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Results and ambition of Dutch working group smart charging

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Summary

The Netherlands have a worldwide leading position and industry in the field of smart charging. In order to inspire and advocate smart charging to the rest of Europe, a national working group has been set-up and three reports have been published. These reports are 1. lessons learned from 25 Dutch smart charging projects, 2 technical requirements for smart charging and 3. Organization of smart charging. With these three reports the foundation has been laid for an ambitious national upscaling program of smart charging until 2025. Goal is to have at least 70% of all Dutch EV drivers actively using Smart Charging in 2025.

Keywords: smart charging, dynamic charging, deployment, mass market, user behaviour

Introduction

1.1 Dutch Climate Agreement

In 2019 the Dutch government concluded a Climate Agreement containing agreements to combat greenhouse gas emissions. Mobility is one of the sectors that needs to be cleaner, smarter and therefore different. Our transport is responsible for a quarter of greenhouse gas emissions. The aim is for all new passenger cars to be emission-free by 2030 at the latest. An important precondition is that mobility remains affordable and that the burden of the transition is distributed fairly, so that all Dutch people can make the switch to emission-free passenger cars. And the preconditions must be in order: charging your electric car must be as easy as charging your mobile phone.

1.2 National Charging Infrastructure Agenda (NCIA)

The Dutch Climate Agreement was further detailed for different industries and has resulted in a coherent package, which also includes an accelerated roll-out of the charging infrastructure. The ambitions for electric transport require a smart, comprehensive and reliable charging network and energy system. The basic principle is that the supply and operation of the charging infrastructure remains primarily the responsibility of the market parties. To this end, municipalities, provinces, national government, network operators, the business community and sector organizations have jointly drawn up a NCIA, which is an integral part of the Climate Agreement.

1.3 Working group smart charging

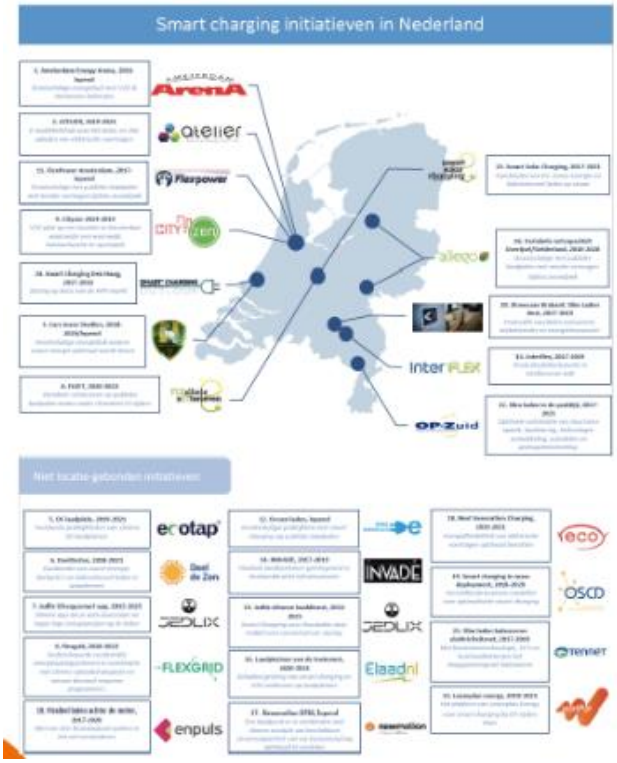
The ambition of the NCIA is to ensure that the charging infrastructure does not form a barrier for the

roll-out of electric transport. This is necessary to retain attractiveness for consumers driving electric now and in the future, for they can rely upon charging infrastructure in a simple and unambiguous way everywhere in the Netherlands and Europe. For this reason, activities have been included in the NCIA that will guarantee future-proof charging infrastructure aimed at smart charging in order to prevent capacity strain on the electricity system as much as possible. The working group dedicated to smart charging aims to realize a stable electricity system in which optimal use can be made of renewable energy and its benefits for EV drivers.

2 Lessons learned from 25 Dutch smart charging projects

The smart charging working group has mapped out recent smart charging initiatives in the Netherlands. The key learnings and knowledge gaps in the field of smart charging have been listed here. The research provides insight into how smart charging has been applied in Dutch initiatives, and derived from these pilots, what has been learned and what knowledge and experience can be further developed.

Based on the analysis of more than 2,000 data points out of 25 selected recent smart charging initiatives key learnings have been identified and divided into different domains: i) role of the user; ii) commercial model; iii) control & optimization; iv) technology & protocols; v) laws and regulations.



The key learnings related to the user are that current EV drivers are happy to participate and are binge persuaded when it is cheaper or greener. In addition, the user wants to have insight and influence, but not to make decisions with every transaction. The most important lessons in terms of the commercial model are that the revenue model contains many uncertainties and the financial incentive is yet limited. In addition, market parties are able to successfully apply steering mechanisms aimed at reducing congestion, without the grid operator having to continuously send steering signals. And they benefit from sufficient power range from the grid operator, since it greatly increases the possibilities for smart charging and the acceptance by market parties. In the field of control and optimization, the key learning is that the problem that appears to be solved by smart charging is in some cases only shifted or a new problem arises. A further key learning is that locally reducing the peak load is a highly developed use case and is often successfully applied. Moreover, there is sufficient flexibility in charging sessions for smart charging, as only 14% of the users sometimes indicate that they have not charged the desired number of kWh. The most important lessons in technology and protocols include that the technical architecture turns out to be more complex for public charging points, as opposed to an often relatively simple technical implementation behind the meter. The smart meter can also play an important role in validating and controlling smart charging. Finally, the most important key learning in legislation and regulations is that there are several significant fiscal and legal barriers to bidirectional charging.

In the study also some knowledge gaps were identified. First of all, there is a lack of experience with car- and building-centric architectures. The analysis of the smart charging initiatives shows that in more than 70% of the initiatives, charging sessions are controlled via the charging station (charger-centric). Knowledge about future user groups and vehicle types is also lacking. The analysis of the initiatives shows that the focus in the majority of initiatives has been on technology, to a lesser extent on the commercial side and least on the user. There is also a lack of knowledge about the effects of other organizational models. Examples are control by the eMSP instead of the CPO or the free energy choice at the charging station. There is also a lack of knowledge about the possible scale effects in large-scale roll-out and the exact contribution of smart charging at system level.

The full report (in Dutch) is available via
https://www.agendalaadinfrastructuur.nl/ondersteuning+gemeenten/documenten+en+links/documenten+in+bibliotheek/handlerdownloadfiles.ashx?idnv=2108318

3 Technical requirements for smart charging

One of the agreements in the NCIA is that in the period up to 2030, only 'smart charging ready' charging infrastructure will be rolled out. The Smart Charging Requirements (SCR) aim to provide an unambiguous definition of "smart charging ready". The SCR describe the technical conditions for making smart charging possible. This concerns the vehicle, the charging cable, the charging point and the electricity installation, the metering device and the grid connection.

Smart charging is a term used to indicate that smart techniques can control the charging transaction remotely. Not the moment of plugging in or out determines the charging speed, but automated logic determines the most optimal charging period and optimal charging speed; , seen from the perspective of the e-driver, the charging station operator or the grid operator. For example, when one or more of the points below apply:

- High supply of renewable energy.
- Sufficient capacity on the electricity network.
- Low electricity prices.

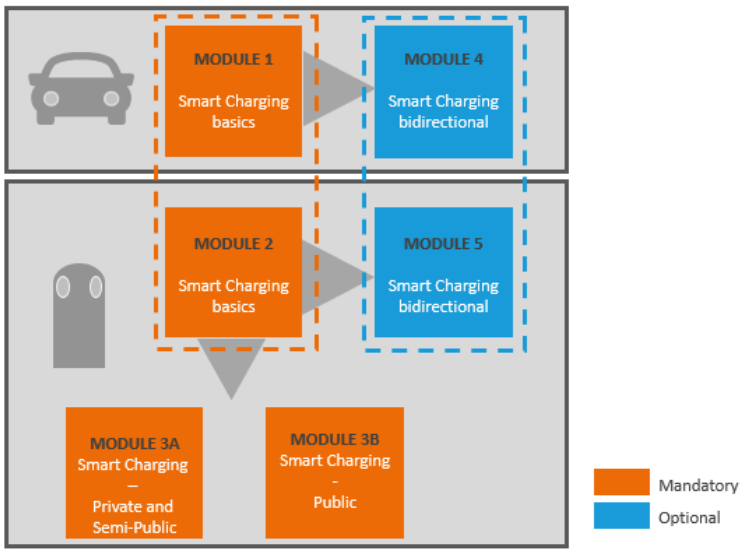
For the first time in history all knowledge and experience is bundled into an integrated set of requirements and conditions for smart charging: the Smart Charging Requirements. The Smart Charging Requirements have the following scope:

- **Destination Charging (including charging at work and at home)**[1]
  Applies to charging sessions where the connection time is usually longer than the charging time. The SCR does not distinguish between charging power and charging technology (AC / DC).
- **All charging locations**[2]
  Applicable in public spaces and on private land, including the possible setups such as a charging point, a charging station and a charging plaza (incl. Master-slave setup).
- **All electric passenger vehicles**[3]
  Applicable to all electric passenger vehicles.

[1] Fast charging next to highways and opportunity charging of trucks and buses are oute of scope because the connection time there is usually the same as the chjarging time and charging happens at very high powers.
[2] By means of Modules it is pointed out which requirements are applicable for which locations.
[3] Buses, trucks and Light Electric Vehicles are out of scope in the current version

- **All types of optimalizations**
  Applicable to all smart charging sessions, regardless of the optimization goal, with associated (information) services.

The Smart Charging Requirements are divided into five modules that can be applied independently or in addition to each other. The illustration shows how the modules relate to each other.



The use of smart charging in the period up to 2030 is essential. The charging infrastructure that is being rolled out today is expected to still work in 10 to 15 years' time and should not form a barrier to smart charging of electric vehicles. The same goes for electric vehicles that are sold today that should still be able to charge smart in a decade. That is why it is essential that with the Smart Charging Requirements a standard package of conditions for smart charging is established to which the entire market is committed.

This bundling of conditions ensures a minimal and uniform set of technical Smart Charging requirements, which creates clarity for all parties involved. The Smart Charging Requirements can be anchored in and used for:

- Drafting (inter) national legislation and regulations.
- Forming (inter) national and local policy, which is implemented in the purchase of charging infrastructure and / or electric vehicles.
- The development of products and propositions by market parties, as a checklist for manufacturers who develop Smart Charging infrastructure and electric passenger cars.

The techniques for charging infrastructure and electric cars are still under development. This means that new requirements are also being developed and existing requirements may be tightened. From an innovation perspective, parties can choose to implement requirements that are still under development and not yet included in the SCR.

The intention is to review the Smart Charging Requirements on a regular basis (eg every 2 years) based on the then applicable standards and norms. The anchoring and updating of the Requirements in a Dutch and European context is part of the tasks of the NAL Smart Charging Working Group.

The full and detailed set of technical requirements or is available via
https://www.agendalaadinfrastructuur.nl/ondersteuning+gemeenten/documenten+en+links/documenten+in+bibliotheek/handlerdownloadfiles.ashx?idnv=2108316

4 Organization of smart charging

Through involvement of stakeholders from the entire ecosystem, the smart charging working group explored various touch points in which smart charging is organized. The underlying question in this exploration has been “Where are changes in the organization of smart charging desirable, with a perspective of overall goal and general interest, and whether it would be better to leave the development of smart charging to the market?”. The intention of this exploration was to provide direction and focus, with broad support from the parties involved on both content and process.

The aim of possible adjustments to the organization of smart charging is to promote electric driving and the broad transition to renewable energy in a stable, transparent and affordable energy system. For this reason, a framework has been drawn, including potential considerations/triggers in this regard. In addition the framework contains criteria for a number of perspectives from the general interest: market (user, market parties), society and transition.

The availability of smart charging is currently limited. For publicly accessible charging locations, the range of smart charging is often limited to optimizing the use of the grid connection. Broader experience is gained through pilot projects. More services are already available for private charging locations (such as home charging). A wide range of bottlenecks has been inventoried in order to scale up smart charging. From these bottlenecks, four themes follow on which development is necessary to be able to scale up smart charging:

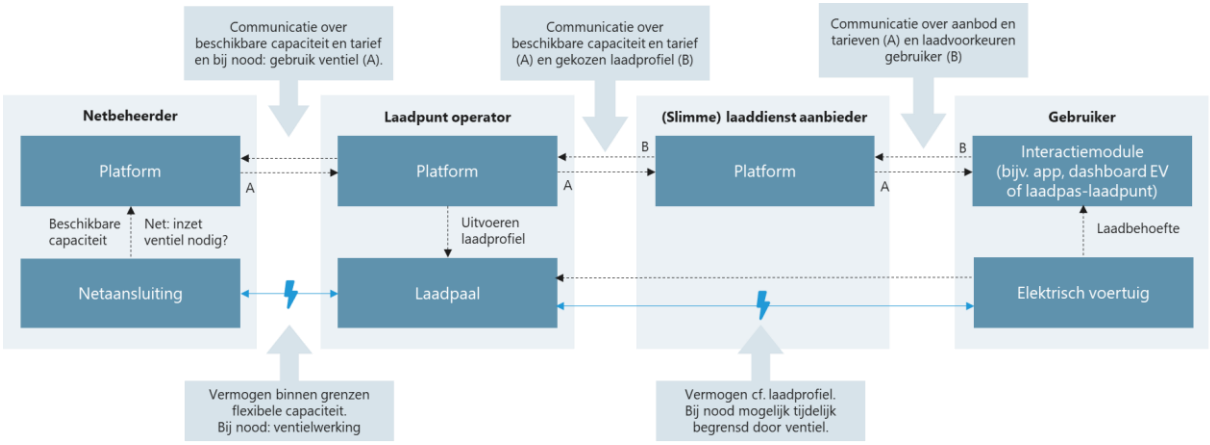
1. User and offer: insufficient influence of the user on a diffuse offer
2. Energy network: lack of tools to prevent local grid congestion and unlock unused grid capacity
3. Charging infrastructure business case: current structure may hinder the smart charging business case
4. Controlling the smart charging offer: limited options for offering smart charging at publicly accessible locations

In addition, based on the input of stakeholders from across the ecosystem, a number of general findings were made:

- Concepts of smart charging are not always unambiguous. The term smart charging and involved roles are often interpreted in different ways in the same conversations. It helps to have clear definitions and demarcation.
- The organization of smart charging is about electric charging as a whole. Issues such as financing, the offer and the position of the user and management of the offer are intertwined for smart and 'normal' charging. Development on smart charging therefore also means development on electric charging.
- View of the EV driver (user) is limited. Current users are gaining initial experience: this says little about the charging behavior and needs of millions of EV drivers in 2030. Outlining user needs is therefore always based on expectations, and not on insights from practice.
- There is uncertainty in the market about the way in which bottlenecks can be solved. This may inhibit the will to invest, or may affect business cases of existing investments. There is a broad need to ensure clarity, a level playing field and a future-proof image.
- The management of the development of smart charging is diffuse, partly because there is no specific regulation for electric and smart charging. Existing instruments with other purposes are used, with which (public) clients try to give additional direction to further development. For structural assurance, more clarity is needed about what is invested where.
- The technology for smart charging appears to be in good order: discussions are still mainly about the implementation speed of improvements (such as protocols) or new technical developments (such as V2G).

Further development is needed on four themes for scaling up smart charging. These themes are widely endorsed. Recommendation is to take the step towards implementation and upscaling for the themes user and energy network.

- User: guaranteeing minimum requirements for an unambiguous charging offer for users. This offer must then be applied in practice in order to gain practical experience on a large scale – in line with the flexible grid connection (period 2022 – 2024). From 2025, the agreements must be secured in a suitable instrument.
- Energy network: developing a flexible network connection in two phases that provides sufficient incentives to market parties and users to charge within the boundaries of the energy system. Phase 1 (until 2025) is aimed at gaining large-scale practical experience that transcends the region or client. In this phase, implementation takes place on a national scale – as if the flexible grid connection was active. Phase 2 (from 2025) concerns structural assurance through the regulatory framework of the network operators.



Scheme of information flows and charging based on a flexible network connection

With regard to the business case charging infrastructure and management of smart charging, further substantive exploration is first required of alternative options to arrive at a broadly supported direction.

- Charging infrastructure business case: exploration focuses on examining the different cost and revenue structures for public charging infrastructure focused on (1) usage and (2) asset performance. The aim is to get a clear picture of the future finance ability of public charging infrastructure and the associated chance of success for smart charging.
- Controlling smart charging on offer: make use of the (technical) benefits of current programs in which experience is gained with Third Party Access and combine this with insights and experiences from other (such as the telecom) markets. Use these insights to discuss, together with the stakeholders involved, the way in which the management of the offer of smart charging can be implemented.

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5 Upscaling smart charging to at least 70% of all Dutch EV drivers

The Dutch smart charging market is expected to be able to function independently from 2025: flexible network tariffs will then have been introduced and other incentives are strong enough (such as from balance responsibility). However there is a short term need and no-regret action to prepare the mobility infrastructure and energy system for the rapid growth in the number of EVs. Via a national upscaling program we will accelerate the rollout of smart charging services via a set of different instruments such as information, standardization, covenants and other incentives.

In the program we will focus on smart charging services that are currently possible and which parties would like to develop. To scale up smart charging, we emphasize on simplicity and as such we opt for progress: to get the market moving as quickly as possible. We do this by going for simplicity, clarity, accessibility and with a good-is-good-enough attitude: We do not let perfection get in the way of progress. We want to enthuse market parties with targeted choices that lead to action.

The program will focus on Destination Charging. The use of Smart Charging Services is most obvious in locations where a User stays longer. In these cases there is no need to fully charge the battery in a short time. Destination charging is predominantly home and work locations. At these locations, of course, use is made of various charging solutions on private, semi-public and public land.

Charging guarantee is important for (future) users. This means that Users know what to expect at the end of a charging session, even if it is smart. In this way they can adopt Smart Charging as the standard for Destination Charging with a sense of comfort. This works slightly differently with private home charging points than with charging points with multiple Users. At private home charging points, there is (usually) a permanent User. This User can influence the construction of the charging point and the contracting of Smart Charging Services. There is then always a direct relationship between the User and the Provider. The relationship looks different for (semi-)public charging points for multiple Users. The client of the charging infrastructure (eg the employer, regional or municipal concession provider) also has a lot of influence on the options and charging guarantee for the Users.

In the program a tentative choice is made for a default setting for ALL (smart) charging services on EVERY Destination location of 6 hours with a minimum desired charging volume of 30 kWh. This corresponds to a pre-guaranteed average charging speed of 5 kW (at 3 phases, 7 Amps per phase) over the entire charging time. To be clear, with the default setting the actual charging speed will fluctuate between 0 kW and 11 kW, depending on the optimalisation goal chosen by the User (either costs and/or climate). Users have the option to change their (default) preferences (once), for example because of early departures the next day, which can mean opt-out for Smart Charging, possibly at a higher rate. As an alternative for the opt-out option, a User can choose to first make use of a fast charging station and then use the Destination charger with its default setting.

All Smart charging services are expected to make use of the locally available grid capacity as optimally as possible to benefit all electricity users in a district. On the one hand, this is done by encouraging Users to select the lowest possible base capacity for a grid connection. The basic capacity determines the guaranteed (possible) maximum charging capacity within a charging session, whether smart or not. On the other hand, this is done by giving Providers the opportunity to apply neighborhood-friendly solutions that provide extra range for Smart Charging. In combination with pooling or additional capacity (see below), more capacity can become available to charge an electric car with a higher maximum capacity (at times when this is smart):

- Pooling: the available basic capacity of several charging points within a district is combined, so that an electric car can charge with a higher maximum capacity. Example: a Provider has 3 private charging points in a district, of which he currently wants to charge a car at 1 charging

point. The Provider has chosen to offer a basic capacity of 5 kW. Pooling means that a total of 3 x 5 = 15 kW is available. The car can charge with 15 kW if technically feasible.

- Additional capacity: more than sufficient capacity is often available during the day. This extra capacity is made available to the Providers in the district via the additional capacity (via a profile). The extra capacity is divided equally per charge point among the Providers who can use it. This allows an electric car to charge with a higher power at specific times during the day.

Finalization of the national upscaling program is planned for May/June 2022. Given the timing of EVS 35, we expect to be able to share the latest details of the upscaling program in the conference.

Author

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.

Frank has over 20 years' experience in the energy sector and over 10 years' experience in the eMobility sector. He is a regular speaker on many international conferences.

Some examples of Franks' recent activities: Scale-up program for Smart Charging in the Netherlands (Smart Charging for Everybody), Scale-up project for Smart Charging and bi-directional charging in Europe (SCALE), testing a new Grid Connection with flexible capacities in FlexPower Amsterdam, Smart Solar Charging based on V2G in Utrecht area and development of a GridShield as a measure of last resort to protect the grid against local power failures from unpredicted congestion based on decentralized and autonomous technology.