SMART CHARGING & ELECTROMOBILITY

DRIVING ON SOLAR AND WIND POWER!

Colofon
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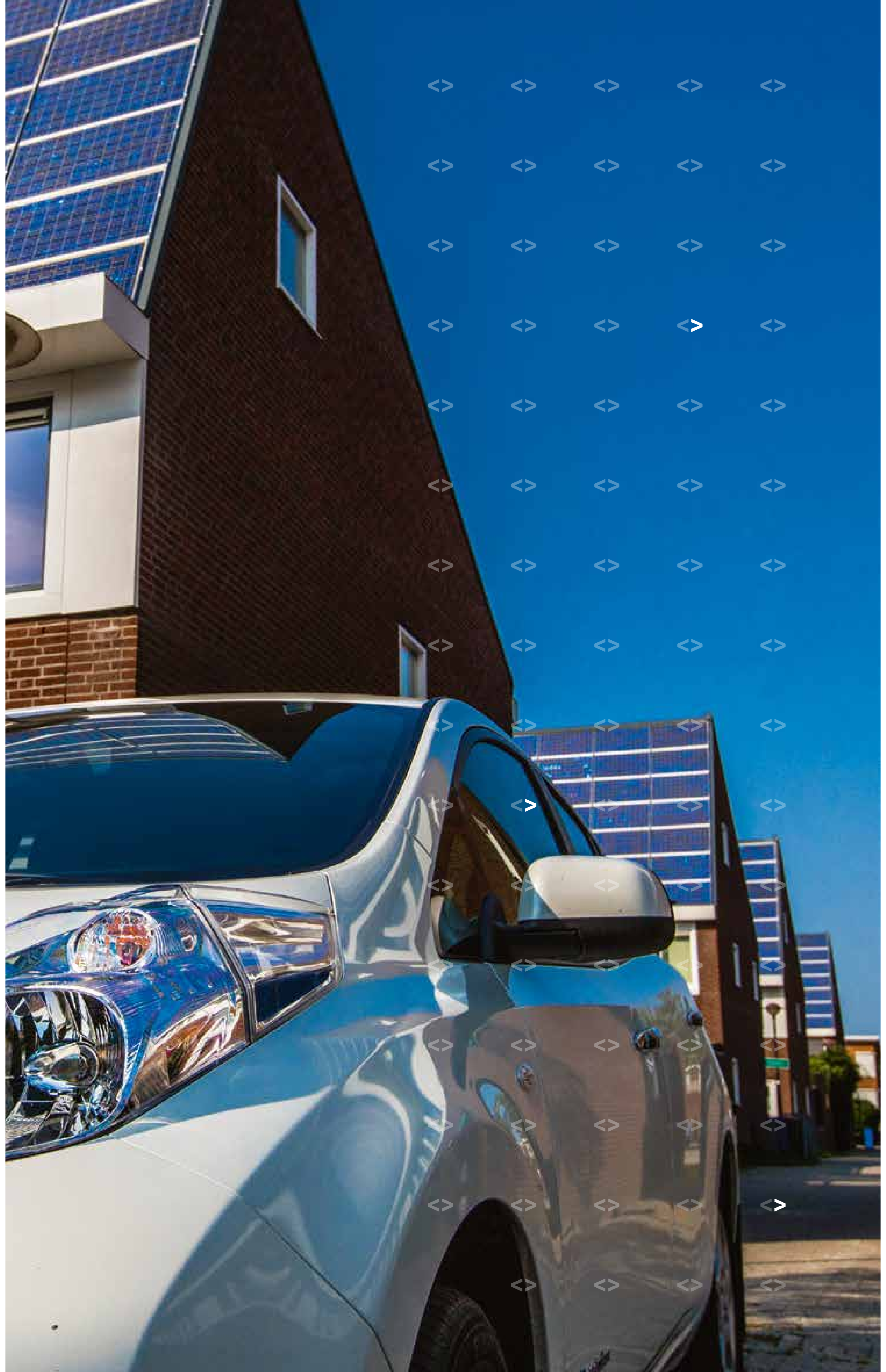

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INTRODUCTION

Electric transport is the future. It's better for the environment, better for our health and leads to cleaner air and less noise pollution. Electric vehicles can make a huge contribution to how we tackle climate change.

Electric vehicles are becoming increasingly attractive. Although a new electric car is still more expensive to buy than a comparable petrol car, electric cars are rapidly becoming more affordable. It won't be much longer before electric cars are within everyone's reach. The newest models will soon be able to cover at least 500 kilometres on a single battery charge. They will also increasingly be able to be charged more quickly. All the usual issues and complaints are slowly being eliminated.

In order to facilitate this development and stimulate it further, now is the time for us to take the necessary steps and invest in a proper charging infrastructure. Many people still dread being unable to charge their car up in time - it's one of the main sticking points to making the switch to an electric car. The large number of petrol and diesel filling stations reassures motorists that they won't get stuck at the roadside with an empty tank. In order to offer a real alternative, it's important for electric cars to provide this sense of security as well. That means ensuring the availability of accessible charging infrastructure that is fit for purpose.

It's also important for owners of electric cars to be able to use them in other countries. For this reason, every effort must be made to harmonise the charging infrastructure right across Europe. The Netherlands and other leading countries, such as Norway, Germany and France, will have a clear pioneering role to play in this regard.

Operators wanting to install charge points still have to negotiate their way through a maze of requirements. This slows progress and increases costs. In order to further facilitate the roll-out, we want similar requirements to be applied on a European level. This will simplify tender exercises for charge points and enable a straightforward exchange of experiences. A car travels an average of 37 kilometres a day in the Netherlands and is therefore unused for an average of 23.5 hours. That offers plenty of opportunity for charging it at the most convenient moment.

The Netherlands is the biggest test site in the world for Smart Charging. The figures? More than 100,000 electric cars, more than 65,000 charge points, more than 375 partners - profit and non-profit, government and knowledge institutions. They are working together to shape the energy transition: organising the technical and organisational chain involved in the storage and return supply of energy from sustainable sources in electric cars. We've already taken big steps in this area. And want to take the next steps together.

The electric transport landscape is constantly changing. The technology, market and needs are driving new developments. Consequently, there is no definitive blueprint available. This blueprint is being pieced together in stages on test sites, in studies and by carrying out tests

That's why we're looking to cooperate with parties from outside the Netherlands. We want to share our accumulated expertise and combine it with knowledge we don't have ourselves. Because through intensive international collaboration - bottom up and top down - we can close the chain and complete the puzzle of energy transition together.

Living Lab Smart Charging came into existence on 17 March 2016. We've been rolling out the Dutch charging infrastructure on a massive scale since 2011 - when there was just one charge post in the entire country. Since then, we've made the charging infrastructure 'smart' by developing open protocols and standards that are now in use in the Netherlands and abroad, such as OCPP (version 1.6 currently being rolled out).

Here in the European Union, we will only be able to claim that the roll-out of electric transport has been a success (in the wake of the Climate Accord and the national Energy Accords) when we are able to provide interoperable charging across Europe as if there were no borders and when the electricity supplied by the charging infrastructure comes from solar and wind power. And it can. The technologies exist. We only have to connect them and develop them to their full potential. We want to cooperate to fill in the missing gaps in our expertise.

What matters first and foremost is the roll-out of a Europe-wide comprehensive public charging network that is Smart Charging Ready. We'd like to share the expertise we have, both for the roll-out of the charging network and for the basic technologies of Smart Charging Ready. This publication contains everything you need to know and will be updated on a regular basis.

Installing the charging infrastructure
It all begins with the formulation of policy. To this end, we provide an insight into the possible models that have been tested in the Netherlands. We also explain to you from the outset how we have looked at local licences, tenders, parking policy, pricing, enforcement and similar issues.

The next step involves rolling out the charging infrastructure. To this end, we provide an insight into the accumulated expertise in hardware, software, management, maintenance and - most importantly - interoperability. This also matters for your existing infrastructure because you may want to convert it to Smart Charging Ready. The appendix refers you to a number of guidelines that we have implemented for this in our networks. What do you have to consider before you get started?

Installation is one thing. It's also important to keep interoperability and Smart Charging in mind. To avoid divestments. Municipal policy is also aimed at making the energy infrastructure sustainable. The stability of the energy network is very important when it comes to forming policy as well as implementing software and hardware in your charging network. So think about Smart Charging from the outset. Open protocols based on open standards are used for this.

In the near future, this may put drivers of electric vehicles (EV drivers) in a position to earn money with their electric car. And just think how many new business models could be developed on the basis of this.

Note: this publication may contain technical terms used in the Netherlands that are not common in other countries or are called something else. If you are unsure about anything in this regard, please feel free to get in touch with us.

WHY THIS PUBLICATION?

Cars spend most of the day doing nothing - up to 95% of it. And that's when they're parked at charging stations. The car is therefore a part of the energy network, because it can charge whenever required and as quickly as needed, store energy, and even supply it back to the grid. All of this happens in a 'smart' way: at just the right moment. When the wind is blowing hard and the sun shines for hours at a time - that's when we want to charge the car and store the unneeded sustainable energy in its battery. When the demand for energy increases, the stored energy can be supplied back to the grid. It's an ideal way for us to use the excess electricity generated by the sun and the wind.

We want to share what we've learned along the way. The reason is simple: it avoids having to reinvent the wheel. The goal is for us here in Europe and possibly around the world to be able to draw on a proven working technology and in doing use the power of thought to take the next steps forward. Because this involves open standards, there is no earnings model based on those standards. They belong to everyone. We multiply value by making the expertise we have accumulated available free of charge through this publication. We will have to take the next steps together in order to arrive at European standards for sustainable electric transport in Europe.

BACKGROUND

Smart Charging is often implemented from a single perspective. Such as reducing an imbalance of a party responsible for the programme. Or for frequency maintenance. Or for a responsibility of the TSO (the transmission system operator). Or for the optimal balance between self-production and self-consumption by a prosumer (a portmanteau of producer and consumer). Or for congestion management (preventing the network supply being greater than its capacity) by the DSO (distribution system operator). The next step involves testing Smart Charging from various perspectives and in larger numbers. Other aspects also have to be (more broadly) considered, such as: customer behaviour, return supply and Smart Charging for a combination of local and national energy systems.

Interoperability is - apart from digitisation and 'connected stations' - a precondition for the broad-based implementation of Smart Charging from various perspectives.

CIR & OCHP

ElaadNL (formerly stichting e-laad) was at the birth of interoperability in the Netherlands and beyond. One of the first milestones was the development of CIR in the Netherlands together with the associated interoperability agreements. The next critical step was the setting up of e-Clearing.net and OCHP (open clearing house protocol). This laid the foundations in the as yet untapped electric vehicle (EV) landscape: communication and negotiation between EMSPs and CPOs.

OCPP

ElaadNL started developing OCPP - open charge point protocol - in 2009. This has become one of the most mature and widely adopted standards. This open protocol is aimed at the communication between (individual) charge points and the management system of CPOs. A vendor lock-in is thus avoided. How was that done? It was made possible to charge at all charge points and also to change management system. OCPP was developed so as to enable the exchange of information with other interfaces. Amongst other things, this applies to interoperability and smart charging (in the broader sense). The available system capacity can be communicated through the connection to OSCP, for example. In addition, charge control reports can be received, e.g. from BRPs. This is thanks to a connection with OCPI.

The protocols work together to support the functionalities for a flexible, sustainable, healthy and smart EV landscape.

FOR WHOM?

This publication provides an initial impression of the steps that can be taken to roll out charging infrastructure in a municipal structure. Publicly accessible charging infrastructure is always located on the land of the local authority.

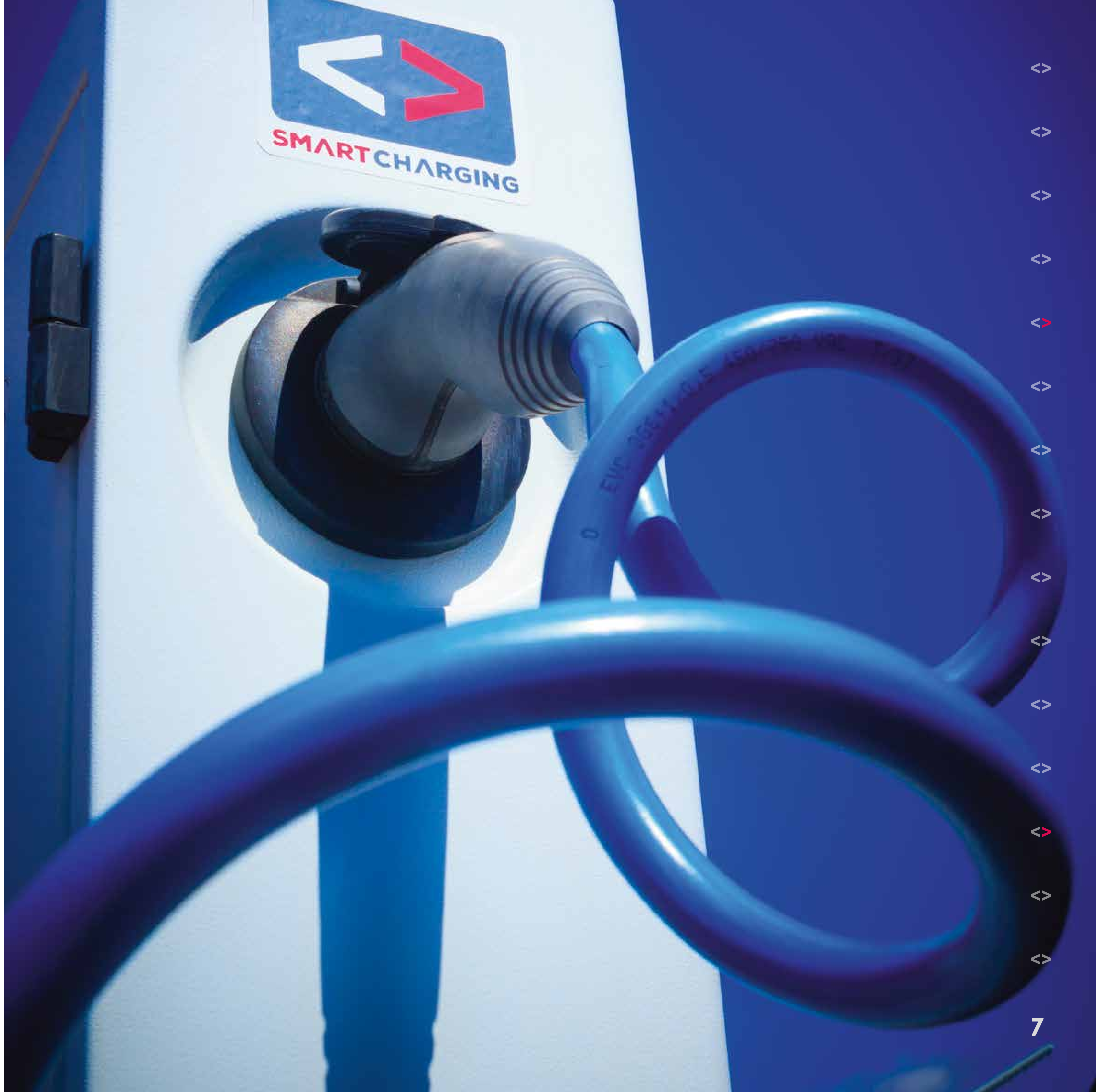
At the same time, this charging infrastructure can only be profitable if commercial parties are able to exploit it. It is necessary to identify a market model in which this can optimally thrive. There can be no electric transport without a functioning market model. This information is therefore also useful for commercial parties.

Regional, national and European governments may also be able to benefit from the knowledge contained in this publication.

Why? Because the description of the accumulated expertise in local interests often cannot be applied without major investments (public space, networks, etc.). Thus, overarching legislation can take account of local interests. Furthermore, the design of overarching legislation benefits technological expertise and its impact on industries. The existing consensus on this can be found in the publication.

STRUCTURE OF THIS PUBLICATION

We start by looking at the installation of the charging infrastructure. The 'why' of interoperability is also considered. After that, we briefly attempt to touch on why Smart Charging is important, followed by the insights into the current state of affairs concerning the implementation of Smart Charging and the associated protocols. The appendix explains how the charging infrastructure can be adapted to the latest Smart Charging standard.



BI-DIRECTIONAL AC CHARGING (V2G) IN THE NETHERLANDS

Scientific publication bi-directional charging (V2G)

In July 2017 a scientific article was published by Baerte de Brey of ElaadNL on the charging and discharging of electric vehicles (bi-directional charging) in the Netherlands. It is a precise description of the status quo and the wants and needs based on the Living Lab of Smart Solar Charging in Lombok, a district in the city of Utrecht. We remain here with a summary of that scientific article, which can be read at the website of www.scirp.org/journal/jpee as of July 2017.

Important notice: The Living Lab Smart Charging leaves the choice for AC charging or DC charging to the market. Both have up- and downsides. Eg. DC has the capability to charge fast and at higher power, AC has more standardization (eg. the plug) and is cheaper and easier to deploy (charging station).

Journal of Energy and Power Engineering (published July 2017)

It is to be expected that the number of electric vehicles will be growing in the near future. This trend comes together with the development of smaller decentralized generation units, like PV. Together with the change on demand side that comes with the global 'electrification', this can lead to serious grid congestion in low voltage grids and massive grid investments in solving this congestion. Smart Charging can partly solve this issue, but with using a connected EV as a small distribution unit, using bi-directional charging or Vehicle-to-Grid (V2G) technology, these investments can be reduced to a minimum.

Grid congestion can be solved more (cost) efficient by using Smart Charging. Smart Charging means charging the car at the proper time, with the proper power to cause as less impact on the grid as possible, but with the e-drivers charging needs taken into account. Smart Charging is also the way to deal with decentralized produced energy, filling up the batteries of EV's with decentral produced energy which is not needed for primary goals at that time. The Smart Charging definition is concluded with the possibility to put power back into the grid or connected buildings.

However, the holy grail of Smart Charging is not only controlling the demand of the EV. To use the entire flexibility from EV's as a connected asset to the grid, it is necessary to use the energy that is stored in the battery at times the demand is high but production is low, and feed this energy into the grid or its connected buildings. In this way, the power in the battery can be used to improve the quality and stability of the grid.

Choice between AC/DC

To begin with, an average European DC (fast) charging systems have all different plugs, from ChaDeMo to Combined Charging System (CCS) and the Tesla variety. This is in contrast to an AC charging station. This has one global charging standard (AC) and the Mennekes plug, in principle making this type of charging station suitable for all electric cars. One standard plug means less hassle for consumers, interoperability among stations and increases consumer adoption of EVs. What's more, this smart charging station is much cheaper than the current DC standard. This savings is achieved through a more compact design, optimization of the technology, lower operational costs on grid connection and large-scale, Dutch production.

In addition, the dimensioning makes this charging station suitable for installation in both public spaces and in any garage or drive. The AC V2G has roughly the same surface as a Dutch curb stone, while de DC is as big as a refrigerator. Moreover, the AC V2G can charge two cars at the same time because it has two outlets, while the DC charger can only charge one vehicle.

Architecture of protocols

In order to work with controlled charging and discharging, there is a need for communication protocols. V2G technology affects the entire communication chain from the vehicle to the charging station, a back office and connected third party back offices. In a recent study the full chain of EV related protocols are presented:

www.elaad.nl/innovatie/download/

The EV charging station market is expected to reach $12.61 Billion USD by 2022, at a Compound Annual Growth Rate (CAGR) of 29.8 percent, between 2016 and 2022. Given the growth trajectory of this market, patent aggression on standards and protocols by companies that seek to constrain innovation and force adoption of sub-optimal proprietary solutions is not unusual.

Royalty free and open source standards and protocols give companies, consumers, governments and other users more choices, ensuring that they are getting the best possible technology for their needs.

Universal Smart Energy Framework
The daily operation and interaction between the actors is operated by the Universal Smart Energy Framework (USEF). Central position in USEF is taken by an aggregator. The aggregator is responsible for acquiring flexibility from customers who not only consuming electric energy but producing it as well (prosumers). In a next step, the aggregator aggregates this it in a portfolio, and offering this flexibility services to different markets and market players.

For the aggregator four possible different market players are distinguished:
1. Prosumer
2. Distribution System Operator (DSO)
3. Balance Responsible Party (BRP)
4. Transmission System Operator (TSO)

For V2G appliances, most interaction will be between prosumer and DSO. The process in the framework starts with a day-ahead load forecast provided by the system aggregator. This is a prognosis based on 96 Program time Units (PTU, 15 min values) and covers the loads and generation which are represented by the aggregator. This forecast will be sent to USEF who will forward this message to the DSO.

The combination of a forecasting in USEF, real life monitoring and the use of OCPP enables the system to avoid a load curtailment by charging and discharging with different flexpower profiles.

Consumer behavior
Most Dutch EVs are not used for about 90% of the time, which makes their batteries available for other purposes. A model was developed by to simulate the potential value of V2G for one year. The model used minutely settlement prices of the Dutch Regulating- and Reserve Power (RRP) market from 2014 to 2015, along with charging- and driving characteristics of Dutch EV drivers. Results show substantial effects of RRP provision in terms of monetary benefits, battery throughput and state-of-charge (SOC) distribution. Provision of RRP resulted in monetary benefits in the range between €120 and €750 annually per EV owner, depending on EV- and user category. This is accompanied by increased battery throughput and lower SOC distributions

Regulatory issues
The shift from central to decentral energy production, combined with V2G, give some perverse incentives. For the Netherland the following tax barriers which hinder smart charging are identified:
1. The lack of netting for charged and discharged kWh in case of bi-directional charging leads to unintended double energy taxation (EB)
2. No adequate EB incentive for efficient use of locally generated renewable energy in combination with Smart Charging
3. No level playing field between public and private charging points; as a consequence, the incentive for Smart Charging, if any, varies considerably from site to site
4. Netting scheme does not provide incentive for optimizing own use by means of Smart Charging
5. Consumption cannot be clustered, either physically or virtually; this complicates free choice of energy provider and causes additional administrative burden
6. VAT liability for EV drivers upon receiving compensation for providing an EV for bi-directional charging

Fortunately, there are possible solutions for breaking these tax barriers. Some are short-term possible solutions. For example, storage may be interpreted in regulation as a service in respect of EB in case of bi-directional charging. As such, EB would only be due on net amount of charged kWh by power provider. This may provide a solution for multiple EB taxation in situations with and without netting scheme.

Clarification of netting article should be done: to the extent that netting applies in the context of Smart Charging that uses storage. As such, EB will only be due on the net balance consumed. It is the government to provide clarity on VAT approach of EV drivers and virtual netting. All these solutions can be fixed on a short term in the regulatory frame.

But also long-term solutions are needed. One of the possible solutions for a slightly longer term includes introduction of a fixed (lower) rate, for charging EVs with renewable energy, in which the service provider can be designated as the taxable subject and the EV driver as user. This will create a more level playing field for charging electric vehicles by means of public and private charging stations. Consequently, the level of the rate will no longer depend on the site of charging. This rate may be applied to offer incentives at peak power demand hours and also provides government with better options for control and insight.

Further (European or even global) study is required to give concrete form and elaboration to these possible solutions, for instance into the question what an efficient level of EB rate is for EVs as users in respect to other consumers. Is an incentive for optimizing peak consumption an option? What is the impact of a change to electrification of our national/European fleet on government revenues? Who owns the data needed for tax collection? And finally, what is the impact on position of grid operators and other stakeholders due to amended systems, mitigation of costs of grid upgrades?

Conclusion
Energy transition. New techniques, behavior but also regulations. To speed this up we need an open market, with open protocols which are royalty free. Besides solving technical issues such as standardization, much attention has to be paid on involving the customer, building a (financially) sustainable business case.

MUNICIPAL POLICY AND ROLES CONCERNING THE CHARGING INFRASTRUCTURE FOR ELECTRIC CARS

Increasing numbers of people own an electric car. This is giving rise to a growing need for charging facilities in the public space. As the owner and manager of the public space, each municipality has to deal with this. E-drivers who are unable to park and charge on their own premises have to seek out a charge point in the public space. Many e-drivers contact municipality to make inquiries about public charging facilities.

Under the banner of the National Knowledge Platform for Charging Infrastructure, parties have collected and given shape to information and advice in the form of the Charging Infrastructure Knowledge Desk. The Knowledge Desk provides a platform on which municipalities can find the answers to their questions about EV and charging infrastructure.

STRENGTHENING ENERGY AND CLIMATE OBJECTIVES

Electric vehicles contribute to international energy and climate objectives, the objectives of the national government and often the objectives of municipalities as well.

International objectives – Paris Climate Accord 2015

To pull out all the stops to prevent the Earth warming by an average of 2 degrees Celsius compared to the pre-industrial age. This agreement was reached by 195 countries on 12 December 2015 in the Paris Climate Accord. In order to reach this target, the signatories to the accord will strive to reach the global peak in greenhouse gas emissions as quickly as possible and thereafter ensure a reduction in emissions. That must lead to a balance between the emission of greenhouse gases and the absorption of these gases by forests and other means in the second half of the 21st century.

Independence from fossil fuels

Working to save energy and using energy from renewable sources will allow the Netherlands to become less dependent on fossil fuels. Coal, oil and gas, for example, are experiencing large price fluctuations. A significant portion of these fuels comes for other parts of the world, meaning that the Netherlands is dependent on other countries for its energy supplies.

Road transport in the Netherlands accounts for a good third of the national oil requirement. The transition to electric road transport will reduce the need for fossil fuels.

Secure energy supply

In the long term, electricity companies will be able to ensure that car batteries are mainly charged at night, when demand for electricity is at its lowest. This can prevent the electricity grid from becoming overloaded as a result of electric cars being charged en masse at the same time. Another incentive for the future is to charge vehicles when there is a large supply of sustainable generated energy available, for example when the wind is blowing strongly. The result is a better distribution of the - increasing - demand for electricity. At a later stage, car batteries will also be able to serve as a storage system for electricity companies. The production of solar and wind energy is particularly susceptible to peaks and troughs due to changing weather conditions. This is when the batteries can act as a buffer: they can be used to temporarily store the excess sustainably generated electricity. In this way, electric driving can make a significant contribution to a secure energy supply in the long term.

DEVELOPMENT OF POLICY

Expectations of e-drivers

E-drivers expect the municipality to provide clarity about the way in which they can charge their electric car in the public space. Does the municipality install charge points or does it facilitate market actors to do this? Or does the municipality refer e-drivers to existing charging facilities? And how does the municipality deal with parking at a charge point?

Policy offers clarity for e-drivers

You can answer all these questions by producing a policy for charging electric cars in the public space. By doing so, you'll be helping future e-drivers. That's important because many drivers demand clarity about local charging options before they decide to buy an electric car. Research shows that there are significantly more electric cars in municipalities with a clear policy for charging facilities than in municipalities without such a policy.

How to develop policy?

Developing a policy for the charging of electric vehicles involves taking many factors into consideration. Firstly about the way you want to deal with requests from e-drivers. For example, do you want to support all e-drivers and allow charge points in the public space?

If you have decided to support e-drivers, you will have to consider how you want to do this. For example, how will you deal with the installation and management of charge points in the public space. Or how does the municipality provide charge points in the public space and what do the organisation and financing look like?

The municipality's permission is also needed if a third party wants to install a charge point in the public space. This leads to an agreement between the municipality and a third party. It goes without saying that this permission will only be granted if the offer meets clear requirements and wishes.

The development of policy goes through the following steps:

- Determine the role of the municipality for charging in the public space.

By determining this role, you are choosing a point of departure for the policy. We recognise four roles: stimulating, facilitating, reacting and mitigating.

- Determine which charging solutions the municipality finds suitable.

en.nklnederland.nl/news/dutch-standards-for-charge-points-available-in-english/

There are various charging solutions on the market, such as the extended house connection or the publicly accessible charge point in the public space. Which solution suits your situation?

Explore and choose how the municipality wants to implement charge points. Various providers can implement charge points. Does the municipality want to work with one or more parties? And what does the cooperation look like in terms of organisation and finance?

Involved departments within the municipality. When developing and implementing policy for the charging of electric cars, various disciplines with the municipal organisation are usually involved:

- Environment. Electric vehicles make a contribution to environmental targets.
- Traffic and transport. Electric vehicles can contribute to sustainable mobility because electric cars are cleaner, emit less CO_2 (depending on the use) and cause less noise and air pollution. This department is mostly responsible for the traffic order to be issued.
- Economy. In relation to local business life: sustainable activity and employment.
- Spatial order/public space. Public charging infrastructure has an impact on the public space.
- Parking. Public charging infrastructure influences parking policy and enforcement. Consider the training and instructing of special criminal investigators (SCIs) in the area of electric vehicles.
- Communication. Electric vehicles are an important subject to communicate about. It is related to the municipality's sustainability aims and the stimulation of electric driving.
- Purchasing. Products or services are often purchased centrally; purchase advisers often give the management advice about the purchasing method.
- Legal matters. The concluding of agreements with private individual and professional parties.
- Licences. The granting of licences.
- Management. Management and maintenance of the public area; cables and lines.

It is worthwhile working together with all of these departments to prepare the policy for charging electric cars in your municipality. If the various disciplines are informed about each other's requirements and wishes, the considerations can also be made together. The result is a clear policy that everyone can support.

MUNICIPAL ROLES

Developing policy for the charging of electric cars? And - if applicable - making policy for electric vehicles generally? Then it helps to choose a municipal role as a point of departure. There are four roles: stimulating, facilitating, reacting and mitigating.

Stimulating

A municipality that stimulates is emphatically choosing to make a big success of electric driving. Bearing the charging infrastructure in mind, this can mean that you proactively provide charge points in the public space and/or ensure that the costs of charging remain as low as possible. Tools you can deploy for use include an order, a concession or a licence in combination with a subsidy scheme. Municipalities that stimulate electric driving often choose various projects in order to focus on electric driving. They organise business meetings, for example. Or they create subsidy schemes for charge points in their own area or for the purchase of electric cars.

Facilitating

By facilitating, we mean cooperating on making charging facilities available for electric cars in the public space. This means that the municipality makes agreements with market actors for the installation of charge points. That can be done directly or through a regional cooperation. This is often managed by granting a licence (or agreement) on the basis of policy frameworks for public charge points. The municipality can also pass traffic orders so that the parking bay next to a charge point is designated and set up for the 'charging of electric vehicles'. A municipality that opts for a facilitating role makes no or only a limited financial contribution for charge points in the public space.

Reacting

Some municipalities (still) receive only small numbers of applications for charge points. If the municipality has not held a public tender exercise or created any concessions and has not established policy rules for public charging infrastructure, the minimal municipal role is reactive. If you opt for this role, you will test applications as they come in. An application can consist of two parts:

- A licence application for a charge point as an object in the public space. The municipality must test this against the General Local Ordinance (APV).
- A request for a traffic order. Municipalities are authorised but not required to adopt a traffic order for a charge point.

If the municipality receives too few applications, the reactive role can be a conscious choice. If the number of applications increases, it is recommended to establish policy rules.

Mitigating

Municipalities could choose not to allow charge points in the public space. This should be established in the policy rules. If a municipality chooses not to have an active policy for the charging of electric cars in the public space, it is also desirable to inform residents. This can be done through the municipal website, for example. Are you (provisionally) opting for this role? If so, you should bear in mind that electric vehicles are on the increase and that municipalities are expected to receive increasing numbers of applications for public charge points.

CHARGE POINT LOCATIONS

In order to be able to charge an electric car, two puzzle pieces have to fit together. The first: where can the car be parked during charging? The second: where can the charge point connect to the electricity grid? This puzzle can be solved in various ways. The municipality can shape its policy based on these charging solutions. The solutions fit the role that the municipality chooses for the charging of electric cars to differing degrees.

The charging solutions follow the charging ladder. This ladder is based on the fact that e-drivers make their own provisions as far as possible. Or: where possible, an e-driver charges their car as much as possible outside the public space, and where essential, a solution is sought in the public space. If necessary - and depending on the situation - the municipality plays a strong role as owner and manager of the public space.

Rung 1: charging on private property at a dwelling or business
Where possible, the e-driver makes their own provisions. An e-driver can make their own provisions if they have a dwelling with a driveway or work at a business where it is possible to park on private land. In this case, charge point can be installed for limited costs. There are various parties that offer products for this. Some makes of car also supply a free charge point when an electric car is purchased.

Role of the municipality
The municipality can choose to reimburse owners of an electric vehicle for installing a charge point on private land.

Rung 2a: Parking in a public place with the charge point on private land
Sometimes an e-driver can park in the public space and charge the car via a charge point on private land. This can happen if the owner of the electric car has a parking space in front of their home. This charging method may mean that the charging cable lies across public land (pavement, parking space, cycle path, main road). Experience shows that e-drivers who cannot charge on private land and do not have another charging facility in the immediate vicinity will choose this solution if the distance from the house is small and the charging cable only lies across the pavement.

Role of the municipality
If a municipality considers this solution undesirable, it can choose not to allow it. It is therefore important for the municipality to offer an alternative in order to charge electric cars in the public space.

Rung 2b: Parking in a public parking space and a private charge point in the public space. If a charge point on private land is impossible, the e-driver can ask the municipality for permission for private charging facilities in the public space. Private charge points in the public space can be both an extended house connection and a 'normal private charge point'.

Role of the municipality
With this solution, it is important to make a conscious choice about the type of cooperation. The municipality can opt for one agreement with one market player or for individual agreements with each e-driver. The costs are borne by the e-driver and the market player. The municipality can choose to make a financial contribution.

Note: in practice, the extended house connection works a solution in a limited number of situations. For example, it cannot be used if there is no parking space outside the property. In this case, other charging solutions are needed.

Rung 3a: A publicly accessible parking space on private land with charge point
Owners and operators of, for example, parking garages and business premises can install publicly accessible charge points. The costs of installing these are relatively low compared to those of publicly accessible charge points in the public space. The reason for this is that there is no need for a new grid connection and implementing the charge points can be a simple process. The owner determines how access to and use of the charge point is arranged. Some of these charge points allow any e-driver to charge their car, while others are available to only a limited target group. The owner can also determine the costs of using such charge points.

Role of the municipality
If a municipality wants to avoid having lots of charge points in the public space, it can stimulate charging in the semi-public space via, for example, the provision of information and any subsidy schemes. It is, of course, important that there are practical ways of doing this.

Rung 3b: A public parking space and a publicly accessible charge point in the public space
E-drivers who cannot charge in one of the ways described are referred to charge points in the public space. National agreements are in place regarding access to these. In this way, an e-driver can use all charge points in the (semi-) public space in the Netherlands with a single charging card.

By opting for one of the following models, a municipality can give substance to the public charging infrastructure:

- a licence model: the municipality grants market actors permission to install and exploit charge points for a certain period of time.
- a concession model: the municipality selects one or more actors to install and exploit charge points for a certain period of time.
- an order model: the municipality typically selects one player from which it purchases the installation and exploitation of the charge points.

ALTERNATIVE CHARGING SOLUTIONS

There are two issues related to the installation and exploitation of public charging stations, which might become problematic when many extra stations are installed.

The first problem is that the installation requires relatively large investment costs for municipalities since the business case for charging stations is not yet profitable. The exact costs differ by location, but the contribution of municipalities is around 3000 euro per public charging station. A report by Natuur & Milieu (2014) showed that 75% of municipalities in the Netherlands have problems with financing all requested charging stations.

The second problem is that the placement of charging stations puts pressure on the public space. In city centres, the public space is already loaded with objects such as street lights, traffic lights, road signs, parking meters and billboards. Municipalities try to minimise the addition of even more public objects, making them hesitant about adding many more charging stations. Because of these issues, it would seem interesting to look at new ways of installing and exploiting charging stations so that municipalities are able to provide all of the charging stations that will be required in the near future.

A promising new idea for installing public charging stations is to combine them with existing municipal grid connections. This can be done in two ways.

The first option is to connect a charging station to an existing municipal grid connection. This means that two objects are connected to the same grid connection, instead of having an individual grid connection for each charging station. This creates a combined connection which could save money since only one grid connection has to be made and maintained and electricity consumption can be charged together.

The second option is to physically integrate a charge point into an object that is already connected to a municipal grid connection. By doing so, the public space becomes less crowded since fewer different public objects have to be installed, and money can be saved by also making use of the same connection. In this research, both options are called alternative connections since both are alternative ways of connecting charging stations.

Because of the potential advantages of alternative connections, many ideas are in development for making combined connections or combined objects. Both BWM and Lightwell, for example, have developed a street light with an integrated charge point (BWM, 2015; Lightwell, 2015). Other possibilities include combining charge points with parking meters, sewage pumps or public buildings.

CHOOSING AN IMPLEMENTATION MODEL

Various solutions exist for the charging of electric cars. The municipality can put together a package of charging solutions it finds suitable. It is also possible for it to offer the market space to come up with appropriate solutions. The choice of charging solution and/or implementation model depends on the behaviour of the e-driver (as desired by the municipality), the conditions that the municipality imposes and the costs and financing of the desired approach.

The behaviour of the e-driver

Residents of and visitors to a district who drive electric cars have a need for charge points. By nature, car drivers - and therefore e-drivers, too - have a tendency to park as close to their destination as possible. That's why E-drivers park and charge on their own property whenever possible. If charging on their own property is not possible, e-drivers will search for a solution in the public space. For users of a fully electric car, charging is, of course, essential.

E-drivers can charge in a variety of ways in the public space. This can be done using a cable over the footpath (close to the dwelling or business), or it can be done with an extended house connection and (semi-)public charging facilities. In this case, the e-drivers takes the following points into consideration, among others:

- The distance between the destination and a charge point. If a charge point is long way away (300 metres or more), many e-drivers will be put off using a publicly accessible charge point. The municipality can respond to this by striving for a maximum walking distance between charge points and the e-driver's address.
- The charging costs. If charging costs in the public space are high, it can be financially more attractive to e-drivers to fill up with fuel (for a plug-in hybrid electric car) or to charge using a cable across the footpath. The municipality can respond to this by including the charging tariffs in its policy.
- The availability of a charge point. If a charge point has no or only limited availability because it is frequently being used by other e-drivers, the e-driver will be forced to charge their electric car elsewhere. That also applies to the situation in which a non-electric car is parked at the charge point. The municipality can respond to this with a traffic order that designates the parking places at charge points solely for the charging of electric cars. It is also important to clarify whether there are sufficient charge points in the public space to meet the needs of both residents and visitors. E-drivers can also use apps to see whether a charge point is being used by another electric car.

Conditions concerning public charging infrastructure

The conditions of municipalities concerning public charging infrastructure also determine which charging solutions and instruments are suitable.

There are also conditions that are always important, regardless of the chosen charging solutions. If you make conditions, it is important to also consider the following points:

1. Safety

- You can stipulate conditions for safety in the public space. This lets you specify that cables laid across pathways are not allowed in order to ensure the safe use of public roads. This means that you also impose restrictions on allowing extended house connections, for example.
- You can stipulate requirement for the safety of the charge points. Also bear in mind that the system operator's component in the charge point (this is the part of the charge point to which the supply is connected) must comply with the current regulations of the system operator. This is important in order to be able to guarantee the reliability of the electricity grid. For this reason, ElaadNL provides central licensing days for charge points on behalf of the participating system operators. In this way, market actors are supported with complying with the right requirements.

2. Technical conditions

- You can stipulate conditions for the accessibility and interoperability of charge points. A possible condition is that all public charging points use the same standards for access using charging cards. Or that standard plugs have to be used on each charge point.
- It is a good idea to ask the operating party for an open standard, such as the Open Charge Point Protocol. This international open standard ensures that each charge point can communicate with each back office system. It prevents your municipality from being tied to a specific back office. A specific back office can give rise to problems such as another party taking over the management and maintenance of the charge points. An open standard offers maximum flexibility for the future and is the prescribed standard in the Netherlands and in many other countries.
  You can read more about open protocols in the 'Smart Charging' section.
- Also consider the interface with a back office system. This makes it possible for charging transactions and costs to be settled with users, and also offers insight into the use of the charge point. A back office can also ensure that the charge points are visible for maintenance, are visible to navigation systems and can be used in special apps.
- Moreover, the municipality can stipulate conditions for the minimum functionality of the charge points and the deadlines for the rectification of faults and damage. Providers of charge points usually use standard service levels for this.

3. Choices concerning the public space

- You can make choices for the locations of charge points on the basis of safety, availability and parking pressure.
- You can impose aesthetic requirements which charge points in the public space have to comply with. You can also determine the extent to which charge points with a different design are permitted. What usually applies in this regard is: the higher the requirements, the higher the costs. Municipalities often choose to implement charge points in the public space in the same colour. Due to aesthetic considerations, you can also impose restrictions on permitting an extended house connection, for example.

An important point to consider when imposing conditions is that they often result in increased costs for the private individual or operator who installs a charge point. For private individuals, for example, an extended house connection is less interesting than a connection that has to be accessible to everyone. For operators, specific requirements can have a limiting effect on the design or maximum charging tariffs. Of course, this does not detract from the fact that a basic set of conditions is needed.

Financing of charge points versus the offer from the market

The costs of charge points are often higher than the returns; a charge point costs more than it delivers. The figure below gives an indicative example of the annual costs and revenues of a charge point. Ultimately, the yield of the charge point is strongly determined by the space provided by the municipality. If there are less strict requirements (e.g. in respect of the design of the charge point), it becomes easier to lower the costs or to increase the revenues. Roughly speaking, less influence from the municipality can also lead to lower costs on a limited scale.

The licence model, concession model and order model are cooperation models between the municipality and operator for the installation and exploitation of charge points in the public space. Roughly speaking, this means that the impact and costs are the lowest for the licence model and increase for the concession model and order model respectively.

> **"WHEN IMPLEMENTING CHARGING INFRASTRUCTURE SMART CHARGING IS THE NEW STANDARD. OPEN PROTOCOLS ARE NEEDED."**

LICENCE MODEL FOR CHARGE POINTS

The primary starting point for the licence model: each party that complies with the policy rules defined by a municipality is given permission to install, manage and exploit charge points in the public space. Permission can be granted via a licence, but sometimes via an agreement as well. There are currently various municipalities in the Netherlands that work with the licence model.

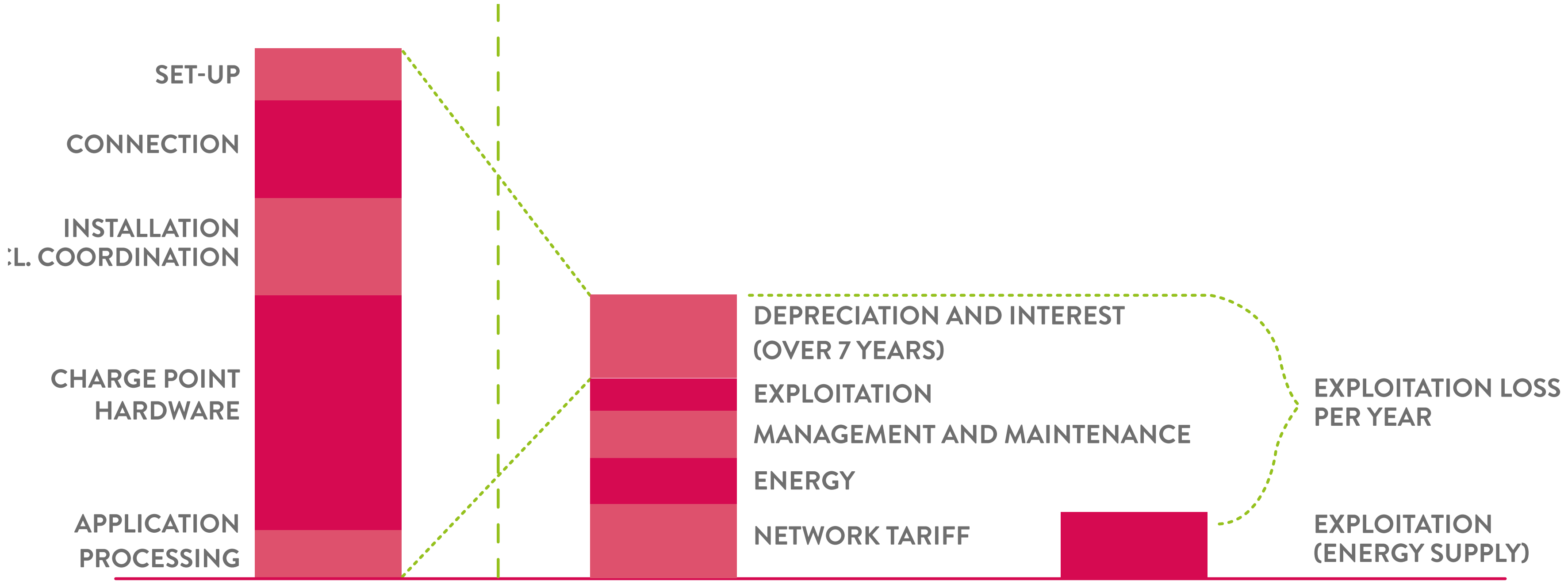
If you want to start working with the licence model in your municipality, you will begin by setting up policy rules. These rules form the conditions under which parties can implement charge points. Policy rules can be adapted at any time to keep pace with growing insights and new developments.

In these conditions, you can focus on aspects such as:

- The control that the municipality has when choosing the locations of charge points. This means that the municipality can decide whether or not to allow a charge point in a specific location.
- General starting points for the possible installation of a charge point. An often important condition is that no other charge point is installed within a walking distance of, say, 250 or 300 metres.
- The designation of a parking bay next to a charge point for 'charging an electric car' by means of a traffic order.
- The design of the charge point: this is usually limited to the colour and height of the charge point.
- The functionality of the charge point: it must function properly, be safe for users and be repaired if it is defective.
- The conditions for withdrawing the licence for a charge point in a certain location, for example, if a point is not structurally used or does not function properly.
- That the charge point is interoperable. This means that it is accessible for all charging cards that are suitable for public charge points.

In practice

You explain on the municipal website that e-drivers can apply for a charge point. You can also show here which market player(s) the municipality cooperates with. The e-driver then submits an application to the market player. The market player then takes care of getting in contact with the requesting party and approving the application in accordance with the conditions of the municipality. You agree to the final location (and play a determining role in this), furnish the necessary licence to the market player and issue a traffic order, if necessary. The market player is responsible for the actual installation as well as the operation and management of the charge point. Finally, the municipality sets up the parking bay and installs the signage.



Schedule with business case components for implementing charging infrastructure.

Important points for attention and considerations:

- The licence model can entail that you cooperate with several market actors. The result of this is a mix of charge points with a different appearance. You can stipulate the height and colour in your policy, subject to the colour being one of the standard colours. Other colours will lead to additional costs.
- In general, the municipality is unable to control the charging tariff for the user. This is determined by the market player and can result in the charge points in the municipality having different charging tariffs. However, in combination with a subsidy scheme, you can aim at a low charging tariff.
- In this model, the costs for the municipality are mostly limited to the traffic order (if applicable) and the designation of the parking space for charging only. The e-driver often pays a higher charging tariff than for a tender or concession co-financed by the local authority. The municipality does have the possibility to apply a subsidy as described above.
- The licence model ensures continuous market function with a low threshold for market actors to participate and implement charge points. A party can always choose to roll-out on a smaller scale.
- Most municipalities that use such a model only award a licence to the market player. There are also municipalities that prefer to conclude an agreement.
- The licence always contains a repetition of the policy rules drawn up by the municipality that are relevant for the period of use. If a party fails to comply with the policy rules, then the licence can always be withdrawn.
- As soon as there any technological or policy developments which, for example, fit the energy transition, these can be adapted directly in the policy rules. It's a way of letting you react flexibly to changes.

CONCESSION MODEL FOR CHARGE POINTS

The primary starting point for the concession model: one or more parties obtain the right of exploitation for the installation and operation of charge points in the public space. The parties are usually selected via a purchasing procedure.

As soon as the value of the concession exceeds the European threshold or has clear international importance, the principles of European tender law must be followed. Amongst others, the municipality of Arnhem and a cooperation of Gelderland municipalities have successfully implemented charge points under a concession model.

Effects of choosing the concession model

The main effects of choosing the concession model are as follows:

- Under the concession model, it is possible for several municipalities to cooperate on the installation of charge points. The municipalities can jointly select one or more charge point operators for this.
- Under the concession model, an additional contribution per charge point is often needed by the municipality and/or other devolved authorities. The concessionaire must therefore be selected through a public and possibly European tender procedure. It is important here to focus on ensuring a good cooperation between the municipalities, including the obligations required under the Tender Act for the division of work into different parcels.
- The concession model enables the municipality to compel the concessionaire to install charge points in less profitable locations as well. If required, the client and the operator can make agreements about the risks. This also makes it possible to install charge points for visitors or in visible locations.
- When the concession expires, the municipality or client can take possession of the charge points and select a new operator via a new selection procedure. In this way, the municipality ensures certainty for the long term.
- Opting for a concession means that one or more charge point operators is selected at the point of selection. These parties obtain the right to exploit the charge points for a certain period of time (to be set under the terms of the concession). This results in a 'closed' situation: other operators cannot install any charge points.
- A concession makes innovations enforceable. For example, the client can stipulate in the agreement that the concessionaire is required to implement desired innovations, even if they are developed only after the licence is granted.
- The concession model offers certainty for (future) e-drivers if several municipalities work together. At that moment, a guarantee actually exists that an operator has to install a charge point, subject to the municipality approving the intended location. This makes electric driving more accessible.
- The concessionaire has the certainty that applications from a certain region are sent to one or more charging service providers. This makes a lower price possible and increases the chance of roll-out.

The most important agreements in a concession agreement

A concession agreement enables agreements over aspects such as:

- The control that the municipality has when choosing the locations of charge points. This means that the municipality can decide whether or not to allow a charge point in a specific location. If required, the municipality determines possible locations for charge points in advance.
- General starting points for the possible installation of a charge point. An often important condition is that no other charge point is installed within a walking distance of, say, 250 or 300 metres.
- The designation of a parking bay next to a charge point for 'charging an electric car' by means of a traffic order. Municipalities usually choose to absorb the costs of the traffic order - including the installation of the signage.
- The design of the charge point: the conditions are usually limited to the colour of the charge point.
- Any supplemental contribution per charge point.
- If required, the pricing, which can consist of an initial tariff, a tariff for use, and a tariff that encourages moving an electric car when it is fully charged.
- The implementation of innovations.

ORDER MODEL FOR CHARGE POINTS

Under the order model, the municipality (or a cooperating group of municipalities) purchases the installation and exploitation of charge points. This means that the charge point operator which installs and exploits the charge points receives a one-off and/or periodic order to do so (e.g. monthly or annual).

Under the order model, the risks for the operator of the charge points are limited. The municipality contributes - usually significantly - to the exploitation costs. Amongst others, the municipalities of Amsterdam, Rotterdam, Utrecht and The Hague employ the order model.

Effects of choosing the order model

- Under the order model, municipalities can cooperate on the installation of charge points. It is possible for them to jointly select one or more charge point operators for this.
- Under the order model, the municipality purchases the installation and exploitation of the charge points. This means that the municipality also makes a financial contribution. When using the order model, the municipality must take account of the law and legislation concerning purchasing. Threshold amounts set by the municipality often determine what the purchasing procedure looks like.
- The municipality has a strong level of control under the order model. It is therefore possible to set specific requirements for the design, colour as well as locations of charge points. It is possible to force the installation of charge points in a specific location. The municipality can also set a specific price for charging, e.g. the tariff per kWh.
- The municipality or client can select a new operator at the end of a contract period. In this way, the municipality ensures certainty for the long term.
- A cooperation contract / order makes innovations enforceable. For example, the client can stipulate in the agreement that the concessionaire is required to implement desired innovations, even if they are developed only after the licence is granted.
- The order model offers certainty for (future) e-drivers. If a request meets the conditions, a new charge point is actually installed.

The most important agreements under the order model

- The control that the municipality has when choosing the locations of charge points. This means that the municipality can decide whether or not to allow a charge point in a certain location. If required, the municipality determines possible locations for charge points in advance.
- The designation of a parking bay next to a charge point for 'charging an electric car'. This is done via a traffic order. Municipalities usually choose to absorb the costs of the traffic order - including the installation of the signage.
- The design of charge point, such as the colour.
- The charging tariff including the tariff structure (e.g. tariff per kWh, starting tariff* and connection tariff**).
- The implementation of innovations.
- Duration of the cooperation contract and conditions for the transfer/removal of the charge points at the end of the contract period.
- The starting tariff is the tariff that the e-driver has to pay to start the charging session.
- The connection tariff is a tariff that the e-driver has to pay for parking without charging.

* *The starting rate is the rate payable by the e-driver to start the charging session.*

** *The connection rate is a rate the e-driver has to pay for parking without charging.*

“ONCE THE POLICY IS ESTABLISHED, PRACTICAL IMPLEMENTATION FOLLOWS. HOW IS THIS DONE?”

IMPLEMENTATION AND MANAGEMENT OF CHARGING INFRASTRUCTURE

STEPS FOR IMPLEMENTING CHARGE POINTS IN THE PUBLIC SPACE.

The implementation of a charge point follows a number of steps. Various parties are involved. The exact process varies by municipality, but the diagram below gives an overview of the steps that are always followed.

APPLICATION AND ASSESSMENT → LOCATION DETERMINATION → TRAFFIC ORDER → INSTALLATION AND CONNECTION → MANAGEMENT

Step 1: application and assessment
Application and assessment: an e-driver makes a request for a charge point in their locality. This application is usually received in electronic form. The municipality and/or the operator assesses whether the application meets the conditions of the municipality. For example, can an e-driver not park and charge on their own property? In order to manage the inquiry process properly, a ‘desk’ is often set up for a concession or order model. The desk has a coordinating role, handles incoming inquiries and takes care of internal and external communication. Under the licence model, the application often passes through the usual organisational elements of parking policy, APV licences and traffic orders. The following tasks can be placed with the municipality and/or operator. This depends on the chosen model and the agreements made.

- Communication with the inquirers about the inquiry and the steps involved in the process.
- Assessment of the applications.
- Making location proposals and coordinating with the various disciplines that have to make an assessment of the proposed location.
- Coordination with the operator and/or system operator about existing and new charge points.
- Preparation of traffic orders.
- Handling of received objections to traffic orders.
- Instructing the setup of parking bays.
- Coordinating role for the relocation of charge points.
- General monitoring of the application and implementation process
- Management of data from existing charge points..

Step 2: determining the location of the charge point
If an application meets the conditions, a suitable location is sought. Determining the location of a charge point is mostly a collaboration between the municipality and the operator. This is often looked at by employees from several municipal departments. The desired location must also be technically suitable; there should preferably be a suitable electricity cable in the vicinity. It is also advisable to work with a map showing all possible locations for charge points. This makes it clear to the applicant (e-driver), municipality and operator in advance where charge points can be implemented.

Step 3: issuing the traffic order
A traffic order is necessary in order to exclusively reserve the parking space for the charging of electric cars. This order can then be upheld in this location. This order can then be enforced in this location. Before a traffic order become irrevocable, an objection period often has to be allowed first. Issuing a traffic order is not mandatory in the Netherlands, but results in the location remaining available for the charging of electric cars and not being occupied as a ‘normal’ parking space. You can find more information in the section ‘Policy concerning parking bays with charge points’.

Step 4: installing and connecting the charge point
One a traffic order becomes final, the charge point can be installed. The operator places an order for the charge point, concludes the energy contract for the charge point and submits an application to the system operator to connect the charge point to the electricity grid. In the Netherlands, this is done via the connection service of ElaadNL. Next, the operator provides the installation of the charge point, the making of the grid connection (in consultation with the grid operator) and the setting up of the charging location (in consultation with the municipality).

Furthermore, the following actions are performed:

- notification of the applicant;
- the necessary notification of excavation works or the application for an excavation permit;
- the necessary granting of an excavation permit by the municipality;
- KLIC notification by the system operator;
- the necessary notification of the maintenance department about the new location;
- the informing of the person responsible for the installation about the placing of a traffic sign and any road markings, crash barrier and tiling. This is sometimes outsourced to the operator.

Step 5: managing and exploiting
A charge point requires maintenance. This method of management and maintenance is dependent up on the model chosen for the cooperation between municipalities and operator(s). You can find more information in the section ‘Exploiting and managing charge points’.

RECOMMENDATIONS FOR THE APPLICATION PROCEDURE

- Give applicants clear information about the conditions for applying for a charging object, so that fewer applications are rejected.
- Setting up the desk so that only requests that meet the requirements can be submitted.

- Criteria against which a request can be rejected as early in the process as can be detected.
- Communication with the applicant should be as standardised and automated as possible.
- When a new application is received, it is useful for the location of the applicant and the location of the charging objects in the vicinity to be visually displayed, e.g. on Google Maps. If possible, data on utilisation and consumption must also be provided here. That gives applicants the chance to see whether charging objects are available in the vicinity.
- It is handy to visually show on a map any applications that are referred to an existing charging object. This creates an overview of existing charge points, referred applicants and applications on the basis of which a new location is developed.
- Minimising the number of transfer moments, because more contact means more complexity.
- Creating clear points of contact within various parties. Ensuring a uniform transfer of information.
- The process is speeded up considerably when the municipality identifies locations in advance. The process of selection, approval and drafting of the location document can then be transferred.
- If the application for a connection is submitted at the same time as a traffic order is issued, the process is not held up for six weeks. 'Six weeks' is the objection period for the traffic order.

GUIDELINES FOR THE GRANTING OF CHARGE POINTS

A resident or business submits a request for a charge point in the public space. How can you assess whether the installation of a charge point is actually a good idea?

Conditions are usually attached to the approval of an application, such as:

- An applicant must use (be about to use) an electric car. This is often demonstrated with a registration certificate, purchase contract or lease agreement. Conditions are sometimes imposed on the minimal electrical range of the car.
- The must be no charge point present at a maximum distance of usually about 200 to 300 metres. Otherwise the applicant will be asked to make use of the existing charge point. Should the existing charge point be heavily used, a decision can be taken to install another charge point.
- That applicant must not have their own parking arrangements. For example, if the applicant has their own driveway, they can easily have a private charge point installed.
- Sometimes, the applicant must undertake to use the charge point a certain number of times per week.
- If a charge point is installed in area where 'free parking' applies, the applicant must have a parking permit.

DETERMINING THE LOCATION OF CHARGE POINTS

An important step when implementing charge points in the public space is a properly considered choice of location. Some municipalities choose to install a few charge points in strategically visible locations, e.g. in front of public buildings such as the town hall or railway station. However, the e-driver who lives or works in the municipality mostly needs a location near to where they live or work.

Spot map of possible charging location

Some municipalities work with a so-called spot map for the possible locations of charge points. The map makes it clear to the municipality, e-drivers and operators where charge points can be implemented.

Considerations for the determination of charging locations

First of all, it is useful for the municipality to formulate a clear policy on the basis of which charging locations are determined. Locations can be easily indicated and discussions over specific situations avoided.

The municipality can determine the location of charge points on the basis of various considerations:

- Bundling or dispersing. A municipality can choose to install charge points as close to users as possible. An alternative is to bundle the charging infrastructure, e.g. on parking lots. It is also possible to install a number of parking spaces at the beginning of the street.
- Practical options. The choice of the exact location is also dependent on the immediate surroundings and technical possibilities. Consideration must be given to tree roots, cables and pipelines as well as slow-moving traffic.
- A greater or smaller need for parking places locally. A charging location (usually) takes up two parking bays, and parking bays may be in short supply.
- Existing parking schemes, such as paid parking, blue zones and permit holder zones. Sometimes, a charge point is installed in a location where a parking scheme with parking duration restrictions applies. This can be at odds with the time needed for charging.
- Existent or non-existent traffic order. In order to guarantee the exclusive use of a parking space, it is desirable for the municipality to issue a traffic order stipulating that a parking space is intended solely for the charging of an electric vehicle. This can be made visible with a specific and recognised traffic sign.

Charge points at strategic locations

Some municipalities install charge points at strategic locations as a service to e-drivers. These include, for example, shopping centres or business parks. Sometimes, charging posts are strategically installed near businesses, shops or government buildings because they look sustainable. Note: practical experience shows that charge points at strategic (visible) locations are used relatively little and therefore require a financial contribution from the applicant.

Charge points in parking garages

Applications in the city centre? The municipality can give preference to investigating how far the applicant can benefit from a charge point in a municipal parking garage. This is based on the following consideration: on the one hand, the desire 'to be seen from the road', on the other, the possible negative effect on the operation of the parking garage. It is also important to consider the operation possibilities in the parking garage, the visibility of the charging bays as well as the technical possibilities and the implementation costs.

Charge points on request (or: charge point follows car

Residents or businesses without parking and charging facilities on their own property request charge points for the charging of an electric car they own or are looking to buy. The municipality communicates actively about the possibility to submit applications. The charge point to be installed remains public; anyone can use it.

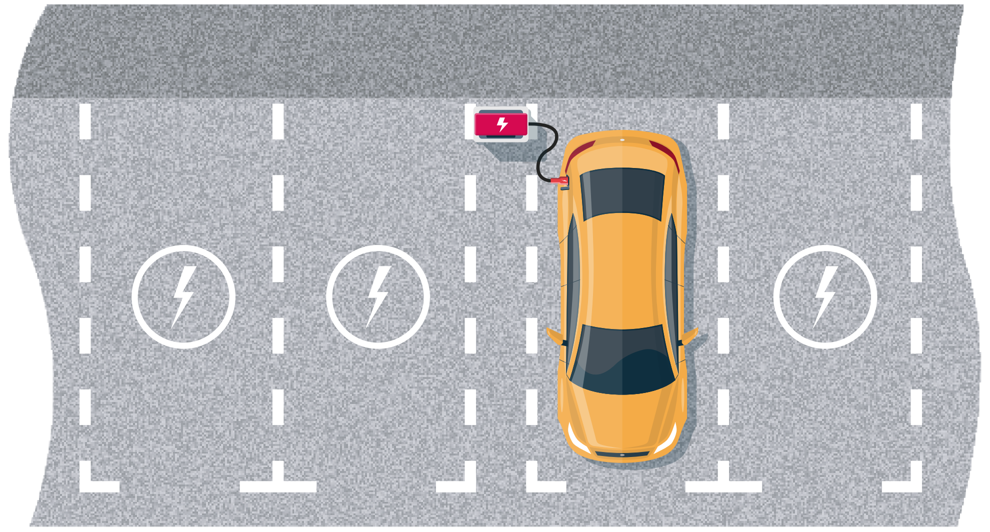
SETTING UP THE CHARGE POINT LOCATION

The municipality has more to consider than just determining the location. There are also aspects relating to the setting up of the location.

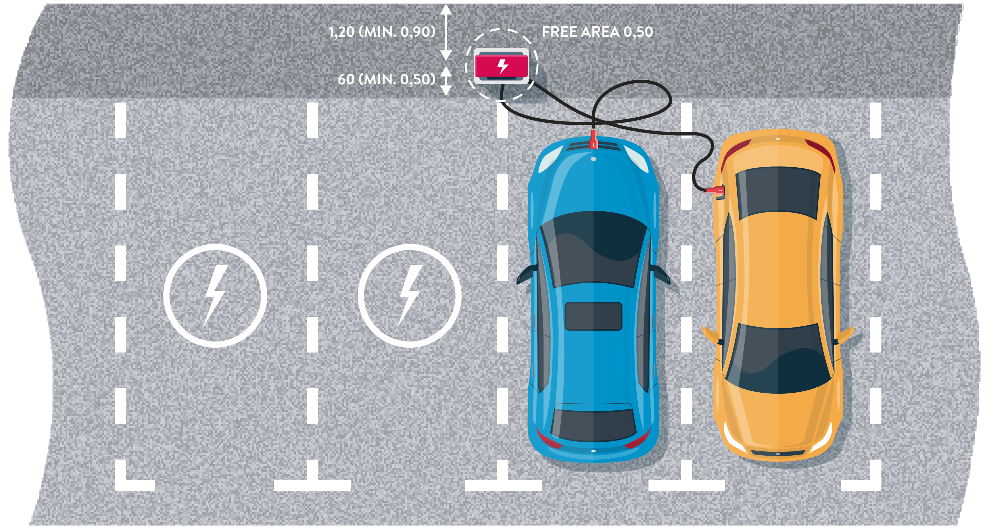
The most frequently used charge point is the one with two connections, so that two vehicles can be charged at the same time. When working out the location of the charge point, careful consideration has to be given to the layout and integration. A number of aspects are important for this:

- A charge point must enable optimal use if it can be reached from two parking bays: because there are two connection points. Possible configurations are (dimensions in metres):
- Preference is given to installing the charge point a maximum of 0.60 metres from the parking bay. This enables the car to be connected properly using the charging cable, which is usually 5 metres in length.
- To enable proper enforcement, the location must be provided with the correct traffic sign.
- Free space to walk around the charge point is important with regard to installation and maintenance. Apply the following guidelines:
  o free space of at least 0.50 m around the charge points;
  o if a charge point is installed on a pavement, maintain at least 0.90 m and preferably 1.20 m of free space on the pavement;
  o install a crash barrier if:
  o a charge point is installed at street level/same height as the parking bay(s)
  o a charge point is installed a minimum of 0.50 m and preferably 0.60 m from the edge of a pavement (and of the parking space).
- Avoid installation near a tree. If this is unavoidable, install the charge point so that the tree's root system suffers the least possible damage.
- A hard surface around the charge point is user friendly and simplifies maintenance.
- Use of the charge point must not impede the flow or safety of the traffic.
- Service hatches on the charge point must always be accessible, e.g. for maintenance and dealing with faults.

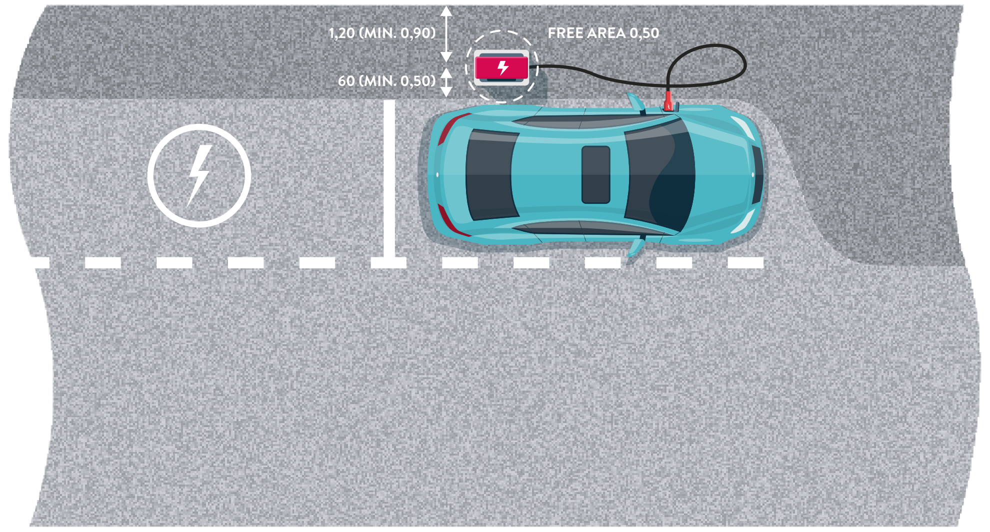
INSTALLATION OF THE CHARGE POINT IN A PARKING BAY:



EXAMPLE SETUP 1: INSTALLATION OF THE CHARGE POINT IN A PARKING BAY



EXAMPLE SETUP 2: INSTALLATION OF THE CHARGE POINT ON THE PAVEMENT



EXAMPLE SETUP 3: INSTALLATION OF THE CHARGE POINT IN PARALLEL PARKING BAYS

Signage
Municipalities usually expressly choose to reserve parking bays with charge points for electric cars (with a plug). More specifically: these parking bays are exclusively provided for the charging of electric cars. This is regulated with a traffic sign. The choice of sign depends both on the municipality's choice of target group and on whether it requires an electric vehicle to be charged when using the parking bay.

POLICY CONCERNING PARKING BAYS WITH CHARGE POINTS

Two things are important when drafting policy concerning parking bays with charge points. These are: the desired maximum stay and traffic orders.

Alignment with parking regulations
Some charge points are situated in locations where regulated parking applies. The legal interpretation is that regulated parking also applies to electric cars parked at a charge point.

Maximum stay in parking bays
A maximum stay for charging electric cars does not usually apply to charging bays. An exception to this is the fast charge points. These are intended for charging cars in a short space of time. A relatively large number of cars can make use of a fast charger each day. This is made possible by applying a maximum time to the use of a fast public charge point. Once this time expires, an e-driver must make way for the next one. A realistic 'maximum parking time' for fast chargers is 1 hour, for semi-fast chargers 2 hours. The parking time can be indicated on the traffic sign.

Alternative arrangements for the maximum stay can be organised by the operator of a charge point. Once a car is fully charged, a higher tariff applies for as long as the vehicle remains plugged in. This can motivate the user of the car to move the vehicle in order to free up the charge point for the next user. Operators are carefully experimenting with this at present. This can offer a solution, especially in busy charge locations.

Traffic order
Do you want to designate a parking bay next to a charge point for the 'charging of electric cars? Then a traffic order is required. What does this mean?

- The municipality uses a traffic order to designate a parking bay for the 'charging of electric vehicles'. This designation ensures that the parking bay next to a charge point may only be used for the charging of an electric car.
- Before the traffic order can be implemented, the charging location must be set up. This consists of at least a traffic sign. There are as yet no defined signs in the Netherlands that display an electric car.

Considerations when issuing a traffic order.
Below are just some of considerations a municipality can make for a charge point that is suitable for two cars:

- **Is parking pressure low and is the charge point well used?** The municipality can then choose to designate both parking bays as electric parking bays.
- **Is the charge point used too little?** The municipality can then choose to designate one of the parking bays as an electric parking bay.
- **Is the parking pressure very high?** The municipality can also choose to designate only one of the parking bays as an electric parking bay.
- **Encouraging electric driving?** The municipality can choose to waive paid parking while an electric car is being charged.

ENFORCEMENT

Municipal parking wardens and the police can check whether the parking bays next to charge points are being used correctly.

They can issue a penalty if a car is not connected to the charge point via a charging cable if the parking bay is designated for the 'charging of electric vehicles'.

Additional agreements are often needed with the enforcement department or the police in respect of enforcement. This is part of a municipality's policies.

INSTALLATION OF CHARGE POINTS

The operator usually performs all steps necessary for actually being able to install a charge point. The municipality plays a limited role in this.

The operator provides the following:

- arranging the activities concerning the installation of the charge point;
- applying for the licences from the municipality and the energy contract;
- connecting the charge point to the electricity grid;
- coordinating the setup of the charging location with the municipality.

The municipality can ensure rapid provision of the licences in this process. The setup of the charge location is also often a task for the municipality. The municipality installs the signage and applies any lines required around the parking bay. Sometimes, crash protection is also needed.

"PRACTICAL: PARKING ATTENDANTS AND/OR THE POLICE CAN CHECK THE JUST USE OF PARKING SPACES WITH CHARGING INFRASTRUCTURE."

“OBLIGING THE IMPLEMENTATION OF OPEN SMART CHARGING PROTOCOLS LEADS THE WAY TO A FASTER ENERGY TRANSITION”

EXPLOITATION AND MANAGEMENT

The municipality makes agreements with the operator(s) of charge points about the tasks, competencies and responsibilities concerning the exploitation and management of charge points.

This is done in advance for all implementation models, e.g. via tender documents, agreements, policy rules and/or licences.

Also consider the following tasks:

- Legal and economic ownership of the charge points.
- Maximum charging service tariffs.
- Communication about charging service tariffs for e-drivers.
- Minimum charge speeds.
- Design of the charge point
- Responsibilities for maintenance and faults.
- The service. Making performance agreements about, for example, the handling of faults and the minimum availability of the charge point.
- Liability and risks.
- Motivational tariffs, whereby the e-driver is encouraged to free up a charge point once the car is fully charged.
- Service provision innovations, such as paying by smartphone.
- An efficient setup of the application and implementation process.
- Use of ICT applications that give insight into availability, faults, planning as well as the application and implementation process.
- Ownership and use of the utilisation data supplied by the charge points.
- Agreements concerning the removal or relocation of charge points.

Management

After the preparatory steps, the management phase begins:

- Installation of the charge point by the party with which the municipality works or has placed an order;
- Operation, management and maintenance of the charge point. This also includes the municipality checking compliance with the cooperation agreement.

The operator can be the municipality itself, but also the party that performs this task in the municipality. The following tasks play a role in this:

Technical management

- The preventive and corrective management and maintenance of the charge points and related ICT systems.
- Service and maintenance in order to resolve faults within the set deadlines.
- A continuous fault service, 24 hours a day. The municipality can, for example, insist that problems relating to the disconnection of vehicles and safety issue are resolved within a set number of hours.
- Helpdesk function for other faults or malfunctions. These cases are, for example, resolved or answered on the first working day after being detected or reported at the latest.

Administrative management/service provision

- Account management for users; this includes a (digital) desk/helpdesk function where users can apply for a suitable access card or can have their existing card adapted, report faults and obtain information and additional services (map, SMS services, app).
- Subscribing, invoicing and/or settlement, depending on the revenue model chosen by the municipality.
- Ensuring interoperability and access to the charge points for e-drivers who have a charge card issued by another service provider.
- Service for providing the e-driver with maximum information about use and availability, consumption, charge status, etc., via various media. Communication takes place over, for example, the internet, mobile phone applications and SMS.
- Supplying the municipality with management reports and information containing use, user, control and management data about faults, the functioning and use of the charge points. This is intended not only as a form of corporate accountability but sometimes also as something the municipality can learn from.

Insight into use

The number of transactions - with related start and stop times and charged kilowatt hours - is maintained in a database for each charge point. This is possible thanks to the connection between the charge points and back office system. This information is valuable because the municipality can use it to decide whether to maintain, remove or install an additional charge point. Municipalities wanting to gain access to this data must make agreements in this regard with the infrastructure provider.

“MUNICIPALITIES CONTRACT CHARGE POINT OPERATORS ON TASKS, DUTIES AND RESPONSIBILITIES FOR OPERATION & MANAGEMENT OF CHARGING INFRASTRUCTURE”

RELOCATING OR REMOVING CHARGE POINTS

Sometimes, it is necessary or desirable to relocate a charge point. Consider the situation in which a charge point is used too little or not at all, or permanent relocation is required due to the reconstruction of a road.

A relocation costs time and money. The process for installing a charge point is often run through from the beginning, including the costs incurred for the procedures and carrying out the work. The municipality can submit a request to the operator for the relocation of a charge point. The agreements between the operator and the municipality usually also stipulate which party will bear the costs of relocating or removing a charge point.

COMMUNICATION CONCERNING THE CHARGING INFRASTRUCTURE

External
Municipalities can actively choose to communicate externally with companies and residents. Logical communication moments are:

- When the policy is established
- When a contract/licence is concluded with an infrastructure provider.
- When new charge points are installed

These moments are also a good opportunity to ask about the municipality's ambitions and developments in the area of sustainability and electric vehicles. Moreover, the municipality can use this communication moment to draw the attention of e-drivers to the possibility of applying for a public charge point.
Examples of communication channels:

- Municipal page and local newspaper
- Municipal website
- Inclusion in Q&A of the municipal helpdesk

Internal
In order to prepare the policy, it is important for the municipality to have a well organised internal structure. This is even more important when it comes to implementation. Different departments and employees have several roles in the application and installation process. The employees work in areas such as traffic, enforcement, licensing, spatial order, sustainability and communication. It is important to make clear agreements about responsibilities and process agreements. It is essential to appoint a workgroup/project group for this and to convene it on a regular basis. Develop and define process agreements within this workgroup.

Communication naturally also takes place between the municipality and the infrastructure provider. It is advisable to appoint a fixed contact person for both parties. This partly concerns the practical execution out of the application and implementation process. For example, the municipality can use a digital system to obtain an insight into the progress and planning of the application and implementation process. On the basis of this, the municipality can inform its residents and employees about progress. Furthermore, agreements can be made in respect of quarterly or management reports containing full information about the use of the charging services.

USER TYPES

There are various types of electric car users. They have an often specific need for ways to charge their vehicle. The following main groups of users can be found in municipalities:

Residents
Residents of the municipality who own an electric car or who have been provided with an electric for commuting and private use by their employer or a lease company.

Companies
Companies with their own electric cars or buses; employees who make use of electric cars for commuting and/or business trips. Companies with electric cars in their own fleet are also included - these are often used as pool cars. Finally, this group also includes taxi companies with electric vehicles.

Visitors of companies (customers, business visit)
Some companies want to offer their customers a charge point on their own premises. It is beneficial for this charge point to be publicly accessible (not only for visitors of the company) and also visible on various maps and websites. For companies that want a charge point 'on the road', the municipality can cooperate in the implementation of a (public) charge point if the expected visitor stays longer than two hours and the charge point is useful for various other companies in the vicinity.

Visitors to the municipality
A half of all visitors park for longer than 2.5 consecutive hours (and can make use of a 'normal' charge point during that time). The other half parks for less than 2.5 hours (and opts for a fast charge point). The first group avails itself of strategic charge points that are distributed across the municipality. These e-drivers can also make use of the roadside charge points applied for by others. Visitors who stay for less than 2.5 hours mainly have a need for a fast charge point. The market aims at implementing fast charge points at filling stations and in the hospitality industry. Where possible, visitors use private charge points at companies and private individuals as 'guests'.

Connecting charge points to users
The various target groups ask for different charging locations. Owners/residents/companies have a need for a charge point as close to them in the neighbourhood as possible. These charge points are provided on the basis of a clear demand or need. They are directly related to users of electric cars. Charge points can be installed for visitors in locations where electric cars are to be expected. These locations are often called 'strategic locations'. A user is not directly linked to them.

STATUS QUO

The first phase is complete: knowledge about the installation of charge points on the basis of the Dutch model is available. There now follows the most important aspect concerning the installation of charging infrastructure: ensuring interoperability and Smart Charging Ready charge points. In the Dutch situation, which is based on the existing charging infrastructure, the will exists to increase installation with the immediately future-proof installation of the charging infrastructure. This should be done with open protocols and open standards so that a market can be created. It is understood that there will always be developments - and we want to be prepared for them.

THE ROLES INVOLVED IN INTEROPERABLE CHARGING

- The charging provider makes it possible for an e-driver to charge their car. This could be the municipality or an owner of a parking garage or a company that has a charge point on its parking lot.
- The infrastructure provider implements the charge points and takes care of their management and maintenance (exploitation). At the moment, this role is performed by parties such as energy suppliers and new entrants to the market. A municipality that wants to install charge points in the public space can therefore cooperate on this with an infrastructure provider. By making agreements with service providers, infrastructure providers ensure that e-drivers can make use of the charge points.
- The service provider issues charging cards to e-drivers, who use them to access the charge points. The service providers settle with the e-drivers for use of the charge points. In order to gain access to the charge points, the service providers make agreements with the infrastructure providers.
- The charging customer is an e-driver who wants to charge an electric car. By purchasing a charging service from a service provider, the e-driver can make use of all charge points in the public space in the Netherlands.

Agreements are made via a consultative body over the exchange of information, the charging standards and access to the charge points for e-drivers. This makes the charge points interoperable.

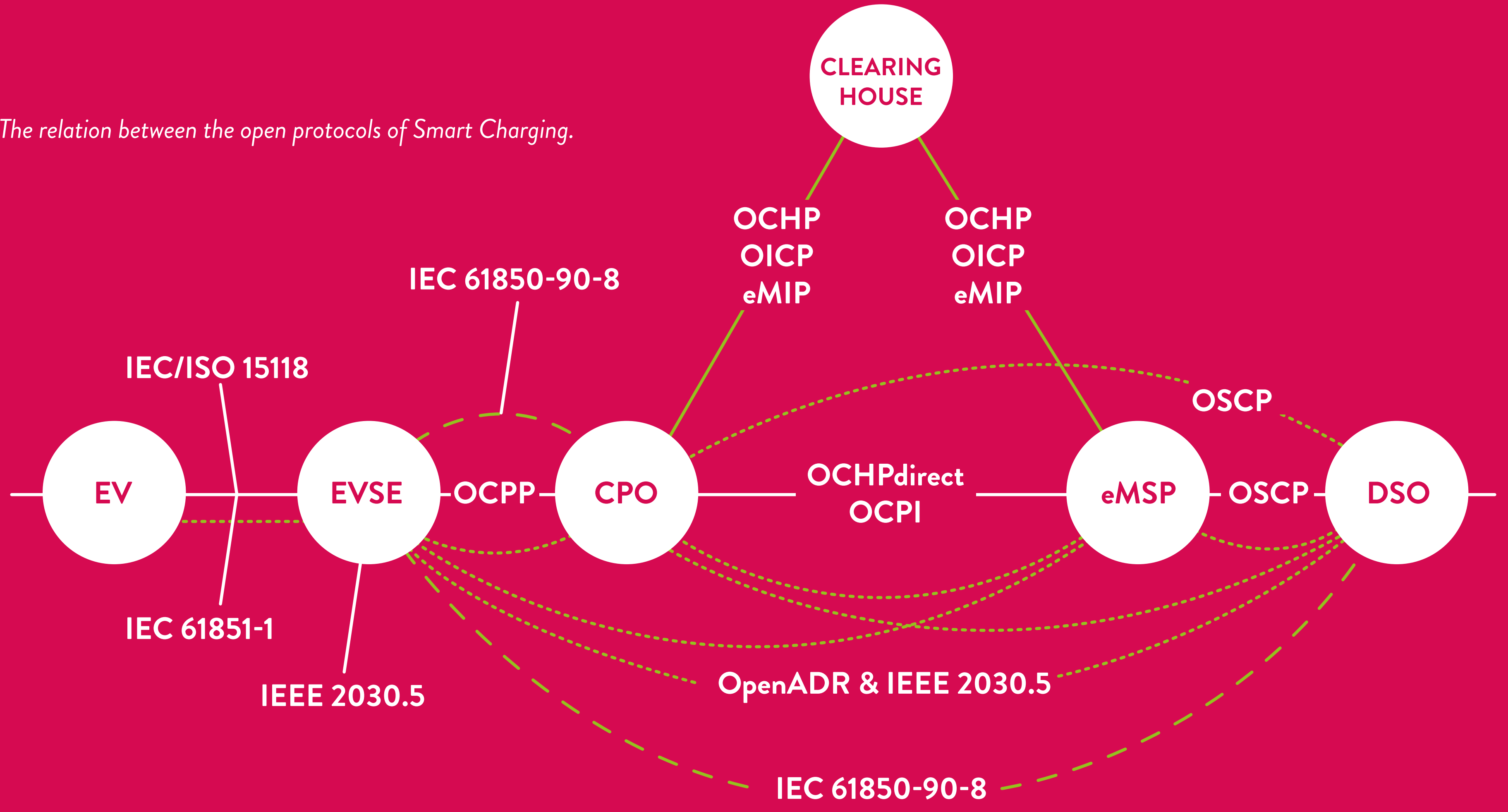
INTEROPERABILITY

The charge points in the public space in the Netherlands are interoperable. This enables any e-driver to use any charge point in the public space: each charge point has the same plugs, the same payment system and therefore gives access to the entire charging network. It makes no difference whether the charging involves private, semi-public, public, fast charging or normal charging. The agreements for this are laid down in a market model for publicly accessible charging infrastructure and is guaranteed by the industry association E-Violin.

This applies to charging technology (such as the plugs), payment methods (RFID card, pay-as-you-go) and operational matters (protocols and processes). Thanks to this approach, nobody is tied to a single supplier; there is no need to modify the cables or plugs. In recent years, the Netherlands has performed an exemplary role on a European level in this area. This is due to the early adoption of Type 2, Mode 3, roaming via the CIR and contributions to open protocols. The projects in the area build on this, because interoperability is and remains essential.

Based on its practical experience, ElaadNL has come across many different protocols within the Electrical Vehicle (EV) domain. The interaction supported by these protocols consists of exchanging information ranging from authorisation identifications (ID) to charge point locations, but also of sending commands for charging control. A selection of protocols encountered by ElaadNL have been investigated further in a study. These protocols and their relationship to the different roles on the EV market are visualised in the figure to the right:

The relation between the open protocols of Smart Charging.



Important here is the reference to the protocol book that was recently published by ElaadNL (LINK). This book contains all protocols. Also important is the section below on Smart Charging: in particular, the open protocols and open standards are most important for being able to create a market.

NEW INSTALLATION FOR IMMEDIATELY SMART CHARGING READY

The protocol chain shown above gives an initial insight into the complexity and workability of Smart Charging. Taking these open standards and protocols into consideration at the same time as creating the infrastructure avoids disinvestments and gives free rein to the energy transition via the electric car. This is what governments are looking for and where market actors and system operators see financial reasons to invest. The 'how and why' of this - as far as we currently know - is explained in the following sections.

CYBERSECURITY

You will find more information about this and references to it towards the end of this book. In this phase of market development, we see increasing pressure exerting itself on the ICT chain. Calls to focus on cybersecurity for Smart Charging and public charging infrastructure are also growing around the world. That's why we make express reference to this subject this status quo phase, now that knowledge about the existing charging infrastructure is available.

An interesting reference work is the recent ENCS investigation into current expertise and state of affairs surrounding cybersecurity in the EV market. See:

elaad.nl/uploads/files/Security_Requirements_Charge_Points_v1.0_april2016.pdf

Note: we do not go deeper into the market model in this document because the situation in the Netherlands does not have to be directly applicable to the situation in other countries. When, from a technical perspective, the open protocols and open standards are set up, the home market will be able to create an open, competitive market. This will strongly accelerate its development.

EV PROTOCOLS

www.elaad.nl/innovatie/download/

"COOPERATING WITH FOREIGN PARTIES ALLOWS US TO FASTEN THE ENERGY TRANSITION VIA SMART CHARGING"

SMART CHARGING

It is important for the charging stations that are installed in the municipality and the back office to which they are connected to be capable of handling various supporting protocols.

This is a condition for municipalities that want to deploy innovative Smart Charging solutions in a variety of ways and in doing so aim to facilitate e-drivers. The more prepared the infrastructure is for this, the easier it will be in future to roll out innovative pilots and thus improve the business case.

To some extent, it is also possible to prepare for further in the future, when cars can supply energy back to the grid, by stipulating technical requirements for the charging infrastructure.

With the arrival of these innovations and related data streams, attention must be paid to security so that the transfer of data is always safe.

It is expected that the charging stations and the back office will be future-proof. This is achieved by paying close attention to the following topics.

EV - THE ELECTRIC CAR BECOMES AN INTEGRAL PART OF SUSTAINABLE ENERGY SYSTEMS

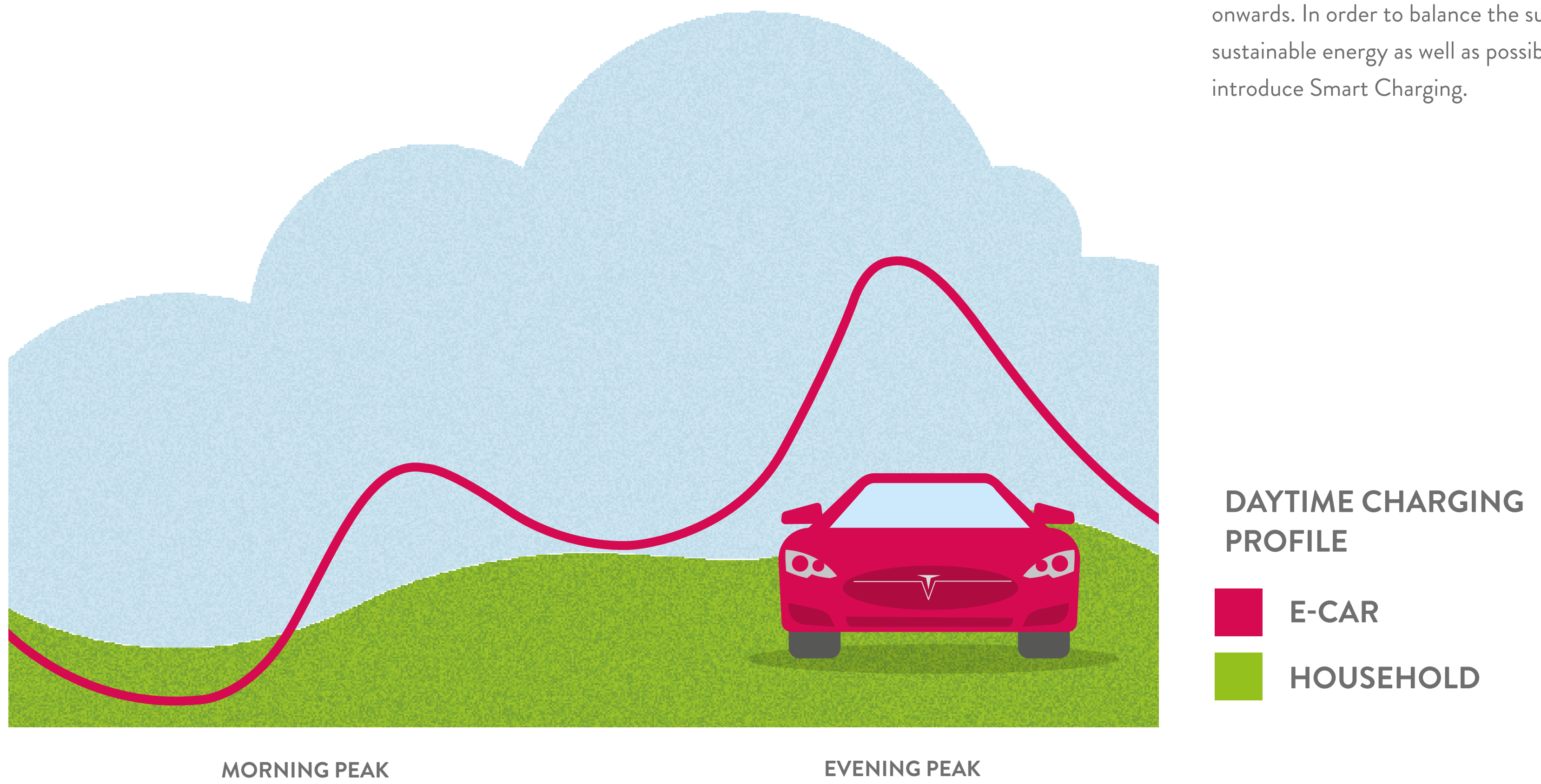
The EU's transport sector is undergoing a major shift towards sustainable mobility. Transport is responsible for about a quarter of EU emissions and is almost exclusively dependent on oil. EVs provide an important part of the solution towards more sustainable transport. They are cleaner, quieter and three times more energy efficient than their conventional counterparts.

Likewise, the power system is in the midst of transformative change. The EU's short-term 2020 and medium-term 2030 agendas for emissions reductions, increased renewables penetration and efficiency improvements are fostering the development of decentralised generation and electric vehicles (EVs). In order to integrate the flows of the new sources of supply and the new forms of demand, the power system will need to become smarter.

Smart Charging turns the car into an integral part of a sustainable energy system. It makes virtually limitless growth possible for electricity from sustainable sources such as sun and wind. It also avoids expensive expansions of the electricity grid. Sustainable electricity, which comes in peaks and troughs, is buffered in electric cars by means of Smart Charging. It's how the electric car can make a further contribution to a clean environment and the energy transition. Smart Charging refers to all smart, innovative technologies that enable electric cars to be charged at the best possible moment.

For a charge profile in which normal charging takes place - or: because there is no control over the charging process, - the charge profile of an electric car appears to largely coincide with the energy profile of a household. This is logical because an e-driver starts to charge the car upon arriving home or at an external location. Starting the charge cycle coincides with a peak in the standard profile of the household.

This can lead to problems in some parts of the energy network - certainly given the Dutch government's goal that only electric vehicles will be sold from 2025 onwards. In order to balance the supply and demand of sustainable energy as well as possible, it is important to introduce Smart Charging.



Charging infrastructure - Smart Charging Ready

It is important for the charging stations and the back office to be suitable for handling various supporting protocols. This enables us to deploy innovative Smart Charging solutions in a variety of ways and in doing so to facilitate e-drivers. The more the charging stations are prepared for this, the easier it will be in future to roll out innovative pilots. To some extent, it is also possible to prepare for a time further in the future when cars can supply energy back to the grid. Finally, with the arrival of these innovations and related data streams, attention must be paid to security so that the transfer of data is always safe.

Smart charge points can 'talk' in two ways. Thus the charging process can be communicated about from outside the charge point and influenced as required. By adding intelligence to the system, an optimal charging plan can be established for the user. Account is taken of the wishes of the user, the available capacity in the electricity grid, the degree to which sustainable energy is available and the price.

Charge Point Operator - Smart Charging from the back office CPO

Smart Charging can be used in many ways and with many goals/reasons. One way of enabling Smart Charting from a back office is to base the communication between the back office and the charging station on the Open Charge Point Protocol (version 1.6). This version of OCPP enables the sending of charge profiles from the back office for implementation by the charge point. In this way, the charging current or the charging power can vary over time, according to the requirements of the Charge Point Operator (CPO), e-Mobility Service Provider (eMSP) or e-driver.

A power controller is needed in the charging station to handle these charge profiles. It is also necessary to prescribe a certain behaviour of the charging station with the goal of satisfying the e-driver to the greatest extent possible. For example, the flexible handling of vehicles that are not quick enough at lowering the charging current when the charging station communicates this via Mode 3 PWM. In order to protect the station, the charging station must switch off the charging current when an EV draws more than is permitted. However, it is advisable to re-offer the charging current several times and to slowly reduce it to give the connected vehicle the chance to reduce the requested power.

It is also smart to prepare the internal wiring of the charge station for future higher power levels and to equip the internal software with ways to deliver maximum current strength without this causing a charge point to fail. The smart distribution of available power is necessary when two or more vehicles are being charged off a single connection. With a 3x25A grid connection and 3x20A system protection, two charging cars can only draw 12A, but when only one car is connected, the charge current can reach 20A per phase.

E-mobility service providers - Smart Charging Services

Actually keeping the promises of Smart Charging will require the development of Smart Charging Services. The market is still in its infancy, but will develop rapidly in the coming years. It's important to create the necessary conditions now in order to enable this development.

Specifically, this means that all charge points will have to be prepared for future smart services today in terms of hardware and communication. This is called 'Smart Charging Ready'. You can read more about this in the following section.

On the other hand, research institutions, universities, authorities, system operators and market actors will have to work together on researching and developing all aspects of Smart Charging Services. Both the energy sector and the transport sector are global markets. International cooperation is therefore essential.

There are already examples of initial Smart Charging Services that are undergoing testing. See the website of Living Lab Smart Charging for a current overview.

System management - Insight into system capacity from the system operator's perspective

Whoever wants to implement Smart Charging pilots on the basis of actual and dynamic system capacity will need input from the system operator. Amongst other thinks, this can be done using the Open Smart Charging Protocol. OSCP provides the link between the charge point operator (CPO) and the system operator and is managed by the Open Charge Alliance. The latest version of the protocol can be downloaded here: www.openchargealliance.org.

The (changes in) system capacity can be passed to the CPO from the system operator via OSCP. The back offices of the subscriber must then be able to receive OSCP reports and convert these into the correct charge profiles, which in turn can be sent to the charge point with OCPP.

Various solutions exist around the world for communicating system capacity. There is still no single standard. That is why OpenADR and 61850 will have to be investigated as possible protocols for the connection to the system operator.

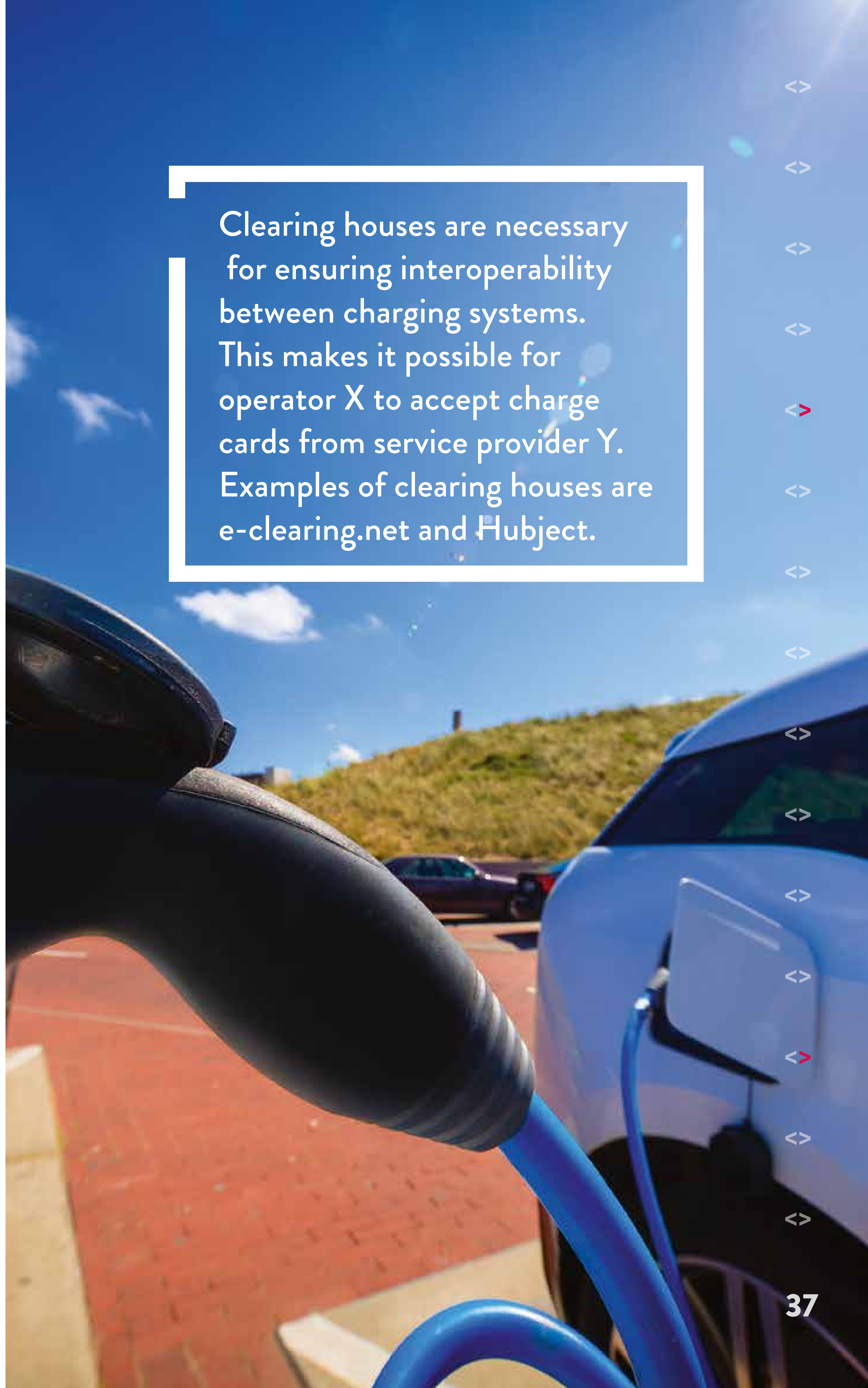
Clearing house – simplification of B2B and cross-border smart charging

Starting in 2009, e-laad foundation and the predecessor of the eViolin association specified two standards in order to retrieve charge point details and the active state. These are called the VAS interface and the Amsterdam interface. In the same period, a CDR format for the exchange of charge sessions between eViolin members was defined. This format is currently in use by the majority of eViolin members. (eViolin is the industry organisation for EV operators and service providers in the Netherlands and responsible for national roaming and the issuing of IDs). This resulted in the development of OCPI in 2014.

In Europe, initiatives have been taken to create clearing houses. The best know of these are: e-clearing.net, GIREVE SAS, MOBI.E S.A., Enel and Hubject GmbH. In March 2015, these five organisations announced the launch of a cooperation aimed at interconnecting the major eRoaming platforms in Europe. The Pan- European initiative aims at further simplifying the charging of electric vehicles with single EV charging supply contracts across provider lines and national borders.

All of them have established their own eRoaming solutions and service offerings in different countries. The pan-European eRoaming initiative was launched by representatives of these companies in the autumn of 2014 to join forces with more than 30 other companies from different industry backgrounds. Their common goal is to lower the barriers that exist to using an electric vehicle. By committing themselves to interconnect their individual platforms, the members are following a path desired by European policymakers. The pan-European eRoaming initiative thrives on the experience of the participating companies. Emobility entities are therefore invited to take part in the initiative.

Clearing houses are necessary for ensuring interoperability between charging systems. This makes it possible for operator X to accept charge cards from service provider Y. Examples of clearing houses are e-clearing.net and Hubject.


Clearing houses are necessary for ensuring interoperability between charging systems. This makes it possible for operator X to accept charge cards from service provider Y. Examples of clearing houses are e-clearing.net and Hubject.

COMMUNICATION AND PROTOCOLS

In order for a CPO to obtain third-party input on which charge profiles can be based requires a connection to be made from the CPO. There are various ways of doing this. Interoperability makes it possible for EV drivers to make use of the charging infrastructure regardless of where they are, regardless of the type of EV and regardless of the charge point operator and service provider.

The Netherlands is the only country in the world to have introduced virtually nationwide interoperability (since 2010). This is done via the Central Interoperability Register (CIR), which is managed by the policy-supporting association eViolin and to which charge point and service providers are connected. This makes it possible for operator X to accept charge cards from service provider Y.

eViolin, the Dutch association of operators and service providers responsible for access to public charging infrastructure, announced at the end of November that it will start using the European roaming platform e-Clearing.net. This will be done via the open OCPI protocol.

OCPI (Open Charge Point Interface) was launched by a number of Dutch market actors. OCPI can be used in both a bilateral context (direct CPO – MSP link) as well as via a clearing house. OCPI enables EV drivers to see price information in real time (at a charge point), taking into consideration components such as the price of the operator and, if necessary, the price of the service provider. The OCPI project aims at implementing a nationally and internationally supported, independent user interface which supports the affordability and accessibility of charging infrastructure.

The protocol description of OCPI is available at www.github.com/ocpi.

The Open Smart Charging Protocol communicates forecasts of the available capacity of the electricity grid to other systems. This protocol was first created by Dutch DSO Enexis and EMSP7 / CPO GreenFlux but has since been transferred to the Open Charge Alliance for further development. The protocol is based on a budgetary system, where client systems can indicate their needs to a central system. This guards against overuse of the grid by handing out budgets per cable. If a system requires more, it can request more; if it requires less, it can hand back part of its budget for use by other systems.

OSCP has no direct relationship with the charge points; the protocol is by design more generic. It can, in principle, be used for allocation of capacity in general (energy, bandwidth, euros etc.) from a higher level system to a lower level system. However, the naming is quite DSO-specific. The exact reason why a client system manages power is beyond the scope of the protocol.

Use cases supported by OSCP

The use cases supported by OSCP are currently quite specific for the scenario where a DSO manages grid capacity by distributing capacity forecasts i.e. to either EMSPs or CPOs. The high-level use cases as listed in paragraph 1.3 and supported by OSCP are:

- Smart Charging (capacity based)
- Managing the grid. In more detail, this includes:
- Handing out capacity budgets
- Managing grid capacity using these budgets
- Smart charging by communicating capacity forecasts

MATURITY

The current OSCP version is 1.0 and dates from 2015-04-09. This is the first public version of the protocol. The level of detail of the specification is moderate; no test specification is available. Furthermore, the specification does not mention whether or not all parts of the standard are to be implemented, although this is suggested by the (behaviour) scenario, which is explained in the specification.

No plans for new versions / releases from the Open Charge Alliance are known about. Certification is not currently possible, no testing tool is available. Based on the above, the maturity of the protocol is classified as low.

Interoperability

The protocol describes a quite specific use case including the prescribed behaviour of the actors involved. The messages are defined in a strict WSDL (scheme). It is not specified which messages are mandatory and which are not. The interoperability between parties on a technical level is high, the behaviour level is classified as medium / high. The overall interoperability is classified as high.

Market adoption

OSCP version 1.0 is in use at fewer than 10 locations in the Netherlands for smart charging based on available capacity (for a combination of building and parking garage). No active development is currently taking place. It is currently used at two DSOs in the Netherlands and (at least) one CPO. Several parties have expressed interest in the protocol, but no other locations are known where OSCP is actively used. Market adoption is therefore classified as low.

Openness

The OSCP protocol is publicly available free of charge from the website of the Open Charge Alliance and contains no intellectual property besides the copyright of the Open Charge Alliance. This is not considered an accredited standards organisation. The openness is therefore classified as medium.

SMART CHARGING PROTOCOLS: WORK IN PROGRESS

It will have become clear to the reader that many protocols are still in development. That also applies to the relationship between the protocols for making the entire chain 'Smart Charging compliant'. ElaadNL recently carried out a study into the status of the various protocols. This analysis can be found at www.elaad.nl.

NEW SMART CHARGING DEVELOPMENTS

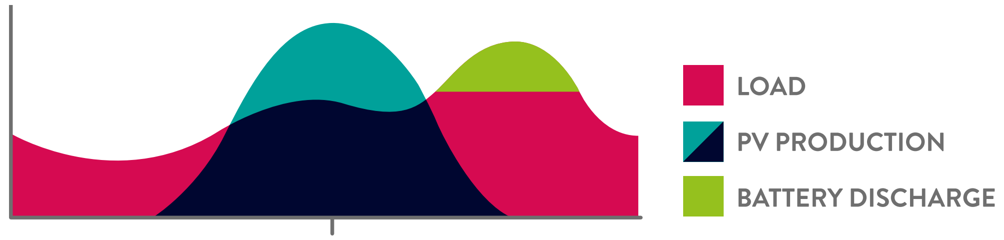
The market is constantly on the move. Following the further development of hardware and open protocols, the next developments are already on the agenda. These are also in development in a broad sense in the Netherlands. We are pleased to share the insights we have obtained in this regard with you.

VEHICLE TO GRID/V2X

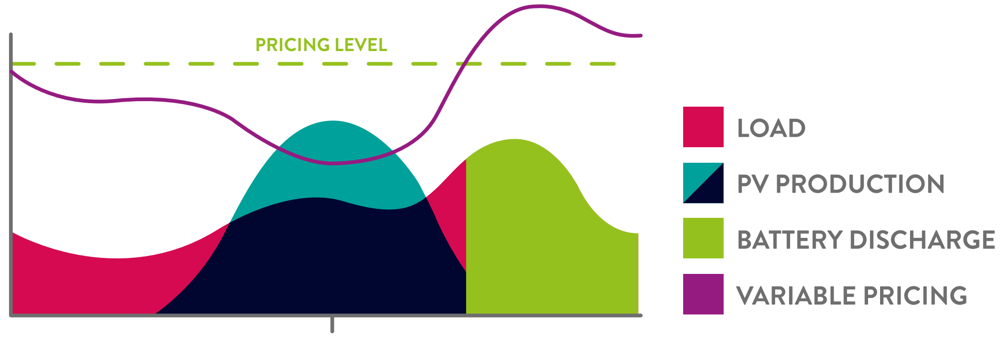
Various car makers are working on technologies that enable an electric car to return energy to the charge point, which is connected to the grid or, for example, a house. The precise technical details of these solutions are not yet known but this development can already be taken into consideration. The technical conditions for supporting V2x will be developed further in the coming months and years. They are also dependent on (international) agreements arrived at by car markers in this regard.

All ways in which a vehicle can return energy to the house, building or grid - i.e. V2H, V2B or V2G - can be referred to with the collective term V2x.

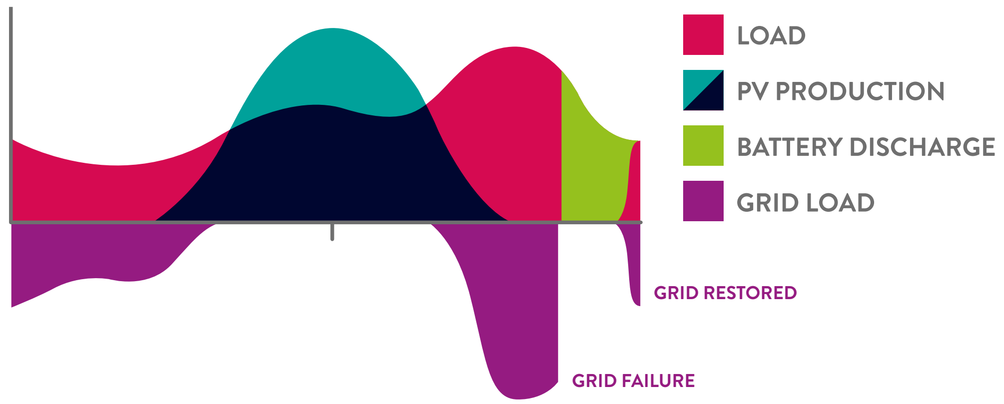
V2H = Vehicle to Home
V2B = Vehicle to Building
V2G = Vehicle to Grid
V2x = All of the above



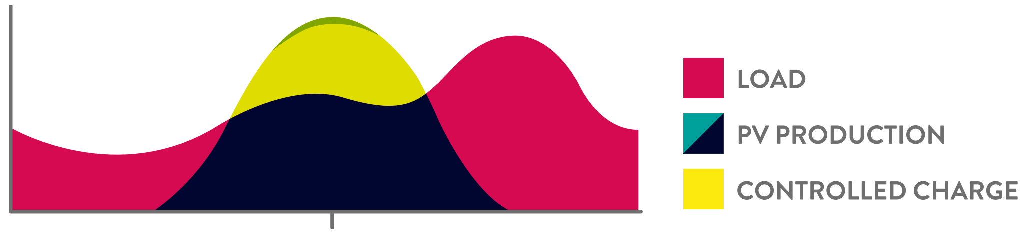
Peak Shaving: *Solar productioin is stored to later reduce the peak load on the grid.*



Pricing: *Solar production is stored and only used when electricity from the grid reaches a profitable price (applicable with variable pricing).*



Back up: *Solar production is stored and used as a back-up solution in case of grid failure*



Charge control: *Electric vehicle only charges when a surplus of solar power is available.*

Each electric car is fitted with a battery. The battery's energy content varies between approx. 10 kWh for small cars or plug-in hybrids and 90 kWh for full electric cars. Furthermore, the average car spends most of its time stood idle.

This combination of information makes the battery of the electric car interesting for use in ways other than simply driving the car.

APPLICATIONS

There are various applications that can be considered for using the battery of an EV.

Home storage – Vehicle2Home (V2H)

Increasing numbers of households have solar panels or generate energy in other ways. On sunny days, the energy generated often exceeds what the household needs. Sometimes, the timings of generation and use do not coincide either. This is where an EV connected to the house via a wall box offers an interesting solution. By storing the excess energy generated in the battery of the EV when the household has a lower energy demand and using the energy from the battery precisely at moments when demand is greater than generation, efficient use can be made of the sustainably generated energy. The total energy demand of the house will remain the same, but the energy costs will fall.

Part of the chain – Vehice2Building (V2B)

When an EV arrives at the office in the morning and a part of the battery's stored energy has been used, it can immediately begin charging up. Around lunchtime, the battery will be charged up enough for it to also be used in this environment. When the office building demands more energy around lunchtime as various appliances are switched on, more energy will usually be drawn from the grid. Several electric cars with a partially/fully charged battery are then suitable for covering the spike in energy demand. The only condition is that once the spike in demand has passed and some of the energy has been drawn from the battery, there is sufficient time left to charge the cars again for the drive home.

Asset in the electricity grid – Vehicle2Grid (V2G)

Although the term V2G is often used to refer to all possible use cases for 'back-charging' from the battery, this term can also refer to a specific situation. This involves an EV battery which is used via a charge point to cover spikes in supply and demand in a public electricity grid. This is also called frequency control, because spikes in the supply and demand of energy often have a negative effect on the frequency of the voltage. By charging the battery when there is a spike in supply (e.g. because the sun suddenly shines strongly or the wind blows harder) and discharging it faster when there is a spike in demand, an EV connected to the mains electricity supply can serve as a reserve. This can certainly offer interesting possibilities when many cars are connected in a certain area. If a third party (such as a system operator) wants to make use of these cars/batteries, proper agreements will have to be made about quantities and timings. That will avoid e-drivers being faced with surprises.

Technology

The properties of batteries largely determine the technology for V2x; the output of a battery is always direct current (DC), while the mains supply is alternating current (AC). The current returned from the battery to the grid or a building must therefore be converted. There are various ways to do this.

Inverter in the car; power from the car is alternating current (AC)

When an inverter is installed in the vehicle, the output of the car is directly Alternating Current, and usable for the power grid. A precondition for AC return delivery is that an extra component is added in the car. This may have effect on the cost price and the weight of the car. Furthermore, protocols must be developed to provide control of the discharge process.
in this case it is sufficient that the charging station receives directions from of the vehicle: a plug suitable to allow flow of electricity in two directions and a meter that can measure in two directions.

No inverter in the car; power out of the car is direct current (DC)

If the power from the battery is not transformed in the car, the output from the vehicle is direct current (DC). To use this power in the grid, it must be transformed outside of the car, in the (dis)charging station.
The inverter is in the charging station? Then the charging station must be equipped with suitable components to achieve this transformation. This affects the size of the charging station. The unit which ensures that the delivered energy can be used again in the underlying net, is also called the Power Conditioner (PCS).

Again, a protocol is required which controls the (un)loading process. There already are several implementations of the CHAdeMO protocol. This provides for (fast) charging and discharging. Cars like the Nissan Leaf, Mitsubishi Outlander and Mitsubishi iMiev feature this protocol and can discharge, provided that the charging station has the same CHAdeMO support.

At the moment, newer vehicles with CHAdeMO can provide power back to DC charging stations with the right hardware and a suitable CHAdeMO implementation. The development of vehicles that have a built-in transformer and thus can deliver AC directly back to the charging station, aren't on the market yet. This development is partly related to the development of the High Level Communication protocol 15118, which regulates communication between vehicle and charging station. In 15118 V2X supporting messages are included. The release of Edition II of this protocol is tentatively scheduled for the end of 2018.

Free choice of energy:
Normally, the energy supplier is determined for each charge point. The e-driver cannot choose which party supplies the electricity. In the future, there may be a lot of demand for this, also because increasing numbers of people will generate their own energy and would like to use this via the public charge point.

CYBERSECURITY

The importance of good cybersecurity for charging infrastructure increases the more the charging of cars can be controlled via Smart Charging. Since there are still relatively few electric cars on the roads, steps can be taken to provider proper security arrangements.

This can be compared with traffic in the early years of the car. When there were still only a few cars around, there was also little need for rules, signs, traffic lights and guardrails. As more cars took to the roads, the demand and need for legislation also grew. Legislation for ensuring the traffic flowed smoothly and safely. The same applies to the charging infrastructure in the Netherlands. The number of charge points is still relatively low but will increase rapidly in the coming years. In the long term, cars that charge at the same time will be responsible for generating a power output comparable to that of several large power stations. All of this will be controlled via Smart Charging. It is also important to make proper arrangements for cybersecurity now.

The energy transition will result in increasing numbers of IT systems being needed in the electricity network. This will enable the supply and demand of electricity to be matched to each other and is about more than just charge points. The reliability and availability of these IT systems in our electricity network are becoming increasingly important, as is the need for good cybersecurity in the design.

Charging stations are becoming smarter and systems are becoming more and more interconnected. As a result, the data stream is become more extensive and it is important to make good data security arrangements. ElaadNL has created a set of security requirements in cooperation with ENCS.

The complete set of security requirements can be found at: www.elaad.nl/uploads/files/Security_Requirements_Charge_Points_v1.0_april2016.pdf

Two sets of requirements are included:

1. A set of requirement for the procurement of the charge point. This set includes requirements to make sure the charge point itself is secure (Section 2), that it has all the functionality needed to set up secure operational processes (Section 3), that its Vendor takes measures to ensure its security throughout its lifecycle (Section 4), and that measures are taken to ensure that security measures have been implemented well (Section 5).

2. A set of requirements for secure communication between the Charge Point Operator (CPO) and Distribution System Operator (DSO). These requirements can be used as part of the security requirements when new server systems are procured or set up.

EPILOGUE

As you can see, we aren't there yet. But we're well on our way there. That's why we're seeking to cooperate with you in order to take the next steps. Living Lab Smart Charging in the Netherlands is growing unabated. We build on existing and proven technology and on authorities and market actors who demonstrate the will to shape the energy transition. We are looking for cooperation partners who can give life to our joint efforts. Because we can't do it on our own. And even more importantly, we don't want to do it on our own. A market will only be created if we work together. And profit from it together - both environmentally and economically.

Do you want to take up the challenge with us? We are an independent platform - founded by the system operators and in broad participation with businesses and authorities - that shares expertise and establishes a lead for the automotive sector, system operation, government and business. Why not establish your lead with us?

"WE INVITE YOU TO STRENGTHEN THIS INTERNATIONAL LEADING POSITION WITH US IN ORDER TO FASTEN THE ENERGY TRANSITION. TOGETHER."

"A NEW MARKET CAN ONLY RISE TO ITS OCCASION WHEN WE CO-DEVELOP AND COOPERATE & WHEN WE BOTH ENVIRONMENTALLY AND ECONOMICALLY PROFIT FROM IT. TOGETHER."

APPENDIX

PROGRAMME OF REQUIREMENTS: CONVERTING CHARGING OBJECTS TO SMART CHARGING READY

The following list is important for the conversion of existing infrastructure into Smart Charging Ready infrastructure. Or: to avoid any disinvestment of the existing charging infrastructure. This list was successfully applied in the Netherlands in 2016 to more than 1,700 charge points.

GENERAL DEMANDS

The client may request two contracts: either single-socket or with a double socket.

Are you looking for a basic set of requirements for the installation of new charging infrastructure that has to be immediately Smart Charging Ready? Then please see the Basic Set of Requirements for Charging Infrastructure on the website of the Netherlands Knowledge Institute for Charging Infrastructure at http://www.nklnederland.nl/kennisloket/basissets-afspraken (Dutch version)

Requirement number	Description of requirement
1.	The RFID reader (and the firmware) can read all common types of charge cards, including Mifare Desfire. The charging object communicates the ID code unchanged and in big endian format.
2.	The RFID reader has to be replaced and/or upgraded for future changes.
3.	The charging object has a modular structure. Open (hardware and software) interface standards are used between components and systems, which ensures that future components and systems can be interchanged. The open standards used are disclosed to the client in the technical documentation.
4.	DThe charging object forwards active status changes of errors that occur in at least the following components (more components are permitted): - RCD (earth leakage protection); - Overcurrent protection; - Relay; - kWh meter; - Plug lock; - RFID reader.
5.	The charging power, depending on the connected electric car and charging cable, is a maximum of 13.8 kW per charge point - (230V AC 50Hz / 20A / 3-phase)
6.	Each charge point is equipped with a separate 4-pole 30mA earth leakage protection of at least Type A, which only switches off the energised parts of the respective charge point in the event of unwanted fault currents.
7.	Within each charge point, detection and deactivation take place by a back-feeding direct current greater than 6 mA (by definition not by means of an RCD Type B).
8.	Each charge point is protected against overcurrent and short circuit. This protection is selective with the protection in the mains connection.
9.	The charge object is equipped with misalignment detection so that the back office can see if a charge point is no longer level.


QUALITY REQUIREMENTS

Requirement number	Description of requirement
10.	In the case of obsolete components (the same component that suffers a defect in 5 charging objects within a period 6 months), the entire series of components will be replaced at the expense of the contractor.
11.	The delivery of spare parts never leads to a delay in the normal fault process.
12.	For changes involving software and hardware, the client receives a change proposal. The client may or may not give its approval.
13.	The counterparty is responsible for the roll-out of new firmware and the correct functioning of the charging objects after the roll-out. The roll-out planning is determined in consultation with the contractor and the client. With the agreement of the client, the new firmware is installed according to the planning.
14.	The charging object is connected to the back office for at least 95% of the time on an annual basis and available for the charging of electric cars. In order to calculate the availability of the charging object, no periods are included in which serious damage by exogenous causes is responsible for its failure.

LEGISLATION AND STANDARDS

The applicable legislation and standards are shown below.

The counterparty shall keep its product up to date with at least the following legislation and standards for the entire service life of the charging objects.

FUNCTIONALITY REQUIREMENTS

Requirement number	Standard	Scope of the standard
15.	IEC61851-1 und IEC6185122	Stipulates the requirements for alternating current charging objects with a conductive connection to an electric vehicle.
16.	IEC62196	Stipulates the requirements for power plugs, power sockets, vehicle power plugs and vehicle power sockets for the charging of electric vehicles over a cable with alternating current up to 250 A and with direct current up to 400 A.
17.	NEN1010	Stipulates the minimum safety requirements that low-voltage installations must comply with.
18.	EMC standards	The electronics in the charging object are immune to EMC fields in normal operation and during disruption, and do not themselves generate any EMC fields that could disrupt the other equipment inside or outside the charging object. The charge point is insensitive to interference from the vehicle and does not itself introduce any interference.


FUNCTIONALITY REQUIREMENTS

Requirement number	Description of requirement
19.	The charging of the electric cars takes place according to the Mode 3 charging protocol, in accordance with IEC61851.
20.	The charging cable can always be removed from the charging station, even during a power outage.
21.	When the power supply to the charging object is restored after a power outage, there is no voltage at the plug contacts until a new transaction is started. The cable is not locked again; the current transaction is ended.
22.	The charging object cancels the transaction if a vehicle is not connected by the user within 120 seconds of authentication taking place.
23.	The charging object reads the current drawn by the vehicle per phase from the kWh meter. If the current exceeds the value as indicated by the PWM signal by more than 10 %, the charging object switches off the current. The charging object tries to restart the charging process three times. (Optional: before the charging object switches off, it attempts to reduce the current to the desired value by lowering the duty cycle. If this is unsuccessful, the shutdown of the charging current can follow.) The cable remains locked.
24.	The transaction values are at all times the same as the charged quantity of energy, and are linked to a correct timestamp.

FUNCTIONALITIES THAT THE CLIENT MUST BE ABLE TO OPERATE

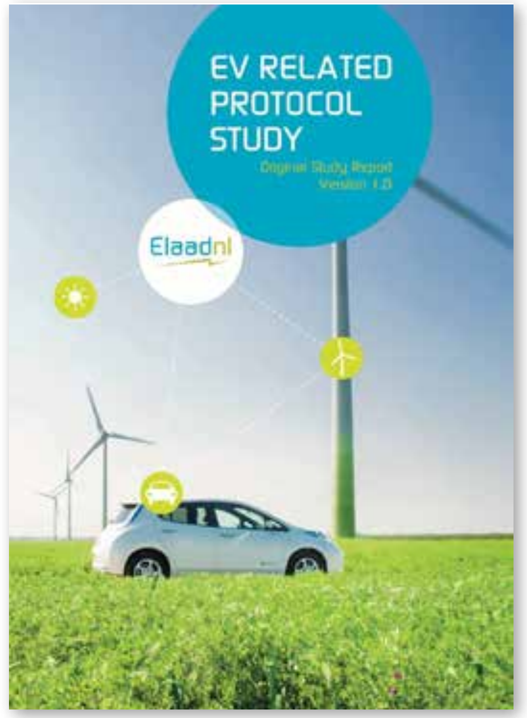
Requirement number	Description of requirement
25.	The contractor gives the client the opportunity to personally operate all functions and configurations of the charge point. Included in this are the changing of settings and the OCPP access point address.
26.	The contractor gives the client the opportunity to personally change the URL and APN for logging into a backend system (both locally and remotely) without this necessitating a complete firmware update. For security purposes, local access (in addition to physical protection) is protected with a form of access control.
27.	The contractor gives the client the opportunity to personally make configuration changes (both locally and remotely) without this necessitating a complete firmware update.
28.	The contractor gives the client the opportunity to personally update the internal firmware of the charging object remotely, to reset it and to read it out on demand via the back office system.
29.	The contractor gives the client the opportunity to also personally request diagnostics of the charging object (via the back office system). The contractor provides the correct instructions and, if necessary, the correct tools for being able to open and read the diagnostics. In the diagnostics, the charging station reports the data from the kWh meter for each socket.


European Network for Cyber Security
Commissioned by ElaadNL
EV Charging Systems
Security Requirements
Elaadnl
Version 1.0 - April 2016

SPECIFIC MODE 3 REQUIREMENTS

Requirement number	Description of requirement
30.	The charging object never gives a PWM duty cycle that implies a higher charging current than the maximum charging current permitted by the protection, the system connection and the used charging cable.
31.	The charging object has complete control over the Mode 3 signal. The PWM duty cycle and the start/stop of the Mode 3 signals can be adjusted in the firmware.
32.	Mode 3 communication is only active when a transaction is active.

The charge points will be managed in an external back office. The counterparty is personally responsible for supplying a connection to this back office. In the event of communication problems, the contractor works with the telecoms provider on a structural solution.



OCPP AND COMMUNICATION CONNECTION

Requirement number	Description of requirement
33.	The firmware structure for the correct data connection between the charging object and the back office system is designed according to the Open Charge Point Protocol version 1.6. The contractor is responsible for the implementation and correct working of OCPP.
34.	At a time in the future to be indicated by the client, the version of OCPP will be updated to a subsequent version. The contractor will make this update available free of charge and implement it without additional costs.
35.	The charging object communicates over a mobile data connection via the Open Charge Point Protocol with the back office system of the client.
36.	The charging object attempts to actively restore the communication connection in the event of its failure, for example by resetting the modem. The charging object will continue to repeat these attempts to restore it for as long as there is no connection.
37.	The hardware of the charging object is suitable for secure communication over the mobile connection. Enablement of this protection takes place in good time without additional costs.
38.	If the data connection between the charging object and the back office system drops for any reason whatsoever, all transaction-related events must be stored locally and, when the connection is restored, sent to the back office system together with the timestamp of when the event took place.
39.	If the data connection between the charging object and the back office system drops for any reason whatsoever, a current transaction can always be ended by the user.
40.	Transactions that take place during the absence of a data connection between the charging object and the back office system, must be checked for legality the next time the connection is made. If it appears that an illegal charge transaction is taking place (e.g. using a blocked card), the charging will be immediately ended when data communication is restored. (The transaction may remain open and the cable must remain locked until the user logs off; after this, the transaction will be terminated).
41.	The kWh consumption is transported to the back office system by means of OCPP using the MID-certified meter found in each charge point, via the internal intelligence of the charging object. The meter reading is sent to the back office system each quarter (regardless of whether a transaction is in progress).

OCPP AND COMMUNICATION CONNECTION

Requirement number	Description of requirement
41. (cont)	The meter reading must be sent to the back office system: • every 15 minutes; • in the start and stop report of a transaction. (According to OCPP, these meter readings replace the usual heartbeats). During a transaction, a MeterValues report therefore contains the current kWh reading as well as the voltage and current per phase at the moment of sampling.
42.	In the event of a voltage failure or loss of communication, the charge point updates the time and date for a minimum period of 7 days.
43.	The charging object synchronises the internal clock with the back office system at least once every 24 hours.

PROBLEM ANALYSIS, LOGGING AND MEMORY

Requirement number	Description of requirement
44.	The logical control unit (controller) of the charging object is able to store the request, processing and any problems (with so-called server or network time synchronised time stamps) in an internal log buffer, which can be consulted by the operator within 48 hours for fault analysis purposes. The log data remain stored for 48 hours, after which they are overwritten by new log data.
45.	This internal log will be stored in non-volatile memory prior to a reset.
46.	The internal log buffer of the controller of the charging object is able to log the start, process and end of communication with the back office system on various levels: status of radio connection and signal strength (rssi values), data connection status (pdp context), connection status (IP connection), session status (http soap) and transaction status.
47.	The log data are stored in non-volatile memory.
48.	The (internal) memory of the charging object must be sufficient in all situations. The memory must not be fully utilised and/or disrupt the operation of the charging object.

LIST OF INTERESTING ADDRESSES

These can be found on the website at www.livinglabsmartcharging.nl

SOURCE LIST

www.encs.eu
www.elaad.nl
www.nklnederland.nl

LIVING LAB SMARTCHARGING

DEFINITIONS

CIR *Central Interoperability Register*

Clearing *Clearing is a term from the finance industry. In the EV market, it refers to the process of exchanging information such as transaction information ("CDRs") for billing ("settling") and roaming purposes.*

Clearing House *A Clearing House is an institution or system that facilitates (automatic) clearing*

Connector *A connector is an independently operated and managed electrical outlet on an EVSE.*

CPO *Charge Point Operator. A party that operates and maintains charge points.*

DSO *Distribution System Operator. A net operator or grid operator.*

EMSP / eMSP *E-Mobility Service Provider. A party that handles all communication and billing in respect of EV users. These roles of EMSP and CPO are not separated in all markets; in some countries these roles are performed by the same party.; However, this distinction is still relevant for enabling the customers of one party to use a charge point of another party.*

EV *Electric Vehicles that have battery energy storage (sometimes referred to as Battery Electric Vehicle, BEV). This includes PHEV (Plugin Hybrid EV).*

Flexibility *Within the energy system, this refers to the property that indicates to the extent to which adjusting generation and / or consumption patterns is possible in reaction to an external signal (e.g. price signal).*
Within the EV domain, flexibility more or less equals smart charging.

OCHP *Open Clearing House Protocol*

OCPI *Open Charge Point Interface*

OCPP *Open Charge Point Protocol*

OEM *Original Equipment Manufacturer. Refers to EV manufacturers.*

OICP *Open InterCharge Protocol*

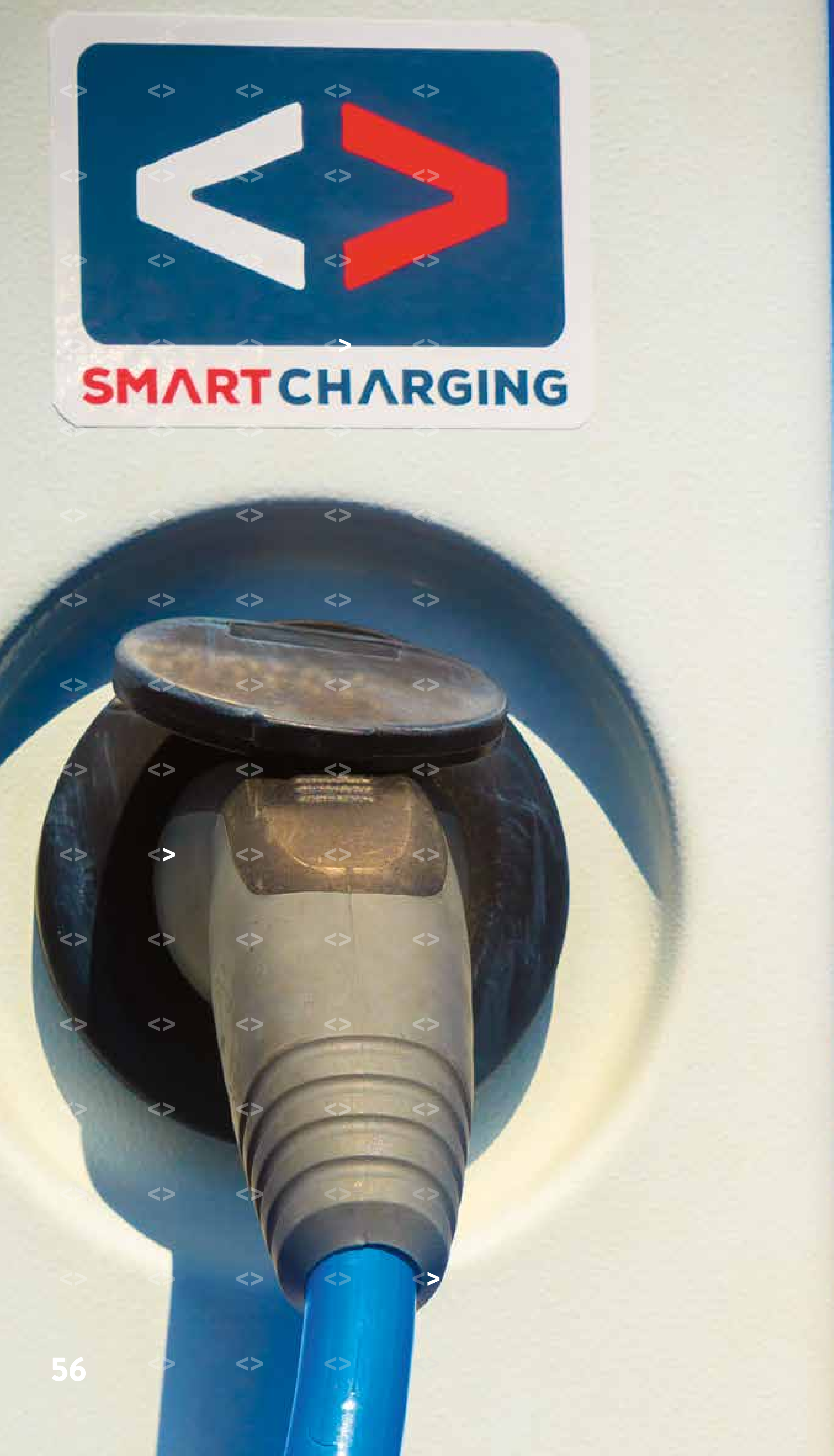
OpenADR *Open Automated Demand Response*

OSCP *Open Smart Charging Protocol*

Roaming *In the telecom industry, roaming is the ability of users to make us of their phones/subscriptions beyond the limits of the network of their provider of choice.*
It also covers the agreements between providers to make this possible. In the EV domain, roaming is very similar: this is what allows EV drivers charge their EV at charging stations that are not part of the charging network of their CPO using the same identification.

Smart Charging *According to [CCE2012] and [EUEL2015], the definition of smart charging is when charging an EV can be externally controlled (i.e. "altered by external events"), "allowing for adaptive charging habits, providing the EV with the ability to integrate into the whole power system in a grid- and user-friendly way. Smart charging must facilitate the security (reliability) of supply while meeting the mobility constraints and requirements of the user."*

TSO *Transmission System Operator*



"THIS WAY THE ELECTRIC VEHICLE IS PART OF THE ENERGY TRANSITION & ENVIRONMENTAL CARE"