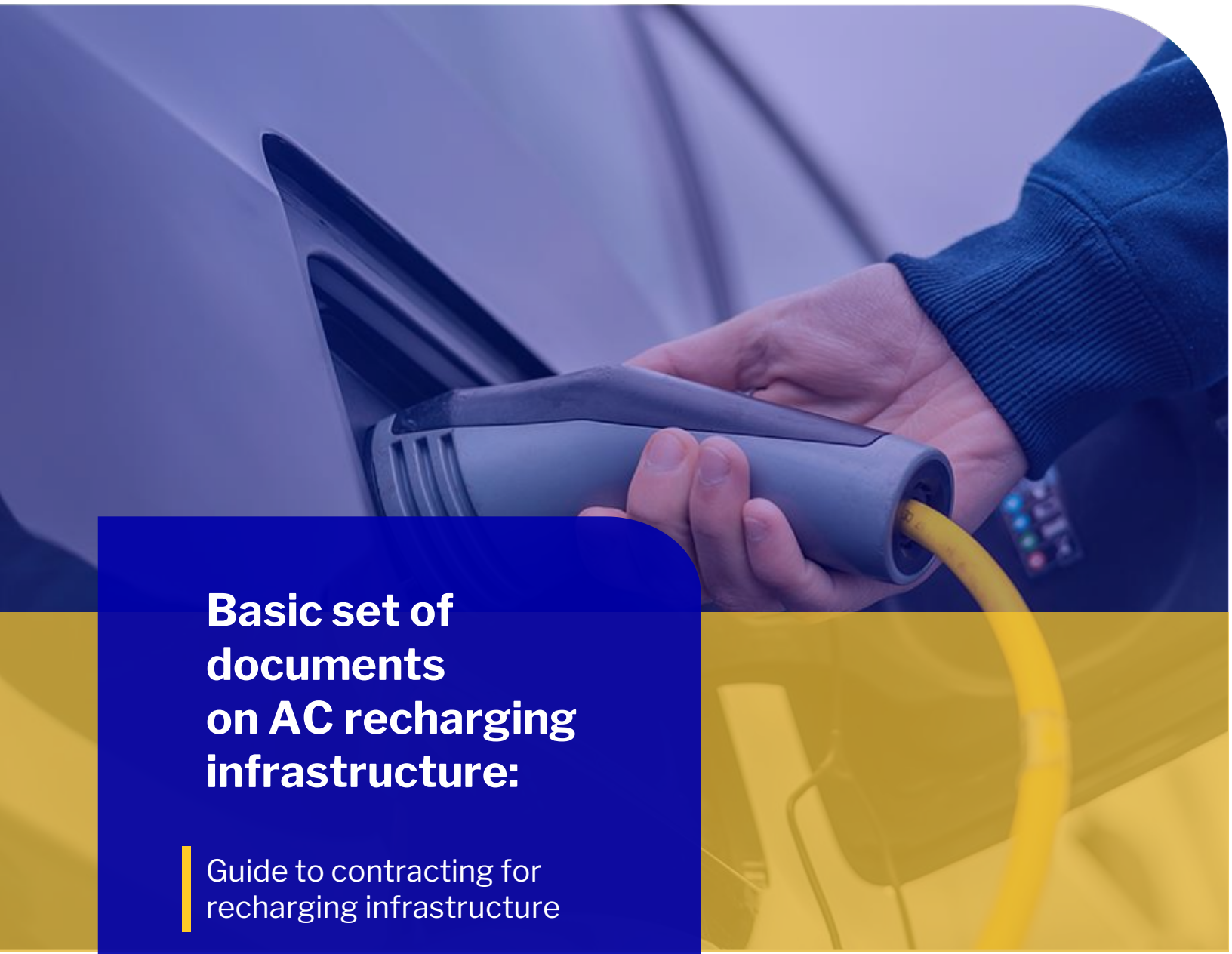
SUSTAINABLE TRANSPORT FORUM



Basic set of documents on AC recharging infrastructure:

Guide to contracting for recharging infrastructure

Colophon

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This document can be used by commissioning parties to enter into contractual arrangements with market operators for the installation, management and/or operation of recharging infrastructure in public, publicly accessible or private spaces. When preparing to contract with a market operator, there are a number of decisions to make and add-ons to choose. This document provides insight into, and guidance, on making these decisions as well as choosing add-ons, and is to be used by public authorities and other contracting parties, including private parties such as car park operators.

How can this guide be used?

This document sets out the main decisions to be made when purchasing recharging points. The document can be used by commissioning parties regardless of whether they have experience in the subject.

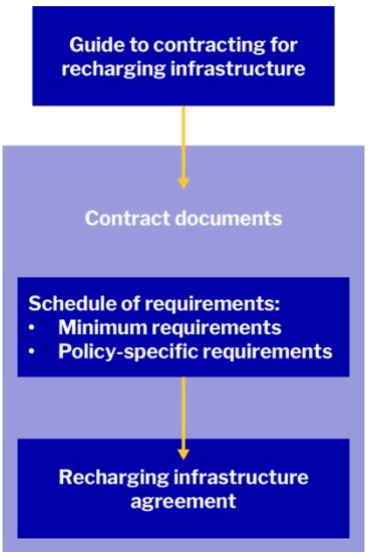
Alongside this guide, a set of minimum and policy-specific requirements for recharging infrastructure is available, as well as a template agreement.

The minimum requirements should always be applied. They were developed in cooperation with a large number of government bodies and market and grid operators. The policy-specific requirements may be applied by the commissioning party depending on its own aims or ambitions. The minimum and policy-specific requirements are set out in a single document, the **schedule of requirements**.

This document is available in editable format (Word) so that it can be used as a basis for new contracts and tenders. It should be noted that these requirements focus on regular recharging infrastructure (AC chargers) and not on fast recharging infrastructure (DC chargers). The schedule of requirements can be used in conjunction with an agreement to form a contract document.

Methodology

Start by using this guide to consider decisions and choose add-ons, and to learn from existing contracts. Then use the schedule of requirements as a starting point to draw up your own contract document, deciding which policy-specific requirements you would like to include in addition to the minimum requirements. Finally, you may have additional requirements you want to include, which are not present in the schedule of requirements. A schematic representation of how to apply this methodology is given in the figure below:



Decisions and add-ons

The guide distinguishes between decisions and add-ons. Decisions must always be made, whereas add-ons are optional. This document covers the following decisions and add-ons:

Decisions:	Add-ons:
1. Scope 2. Contractual arrangements 3. Deployment strategies	1. Innovations 2. Smart recharging and energy services

These decisions and add-ons are further developed in this document. For each decision or add-on, it provides an explanation, an insight into the consequences and highlights a number of things to consider. It also provides a number of guidelines to be integrated into the contract documents, building on existing contracts and lessons learned from contracting authorities. For each topic, an existing contract is referenced to draw on lessons learned elsewhere.

How has this document been produced?

This guide draws on experience gained from recent calls for tenders for public and publicly accessible recharging infrastructures. The tenders were analysed based on a number of principles. In-depth interviews with both contracting authorities and market operators were also carried out.

Decision 1: Scope

The first decision to be made when drawing up a contract is in defining its scope. The scope contains the following elements:

1. type of recharging infrastructure
2. technical demarcation
3. recharging infrastructure including or excluding energy supply.

1. Type of recharging infrastructure

In the Netherlands, types of recharging infrastructure are differentiated by their accessibility and recharging speed.

Accessibility: public, publicly accessible and private

We differentiate between three types of recharging infrastructure:

- **Public recharging infrastructure** is located in public spaces. The land is owned by the municipality, which authorises the market operator to install recharging infrastructure, or installs the recharging infrastructure itself. The locations are available 24 hours a day, 7 days a week, and are accessible to all. Users do not need permission to use them.

  Public recharging locations typically have their own grid connection with one specific energy supplier.
- **Publicly accessible recharging** infrastructure is located on private land. The owner makes it available to third parties so that they can use it for recharging. Users do not need permission to use it. Access to publicly accessible recharging points may be restricted due to parking times or opening hours. This includes, for example, recharging points in multi-storey car parks, hospitality establishments, shopping centres or petrol stations.

  The recharging points are usually connected to an existing electrical installation and/or grid connection belonging to the landowner, and the electricity is often supplied through an existing contract. A separate grid connection or a separate supply point fed from an existing grid connection is also possible, so that energy is supplied through a different contract.
- **Private recharging infrastructure** is located on private land. These recharging points are not accessible to the public; the owner or user of the land decides who can use them. This could therefore be a recharging station at a house or on a (private) business park.

Recharging speed: regular and fast recharging

Recharging speed is also an important distinction. A **regular** recharging point has a maximum recharging capacity of 22 kW. Whether this maximum can be reached depends on the electric car. Many electric cars have a maximum recharging capability of 11 kW. At this recharging speed, it takes a few hours before the battery is charged. This is often not a problem, as these chargers are installed in regular parking areas, where cars park for at least a few hours.

Regular recharging points are usually what are known as alternating current (AC) chargers. These chargers use alternating current from the grid. This is converted by the electric car itself into direct current, which is used to charge the battery.

A **fast** recharging point has a higher recharging capacity, up to as much as 350 kW. At this recharging speed, an electric car receives enough charge within a few minutes, and at most an hour. Fast chargers are direct current (DC) chargers.

The schedule of requirements does not currently contain any minimum or policy-specific requirements for fast chargers. They are subject to separate requirements.

Things to consider

Before contracting with a market operator for the installation (and management and operation) of recharging infrastructure, it is necessary to identify the type of recharging infrastructure required. The table below sets out these considerations, including example guidelines and text to include in the necessary documents.

Example guidelines and reference projects

See below:

Scope – type of recharging infrastructure				
Example guidelines	**Guideline**	**Description of guideline**	**Document to be included**	**Example tex**
	Type of recharging infrastructure	State explicitly what type of recharging infrastructure is covered by the contract.	Contract	See text on accessibility in Article 1.2 of the template agreement. Requirements for regular recharging infrastructure have been included in the minimum requirements under the 'Functionalities' tab (requirements for fast recharging infrastructure are being prepared).
Reference projects	**Where has this been applied previously?**			
	Municipality of Rotterdam public multi-storey car parks (publicly accessible regular recharging infrastructure) Municipality of Amsterdam public car parks (publicly accessible regular and fast recharging infrastructure)			

2. Technical demarcation
(publicly accessible and private recharging infrastructure)

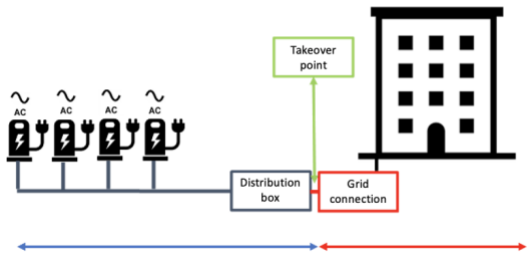
Technical demarcation sets out the technical division of responsibilities between the commissioning party and the contractor. It makes it clear exactly what the two contracting parties have to do. This is important in the case of publicly accessible and private recharging infrastructure, because with these types of infrastructure, contractors make use of the commissioning party's grid connections, electrical installations and buildings and land.

Recharging infrastructure is largely made up of five components. This demarcation lets you know who is responsible for which component:

1. The recharging station/column to which electric vehicle (EV) drivers connect their recharging cable to start recharging.
2. The cabling from the recharging station to the existing electricity grid or an existing electrical installation.
3. A grid connection.
4. A lockable cabinet. The power cable to the recharging stations runs into this cabinet, and equipment, safety devices and switches are also installed here for control, monitoring, power distribution and the subsidiary distribution of power to the recharging stations/columns.
5. Layout of the car park.

The figure below gives a schematic representation of the demarcation for publicly accessible recharging infrastructure. The recharging infrastructure is connected to a building's existing electrical installation. A 'takeover point' has been added here. This marks the separation of responsibilities:

- the contractor installs the recharging stations and cabling;
- the contractor installs the power distribution box;
- the commissioning party manages (or arranges the management of) the existing electrical installation and supplies power to the recharging stations via a connection to the distribution box.



Things to consider

The division of responsibility for the five components mentioned above should be laid down. In other words: where is the takeover point? Determining the takeover point is particularly important in the case of publicly accessible and private recharging infrastructure. When determining the takeover point, the following points should be considered:

- To what extent does the commissioning authority intend to carry out modifications to the electrical installation of the existing building or land?
- Who is responsible for the existing electrical installation and who is responsible for the recharging infrastructure?
- Investment can vary considerably, especially in the publicly accessible sphere. The distance between the recharging points and the electrical installation is very important in this respect.

Example guidelines and reference projects

See below:

Scope – demarcation				
Example guidelines	**Guideline**	**Description of guideline**	**Document to be included**	**Example tex**
	Demarcation	Make it clear where the takeover point is and where the responsibility of the market operator ends	Schedule of requirements	See policy-specific requirements, D1-D3
Reference projects	**Where has this been applied previously?**		**Link to documents**	
	Concession for recharging infrastructure on municipal land, Municipality of Rotterdam		Link	
	Call for tenders for recharging points at the Central Government Real Estate Agency (RVB)		Link	

3. Recharging infrastructure including or excluding power supply?

If the installation, management and maintenance of recharging infrastructure is contracted out, the commissioning party may opt for the contractor to supply power as well.

Things to consider: public recharging infrastructure

In the case of public recharging infrastructure, the contractor is almost always responsible for the energy supply. The commissioning party almost always imposes requirements on this energy, mainly regarding its renewable nature.

For this purpose, contractors negotiatea contract with an energy supplier (although sometimes the contractors themselves are also energy suppliers). At the recharging stations, therefore, EV drivers always use energy from the supplier contracted by the contractor. There are also pilots taking place where EV drivers can choose the energy supplier. There is more on this under add-on 2, ‘Smart recharging and energy services’.

Many market operators that are involved in operating recharging stations also include energy provision as part of their revenue model. If the energy supply is covered by a separate contract, it is necessary to ensure that there is an adequate revenue model to operate the recharging infrastructure.

Things to consider: publicly accessible and private recharging infrastructure

Publicly accessible recharging infrastructure is often connected to an existing electrical installation and grid connection, with an existing energy contract. The energy supplied to the recharging infrastructure therefore comes via that contract. This electricity is paid for by the contract holder – often the manager of an existing building. In this instance, a financial settlement between the contractor and the holder of the existing energy contract is necessary.

The commissioning party may also choose for the contractor to supply the energy itself and therefore enter into a contract of its own. This can be done by creating a new grid connection.

However, this is not always possible, as grid operators do not allow more than one grid connection per location. The creation of a separate grid connection also entails costs.

The supply of energy under a separate contract but via the existing grid connection is also possible, using a 'second supply point'. This can be requested from the grid operator (known as 'multiple energy suppliers via a single connection', or MELOEA as per its Dutch acronym).?

Example guidelines and reference projects

See below.

Scope - installation including or excluding power supply				
Example guidelines	**Guideline**	**Description of guideline**	**Document to be included**	**Example tex**
	Energy supply	Make it clear whether the energy supply is or is not part of the energy contract.	Agreement	As part of the agreement: see the option in Article 1.1 of the template agreement. In a separate contract: to be included in a contract to be drawn up separately.
	Settlement of energy supply with building owner.	Stipulate that the contractor must periodically settle the costs of the energy supplied under the existing contract with the holder of that contract.	Schedule of requirements	The energy costs per kWh are settled monthly with the commissioning party by means of a credit note to be drawn up by the contractor.
Reference projects	**Where has this been applied previously?**		**Link to documents**	
	North Brabant and Limburg concession (contract including energy supply)		Link	
	Groningen concession (energy supply in a separate lot)		Link	

Decision 2: Contractual arrangements

Contractual arrangements

For the construction, maintenance and operation of recharging infrastructure, the commissioning party and the market operator enter into a contract together. This contract sets out arrangements on the division of responsibilities. This division therefore goes beyond the technical responsibilities laid down in the demarcation.

We have set out these responsibilities based on a design, build, finance, maintain and operate (DBFMO) framework. The table below summarises these responsibilities along with the corresponding characteristic activities.

Responsibility	Characteristic activities
Design (D) Designing a recharging network	• Consulting EV drivers on the expansion of the recharging network; • Expanding the network based on applications, usage data or forecasts, for example; • Selecting locations for new recharging stations in public spaces; • Issuing traffic orders.
Build (B) Constructing a recharging network	• Delivering a recharging station; • Requesting a connection from the grid operator; • Positioning the recharging station and connecting it to the grid, possibly in a single operation; • Equipping the recharging area with signage, line markings and, where necessary, collision protection barriers.
Finance (F) Financing the costs	• Financing D, B, M and O activities. • The financing component can also be used as a steering mechanism in the contract (e.g. by reimbursing on the basis of the number of recharging stations installed, uptime, usage, etc.). • Up-front financing can be provided by the municipality, the market operator or a combination of the two
Maintain (M) Maintaining a recharging network	• Providing hosting services giving information to EV drivers, access and settlement of costs; • Carrying out preventive maintenance and reactive repair of malfunctions and damage.
Operate (O) Operating a recharging network	• Operating the recharging network, including bearing the risk in terms of revenue from the use of the network

Contractual arrangements are often concluded following a tendering procedure. As the commissioning party, it is a good idea to be aware of the administrative burden this imposes on (potential) contractors. It is therefore advisable to standardise requirements as much as possible so there is no need to trawl through the documentation every time. The following is also recommended:

- Give advance notice of a publication in good time, so that tenderers can take into account the staff they have available. Also take other calls for tender into account.
- Plan sufficient time for tendering procedures, taking holidays into account.
- Ensure that questions can be asked at any time (and answered, to avoid the need to wait for information).

In the Netherlands, contracts generally fall into the following categories:

- open market model / licensing model,
- concession model,
- commission model.

The characteristics of these models are explained in more detail in the table below. For each section of the DBMFO framework, activities have been divided between the commissioning party and the contractor

Open market model / licensing model	Concession model	Commission model
The contractor is responsible for constructing and managing the recharging stations. Market operators apply for authorisation (a licence) from the municipality to install and maintain recharging infrastructure.	The contractor has the right and the obligation to install and operate recharging infrastructure. For this purpose, the contractor and the commissioning party enter into a DBFMO agreement.	The commissioning party asks the contractor to build and manage the recharging infrastructure. The commissioning party decides where the recharging infrastructure is built, provides the financing, bears the risk and receives the revenue.
Commissioning party's activities Authorise the installation of recharging infrastructure and the adoption of traffic orders.	**Commissioning party's activities** Design (optional), finance (optional)	**Commissioning party's activities** Design, finance, operate
Contractor's activities Design, build, finance, maintain, operate	**Contractor's activities** Design (optional), build, finance, maintain, operate	**Contractor's activities** Build, maintain

Things to consider

When determining the division of responsibilities, there are various aspects to consider. An important question is the extent to which you place the risk on the contractor. In general, the more the risk lies with the market, the less you as the commissioning party can work towards objectives that may be important. These could include the installation of recharging infrastructure in areas that are less profitable, but that are nonetheless important for ensuring recharging availability and hence the growth of electric transport.

It is also advisable, as the commissioning party, to consider the degree of freedom given to the contractor. This could be based, for example, on KPIs reflecting the commissioning party's objectives. This gives the market operator the freedom to meet these KPIs as it sees fit. An example of this is decision making based on the pressure on recharging capacity, as applied in the Municipality of Utrecht.

The pressure on recharging capacity must not exceed a certain limit for each neighbourhood. This ensures that recharging capability is available to EV drivers. The market operator has the freedom to choose how it keeps the pressure on recharging capacity under the limit. This could include adding more public recharging infrastructure, promoting recharging in publicly accessible spaces, building fast chargers or promoting efficient use of existing recharging infrastructure (e.g. through overstay fees).

Example guidelines and reference projects

See below.

Contractual arrangements				
Reference projects	**Model**	**Where has this been applied previously?**	**Type of recharging infrastructure**	**Link to documents**
	Licensing model	Municipality of Tilburg, Municipality of Dordrecht,	Public Public	Link Link
	Concession model	Gelderland, Overijssel, MRA-e, Concession for recharging infrastructure on municipal land, Municipality of Rotterdam, Concession for recharging infrastructure in public multi-storey car parks.	Public Public Private Publicly accessible	Link Link Link Link
	Commission model	Municipality of The Hague.	Public	Link

Decision 3: Deployment strategies

Ideally, the size of a recharging network should develop just ahead of demand for recharging infrastructure, avoiding shortages and ensuring recharging availability for EV drivers. When developing a recharging network, it is important to consider the business case of the overall network and not focus only on successful or underperforming recharging stations. There should be a balance between successful and underperforming recharging stations. It is not desirable to put a network of only underused recharging stations on the market.

It also puts too much pressure on public spaces and unnecessarily increases parking pressure. The recharging network can be expanded using three strategies:

1. installation based on applications,
2. installation based on forecast maps,
3. installation based on usage data.

These strategies are also not mutually exclusive; they can complement each other and be used side by side

1. Installation based on applications

The contractor installs recharging infrastructure based on applications from EV drivers. This strategy is used for public recharging infrastructure. Applications are assessed based on fixed criteria, such as whether EV drivers have recharging capability at their own premises as well. If an application is approved, a suitable location is sought. Sometimes zoning maps are used, on which suitable locations have been identified in advance. This reduces the turnaround time between application and installation.

Things to consider

Benefits

This deployment strategy has been the most widely used to date. For the parties concerned — the municipality and the market operator —this is a tried-and-tested way of expanding the recharging network. Installation based on applications provides a reasonable degree of security that the recharging station will see sufficient use. This prevents the installation of unnecessary recharging stations and the associated disinvestment and pressure on public spaces. This deployment strategy is particularly suited to less urban areas, where it is more difficult to select locations on the basis of forecasts or usage data.

Things to be wary of

Installation based on applications is often a time-consuming process. Individual applications are dealt with separately and require a significant number of steps to be taken. The period between the recharging station being applied for and being installed can often exceed 6 months, although the use of zoning maps can shorten these turnaround times.

This creates the risk of the recharging network lagging behind charging demand. An emerging second-hand market for electric cars —with short delivery times — means that long turnaround times are undoubtedly an issue. The administrative burden on the commissioning party and the contractor is also high (the municipality has to adopt a traffic decision for each recharging station).

When implementing this deployment strategy, it is important for stakeholders to coordinate with one another to organise the process as efficiently as possible.

Example guidelines and reference projects

See next page.

Deployment strategies – installation based on applications				
Example guidelines	**Guideline**	**Description of guideline**	**Document to be included**	**Example tex**
	Application and installation	Specification of the application and installation process	Schedule of requirements	See minimum requirements (AR1 – AR3), supplemented by policy-specific requirements where applicable (AR1 – AR31)

Reference projects	**Where has this been applied previously?**	**Link to documents**
	MRA-e concession	Link
	Gelderland/Overijssel concession	Link
	MRDH (Rotterdam-The Hague Metropolitan Area) concession	Link
	Groningen Drenthe concession	Link

2. Proactive installation based on forecast maps

This strategy uses forecast maps based on a predictive model using various data sources. These data sources include information on demographics, urbanisation levels, purchasing behaviour, expected growth of electric transport and existing recharging infrastructure. Based on this forecast, the municipality, the grid operator and the market operator decide on possible locations.

Things to consider

Benefits

Forecast maps provide an early insight into where the recharging network needs to be expanded. This makes it possible to proactively expand the recharging network and respond in a timely manner to the growing demand for recharging points. The National Agenda for Recharging Infrastructure (Nationale Agenda Laadinfrastructuur, NAL) also advises working with forecast maps and installing recharging stations in anticipation of demand, where possible (mostly in urban areas).

Things to be wary of

Installation based on forecast maps – i.e. not based on applications from EV drivers – is relatively new, and experience with this strategy is still limited.

There is therefore no consensus on the predictive value of forecast maps. In a concession for public recharging infrastructure in North Brabant and Limburg, forecast maps are being used on a large scale for the first time. The lessons learned will be important for new initiatives using this deployment strategy.

Example guidelines and reference projects

See next page.

Deployment strategies – proactive installation based on forecast maps				
Example guidelines	**Guideline**	**Description of guideline**	**Document to be included**	**Example tex**
	Not applicable	There is no standard procedure yet for this method of selecting locations. Please refer to the procedure used in the North Brabant and Limburg concession. It is expressly recommended to contact the people involved to find out what lessons were learned		
Reference projects	**Where has this been applied previously?**	**Link to documents**		
	North Brabant and Limburg concession	Link		

3. Proactive installation based on usage data

This strategy is based on usage data from existing recharging points. There must already be a reasonably comprehensive recharging network in place with accessible usage data. With the help of this data, arrangements can be made to keep the recharging infrastructure's capacity utilisation below a fixed ceiling for each neighbourhood. This is done by the market operator by, for example, swiftly installing additional recharging infrastructure or by getting EV drivers to make more efficient use of existing recharging points. The installation of additional recharging stations can be accelerated by using zoning maps with recharging locations that have been determined in advance (including traffic orders).

Things to consider

Benefits

The usage data shows at an early stage where the recharging network needs to be expanded. This makes it possible to expand the recharging network swiftly, without going through an application and implementation process. This strategy allows the commissioning party to focus on capacity utilisation KPIs and gives market operators (more) freedom to decide for themselves how to meet those KPIs.

This model is also well suited to bringing different types of regular and fast recharging under a single contract.

Things to be wary of

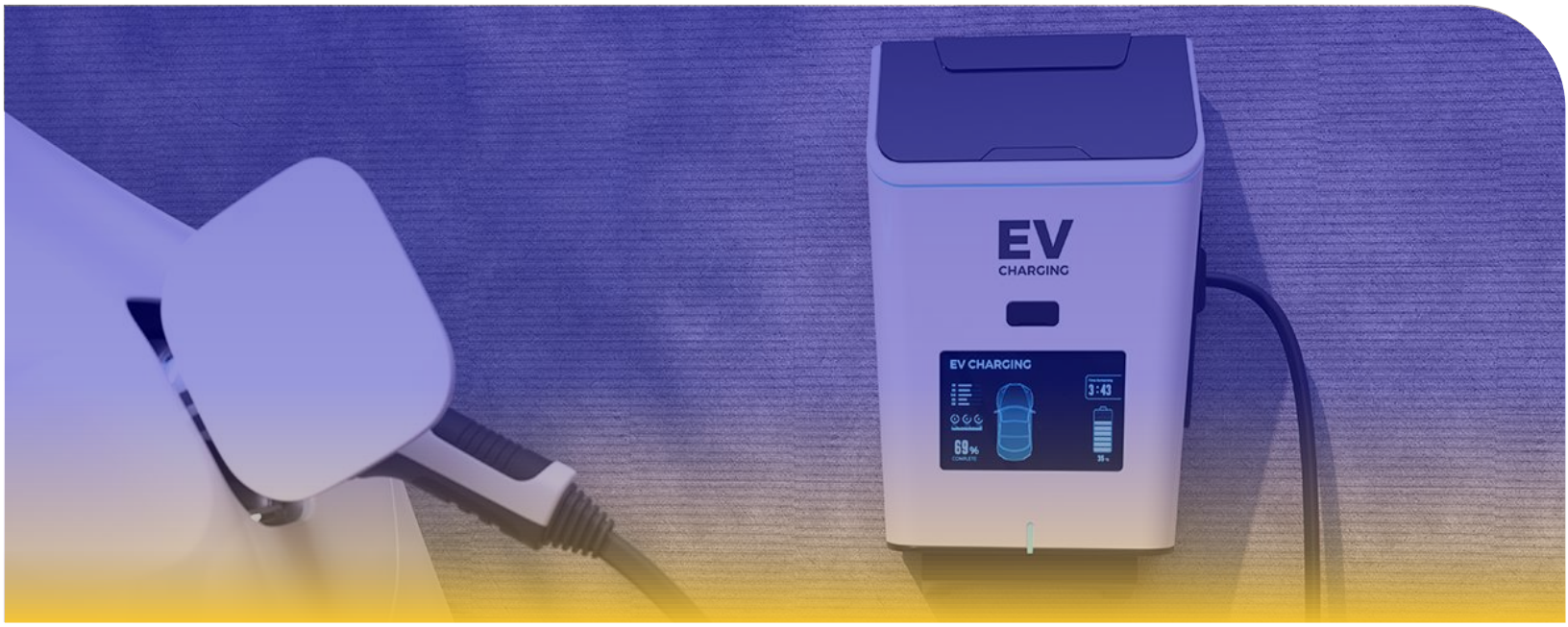
For recharging demand to be measured based on usage data, recharging points are needed within reasonable walking distance at various points throughout the municipality. This deployment strategy is therefore appropriate only in municipalities that already have reasonable coverage.

Furthermore, the availability of up-to-date and reliable data on the use of existing recharging points is a prerequisite.
This model has recently been used for the first time in the Municipality of Utrecht. Experience gained in Utrecht should show how well the model works and where there is room for improvement.

Example guidelines and reference projects

See next page.

Deployment strategies – proactive installation based on recharging pressure				
Example guidelines	**Guideline**	**Description of guideline**	**Document to be included**	**Example tex**
	Not applicable	There is no standard procedure yet for this method of selecting locations. Please refer to the procedure used in the Municipality of Utrecht concession. It is expressly recommended to contact the people involved to find out what lessons were learned.		
Reference projects	**Where has this been applied previously?**		**Link to documents**	
	Municipality of Utrecht concession		Link	



Add-on 1: Innovations

Innovations

The commissioning party can choose to request innovations. Innovations are additional services that have not yet been implemented, are currently being explored and are yet to be proven. Innovations have the potential to contribute to, for example:

- user-friendliness for EV drivers;
- increasing price transparency for EV drivers;
- efficient use of recharging points;
- physical integration into the environment;
- reducing the recharging load or balancing the grid through smart recharging;
- combining different functionalities within a recharging station;
- swift scaling up of recharging infrastructure.

There are a great number of innovations to choose from, so this document does not go into them in detail. When deciding whether or not to implement specific innovations, there are a number of helpful questions to ask.

Why implement innovations?

The world of electric transport and energy is constantly evolving. Recharging infrastructure solutions are therefore required to meet stakeholders' needs.

There are questions that need to be answered, such as: how does your recharging infrastructure fit into the public space? How do you increase user-friendliness for EV drivers?
How does recharging infrastructure fit into the sustainable energy system of the future, with a high share of solar and wind energy? These challenges require solutions that have not yet been developed. Innovation is therefore very important. At the same time, innovation should not clash too much with other interests. You should therefore ask the question: what impact does a specific innovation have on a contract?

What impact does a specific innovation have on the contract?
Here, the following questions should be asked:

- What impact does the innovation have on the cost price of the recharging service?
- Who will pay for any increase in the cost price? Will it fall on EV drivers, indirectly reducing the attractiveness of electric vehicles? Will the commissioning party provide additional resources for this purpose? Or is the market operator ultimately responsible for this? Is there sufficient earning potential for the contractor, and are the risks, if any, acceptable? What do you, as the commissioning party, consider important and acceptable?

- What impact does the innovation have on the quality of the recharging service for EV drivers?
- What impact do these innovations have on the speed at which recharging infrastructure is deployed?

Tip: an innovation should contribute to the societal goal of promoting EVs, thereby working towards the sustainable energy system of the future. Potential contractors and/or market operators, among others, should be involved in deciding whether to include an innovation.

Choices to be made

Depending on the innovation in question, the following choices are available to the commissioning party:

- Keeping the innovation outside of the contract / call for tenders. For example if it makes an insufficient, or even negative, contribution to the objective of the call.
- Implementing the innovation only on a small scale within an existing contract.
- Asking the market operator to distinguish itself qualitatively from its competitors by submitting a plan to provide the innovation requested.
- Including the innovation as a requirement for the entire contract. In this case, it is very important to be aware of potential cost increases.

Reference projects: learning from each other and working towards common standards

No concrete guidelines on this subject have been included, as the number of topics is too large. However, it is important to learn from innovations that have been implemented elsewhere.

It is also important to standardise proven innovations, so they can be included as minimum requirements in future contracts. The next page provides an overview of innovations that have been implemented, with links to relevant documents.

Innovations			
Reference projects	**Innovations**	**Where has this been applied previously?**	**Link to documents**
	Price transparency	Brabant and Limburg concession, MRA-e concession	Link Link
	Recharging hubs	Brabant and Limburg concession, Groningen and Drenthe concession, MRA-e concession..	Link Link Link
	Preparing new construction projects	Brabant and Limburg concession, MRA-e concession.	Link Link
	Alternative payment methods	MRA-e concession, Brabant and Limburg concession.	Link Link

Add-on 2: Smart recharging and energy services

Smart recharging and energy services

Smart recharging refers to variations in recharging speed (power) and direction depending on factors such as the load on the local grid or the availability of renewable energy. Electric cars can therefore be charged more quickly or more slowly — or recharging can be paused — when this is deemed desirable or if requested by the grid. A less common and more advanced form of smart recharging is 'bi-directional' recharging, where energy is fed from the vehicle back to the grid. This is known as vehicle-to-grid (V2G) recharging.

Load balancing
A common form of smart recharging is 'load balancing'. Here, recharging speed is determined based on the available capacity of the charging infrastructure's grid connection. This can be done by, for example, setting an upper limit on the power available, which is then divided among the cars being charged. A more sophisticated form of smart recharging is dynamic load balancing, where the available power is adjusted in real time depending on demand from other energy users on the same grid connection or the availability of locally generated energy.

Smart recharging tends to have three objectives:

- Varying recharging speeds at times whenever there is sufficient capacity on the grid or on the local grid connection. This stops the grid from being overloaded and avoids the potential need for grid reinforcements (and the accompanying costs).
- Varying recharging speeds to balance the grid. The national grid operator may make financial compensation available for this purpose.
- Varying recharging speeds to optimise the use of renewable energy (solar and wind), recharging more slowly at times when renewable energy is in short supply and vice versa. With a high supply of renewable energy, energy prices are generally lower, so recharging becomes cheaper.

In general, therefore, smart recharging can lead to cost savings and optimal use of renewable energy. However, it also requires cost-increasing investments, for example, in areas such as hardware. It is a good idea to agree on the financial advantages and disadvantages of smart recharging. It is also important to ensure the revenue model of the recharging infrastructure operator. This may require revenue models other than the usual model based on number of kWh charged.

Two examples of smart recharging are included in the box on the previous page.

Things to consider

Smart recharging is a broad term. Exactly how smart recharging is implemented depends on the objective to be pursued. Once an objective has been set, it is then possible to look at the technical details and the arrangements to be reached between the parties involved.

To enable smart recharging on the recharging infrastructure, a number of technical requirements need to be met. The set of minimum requirements includes the minimum technical specifications for the recharging infrastructure. These minimum requirements make it possible, in principle, to control recharging speeds. However, the technology is still in development. For example, work is under way on the further development of new protocols. The Dutch Knowledge Platform for Recharging Infrastructure (Nationaal Kennisplatform Laadinfrastructuur, NKL) aims to keep the baseline requirements as up-to-date as possible.

It is also important to stress that smart recharging involves many different parties, all of whom have or may have an interest in the way recharging takes place. These include, among others:

- EV drivers,
- recharging station managers/operators,
- grid operators,
- energy suppliers,
- aggregators,
- municipalities and other commissioning parties.

There is (as yet) no clear set of arrangements under which smart recharging can take place.
This issue is under discussion within the sector, including in the NAL's Smart Recharging working group.

Example guidelines and reference projects

No concrete guidelines on this subject have been included, as the number of topics is too large. However, it is important to learn from innovations that have been implemented elsewhere. The next page therefore provides an overview of innovations that have been implemented, with links to relevant documents.

Smart recharging and energy services				
Reference projects	**Innovations**	**Description**	**Where has this been applied previously?**	**Link to documents**
	Variable grid capacity	Avoid congestion on the grid by lowering recharging speed at peak times, although with the option for EV drivers to override this. Outside peak hours, a higher recharging speed than usual is available.	Gelderland/Overijssel concession	Link
	Flexpower	Avoid congestion on the grid by lowering recharging speed at peak times. Outside peak hours, increased recharging speeds depend on the supply of renewable energy.	Flexpower, Municipality of Amsterdam (Flexpower)	Link
	Free choice of energy supplier	Any supplier can supply energy to public recharging stations. This challenges them to offer smart recharging services.	Groningen and Drenthe concession, Brabant and Limburg concession	Link Link
	Balancing the grid	Recharging speeds are adjusted to balance the grid.	Private recharging infrastructure	Link

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