you believe that similar recommendations are needed for refuelling infrastructure for other alternative fuels, you will have the opportunity to indicate this at Question 12 of the questionnaire, specifying the requirements that should be covered by such a recommendation.

This questionnaire is therefore inquiring about **your past, current and possibly future experiences and practices for awarding concessions or State aid or simply procuring recharging infrastructure, and in particular the requirements set for such infrastructure.** We would be particularly interested to find out where such requirements have changed over time, and why you have decided to change them. We would also like to invite you to share the full texts of your concession awards or tender specifications with us (hereinafter for reasons of simplicity referred to as “tender specifications”). Those can be uploaded at the end of the questionnaire or sent to us via mail to the following address: MOVE-STF@ec.europa.eu. Similarly, any questions in relation to this questionnaire can be addressed to the aforementioned email address.

In sum, for the avoidance of doubt: to the exception of question 12, all questions in this questionnaire exclusively relate to:

- **Public procurement of / concession awards for / State aid grants for**
- **Publicly accessible**
- **Recharging infrastructure**
- **For passenger cars and vans (LDV)**

Information and opinions gathered through this exercise will be used to develop common recommendations for good practice of public authorities in this field. It will also feed into ongoing processes of integrating roll-out of recharging infrastructure into overall planning of sustainable urban mobility in cities, such as in the concept of the guidance issued on Sustainable Urban Mobility Plans (SUMPs).

Except if and where you explicitly indicate so otherwise, it is assumed that your responses can be used and referenced in the Guidance document under development by the Sustainable Transport Forum. In case you only want anonymized references to your procurement experiences, please indicate so clearly.

This questionnaire is a first step in the process of developing the Guidance document. A stakeholder workshop will be organised later this year, at which stage stakeholders will be invited to provide comments on the draft version of the Guidance document.

Thank you very much for your time to complete this Questionnaire!

1. RESPONDENT INFORMATION

1.1. Please state the full name of the public authority on whose behalf you are responding to this questionnaire.

1.2. Please provide your full contact details (name, surname, title, telephone, email).

1.3. Please state the Member State where your public authority is located. For authorities located in a non-EU country, please select "Other" and specify.

( )Austria
( )Belgium
( )Bulgaria
( )Croatia
( )Cyprus
( )Czech Republic
( )Denmark
( )Estonia
( )Finland
( )France
( )Germany
( )Greece
( )Hungary
( )Ireland
( )Italy
( )Latvia
( )Lithuania
( )Luxembourg
( )Malta
( )Netherlands
( )Poland
( )Portugal
( )Romania
( )Slovakia
( )Slovenia
( )Spain
( )Sweden
( ) Other: please specify

1.4. Please specify whether you represent:

☐ A national public authority (transport ministries, agencies)
☐ A regional public authority (a federal or regional state entity, province, department etc.)
☐ A local public authority (city, municipality, etc.)
☐ A non-governmental body entrusted with a public task or service of general economic interest
☐ A public transport operator
☐ Other

1.4.1. If other: Please specify

1.5. How would you describe your level of experience in relation to concession/tender/public procurement practice for developing/operating (public) recharging stations?

☐ Very experienced

☐ Somewhat experienced

☐ Rather unexperienced

☐ Very unexperienced

2. DEPLOYMENT OF INFRASTRUCTURE / NETWORK PLANNING

2.1. Did your authority develop a Sustainable Urban Mobility Plan (SUMP)?

☐ Yes

☐ No

☐ I don't know

2.1.1. If yes, did this SUMP includes a plan/strategy for the deployment of recharging infrastructure?

- Yes (please upload)
- No, but we have a separate plan/strategy for the deployment of recharging infrastructure (please upload)
- No, we don't have a plan/strategy for the deployment of recharging infrastructure
- I don't know

2.1.2. [Follow up of 2.1.1 "yes" and "No, but" answers]: Please provide the link to this strategy (if published) or upload document here.

2.2. Did your authority develop measurable targets for electromobility and/or the deployment of recharging infrastructure?

☐ Yes

☐ No

☐ I don't know

2.2.1. If yes, please briefly describe those targets, indicating a time horizon where appropriate and clearly distinguishing between targets for publicly accessible and private recharging points.

2.3. In your opinion, in which order of priority should recharging infrastructure be realized?

Please rank following geographical areas from 1 to 5, 1 being the area with the highest priority:

☐ Urban areas

☐ Sub-urban areas

☐ Rural areas

☐ Highways

☐ Semi-public areas (shopping malls, next to offices etc.)

2.4. What is in your view the best approach to achieve a comprehensive publicly accessible recharging network at municipal level?

☐ Municipality develops unique network via public company

☐ Municipality tenders out development and operation of one or more interoperable networks

☐ Municipality develops basic network but this is complemented by infrastructure developed by private companies

☐ Private companies are best placed to develop the network(s)

☐ Other

2.4.1. Please explain your answer, specifying where relevant which is the approach chosen by your authorities.

2.5. How are the locations of the infrastructure chosen (multiple answers possible)?

☐ We prescribe specific locations for the development of recharging stations

☐ We prescribe specific zones with minimum roll-out requirements to obtain good geographical spread

☐ We leave it to the bidders to determine the best locations for infrastructure roll-out

☐ Other

☐ I don't know

2.5.1. If other: Please specify:

2.5.2. If your authorities ever defined specific locations or zones for the deployment of charging points, which criteria did you use to determine these locations / zones (e.g. distance requirements, density requirements, user requests etc.)?

2.6. When determining the locations of the infrastructure, do you take account of the remaining capacity on the electricity network / potential grid constraints?

☐ Yes, remaining capacity/grid constraints have been mapped for the complete area

☐ Yes, we always do a location specific analysis before awarding concessions/aid for/procuring infrastructure

☐ Sometimes*

☐ Rarely*

☐ Never

☐ I don't know

2.7. In your tender specifications, do you require specific power levels / requirements in terms of installed capacity (e.g. only rechargers with power capacity > 50kW)?

☐ Always*

☐ Most of the times*

☐ Sometimes*

☐ Rarely*

☐ Never

☐ I don't know

2.7.1. If *: How were these requirements determined? Are they location-specific?

2.8. Do you cooperate with other public authorities/levels of government in your Member State when awarding concessions/aid for or procuring recharging infrastructure?

☐ Always*

☐ Most of the times*

☐ Sometimes*

☐ Rarely*

☐ Never

☐ I don't know

2.8.1. If *: How do you cooperate, with whom and on which topics?

2.9. Do you cooperate with public authorities of another Member State when awarding concessions/aid for or procuring recharging infrastructure?

☐ Always*

☐ Often*

- Sometimes*
- Rarely*
- Never
- I don't know

2.9.1. If *: How did you cooperate, with whom and on which topics?

3. INTEROPERABILITY OF INFRASTRUCTURE

3.1. In your tender specifications, do you prescribe the use of certain user identification technologies, such as RFID card/NFC reader, automatic authentication possibility, etc?

- Yes
- No
- I don't know

3.1.1. If yes: Please specify those requirements or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire

3.2. In your tender specifications, do you prescribe the use of specific protocols for communications between vehicle (EV) and recharging point (CP)?

- Yes
- No
- I don't know

3.2.1. If yes: Please specify those requirements or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire

3.3. In your tender specifications, do you prescribe the use of specific protocols for communications between recharging point (CP) and Charge Point Operator (CPO)?

- Yes
- No
- I don't know

3.3.1. If yes: Please specify those requirements or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire

3.4. In your tender specifications, do you prescribe the use of specific protocols for communications between Charge Point Operator (CPO) and e-mobility service provider (EMSP) and/or roaming platforms?

- Yes
- No
- I don't know

3.4.1. If yes: Please specify those requirements or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire

3.5. In your tender specifications, do you require a recharging station to be connected to (at least one) roaming platform?

- Yes, always*
- Yes, often*

 Yes, sometimes*

 Yes, but rarely*

 No

 I don't know

3.5.1. If *: What were your reasons for doing so?

3.6. In your tender specifications, do you require a recharging station to be digitally connected?

 Yes, always*

 Yes, often*

 Yes, sometimes*

 Yes, but rarely*

 No, never

 I don't know

3.6.1. If *: Please specify whether you set specific requirements for digital connectivity (e.g. fixed line) or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire

3.7. In your tender specifications, do you require infrastructure to meet any of the following requirements (multiple answers possible)?

 Smart charging (ready)

 Bi-directional charging

 Wireless

 Other

3.7.1. If other: Please specify

3.7.2. In case you set any of the above requirements, please elaborate on those requirements.

4. USER-FRIENDLINESS OF INFRASTRUCTURE

4.1. In your tender specifications, do you require operators of recharging stations to provide 'instructions for use' to users at recharging points?

 Yes

 No

 I don't know

4.1.1. If yes: Please specify those requirements or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire. Please indicate also specifically in which languages you require those 'instructions for use' to be communicated to users.

4.2. In your tender specifications, do you prescribe minimum uptime requirements (minimum percentage of time the infrastructure is technically available for use by consumers)?

 Yes

 No

 I don't know

4.2.1. If yes: Please specify what minimum uptime you require, how you intend to monitor/control the uptime, whether you make failure to achieve the minimum uptime requirement subject to penalties and, if so, what level of penalties you apply? You may also simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire; in that case, we would still be interested in the mechanism you have in place to monitor the actual uptime.

4.3. In your tender specifications, do you require at least one dedicated parking space adjacent to every recharging point?

- Yes, always*
- Yes, often*
- Yes, sometimes*
- Yes, but rarely*
- No, never
- I don't know

4.3.1. If *: Do you require any technical or other solutions to ensure those dedicated parking spaces are reserved for electric vehicles (e.g. installation of a parking bracket)?

- o Yes
- o No
- o I don't know

4.3.1.1. If yes: Please specify those requirements or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire

4.4. In your tender specifications, do you prescribe minimum support service requirements (e.g. availability of call centre, technical support, etc.)?

- Yes
- No
- I don't know

4.4.1. If yes: Please specify those requirements or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire

4.5. In your tender requirements, do you explicitly prescribe the availability of ad hoc payment options? (ad hoc payment is a legal requirement contained in Article 4(9) of the Alternative Fuels Infrastructure Directive, which holds that "[a]ll recharging points accessible to the public [...] also provide for the possibility for electric vehicle users to recharge on an ad hoc basis without entering into a contract with the electricity supplier or operator concerned.")

- Yes
- No
- I don't know

4.5.1. If yes: Do you, as a minimum, require the possibility to pay for an ad hoc charging session with any of the following means of payment?

- o Cash payment (coins / cash payment terminal)
- o Payment by bank card / credit card (bank card / credit card payment terminal or NFC reader)
- o Payment via third party smartphone payment application (e.g. payment via messages, iWallet, Payconiq, etc.)-
- o Other
- o I don't know

4.5.1.1. If other: please specify

4.5.2. Also if yes: Besides potentially prescribing certain payment options, do you set any other requirements for an ad hoc charging session?

- o Yes

o No
o I don't know

4.5.2.1. If yes: please specify those requirements or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire

5. PROVIDE INFORMATION TO CONSUMERS

5.1. In order to improve transparency of prices for consumers, do you require in your tender specifications that ad hoc prices are communicated to consumers in any of the following ways (multiple answers possible)?

- The ad hoc price must be clearly communicated at each individual recharging point, e.g. on a digital display
- The ad hoc price must be clearly communicated at each recharging station, e.g. on a digital display
- The ad hoc price for each recharging station must be available online
- The ad hoc price must be clearly communicated to the consumer, in advance of any charge, on his mobile phone
- The ad hoc price must be clearly communicated to the consumer, in advance of any charge, on his on-board display (in the car)
- The consumer must be able to get a precise charging offer in advance of the charging session, calculated on the basis of his chosen charging assumptions (kWh needed and time of parking/charge)
- Other

5.1.1. If other: Please specify

6. FOSTER COMPETITION / PROTECT CONSUMERS

According to recital (30) of the Alternative Fuels Infrastructure Directive (2014/94/EU), "The establishment and operation of recharging points for electric vehicles should be developed as a competitive market with open access to all parties interested in rolling-out or operating recharging infrastructures."

6.1. When awarding concessions/aid for or procuring recharging stations, did you apply any of the following measures to foster competition in the market for the establishment and operation of recharging points (multiple answers possible):

- Competitive bidding procedure
- Split up lots to allow different operators to co-exist
- Limit the duration of a concession
- Set a price cap
- Other
- I don't know

6.1.1. In case you applied any of the above measures, please specify the related requirements in your tender specifications or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire.

7. TRANSFER OF DATA / DATA OWNNERSHIP

Many user data are generated by recharging infrastructure, such as regarding their location, charging times, occupancy rates of charging points etc. Such data can be valuable for various purposes both commercially as well as for analyses and planning.

7.1. In your tender specifications, do you require Charge Point Operators (CPOs) to transmit static data generated by the infrastructure (such as location, opening hours, charging capacity, available connectors, access requirements, payment options, ad hoc price information, etc.)

☐ Yes

☐ No

☐ I don't know

7.1.1. If yes: Please specify what data and at what intervals? Did you set any requirements for its transmission (e.g. specifying a data standard)? How did you process/store the data you received? Did you make the data accessible to third parties (e.g. digital map providers, consumers)? In what form? For what purposes did you use the data?

7.2. In your tender specifications, do you require Charge Point Operators (CPOs) to transmit dynamic data generated by the infrastructure (such as technical availability, real time occupation status, etc.)

☐ Yes

☐ No

☐ I don't know

7.2.1. If yes: Please specify what data and at what intervals? Did you set any requirements for its transmission (e.g. specifying a data standard)? How did you process/store the data you received? Did you make the data accessible to third parties (e.g. digital map providers, consumers)? In what form? For what purposes did you use the data?

7.3. In your tender specifications, do you include provisions on the ownership and use of EV-user data?

☐ Yes

☐ No

☐ I don't know

7.3.1. If yes, please specify the related requirements in your tender specifications or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire. In particular, please explain what data is used, by whom and for which purposes.

8. SAFETY

8.1. In your tender specifications, do you include any specific safety requirements for the recharging infrastructure?

☐ Yes

☐ No

☐ I don't know

8.1.1. If yes: Please specify those requirements or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire

8.1.2. If no: Please explain why you did not include any specific safety requirements? Are safety requirements for instance already sufficiently covered in national regulation or do you expect this risk to be fully assumed by Charge Point Operators or any other reason?

9. ENFORCEMENT

9.1. Do you have any specific enforcement mechanism in place to verify that the tender requirements you impose are respected?

☐ Yes

☐ No

 I don't know

9.1.1. If yes: please specify those requirements or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire

10. END OF THE CONCESSION, LICENCE, PUBLIC CONTRACT

10.1. In your tender specifications, do you include any provisions regarding the transfer/hand-over of the infrastructure at the end of the contract term/concession?

 Yes

 No

 I don't know

10.1.1. If yes, please specify those requirements (indicating for example how the end of the contract term/concession/ impacts the ownership of the recharging points) or simply reference the relevant document, page number and paragraph number in case you intend to upload the related tender specifications at the end of this questionnaire.

11. MISCELLANEOUS

11.1. Is there any other key issue or technical barrier that you have encountered or any other important lessons you have learned in the process of awarding concessions/aid for or procuring recharging points which you would like to share with us?

12. INFRASTRUCTURE FOR HYDROGEN, CNG, LNG AND LPG

12.1. Did your authority organise a public procurement procedure/concession award procedure/grant state aid for refuelling stations for any of the following alternative fuels in the last three years (multiple answers possible)?

 Hydrogen

 Compressed natural gas (CNG)

 Liquefied natural gas (LNG)

 Liquefied petroleum gas (LPG)

 None of the above

12.2. For each of the following alternative fuels, please indicate the need to develop specific recommendations at EU level to help contracting authorities organise public procurement procedures/award concessions/grant aid for the construction and operation of refuelling stations

Alternative fuel	Much needed	Somewhat needed	Rather unnecessary	Not needed	No opinion/I don't know
Hydrogen					
Compressed natural gas (CNG)					
Liquefied natural gas (LNG)					

Liquefied petroleum gas (LPG					

12.3. In case you believe that, for any of the aforementioned alternative fuels, specific recommendations at EU level are needed to help contracting authorities organise public procurement procedures/award concessions/grant aid for the construction and operation of refuelling stations, please specify for each such alternative fuel what those recommendations should cover.

13. UPLOAD OTHER DOCS

You can upload any documents you consider relevant here. We would be particularly interested in any tender specifications (of public procurement/concession award/aid granting procedures) you can share with us.

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