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Accelerating national scale up of Smart Charging in the Netherlands

Frank Geerts[1], Marisca Zweistra[1]

[1]*ElaadNL, Westervoortsedijk 73, 6827AV Arnhem, frank.geerts@elaad.nl, marisca.zweistra@elaad.nl*

Executive Summary

Smart charging will enable demand-based management and temporary storage, via millions of electric vehicles. It will make the energy system more flexible, and as such is indispensable for the transitions in mobility and energy in the Netherlands. It will deliver huge advantages for society, EV drivers and providers of charging services. The National Charging Infrastructure Agenda (NAL) sees smart charging as a must have. However, the scaling up of the application of smart charging is taking place more slowly than socially desirable. Against that background, the NAL has elaborated a national programme entitled Smart charging for all 2022-2025 (SLVI2025) with the aim of accelerating the scaling-up process, in collaboration with all stakeholders from the charging chain. This action plan describes the hows, whys and wherefores of this programme.

Although there are plenty of technical solutions available for smart charging, with a proven track record, the extensive scaling up of the market for smart charging is taking its time. Estimates suggest that the proportion of smart charging sessions at the moment represents less than 5% of the total. At the same time, the calls from society for smart charging are becoming increasingly urgent. The integration of electric transport in the energy system is under pressure, with risks of local power disruptions. The challenge lies in urgently getting the market for smart charging moving, with the overall objective that by 2025, smart charging will be the standard for destination charging in the Netherlands.

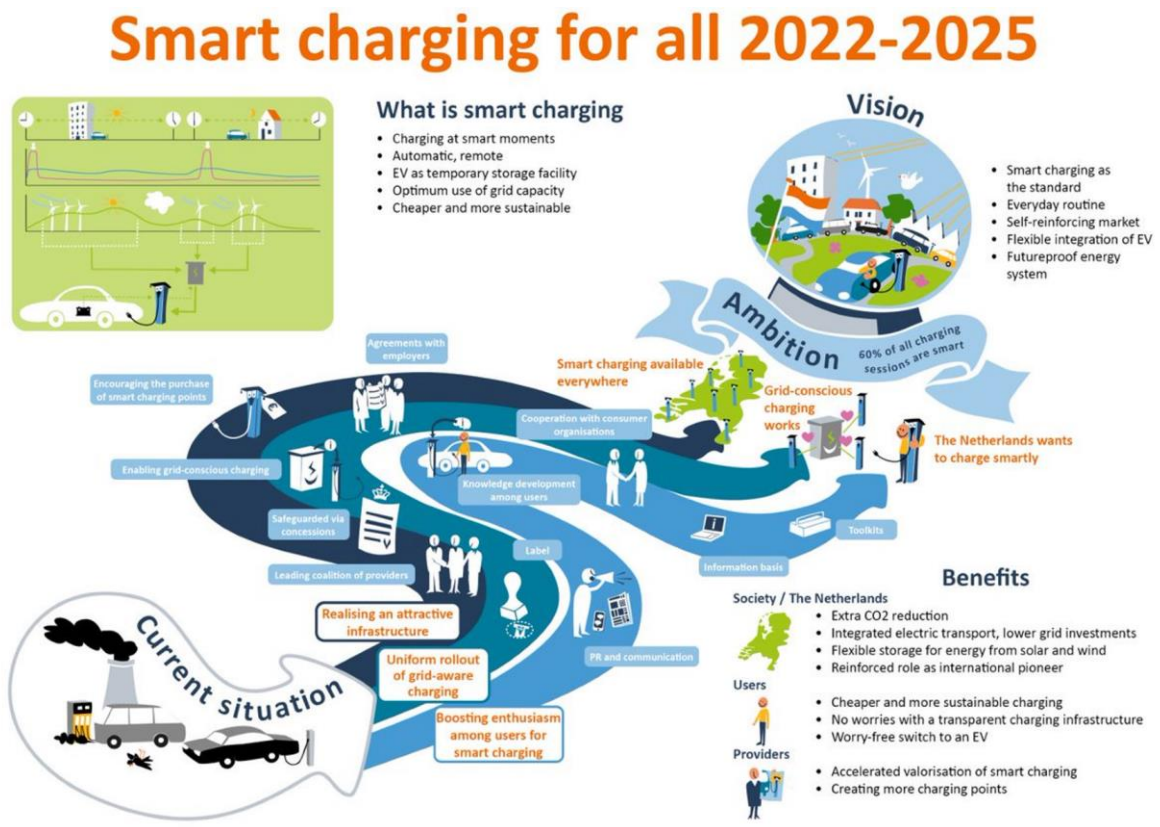
The ambition of the NAL is that by 2025, more than 60% of all charging sessions are smart. To achieve that goal, SLVI2025 is working to realise an attractive offering for users, the national rollout of grid-conscious charging and boosting enthusiasm among users to adopt smart charging. The approach is focused on aspects that will prove effective, in the short term. In the elaboration and implementation stages, SLVI2025 prefers to keep things simple, and will focus on what is achievable.

By 2025, there will be 578,000 EV drivers, of whom 270,000 will make the switch over the next few years. Costs and climate are the primary motives for switching to smart charging. The willingness appears to be high, but the charging offering must provide sufficient ease and charging guarantee.

For that reason, smart charging should be the standard setting, with a simple opt-out possibility. In terms of pricing, the opt-out is expected to be comparable with current cost of charging, while smart charging with the standard setting will be significantly cheaper. By ensuring charging guarantee with a guaranteed volume of energy over a specified time frame, attractive propositions will be offered to users.

On the basis of a profile, providers will be able to optimise the use of the available grid capacity, while taking account of the limitations of the grid, wherever and whenever necessary. The pooling of charging points and the possibility of utilising the available capacity outside peak times will make smart charging even more attractive.

To boost enthusiasm among users for this offering, it is essential that a positive image is created in society based on sound information. It is important that users are approached during the purchase process via reliable channels and with productive communication frames.



All these requirements have been translated into a programme of activities aimed at realising the overall ambition. In other words, safeguarding principles for an attractive and grid-conscious charging offering via requirements in concessions and permits, agreements with employers' organisations, the establishment of a leading coalition of providers and the development of a label. It also requires encouraging the purchase of a smart charging infrastructure, the uniform nationwide rollout of grid-conscious charging and boosting

enthusiasm among users through public information and support. Finally, the action plan aims to develop knowledge focused on the broad implementation of smart charging and the opinions and experiences of users.

The Ministries of Infrastructure and Water Management and Economic Affairs and Climate Policy (I&W and EZK) are the intended commissioning parties, whereby implementation of the action plan is an integral part of the National Charging Infrastructure Agenda (NAL). The task calls upon all the parties that make up the charging chain to take responsibility for the various actions in accordance with their role, based on a recognition of the need for cooperation. Implementation of the action plan will take place within a programme-based approach, with a view to safeguarding coherence and cooperation, with a moment for reflection and reassessment, each year.

This paper entails the highlights of the complete actionplan, which can be found here.

Keywords: policy, smart charging, mass market, user behaviour, business mode, smart grid

1 Vision

Although there are plenty of technical solutions available for smart charging, with a proven track record, the extensive scaling up of the market for smart charging is taking its time. The number of smart charging sessions is currently still relatively low. At the same time, the calls from society for smart charging are becoming increasingly urgent. The integration of electric transport in the energy system is under pressure, with risks of local power disruptions. The challenge lies in urgently getting the market for smart charging moving, with the overall objective that by 2025, smart charging will be the standard for destination charging in the Netherlands.

This chapter provides a picture of the current status of the market for smart charging. What follows is a description of the urgency and the challenge being faced in ensuring that the market can be scaled up, as well as the target situation that smart charging will hopefully bring about.

The current status of the market

Recent initiatives on the Dutch market in the field of smart charging have for the most part involved study and trial projects on a scale of less than 1,000 smart charging points, the purpose of which has been to demonstrate the technical (operational) feasibility of smart charging at a public or private charging point. A number of other initiatives are emerging, on a larger scale, with a commercial rollout intended for users . Based on a common need for facilitating the scaling up of the market, with uniform, nation-wide market standards, smart charging requirements (SCR) have been developed by the NAL. These SCRs list the requirements that the charging infrastructure must satisfy in terms of technology and data communication in order to facilitate smart charging. These requirements will be included in public tender procedures by local governments. At present, it is estimated that the proportion of smart charging sessions amounts to less than 5% of the total.

Getting the market moving

The need for a more flexible energy system is becoming ever more urgent. In the provinces of Limburg and North Brabant, a temporary halt was announced in June 2022 on connecting businesses and organisations to

the electricity grid. The rapid development in the number of heat pumps, charging points, new businesses and measures aimed at making industrial enterprises more sustainable has led to an explosive growth in demand for capacity on the electricity grid. For these reasons, a temporary halt has been announced on businesses wishing to be connected or to upgrade their connection to the electricity grid, both for the purchase and generation of electricity. The Minister has made it clear that the lack of transport capacity as a consequence of the huge demand for electricity transport cannot be easily solved at short notice, despite the best efforts of the grid operators . The urgency was also reflected in recently published grid impact analyses according to which grid operators have published details of the impact of the growing demand on the electricity grid, for mobility purposes.

Despite the technical feasibility and urgency, the scaling up of the market for smart charging is progressing slowly. If this scaling up continues to lag behind, it will result in ever greater problems for the integration of electric transport in the electricity grid, with the risk of local power disruptions.

From a social point of view, it is not desirable to have to wait for the (time-consuming) current processes for changing law and regulations, that partly depend on developments in Europe. The challenge is to get the market for smart charging moving, within a timeframe of around three years, within the existing frameworks.

Smart charging as the standard

In our efforts to accelerate the scaling up of the market for smart charging, a target for smart charging has been set, for 2025. That vision is further elaborated on the next page, and is in line with the vision of the State Secretary for Infrastructure and Water Management , recently shared with the Dutch House of Representatives.

There is an attractive and broad smart charging network available all across the Netherlands. Users have become accustomed to smart charging sessions as an integral part of their everyday routine. There is no cause for concern, they know what they can expect and can make other choices, should they need to do so. As a result, users and employers benefit from cheaper and more renewable energy. Car drivers can switch from fossil to electric power worry-free, and expect to be and indeed are secure in the knowledge that their vehicle will be charged smartly. The transition to the new rates for domestic electricity connections is advancing relatively smoothly: EV drivers are already used to avoiding peaks in their energy demand, via smart charging.

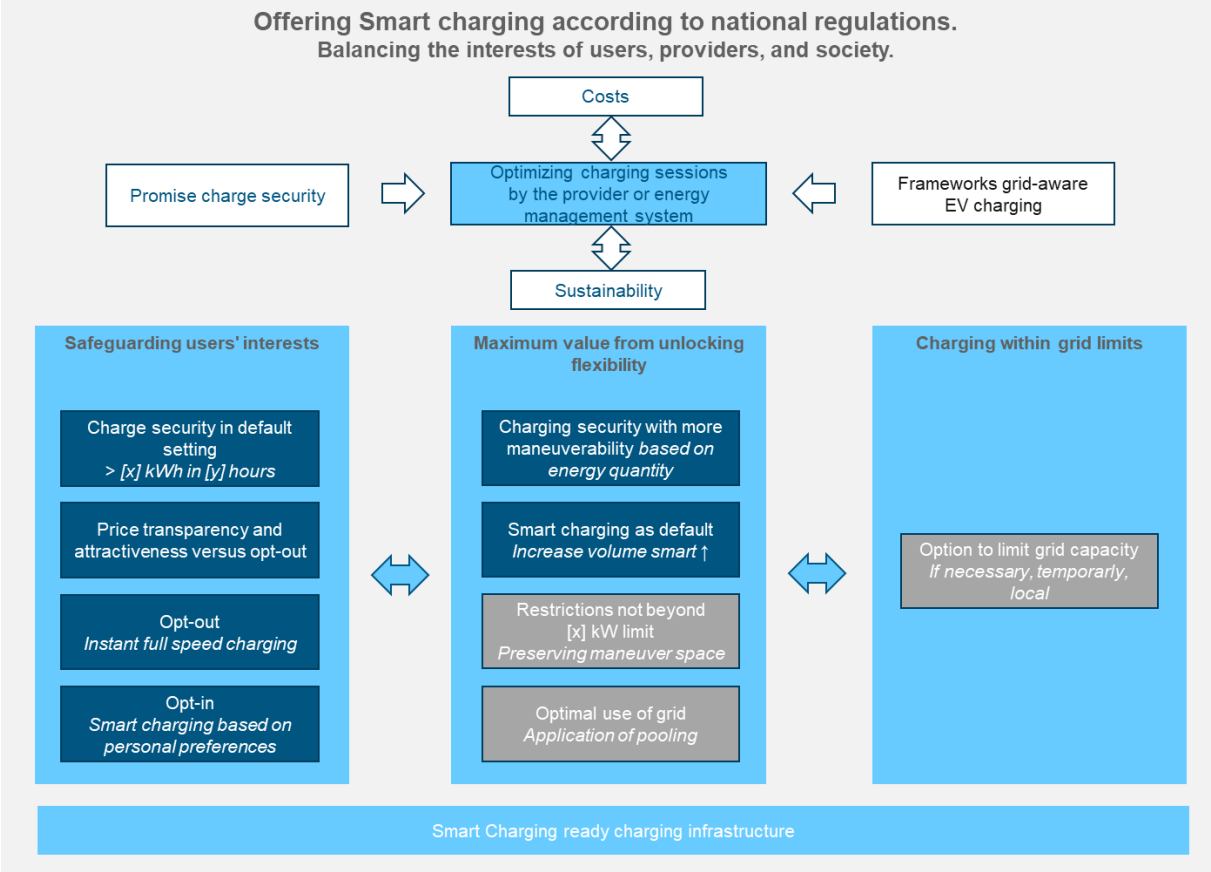
The market for smart charging has grown beyond the critical size, bringing about a self-affirming effect in an ever evolving market. No further efforts are required from a national programme. A number of market parties offer attractive propositions for smart charging, subject to acceptable operating risks and valid business cases.

The timely scaling up of smart charging has made an indispensable contribution to the successful integration of electric transport and the renewable production of energy in a stable, affordable and futureproof energy system. The capacity of the grid is used efficiently, hugely reducing the risk of overloading the network. On an international scale, Dutch companies are an inspiration for others in the development and application of new and smart charging techniques and solutions.

Insights and framework

By 2025, there will be 578,000 EV drivers, of whom 270,000 will make the switch over the next few years. Costs and climate are the primary motives for switching to smart charging. The willingness appears high, but the charging offering must provide sufficient ease and charging guarantee. For that reason, smart charging should be the standard setting, with a simple opt-out possibility. In terms of pricing, the opt-out is expected to be comparable with current cost of charging, while smart charging with the standard setting will be significantly cheaper. By ensuring a charging guarantee with a guaranteed volume of energy over a specified time frame, attractive propositions will be offered to users. On the basis of a profile, providers will be able to optimise the use of the available grid capacity, while taking account of the limitations of the grid, wherever

and whenever necessary. The pooling of charging points and the possibility of utilising the available capacity outside peak times will make smart charging even more attractive. To boost enthusiasm among users for this offering, it is essential that a positive image be created in society based on sound information. It is important that users are approached during the purchasing process via reliable channels and with productive communication frames.



The user

This section focuses on the user: who they are, what they consider important and where they charge.

User segmentation

Table below provides a segmentation of the expected number of EV drivers over the coming years .

	2022		2025		New
Private	105	34%	282	49%	176
Business	202	66%	296	51%	93
Total	308		578		270

In this segmentation, we distinguish between private (purchase or lease) and business drivers (lease). In the first group, the EV driver is both the customer of the charging agreement and the user of the charging session. In the second, the employer is the customer of the charging agreement, for example via a lease company, while the role of the user is taken up by the employees. We also distinguish between current EV drivers and

new EV drivers who are expected to make the switch to electric driving over the next few years.

Motives: cost, climate and charging guarantee

Studies among current EV drivers reveal that the most important positive motivations for smart charging among users are costs and climate, whereby the cost motivation is relatively more important for the second generation of EV drivers than for the first (current) generation. Given the recent developments in energy prices and inflation, this importance is set to rise further. Precisely how a smart charging session is organised is less important for users.

'Range anxiety', the fear of insufficient charging, is the most important negative motivation for current EV drivers in opting for smart charging. One answer to this anxiety is to offer charging guarantee. For the time being, the willingness among current EV drivers to adopt smart charging is high. Whether this applies to the same extent for new EV drivers or employers, is not yet known.

Awareness, willingness and public image among current EV drivers

There is much support for smart charging among users. The awareness of smart charging among current EV drivers in the Netherlands is already relatively high (59%). The willingness to adopt smart charging, at 82%, can be described as high. The National Charging Survey 202120 reveals that 47% of the EV drivers interviewed has on occasion used smart charging. Moreover, everyone who has used smart charging is neutral to very positive about their experience . A recent user survey from England shows that users are keen to switch to smart charging if it results in cheaper or more renewable energy .

Requirements: ease of use, transparency and influence

This same survey revealed a top 3 of user needs in respect of smart charging. The most important is ease of use. Users want their lives to be made easy and it must be simple to charge the car. Transparency is another important requirement, that relates to charging guarantee. It must be clear during every charging session what the user can expect and at what price and subject to what conditions. All these details must be transparent for the user. Lack of transparency for (normal) public charging is still in the top 5 of perceived obstacles, for users. Here, too: the process must be simple. A surplus of information, for example about how the charging session was made possible, is counterproductive because it generates cognitive stress . Finally, the user wants to be able to exercise an influence on how charging is carried out, and to have the option to change the setting per charging session and as standard, as required.

Charging locations

In 2025, we expect to see 800,000 charging points, of which 44% at home locations, 29% at work locations and 27% in public and (other) semi-public locations . For the time being, the majority of EV drivers are home chargers . In 2021, 60% of all electric kilometres were charged at home, in private locations. This is 13% more than in 2020. The 'charging ladder' whereby where at all possible, private charging takes precedence over the public charging, is the underlying principle in national policy. This will help prevent unnecessary pressure on parking spaces and the overburdening of public charging points. In the big four cities (the so-called G4: Amsterdam, Rotterdam, The Hague and Utrecht), additional measures will be taken to safeguard this principle .

Attractive charging offering

The first subtask of SLVI2025 is to realise an attractive, broad-based, large-scale offering for smart charging, for users and employers. Ten Have et al. recommend that uniform frameworks be established as a basis for the desired charging offering, based around smart charging. In the establishment phase of SLVI2025, the operating principles were elaborated, partly on the basis of insights about the users and consultations among various relevant groups of stakeholders. Below, the underlying principles are explained, followed by the considerations.

Principles for an attractive charging offering

In the desired charging offering, smart charging is the standard setting for every AC charging session at a charging location with a domestic use connection or at a charging hub suitable for EVs weighing less than 3500 kg. These applications require no input from users who are thereby assisted in charging more cheaply and/or more sustainably. Users receive a guaranteed volume of energy within a specified timeframe, geared to destination charging, at a predetermined price. Users wishing to start charging immediately after plugging in can make use of an opt-out. In terms of price, the opt-out will be comparable with the cost of normal charging at present, while smart charging subject to the standard settings will be significantly cheaper. This applies for all public, private and work locations. To make this possible, the principles that emerged from the consultation process with stakeholders in the establishment phase of SLVI2025, have been elaborated in the form of a schedule of requirements for providers. See Bijlage C for details.

Considerations

- These operating principles take account of and guarantee the motivations and needs of users.

- At the same time, the standard settings and the related volume of smart charging sessions offer providers more guarantee, clarity and space for developing an attractive proposition for those same users, whereby smart charging can be offered more cheaply than standard charging, while still maintaining a margin for the provider.

- It is important that at the start of a charging session, smart charging requires no (additional) action . With smart charging as the standard setting , users can quickly become familiar with smart charging as part of their (subconscious) everyday routine.

- Users have expressed the importance of having an influence over the charging session. For that reason, it is desirable that a simple opt-out be offered. All the pilots have shown that the opt-out is not often used, but for the confidence of users and the adoption of smart charging, it is important that the possibility is available . A ride to a quick charger forms in a large and growing part of the Netherlands a real additional alternative for EV drivers who want to be charged quickly, before the car arrives at its destination.

- Offering charging guarantee can be in conflict with grid-conscious charging and the available flexibility in a charging session, and as a consequence developing an attractive offering for the same users . Offering charging guarantee by delivering a guarantee of a certain volume of energy in a specific timeframe offers a better balance than guaranteeing a minimum loading speed throughout the entire charging session or a range/energy guarantee for the initial part of the charging session.

- Recently introduced EV models are equipped with a battery with such large capacity that it would be uncommon for them to be driven empty in the course of a single day. As new EV models are introduced in the future, battery capacity is expected to increase even further.

- Users with a form of ‘range anxiety’ or with a smaller battery have been taken into account in offering a simple opt-out.

- An average charging session at home and work locations lasts between 10 and 12 hours (uninterrupted time) whereby between 22 and 36 kWh are charged. The average state of charge (SoC) at the start of a charging session at present is between 40-55%. 26% of current EV drivers at present have the habit of driving until the battery is almost empty .

- Uniformity and simplicity are important for users. It is therefore desirable that the charging offering for all types of charging locations (public, semi-public, private) remains as similar as possible. For this reason, at public charging locations, no distinction is made between users with a charging agreement and users with no agreement.

Grid-conscious charging offering

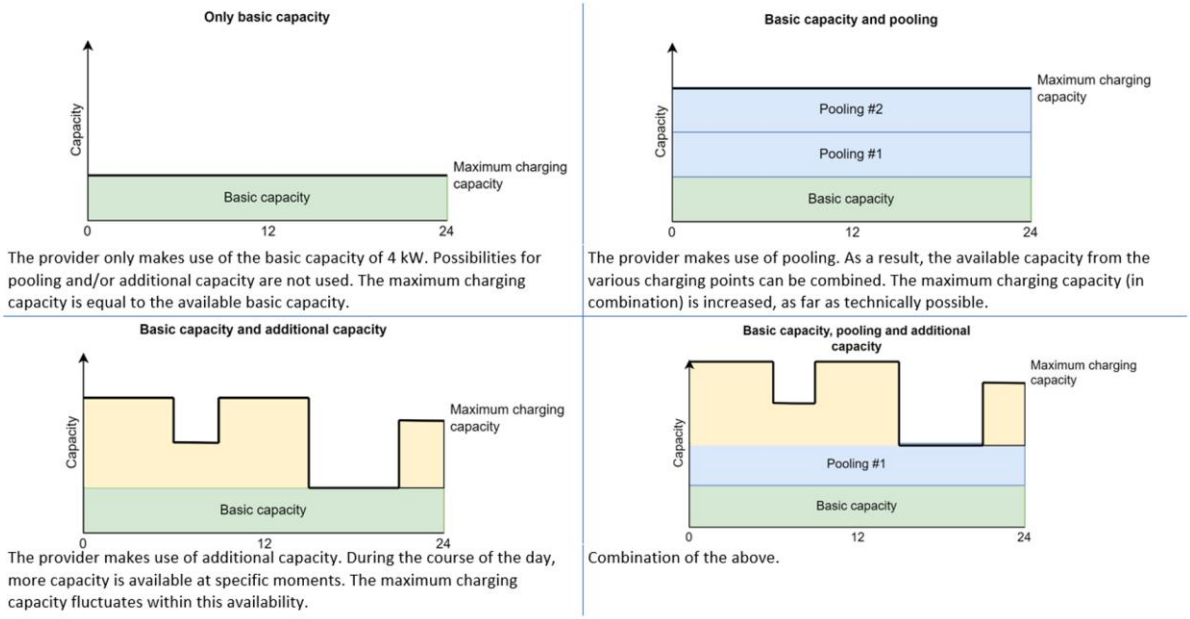
The second subtask of SLVI2025 is to ensure the uniform nationwide rollout of grid-conscious charging: charging within the limitations of the locally available grid capacity. The smart charging of electric cars creates a possibility for preventing local peaks in demand and the resultant congestion. In addition, use of the locally available grid capacity can be optimised. In the establishment phase of SLVI2025, uniform operating principles were elaborated for grid-conscious charging, partly based on the consultation with various groups of stakeholders. There is broad understanding and acceptance for the value and necessity of grid-conscious charging. The explanatory notes to these operating principles appear below, followed by the relevant considerations. Grid-conscious charging has also been made an integral part of the elaborated schedule of requirements for the charging offering in Bijlage C.

Principles for grid-conscious charging

The technical capacity of an individual charging point, often 11 kW, with 17.3 kW for the grid connection , will at all times be fully available for use at the vast majority of charging points. Until 2025, at a limited number of transformer stations in the Netherlands, at peak moments (for example between 5 and 8 p.m.), there will be a real risk of local grid congestion. In such cases, the transformer will have to be preventively relieved. In that situation, at specific locations, during specific times, the maximum available capacity at a charging point is restricted, in the worst case scenario to 4 kW. Even in these cases, a charging volume is guaranteed . During a charging session lasting 6 hours or longer, 30 kWh or more will be charged, albeit that there is less freedom for managing (part of) the charging session according to costs and/or climate.

Outside these peak moments, additional grid capacity is often available, that is not utilised. This is a result of the electricity consumption in the area but may also be due to the fact that not all charging points are occupied, or because not all EVs charge at maximum charging speed continuously and/or simultaneously.

The underlying principle for grid-conscious charging is that the grid operator shares information about the locally available grid capacity with the providers, so that they can offer charging within the limitations of the local grid. The available capacity for a charging session consists of three building blocks, each of which are discussed individually, below.



1) Basic capacity per charging point: As the first building block, users and providers can assume a guaranteed basic capacity of 4 kW per charging point, for the charging of an EV.

In the vast majority of situations, sufficient capacity will be available in an area. To utilise that capacity,

wherever possible, providers will employ what is known as the pooling technique. In addition, grid operators will make additional capacity available, wherever possible.

2) Pooling: providers can combine the available basic capacity from multiple charging points, within a single transformer station. Using this technique, providers can then offer to charge EVs with a higher maximum capacity . For example: a provider has 3 private charging points with a basic capacity of 4 kW in a neighbourhood, at which at that moment he wishes to charge a single car at 1 charging point. By pooling, a total of 3 x 4 = 12 kW is available. The car can then be charged at 12 kW, on condition the car is technically equipped to do so.

3) Additional capacity: during the course of the day, there is generally more than sufficient capacity available from a transformer station. Via a profile of the additional grid capacity, that additional capacity will be made available to the providers in the neighbourhood. The additional capacity is shared equally across all charging points among the providers wishing to make use of it.

The combination of these building blocks determines the maximum available capacity for charging an EV whether or not smartly. Figure 3 provides a further explanation of the combination of the building blocks. In practice, this means that if the three building blocks are added together, as a rule, 17.25 kW of power is available per charging point (the technical maximum), although for specific locations and at specific moments, this will be less.

Considerations

- The cause of the absence of a natural stimulus for grid-conscious charging is that the domestic use rates currently charged by the grid operator are not cost-reflective. The costs for a grid connection are based on an average brief peak in capacity usage per household of 4 kW, while technically, 17 kW can be achieved. For the charging of an EV, 11 kW of that technical capacity are often used.

- With the expected new domestic use rates, starting in 2025, cost reflectivity should be guaranteed, but it is not desirable to wait until that time. Wherever possible, it is important to prevent the growing number of EVs causing grid congestion over the next few years. Even if this were to result in a limited number of incidents nationally, the damage to the public image of both electric driving in general and for the grid operator would be too great. Moreover, this approach will help prevent unnecessary social costs for reinforcing the grid.

- The operating principles tie in with the current dominant thinking among grid operators for the development of the new domestic use rates expected by the end of 2025. A positive side effect is that it will enable flexible introduction if grid-conscious charging is perfected ahead of that date.

- The Netherlands currently has an estimated 80,000 medium and low-voltage (MV/LV) transformer stations. Several hundred of these are already subject to a realistic risk that grid congestion will occur at peak moments between now and 2025 (for example between 5 and 8 p.m.).

- Outside these peak moments, additional grid capacity is often available, that is not utilised. This fact offers extra opportunities for greater flexibility in a smart charging session and an (even) more attractive offering for users. Take for example charging with wind and solar energy in off-peak periods (in the middle of the day or the middle of the night, respectively).

- Restricting the available capacity for grid-conscious charging will reduce flexibility in a charging session. It is therefore important that this only be done at locations and at moments where there is a realistic risk of grid congestion.

- Grid-conscious charging should become a fixed element of smart (charging) in the social perception. Whereas smart charging offers the user advantages (in terms of costs and climate) on the one hand, at the same time it can be a social instrument for ensuring that charging is carried out in a socially responsible manner, with the grid not being burdened more than necessary. This in turn will result in a fairer distribution of the available grid capacity among users of the grid in the neighbourhood.

• One point that deserves attention is user perception. The sentiment could be ‘we always used to have far more capacity for the same price’. It is important to realise that this will apply to all Dutch people, when the new domestic use rates are introduced. Via grid-conscious charging under SLVI2025, EV drivers will be confronted with this situation earlier, and will have the opportunity to become familiar with it, at an earlier stage. The approach angle could be: ‘At your destination you will not even notice that your vehicle is being charged smartly and grid-consciously’.

• One point for attention when implementing a profile in a neighbourhood is that we must avoid a peak still occurring immediately after the original moment .

Activities

This chapter provides a brief overview of the efforts to be made by SLVI2025 between now and 2025 in order to realise its ambition as well as identifying the various players and their roles. These efforts include activities, measures, projects or interventions that will deliver real results.

Key
Activities contribute to the following objectives:

I More attractive, broader based and larger offering of smart charging
II More grid-conscious charging sessions
III Greater willingness and demand for smart charging among users and employers

Table 8: Overview of activities

Section	#	Activity	Responsible parties	I	II	III	Type
5.1		**Safeguarding an attractive and grid-conscious charging offering**	NAL regions, grid operators, providers	✓	✓		Self-regulation / co-regulation
	1	• Via concessions and permits	Employers’ organisations, lease companies, providers				
	2	• Via agreements with employers’ organisations	Sector organisations providers				
	3	• Establishing a leading coalition of providers	Sector organisations providers, independent body				
	4	• Developing a label					
5.2	5	**Encouraging the purchase of smart charging infrastructure**	SLVI2025 to be confirmed	✓	✓		Financial stimulus
5.3	6	**Enabling grid-conscious charging**	Grid operators and providers		✓		Facilitation
5.4		**Boosting enthusiasm among users for smart charging**				✓	Social management Provide information
	7	• Updating information base	SLVI2025				
	8	• Information provision and influencing public image	User and consumer organisations				
	9	• Supporting the purchase process	Sector organisations providers				
5.5	10	**Knowledge development**	SLVI2025, providers User and consumer organisations Knowledge institutions ELaadNL, NKL, RVO	✓	✓	✓	Learning

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Presenter Biography

Frank Geerts is chairman of the Dutch working group smart charging as part of the national climate agreement. He is also director smart charging at ElaadNL where he accelerates the widespread market deployment of smart charging. Frank leads a team of experts which is responsible for the coordination of the smart charging program of the Dutch grid operators.

Marisca Zweistra, PhD MSc, studied bioprocess engineering at Wageningen University where she obtained her PhD in 2007. Since then, she has worked in the energy business. First as a general consultant and since 2019 as a specialist program manager on smart charging of electric vehicles.