SMART CHARGING & ELECTROMOBILITY
DRIVING ON SOLAR AND WIND POWER!
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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 the 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 reassure 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 the same sense of security as well. That means ensuring the availability of accessible charging infrastructure that fits for the 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 increasingly be able to be charged more quickly. All the newest models will soon be able to cover at least 500 kilometres on a single battery charge. They will also be able to charge more quickly. All the usual issues and complaints are slowly being eliminated.

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In order to facilitate the development and stimulate it further, now is the time to take the necessary steps and invest in proper charging infrastructure. Many people still dread being unable to charge their car up at night. We need to consider how we can do it at the roadside at 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.

Cars spend most of the day doing nothing – up to 95% of the time. 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, on a single battery charge. They will also increasingly be able to benefit from the knowledge contained in this publication. 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 in emissions of a party responsible for the organisation. 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 to congestion management (growing the network supply being greater than its capacity) by the DISO (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 & OCPP

CIR (Comité Intersys®) started working (on the planning 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 OCPP (open charging interface protocol). This laid the foundations in the as yet untapped electric vehicle (EV) landscape: communication and negotiation between EHSIP, and CPOs.

OCPP

OCPP (Open Charge Point Protocol) is the first protocol for interoperability and smart charging (in the broader sense). The available system capacity can be communicated through the connection to OCPP, 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 for commercial parties if 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 is 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 legislative benefits technological expertise and its impact on industries. The reader can thus 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 explores how the charging infrastructure can be adapted to the latest Smart Charging standard.
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 or 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 collaborated 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 at a rate that is dangerous for mankind, according to the Intergovernmental Panel on Climate Change, we cannot allow the average temperature to rise by more than 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 thereby 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 independent on fossil fuels. Coal, oil and gas, for example, are experiencing large price fluctuations. A significant portion of these fuels come 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 natural oil requirement. The transition to electric road transport will reduce the need for fossil fuels.

Secure energy supply
In this long-term, electricity companies will be able to ensure that car batteries are rarely charged at night, when demand for electricity is at its lowest. This can prevent the network from overloading, as a result of electric cars being charged en masse at the same time. Another incentive for the future is to charge electric cars during times 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 – currently – demand for electricity. At later stages, 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 temporarly store the excess sustainable generated electricity. In this way, electric driving can make a significant contribution to secure energy supplies 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 these questions by producing 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 their 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 policy for the charging of electric cars involves 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 drivers and allow charge points in the public space?

If you have decided to support drivers, you will have to consider the objectives you want to work for. 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’re 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.

www.rijksoverheid.nl/kennisplatform/artikelen/landenplanenergie

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

Explains and chooses how the municipality wants to implement charge points. Various provisions concerning payment 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 financing?

Involved departments within the municipality. When developing and implementing policy for the charging of electric cars, municipal departments with the division of municipalities run slightly involved:
• Environment: Electric vehicles make a contribution to environmental targets.
• Traffic and transport: Electric vehicles can contribute to sustainability because electric cars are cleaner, emit less CO2 (depending on the fuel) and cause less noise and pollution. This department is mostly responsible for the traffic order to be issued.
• Economy: In relation to local business, the 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 of instructing of special criminal investigators (SGS) in the area of electric vehicles.
• Communication: Electric vehicles are an important subject to communicate about. It is related to the municipality’s sustainability agenda and the stimulation of electric driving.
• Purchasing: Products or services are often purchased centrally, purchasing advisors 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, caves 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.

The Knowledge Desk provides a platform on which municipalities can find the answers to their questions about EV and charging infrastructure.
MUNICIPAL ROLES
Developing policy for the charging of electric cars?

• 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 be
  reminded that electric vehicles are on the increase and that
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Role of the municipality
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Rung 1: charging on private property as a default or habitual

Where possible, the e-driver makes their own
  provisions. An e-driver can make their own
  provisions if they have a space and enough
  money or work at a business where it is possible to
  park an electric car. In this case, charge point can
  be installed for limited costs. There are various
  options that offer products for this. Some makes
  of car also supply a free charge point when an
  electric car is purchased.

Policy for the charging of electric cars in the public space.

• A licence application for a charge point as an asset in the
  public space. The municipality must test this against
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Policy for the charging of electric cars in the public space.
ALTERNATIVE CHARGING SOLUTIONS

There are two issues related to the installation and exploitation of public charging stations, which might become problematic when many such stations are installed. The first problem is that the installation requires relatively large investment costs for municipalities since the business 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. According to Lampedusa (2014) showed that 75% of municipalities in the Netherlands have problems with financing all required 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 benches. Municipalities try to minimize the addition of even more public objects, making hesitant about adding 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 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 installing a new connection for each charging station. This creates a combined connection which can save money since only one grid connection has to be installed for multiple charging stations. In this case, the e-drivers can charge in a variety of ways in the public space. This can be done using a cable over the footpath (connected to the city’s lighting or Lightwell, for example, have developed a street light connection in the public space). Alternatively, e-drivers can use apps to see whether a charge point is available or to reserve it for later use. 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
The equipped cable is the prescribed standard in the Netherlands and in many other countries. It must be accessible to everyone. For operators, specific requirements can have a limiting effect on the design and maximum charging tariffs. For example, you can stipulate conditions for the accessibility and interoperability of charge points. A possible condition is that all public charge points are accessible for anyone using a wheelchair. It is also important to clarify whether the point is being used by another electric car. Co-operate with the traffic order that designates the availability of a charge point. If a charge point has no available charge point, it is not allowed in order to ensure the safe use of public roads. Providers of charge points usually use standard service providers. In this way, market actors are supported with their market space to come up with appropriate solutions. A back office can rise to problems such as another party taking over the charge point.

2. Technical conditions
You can stipulate conditions for the accessibility and interoperability of charge points. A possible condition is that all public charge points are accessible for anyone using a wheelchair. It is also important to clarify whether the point is being used by another electric car. Co-operate with the traffic order that designates the availability of a charge point. If a charge point has no available charge point, it is not allowed in order to ensure the safe use of public roads. Providers of charge points usually use standard service providers. In this way, market actors are supported with their market space to come up with appropriate solutions. A back office can rise to problems such as another party taking over the charge point.

3. Choosing the charging point
You can make choices for the locations of charge points on the basis of the safety, availability and parking permeability. You can impose aesthetic requirements which charge points in the public space has to comply with. You can also determine the extent to which charge points have to be of fixed design and different requirements. For example, it is applicable in this regard that charge points have to be of fixed design and different requirements.

IMPLEMENTING CHARGING INFRASTRUCTURE

SMART CHARGING is the new standard. OPERATIONAL NEEDS are needed.

Choosing the charging point

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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. As often important condition is that no other charge point is installed within a walking distance of, say, 250 or 350 metres.
• The designation of a parking bay next to a charge point for charging in electric cars’ 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 have 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 upgrade.

Important points for attention and considerations:

• 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.
• 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 not 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.

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 of 10% of international imports, 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.
The main effects of choosing the concession model are as follows:

- The concessionaire has the certainty that applications from several municipalities to cooperate in the installation of charge points. The municipalities can jointly select one or more charge point operators for this.
- The concession model offers certainty for (future) e-drivers.
- A concession makes innovations enforceable. For example, the client and the operator can make agreements about the risks. This also makes it possible to install charge points in villages or in visible locations.

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 is the point of departure for 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 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 can specify the design of charge points and the conditions under which the charge point is usable—e.g. the colour of the charge point.
- Any supplemental contribution per charge point.
- The installation and exploitation of charge points. This means that the municipality or client can select a new operator or terminate an existing agreement and that the operator can take possession of the charge points and select a new partner or resign from the agreement. This results in a ‘best situation’ where other operators cannot install any charge points.
- A concession makes innovations enforceable. For example, the client can stipulate in the agreement that at 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.

The most important agreements under the order model

A municipality or a client can use the order model to install and exploit charge points. This means that the municipality or client can select a new operator or terminate an existing agreement and that the operator can take possession of the charge points and select a new partner or resign from the agreement. This results in a ‘best situation’ where other operators cannot install any charge points.

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 municipality or client can select a new operator or terminate an existing agreement and that the operator can take possession of the charge points and select a new partner or resign from the agreement. This results in a ‘best situation’ where other operators cannot install any charge points.

- The municipality or client can select a new operator or terminate an existing agreement and that the operator can take possession of the charge points and select a new partner or resign from the agreement. This results in a ‘best situation’ where other operators cannot install any charge points.
- The control that the municipality has when choosing the locations of charge points. This means that the municipality also makes a financial contribution. When using the order model, the municipality enters into a contract with the municipality concerning purchasing. Threshold amounts set by the municipality ensure 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 starting rate is the rate payable by the e-driver to start the charging session.
| The connection tariff is a tariff that the e-driver has to pay for parking without charging. |
“ONCE THE POLICY IS ESTABLISHED, PRACTICAL IMPLEMENTATION FOLLOWS. HOW IS THIS DONE?”

**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 assess 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 and 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.

**LOCATION DETERMINATION**

- 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.
- Determination of the location 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. Before a traffic order becomes 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 allowed first. Issuing a traffic order is not mandatory in the Netherlands, but results in the location remaining allowed first.

**TRAFFIC ORDER**

- 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 application about the placing of a traffic sign and any road markings, crash barrier and tiling. This is sometimes outsourced to the operator.

**INSTALLATION AND CONNECTION**

- Installation and connection: a charge point requires maintenance. This method of management and maintenance is dependent on the model chosen for the cooperation between municipalities and operator(s).
- Furthermore, the following actions are performed:
  - The informing of the person responsible for the application about the placing of a traffic sign and any road markings, crash barrier and tiling. This is sometimes outsourced to the operator.

**MANAGEMENT**

- 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:
  - 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 application about the placing of a traffic sign and any road markings, crash barrier and tiling. This is sometimes outsourced to the operator.

**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 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.

**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.
The installation of a charge point is actually a good idea? A resident or business submits a request for a charge point. This request is then handled by a number of parties, which often means that a lot of work needs to be done. The following are the main processes involved:

- Creating clear points of contact within various parties.
- Minimising the number of transfer moments, because when a new application is received, it is useful for communication with the applicant to be as immediate as possible.
- Criteria against which a request can be rejected as early as possible.
- The process is speeded up considerably when the municipality mostly needs a location near to where they live or work.
- Some municipalities choose to install a few charge points in strategically visible locations, e.g. in the public space.
- There are also aspects relating to the setting up of the location. The municipality has to consider the location, layout and integration. A number of aspects are important for this:
- Charge points at strategic locations: Some municipalities install charge points in strategically visible locations, e.g. in front of public buildings such as the town hall or railway station. However, the driver who lives or works in the municipality mostly needs a location near to where they live or work.
- Existing or non-existent traffic order: In order to guarantee the exclusive use of a parking space, it is desirable 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.
- Setting up the charge point location:
  - That applicant must not have their own parking arrangements. For example, if the applicant has their own driveway, they usually 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 an area where ‘free parking’ arrangements apply, the applicant must have a parking permit.

DETERMINING THE LOCATION OF CHARGE POINTS

An important step when implementing charge points is to determine the location of charge points. Some municipalities choose to install a charge point in areas where there is no charge point. This is often demonstrated with a registration document for the traffic order. When a new application is received, it is useful for communication with the applicant to be as immediate as possible.

- Considerations for the determination of charging locations:
  - First of all, it is useful for the municipality to formalise a clear policy on the basis of which charging locations are determined. Locations can be easily identified and discussed 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 in strategically visible locations, e.g. in front of public buildings such as the town hall or railway station. However, the driver who lives or works in the municipality mostly needs a location near to where they live or work.
    - Service hatches on the charge point must always be accessible, e.g. for properly using the charging cable, which is usually 5 metres in length.
    - A hard surface around the charge point is user friendly and simplifies the layout and integration. A number of aspects are important for this:
      - That applicant must not have their own parking arrangements. For example, if the applicant has their own driveway, they usually 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 an area where ‘free parking’ arrangements apply, the applicant must have a parking permit.
  - There are also aspects relating to the setting up of the location. The municipality has to consider the location, layout and integration. A number of aspects are important for this:
    - Charge points at strategic locations:
      - Some municipalities install charge points in strategic locations, such as on streets or bus routes. These include, for example, shopping centres or business parks. Sometimes, charge points are strategically installed near businesses, shops or government buildings because they look attractive. A less common, but in principle acceptable, option is to install 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.
      - If a charge point is installed in an area where ‘free parking’ arrangements apply, the applicant must have a parking permit. The municipality communicates actively about the possible to submit applications. The charge point to be installed remains public; anyone can see it.
  - Installing the charge point in a parking bay:
    - The municipality has to consider the location, layout and integration. A number of aspects are important for this:
      - That applicant must not have their own parking arrangements. For example, if the applicant has their own driveway, they usually 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 an area where ‘free parking’ arrangements apply, the applicant must have a parking permit.
  - Service hatches on the charge point must always be accessible, e.g. for properly using the charging cable, which is usually 5 metres in length.
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      - If a charge point is installed in an area where ‘free parking’ arrangements apply, the applicant must have a parking permit. The municipality communicates actively about the possible to submit applications. The charge point to be installed remains public; anyone can see it.
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 vehicles’? This is regulated with a traffic sign. 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 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. 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 active components concerning the installation of the charge point;
• applying for the licences from the municipality and the energy contract;
• 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.”
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 licenses.

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.

This operator can be the municipality itself, but also the party that performs this task in the municipality. The following tasks are typical in this phase:

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 issues 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.

Administrative management/service provision
• Account management for users; this includes a (digital) 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.
• Providing 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.

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 systems. 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”

“OBLIGING THE IMPLEMENTATION OF OPEN SMART CHARGING PROTOCOLS LEADS THE WAY TO A FASTER ENERGY TRANSITION.”
In order to prepare the policy, it is important for the municipality to have a well-organized 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 party consists of 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 reached 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.
  - Employees of the 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 and/or business trips. 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 and
- **Visitors of companies (customers, business visit)**
  - Some companies want to offer their customers a charge point on their own premises. It is especially useful for the 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 works itself of strategic charge points that are distributed across the municipality. These 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’.
The first phase is complete knowledge about the installation of charge points on the basis of the Dutch model is available. Here too follows the most important aspect concerning the installation of charging infrastructure, namely interoperability and Smart Charging, thereby charge points. In the Dutch situation, which is based on the existing charging infrastructure, the roll-out to increase installation with the immediately future-proof contributions 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 service providers in the market. A prerequisite for this is that the infrastructure providers ensure that e-drivers can make use of all charge points. This does not have to be directly applicable to the situation in the Netherlands, because interoperability is and remains essential.

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 a move to use any charge point in the public space and charge point has the same plug, the same payment system and therefore gives access to the entire charging network. It makes no difference whether this charging station is private, public, 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.

The protocols supported by ElaadNL (LINK) contains all protocols. Also important is the section below 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 freedom to the energy transition via the electric car. This is what governments are looking for and where market actors and system operators see finance of returns to invest. The 'how and why' of this - as far as we currently know - is explained in the following sections.

Cybersecurity:
We all know more information about this and references to it, including the book published by ElaadNL (LINK). This book contains all protocols. Also important is the section below Smart Charging: in particular, the open protocols and open standards are most important for being able to create a market.

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.

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 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 freedom to the energy transition via the electric car. This is what governments are looking for and where market actors and system operators see finance of returns to invest. The ‘how and why’ of this - as far as we currently know - is explained in the following sections.
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 to facilitate a driver. 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 various ways and do it to facilitate e-drivers. The more the charging stations are prepared for this, the better it will be to roll out new innovative protocols. To some extent, it is also possible to prepare for it even further in the future when cars can supply energy 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 processes can be communicated about from outside the charge point and influenced as required. By adding intelligence to the system, an optional charging plan can be established for the user. Access it takes at the will of the user, the available capacity in the electricity grid, the degree to which sustainable energy is available and the price.

Charging Point Operator - Smart Charging from the back office CPO

Smart Charging can be both useful and trendy, and with it many challenges. One of the enabling technologies is the Open Charge Point Protocol (version 1.0). This version of OCPP enables the sending of charge profile 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) or Mobility Service Provider (mSP) 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 to the system operator’s charge profile and is also necessary to reduce its input so the connected vehicle has the chance to reduce the required power.

Charging infrastructure - Smart Charging Ready

Charging stations are not quick enough at lowering 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 ideally reduce its input so the connected vehicle has the chance to reduce the required power.

It is also smart to prepare the interval width of the charging 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 single connection. With a 32kVA grid connection and 32kVA system protectors, 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 the 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 networks. 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

Whomever wants to implement Smart Charging pilots on the basis of actual and dynamic system capacity will need input from the system operator. Amongst other things, 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.openchargemap.org.

The changes in system capacity can be passed to the CPO from the system operator via OSCP. The back office 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 no single standard. The only OpenADR and OCPP 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 2014, a few foundations and the predecessor of the various 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 CDR data between different electric vehicles was defined. This format is currently used by the majority of vehicle manufacturers. (AVN) is the industry organisation for e-charging and service providers in the Netherlands for regulatory reasons and the issuing of IDA. This resulted in the development of OCPP in 2014.

In Europe, initiatives have been taken to create clearing houses. The best known of these are e-clearing.net, GREEVOS SAIL, MOBE E.S.A, Eidol and Hubject GmbH. In March 2013, these five organisations announced the launch of a cooperation aimed at interconnecting the major e-charging 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 e-clearing solutions and service offerings in different countries. The pan-European e-clearing initiative was launched by representatives of these companies in the summer 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. Be it by linking themselves to other e-charging platforms or by creating individual platforms, the members are following a path desired by European policymakers. The pan-European e-clearing initiative drives on the experience of the participating companies. E-clearing entities are therefore invited to take part in this 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.
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 points are connected. This 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 protocol description of OCP is available at www.github.com/ocpi. The Open Smart Charging Protocol (OSCP) has no direct relationship with the charge point, the protocol is by design more generic. It can, in principle, be used for allocation of capacity in general energy, bandwidth, transport etc. from a higher level system to a lower level system. However, the naming is quite OSO-specific. The next reason why a client system manages power is beyond the scope of the protocol.

The OCPI project aims at implementing a nationally and internationally supported, independent open interface which supports the affordability and accessibility of charging infrastructure.

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The OCPI protocol (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 in a clearing house. OCPI enables EV drivers to see price information in real time for 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 open interface which supports the affordability and accessibility of charging infrastructure.

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Use cases supported by OSCP
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:
  - Pricing 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 in 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.

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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 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 to the relationship between the protocols for making this analysis can be found at www.elaad.nl.
NEW SMART CHARGING DEVELOPMENTS

When the power from the battery is not transformed in the car, the output of the car is direct current (DC). This power has to be transformed in the (dis)charging station. To use this power in the grid, it must be transformed outside of the car, in the (dis)charging station.

In vehicle-to-grid (V2G) special arrangements, the battery is used via a charge point to cover spikes in energy demand when there is a spike in supply (e.g. because the wind blows harder) and discharging it faster when there is a spike in demand. 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 simulators, 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 V2G, 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 as a building must therefore be converted. There are various ways to do this.

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 developments 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 a technology that enables 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 makers 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.

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

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

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 standing idle.

The 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 – Vehicle-to-Home (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 timing of generation and use doesn’t 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 low 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.

Post of the chain – Vehicle-to-Building (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 the 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 – Vehicle-to-Grid (V2G)

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, 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.

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 swung again in a suitable net is also called the Power Conditioner (PCS).

Again, a protocol is required which controls the (un)loading process. There are already several implementations of the CHAdeMO protocol. This provides for (fast) charging and discharging. Can also be used for Vehicle2Grid (V2G).

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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 provide 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 becoming more extensive and it is important to make good data security arrangements. ElaadNL has created a set of security requirements in cooperation with ENCS.

Two sets of requirements are included:

1. A set of requirement for the procurement of the charge point (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.

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

“CYBERSECURITY IS VITAL. PLEASE FIND SECURITY REGULATIONS ONLINE OR CONTACT US.”
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?

**EPILOGUE**

“We invite you to strengthen this international leading position with us in order to fasten the energy transition together.”
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)

APPENDIX

<table>
<thead>
<tr>
<th>Requirement number</th>
<th>Description of requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>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.</td>
</tr>
<tr>
<td>2.</td>
<td>The RFID reader has to be replaced and/or upgraded for future changes.</td>
</tr>
<tr>
<td>3.</td>
<td>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.</td>
</tr>
<tr>
<td>4.</td>
<td>The 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; - UPS source; - Plug box; - RFID reader.</td>
</tr>
<tr>
<td>5.</td>
<td>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).</td>
</tr>
<tr>
<td>6.</td>
<td>Each charge point is equipped with a separate 4-pole 320mA 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.</td>
</tr>
<tr>
<td>7.</td>
<td>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}.</td>
</tr>
<tr>
<td>8.</td>
<td>Each charge point is protected against overcurrent and short circuit. This protection is selective with the protection in the mains connection.</td>
</tr>
<tr>
<td>9.</td>
<td>The charge object is equipped with misalignment detection so that the back office can see if a charge point is no longer level.</td>
</tr>
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“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.”
10. In the case of obsolete components (the same component that suffers a defect in 5 charging objects within a period of 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.

15. IEC61851-1 und IEC61851-22 stipulate 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 objects are sensitive 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.

<table>
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<tbody>
<tr>
<td>10.</td>
<td>In the case of obsolete components (the same component that suffers a defect in 5 charging objects within a period of 6 months), the entire series of components will be replaced at the expense of the contractor.</td>
</tr>
<tr>
<td>11.</td>
<td>The delivery of spare parts never leads to a delay in the normal fault process.</td>
</tr>
<tr>
<td>12.</td>
<td>For changes involving software and hardware, the client receives a change proposal. The client may or may not give its approval.</td>
</tr>
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<td>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.</td>
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<td>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.</td>
</tr>
</tbody>
</table>

**QUALITY REQUIREMENTS**

**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**

<table>
<thead>
<tr>
<th>Requirement number</th>
<th>Standard</th>
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<tbody>
<tr>
<td>15.</td>
<td>IEC61851-1 und IEC61851-22</td>
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<td>16.</td>
<td>IEC62196</td>
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<tr>
<th>Requirement number</th>
<th>Standard</th>
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<tbody>
<tr>
<td>18.</td>
<td>EMC standards</td>
</tr>
</tbody>
</table>

The electronics in the charging objects are sensitive 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.
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.

25. The contractor gives the client the opportunity to personally operate all functions and configurations of the charge point. Included in this are the charging 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.

30. The contractor 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 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.

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.

The charging object communicates over a mobile data connection via the Open Charge Point Protocol with the back office system of the client.

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.

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.

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.

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.

The charging object synchronises the internal clock with the back office system at least once every 24 hours.

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.

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).

The meter reading must be sent to the back office system:
- every 15 minutes;
- in the start and stop report of a transaction.

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.

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.

The charging object synchronises the internal clock with the back office system at least once every 24 hours.

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.

**OCPP AND COMMUNICATION CONNECTION**

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<tr>
<td>33.</td>
<td>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.</td>
</tr>
<tr>
<td>34.</td>
<td>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.</td>
</tr>
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<td>35.</td>
<td>The charging object communicates over a mobile data connection via the Open Charge Point Protocol with the back office system of the client.</td>
</tr>
<tr>
<td>36.</td>
<td>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.</td>
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<td>37.</td>
<td>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.</td>
</tr>
<tr>
<td>38.</td>
<td>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.</td>
</tr>
<tr>
<td>39.</td>
<td>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.</td>
</tr>
<tr>
<td>40.</td>
<td>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).</td>
</tr>
<tr>
<td>41.</td>
<td>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).</td>
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**PROBLEM ANALYSIS, LOGGING AND MEMORY**

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<td>44.</td>
<td>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.</td>
</tr>
<tr>
<td>45.</td>
<td>This 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 (rss values), data connection status (ip context), connection status (ip connection), session status (http soap) and transaction status.</td>
</tr>
<tr>
<td>46.</td>
<td>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 (rss values), data connection status (ip context), connection status (ip connection), session status (http soap) and transaction status.</td>
</tr>
<tr>
<td>47.</td>
<td>The log data are stored in non-volatile memory.</td>
</tr>
<tr>
<td>48.</td>
<td>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.</td>
</tr>
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</table>
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

DEFINITIONS
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.

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 (Plug-in 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. a price signal).
Within the EV domain, flexibility more or less equals smart charging.

OCIP
Open Charge Interface Protocol
OCPP
Open Charge Point Protocol
OEM
Original Equipment Manufacturer. Refers to EV manufacturers.
OCPP
Open Charge Point Protocol
OpenADR
Open Automated Demand Response
OSCP
Open Smart Charging Protocol
Roaming
In the telecom industry, roaming is the ability of users to make or receive phone calls outside the limits of the network of their provider of choice.
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 step 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 and environmental care.”