

Smart Charging of electric vehicles

Institutional bottlenecks and possible solutions

3 October 2017



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Background to study

Aim of Smart Charging study

In this report we identify institutional bottlenecks that impede the development of the Smart Charging of electric vehicles. We subsequently identify possible solutions for the most important and urgent bottlenecks. In this way, both market and government are assisted with concrete ideas in order to accelerate the development of Smart Charging in the short term. The study also provides a starting point for the design of an efficiently and effectively functioning market.

- *By ‘Smart Charging’ we mean the charging and discharging of an electric vehicle whereby the timing, speed and charging method (charging/discharging) is geared to the e-driver’s preferences and market conditions then prevailing (such as availability of renewable energy). Smart Charging is important to:*
 - *i) stimulate electric transport by means of an efficient charging experience for e-drivers (such as easy availability, timeliness of charging)*
 - *ii) deploy renewable energy as effectively as possible and*
 - *iii) create flexibility in order to maintain the balance in the electricity grid and to reduce or postpone investments in order to prevent regional congestion*
- *By ‘institutional bottlenecks’ we mean obstructions arising from existing or non-existing legislation and regulations at national, regional or local level, relevant sector agreements, and established or still absent/implemented standards.*

A follow-up ... Broadening the inventory of bottlenecks and possible solutions

The study is a follow-up to the PwC study into Tax barriers for Smart Charging (2017), commissioned by stichting ElaadNL. This new study has been broadened with an overview of other institutional bottlenecks that impede the development of Smart Charging. In addition, in cooperation with the market and government (see the appendix for the parties consulted) we have selected the most urgent bottlenecks and make concrete proposals for resolving the bottlenecks that need to be addressed as quickly as possible.

Clients

This report was commissioned by the Municipality of Utrecht and Stichting ElaadNL, in collaboration with MRA-E/G4 and the province of North Brabant. We did not perform analyses on the gathered information that had the nature of an audit. We do not accept liability or a duty of care (either contractually or due to unlawful act (including negligence or otherwise)) to anyone but our clients the Municipality of Utrecht and Stichting ElaadNL.

Summary (1/4)

This report identifies a number of institutional bottlenecks that impede the development of Smart Charging. This new market calls for a framework that makes the charging experience attractive, stimulates the use of renewable electricity for electric transport, thereby rewarding the flexibility made available by smart charging. Old institutional frameworks must be adapted and new agreements are needed to accelerate Smart Charging.

The transition to electric transport....

To reduce emissions of harmful substances (such as CO₂, NO_x and particulate matter) from the transport in the Netherlands, a fuel transition is essential. Electric transport is one of the most important ways of achieving this. In recent years, the Netherlands has been actively involved in stimulating electric transport and has acquired a leading role internationally.

To facilitate electric driving, the development of new infrastructure is vital. The availability and quality of this charging infrastructure largely determines the future success of electric transport.

For the efficient functioning of this new market for electric transport, charging must be further optimised (become 'smarter').

...and the transition to renewable electricity...

Major changes are also taking place in the electricity market. Historically, electricity was centrally generated in large power stations and subsequently transmitted to consumers in decentralised (regional) grids.

The transition to renewable energy increases the amount of decentralised (renewable) electricity fed into the grid. The volatility of (fluctuations in) the electricity supply thus increases. At the same time, the peak demand for electricity also increases due to the growth of electric transport¹ and electrification of the built environment. This creates a greater mismatch between moments of supply and moments of demand.

In order to guarantee a clean, affordable and reliable energy supply in the future, flexibility must be unlocked so that supply and demand can be better aligned.

...lead to a need for Smart Charging

'Smart Charging' can help to improve the alignment of demand and supply of (renewable) electricity by gearing the time, speed, and charging method to market conditions. This helps to give the e-driver an optimal charging experience, to optimise the use of renewable electricity and to unlock flexibility.

The flexibility unlocked by Smart Charging can be deployed for a number of purposes²:
optimisation of own

use of the meter (private), optimisation of the charging session and availability of charging infrastructure (public and semi-public), preventing congestion in the grid of the regional grid operator, substantiation of the supplier's programme responsibility and for use on the reserve markets of the national grid operator. This not only helps to prevent social costs, but also to be able to offer the e-driver an optimal charging experience, which stimulates electric transport.

In order for Smart Charging to work in practice, the various stakeholders in the chain must work together in order to create new partnerships.

A number of Smart Charging experiments are currently taking place in the Netherlands. They aim to scale up further but encounter institutional bottlenecks that delay or block the scaling-up. Current institutional frameworks do not comply with requirements accompanying these new initiatives and may therefore impede the development of Smart Charging.

¹ The demand for electricity by a household can quickly double if an electric vehicle is used

² See page 19 for an explanation of the purposes per party

Summary (2/4)

Below is an overview of the smart charging bottlenecks identified in this study. Bottlenecks occur throughout the smart charging chain. The bottlenecks differ in importance and the period in which they must be resolved in order to accelerate the development of Smart Charging.

See the separate appendix to this report for a complete overview of all bottlenecks with an explanation of the assessment

Identified Smart Charging bottlenecks¹

E-driver

- 2 Fixed electricity tariff for e-driver
- 3 Current netting rule does not provide any incentive for optimisation of storage in electric vehicle behind the meter

- 4 Double energy tax discourages bi-directional charging
- 5 Energy tax differs depending on the type of charge point (public, private, semi-public)
- 6 VAT liability of e-driver discourages bi-directional charging

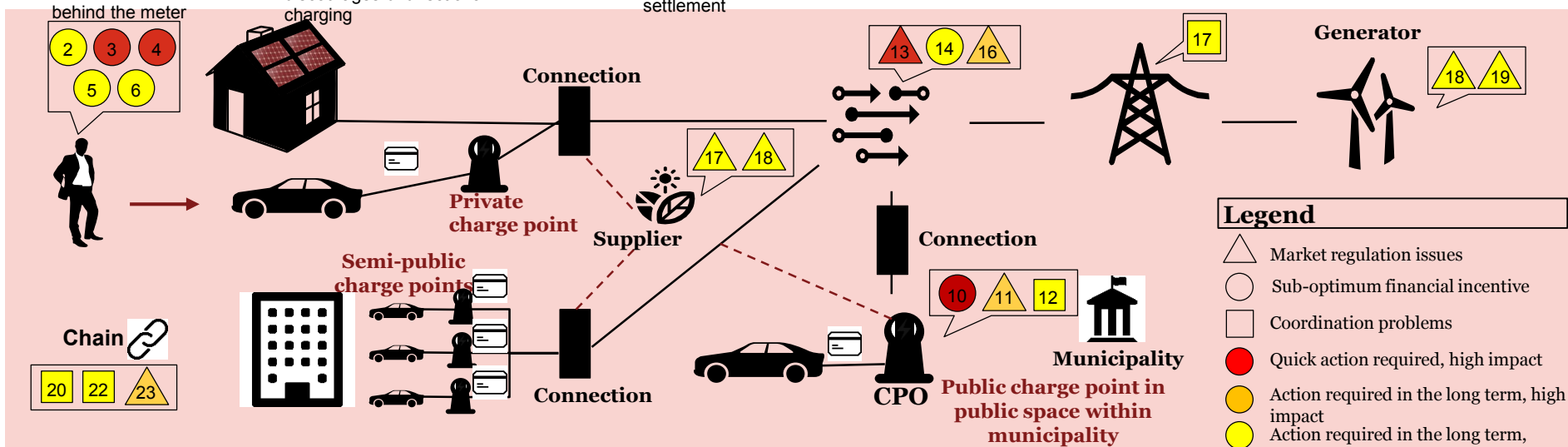
Charge Point Operator ('CPO')

- 10 No incentive for roll-out of charging infrastructure with optimal charging capacity
- 11 Charge Point Operator has an incentive to block third party Smart Charging
- 12 Measuring infrastructure requirements for Smart Charging

Regional grid operator

- 13 Uncertainty about the possible use of Smart Charging for the grid operator's congestion management
- 14 Compensation from regional grid operator for offering flexibility is lacking
- 16 Risk of congestion at regional grid operator

- Manufacturer of electric vehicle



Legend

- △ Market regulation issues
- Sub-optimum financial incentive
- Coordination problems
- Quick action required, high impact
- Action required in the long term, high impact
- Action required in the long term, medium impact

National grid operator

- 17 ENTSO-E rules for participation in reserve markets

Energy supplier and programme manager

- 18 Supplier of electricity at e-driver's home decisive for participation in Smart Charging behind the meter.
- 19 Limited possibilities for Smart Charging at public charge points by other supplier that supplies at the charge point

Chain

- 20 Access to required Smart Charging data is lacking
- 22 Limited experience with data that must be shared for Smart Charging and compliance with privacy legislation

- 23 Uncertainty about who determines use of electric car ('who may exert pressure') and which initiative takes precedence








Note:¹ bottlenecks with a 'low' score on impact or period are not included in this summary, but can be found in the appendix to this report.

Summary (3/4)

A properly functioning Smart Charging market requires structural adjustments in legislation and regulations and other institutional frameworks in order to realise optimal market regulation, effective financial incentives and optimal data exchange. Steps must be taken in the short term in order to solve the experienced bottlenecks and thus facilitate the expected rapid growth of electric transport and renewable energy.

Key bottlenecks until 2020

A number of key bottlenecks¹ that hamper the development of an effective and efficient functioning market for Smart Charging must be resolved in the short term:

Bottleneck	Description
 Missing incentive to optimise own consumption behind the meter in an electric vehicle	E-drivers with (their own) solar panels are not financially stimulated to optimally use the self-generated renewable electricity and the storage capacity from the car for their own (peak) demand for electricity. This ensues from the current netting rule.
 Possible double energy tax for bi-directional charging	Every time the car is charged again after discharging ('bi-directional charging'), it appears that energy tax has to be paid on the charged kWh. As a result of the netting rule, there is currently no double taxation for private charge points at low-volume consumers. It is unclear which regime applies to (semi-)public charge points.
 No incentive for the roll-out of charging infrastructure with maximum charge capacity for Smart Charging	The higher the capacity of the connection, the faster a car can be charged and the more flexibility generated for the use of the car for Smart Charging. However, a high capacity connection is significantly more expensive, so that mostly low-capacity connections are installed in the (semi-)public domain.
 It is unclear whether Smart Charging may be deployed for regional grid operator	The group prohibition in the Electricity Act does not appear to allow regional grid operators to possess storage capacity. It is unclear whether they may use the flexibility that can be accessed using storage in electric vehicles
 Possible incentive for Charge Point Operator to block third party Smart Charging	The importance of the CPO (maximisation of Charge Point Occupancy) differs in some cases from the importance of other players in the chain. There is a risk that the CPO will intervene in the planned delayed or bi-directional Smart Charging charging session in order to optimise its use of the charge point.
 It is unclear who determines the use of the electric car for Smart Charging	It is currently unclear who determines that the battery of the electric car is used for Smart Charging, and, when the e-driver has connected his electric car to several initiatives, which initiative takes precedence.
 Risk of congestion at regional grid operator due to third party Smart Charging initiatives	The use of storage capacity of electric cars for certain types of Smart Charging could lead to congestion in regional grids (e.g. when the cars used simultaneously charge (or discharge) on the same regional low voltage grid).

Urgency to act

In the coming years, a strong growth of electric transport is expected (target: 200,000 electric vehicles in 2020, 1 million in 2025). The tipping point, where economies of scale pay-off and affordable electric vehicles are launched on the market, is expected to be achieved in the coming years.

In order to facilitate the fuel transition and maintain the Dutch lead in electric transport, it is essential to ensure there is a properly functioning Smart Charging market in the short term. Action is also needed in the short term since legislative changes and implementation processes easily take years.

¹ For a complete overview of all identified bottlenecks and their evaluation, see the appendix to this report. See the previous page for a legend

Summary (4/4)

To accelerate Smart Charging, structural amendments to legislation and regulations and other institutional frameworks are required. Until then, a number of short-term measures can be taken that address some of the main bottlenecks, thus facilitating the scaling up of Smart Charging during the coming years.

Structural solutions for bottlenecks are required...

Structural changes to legislation and regulations must to be further investigated and implemented, so that various bottlenecks can be coherently resolved:

- Determine optimal market regulation (roles and responsibilities of players in the Smart Charging chain);
- Adjust current sub-optimum financial incentive for Smart Charging on the basis of tariff components (energy tax, grid management and supply);
- Determine the data to be unlocked in order to efficiently develop Smart Charging concepts.

...where these are delayed, temporary measures can be taken

A lot of (research into) structural amendments to relevant legislation and regulations have been delayed due to the recent change of the Dutch cabinet (e.g., the Energy Transition Advancement Act (“Wet VET”) and the netting rule). It is also relevant for some bottlenecks that no major changes to legislation and regulations are implemented before 2023 as indicated for the netting rule. Here it appears that no amendments are possible in the short term.

In the research performed by the new Cabinet in the coming years with respect to the replacement scheme for the netting rule, the greening of the tax system and the regulation for grid operators, it is important to also explicitly consider the impact on the development of Smart Charging. Until then, a number of temporary measures can be taken to remove some of the most important and most urgent bottlenecks for the acceleration of Smart Charging:

Bottleneck	Solution
Possible double energy tax for bi-directional charging	Publish policy (Ministry of Finance) stating that, for energy tax, a (taxable) supply does not apply if an electric car is temporarily made available as storage capacity and in this respect electricity is supplied back and forth. Instead, this should be regarded as a storage service for which no energy tax is due.
No incentive for the roll-out of charging infrastructure with maximum charge capacity for Smart Charging	Employ a reduced transmission tariff for Smart Charging use, since it leads to lower costs for the grid operator. Similar adjustment as in the case of the energy-intensive industry (amendments to Electricity Act and Ministerial regulation of tariff structures and electricity conditions). A second solution is to set the transmission tariff on the basis of actual consumption. This requires the amendment of the Tariff Code (Article 3.7.13a) and the Ministerial regulation (Article 4(2)) to be initiated by the Ministry of Economic Affairs.
It is unclear whether Smart Charging may be deployed for regional grid operator	The European Commission is currently working on a European Directive (Recast Electricity Directive), allowing regional grid operators to use flexibility solutions to prevent capacity expansion of the electricity grid. Following approval, this Directive must be implemented in national legislation. In anticipation of this, the ACM can be asked for an (informal) opinion.

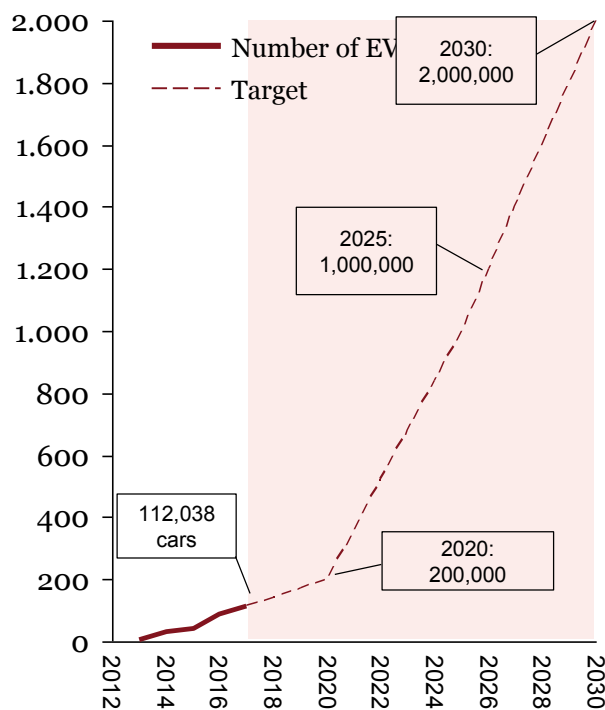
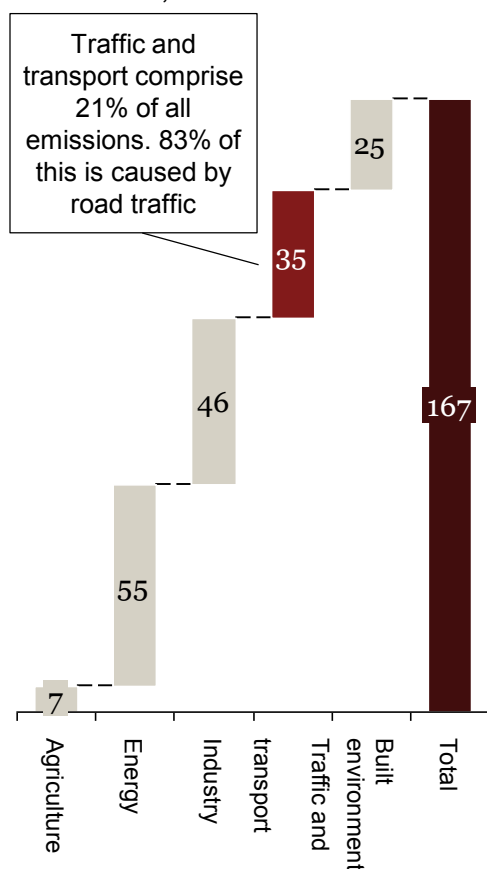
For the remaining three major bottlenecks (11, 16 and 23) as referred to on the previous page, market parties can investigate further whether these can be resolved by means of bilateral agreements.

Smart Charging report

Electric transport and the energy transition

To reduce emissions of harmful substances (such as CO₂, NO_x and particulate matter) from the transport in the Netherlands, a fuel transition is essential. Electric transport is one of the most important options for achieving this.

CO₂ emissions in the Netherlands per sector In million tonnes, 2015
Increase of Electric transport in the Netherlands In 1,000 EV (BEV, E-REV, PHEV, F-CFEV)¹



The importance of electric transport

- The Netherlands is on the eve of a major transition in the traffic and transport sector:
 - Agreements have been reached in the Paris climate agreement about the reduction of CO₂ emissions to ensure that the average temperature increase on Earth is limited (to a maximum of 2 degrees Celsius). The Netherlands aims to emit 25 million tonnes (or 17%) less CO₂ by 2030 compared to 1990 (Brandstofvisie, 2014).
 - By means of limit and target values, local, national and European governments are also aiming to achieve better air quality (including NO_x and particulate matter emissions) in order to reduce health risks.
- In recent years, the Netherlands has been actively involved in stimulating electric transport and is one of the front runners internationally. The Netherlands is ranked second in terms of the proportion of electric cars (including PHEV¹) on the total car market: 6.4% of the new cars were electrically powered in 2016 (IEA 2017).

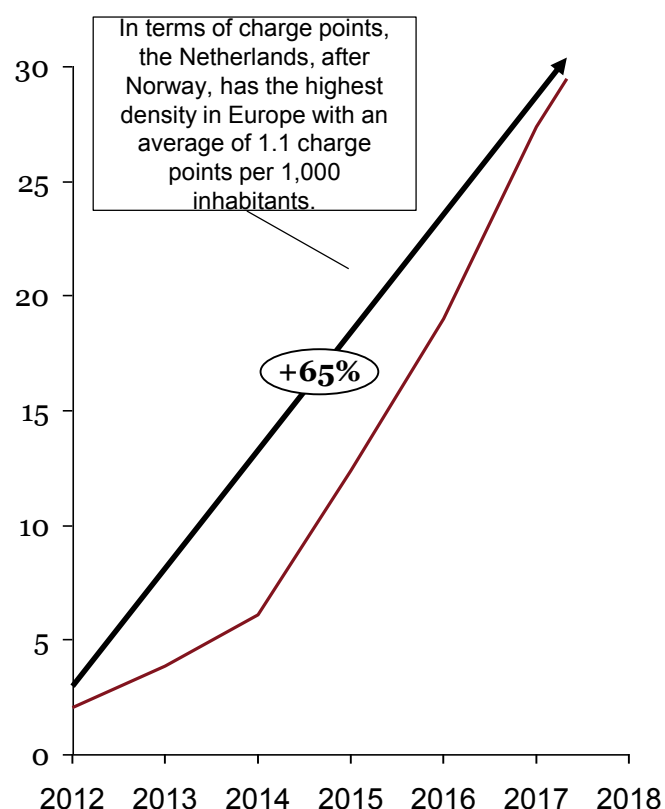
Notes:¹ EV: Electric Vehicle, BEV: Battery Electric Vehicle, E-REV: Extended-Range Electric Vehicles, PHEV: Plug-in Hybrid Electric Vehicle, FCEV: Fuel Cell Electric Vehicle

Sources: Emission registration (2017) & RVO (2017) & Road Transport Electric Transport (2015) & CBS (2017)

To facilitate electric transport, the development of new infrastructure is vital. The availability and quality of this charging infrastructure largely determines the future success of electric driving.

Development of charge points in the Netherlands

In 1,000 charge points (excluding Private points)



Sources: RVO (2017), Jan-2012 – May-2017. ICCT (2016).

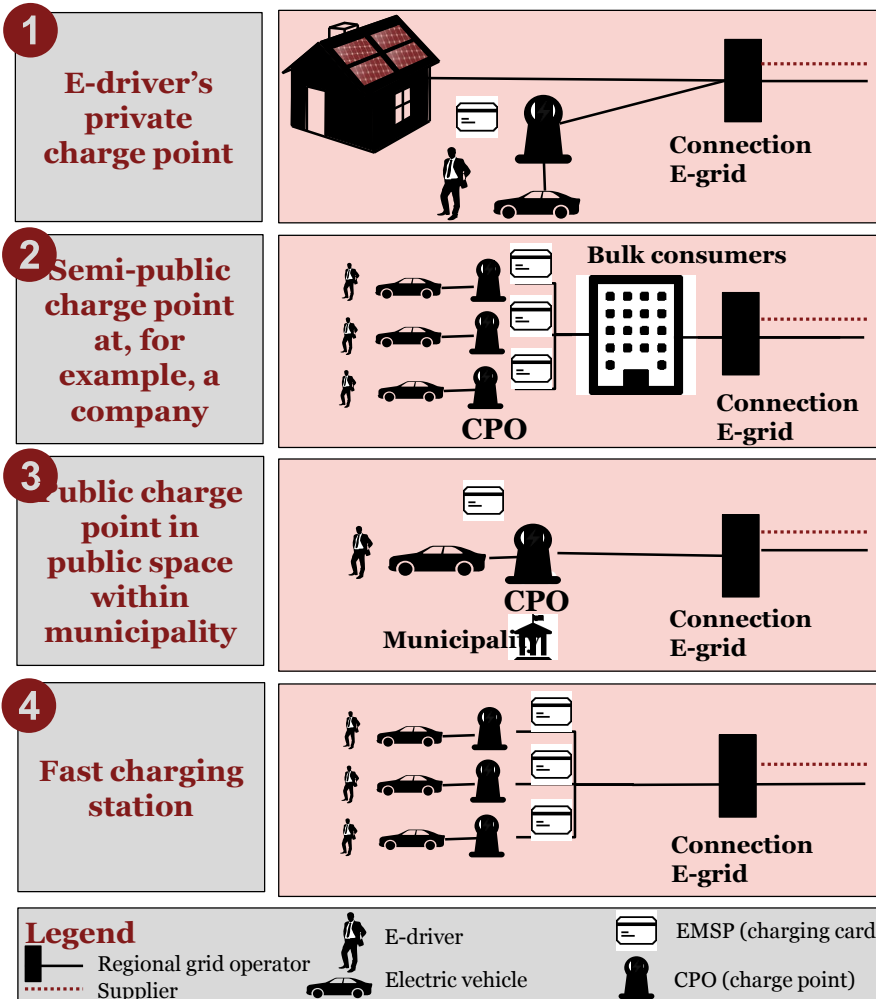
Note:¹ APPM for the National Traffic Management congress (2015) and Multiscope (2015)

The importance of a good charging infrastructure

- The availability of a good charging infrastructure is essential to facilitate the transition to electric driving. According to one study, the ability to charge is the most important factor that determines the share and growth of electric cars in a municipality. It also follows from Multiscope's consumer survey that e-drivers experience the availability of charging infrastructure, in addition to range and price, as an important threshold for purchasing an electric car¹.
- Manufacturers of electric vehicles are dependent upon the available (and expected) quality of the charging infrastructure. The available charging infrastructure determines, for example, the charging speed, the plug required and the technique used to fully charge the car (DC or AC). During the development of the charging infrastructure account must be taken of the developments in technology of electric vehicles.
- Central government, provinces and municipalities are therefore increasingly committed to realising an adequate public charging infrastructure. The Netherlands is leading Europe in the availability of public charging infrastructure. Amsterdam, for example, with 5.5 charging points per 1,000 inhabitants, has the highest density of charging points in Europe, and Utrecht is in fifth place with 2.6 charging points per 1,000 (ICCT, 2016).
- Public charging infrastructure is currently being rolled out with grants from (local) authorities (partly by means of tendering with conditions imposed for sustainable electricity consumption). A cost-effective business case is currently not yet possible for this charging infrastructure (RVO, 2016). It is expected that this will be possible in the future if charging capacity increases and the costs of hardware, installation, grid costs and other operating costs decrease further. Until that time, governments will stimulate the charging infrastructure.

In order to make this new electric transport market function efficiently, new interactions between (new) parties are required. Charging must be further optimised (become ‘smarter’)

Charging options for e-driver’s electric vehicle



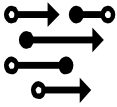
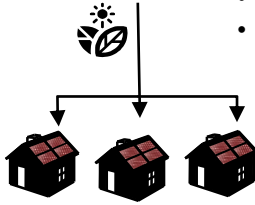


Development of charging infrastructure and charging

- Four different forms of charging infrastructure can be distinguished: (1) the private charge point, where the e-driver installs a charge point on his home connection, (2) the semi-public charge point, where the e-driver can charge at a bulk consumer who has installed charge points on his connection, (3) the public charge point, where the municipality, in a tender, subsidises the roll out of charge points for public use and (4) a fast charging station, where the driver can quickly charge his electric car on roads and motorways.
- With all forms, the charge point is connected to the grid of the regional grid operator. The energy supplier is responsible for the supply of electricity on the connection. New roles have also arisen: the *Charge Point Operator* (‘CPO’) that manages the charge point and the *Electric Mobility Service Provider* (‘EMSP’) that is responsible for the (monthly) settlement via the charging card. To charge an electric car, interaction between the various players in the chain is required at both technical and administrative levels. Communication standards for these interactions are further optimised.
- The charging of an electric car is still relatively easy at the moment. If the e-driver inserts the car’s plug into the charge point and presents his charging card, the car starts charging. Very little account is currently taken of the wishes of the e-driver (when should the car be fully charged) and the market conditions (such as the availability of renewable energy, or the grid load at the regional grid operator).

Major changes are also taking place in the electricity market. Historically, electricity was generated centrally, fed into the grid and transmitted...

Historic tasks, roles and responsibilities of the electricity grid

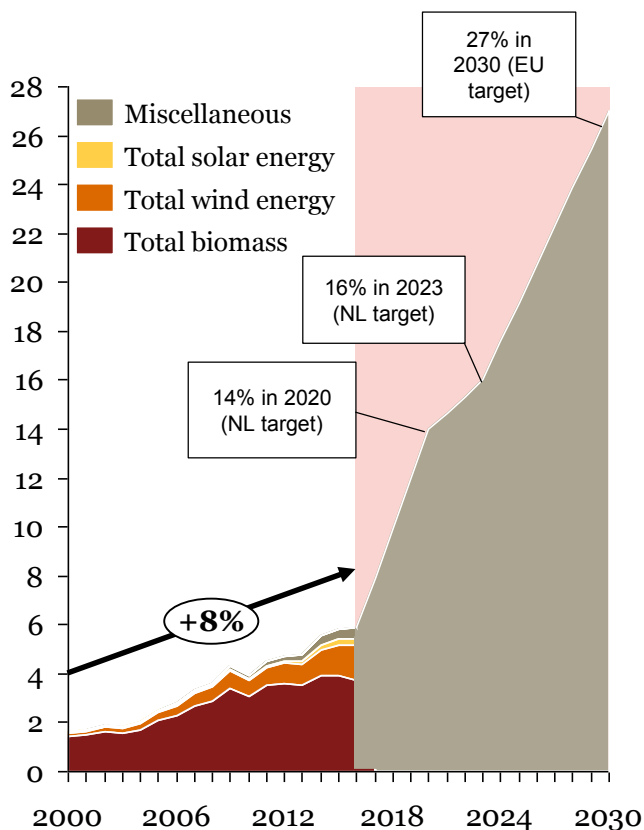
Graphical representation of the grid		Roles and responsibilities	
Tasks			
Generation	Electricity generator		<ul style="list-style-type: none"> • Generation of electricity with wind turbines, solar energy or gas power plants, for example
Transmission	National grid operator TenneT		<ul style="list-style-type: none"> • Investment and maintenance of the high-voltage grid • Maintain system balance with the primary, secondary and tertiary reserve markets
Distribution	Regional Grid Operators		<ul style="list-style-type: none"> • Investment and maintenance of medium and low voltage grid • Congestion management to address possible temporary shortfalls in transmission capacity.
Supply	Suppliers/ Programme manager		<ul style="list-style-type: none"> • Supply of electricity to consumers • Prediction of consumption and production in programme for TenneT (previous day) and realisation of this programme (trading on day-ahead and intraday market)

Market structure of electricity market

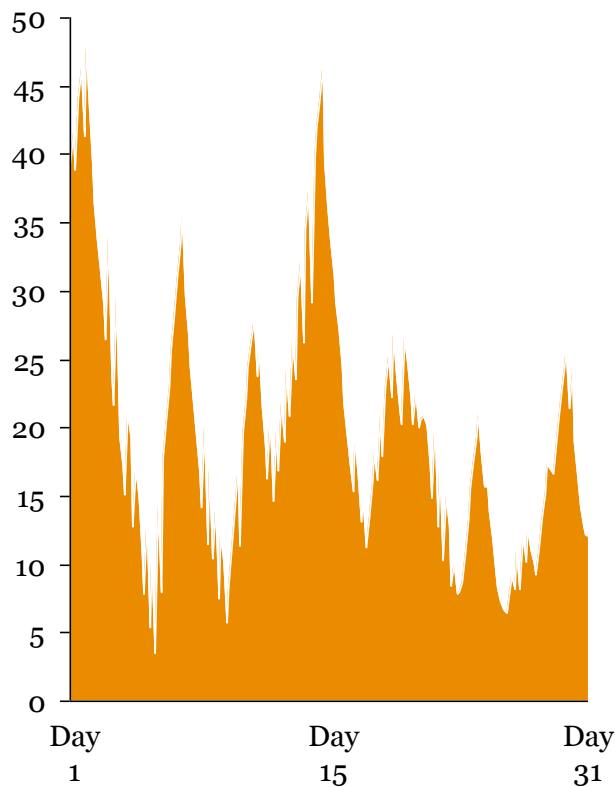
- Historically, electricity was generated centrally, fed into the grid and transmitted to end users. The Electricity Act makes a distinction between transmission/distribution and the generation/supply of electricity. Grid operators are responsible for transmitting/distributing electricity. They may not develop generation/supply activities (the ‘group prohibition’).
- The market for transmission and the market for distribution are a (legal) natural monopoly. The revenues of TenneT and the regional grid operators are therefore regulated by ACM to protect consumers and give grid operators an efficiency incentive.
- The energy suppliers make a daily ‘programme’ with their expected electricity consumption. They are responsible for complying with this programme. They can solve any threatening aberrations by means of the day-ahead and intraday market. Should an imbalance threaten to arise in the grid, TenneT will solve this by means of the reserve markets.

...but with the transition to renewable energy, the amount of decentralised (renewable) electricity fed into the grid increases. The volatility of the electricity supply also increases

Development of renewable energy in NL
% in relation to total energy consumption



Total production of solar PV in the Netherlands
Example for one month in GWh



Impact of the growth of renewable energy

- The Netherlands has set itself the goal of increasing the share of renewable energy to 15% by 2020, 16% by 2023 and in 2030 to contribute to the European target of at least 27%.
- In order to achieve these targets, the share of renewable energy must increase significantly in the coming years. The generation of wind and locally generated solar energy is therefore expected to play an important role.
- This leads to a growing amount of decentrally generated electricity being fed into the grid. In addition, the generation of wind and solar energy is accompanied by supply peaks, in contrast to many traditional non-sustainable sources. The wind does not blow constantly at the same speed and the sun is not always available with the same strength. This leads to an increase in the volatility of the electricity supply.

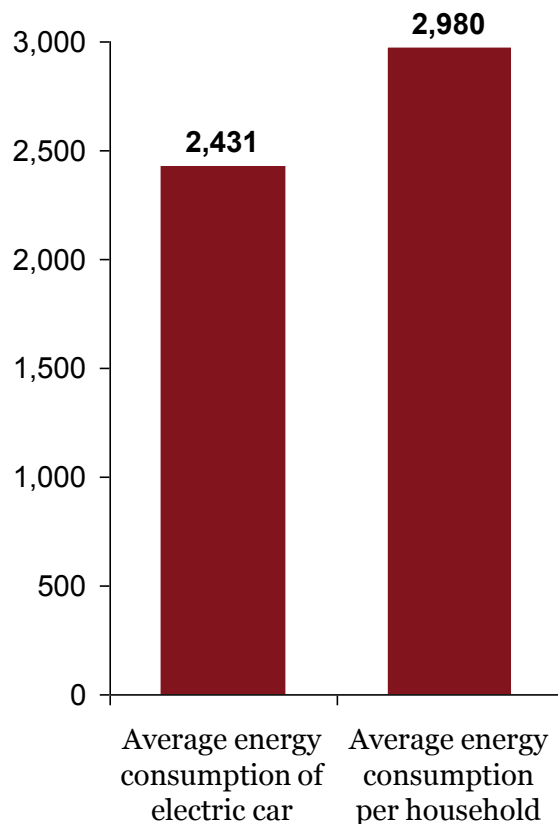
Source: CBS (2017) & EnTranCe(2016)

At the same time, the growth of electric transport and electrification of the built environment increases the peak demand for electricity

Consumption of an e-car in perspective

In number of kWh per year¹

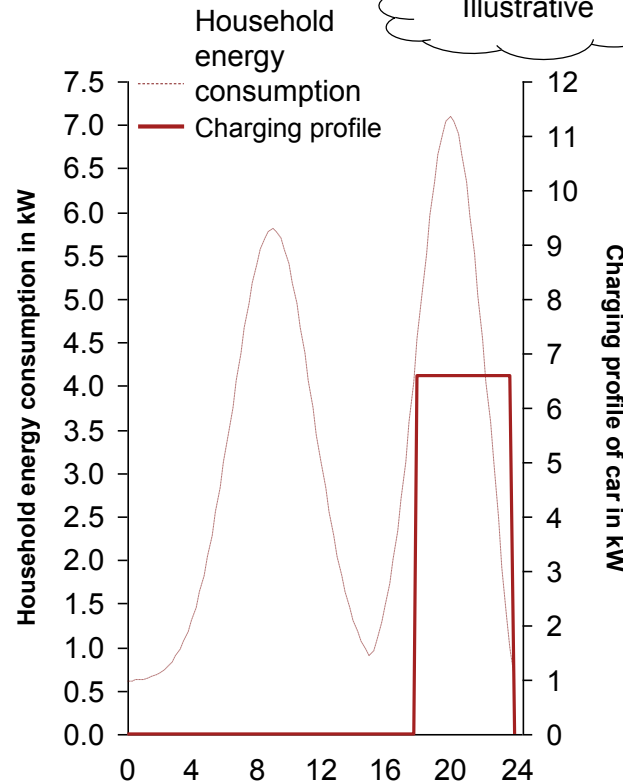
Example



Electricity demand and charging profile of EV

In kW at any hour of the day, stylised example

Illustrative



Peak demand in regional grid

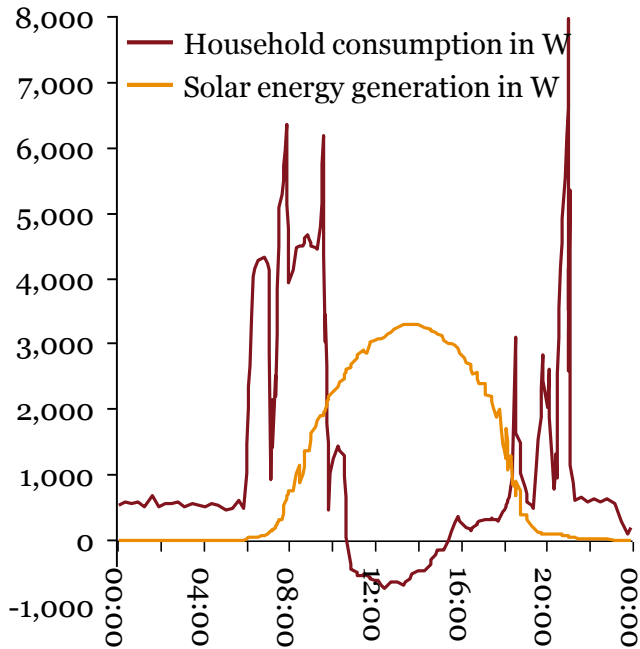
- The demand for electricity increases due to the growth of electric transport and electrification of the built environment.
- The energy consumption of electric cars is characterised by a high peak demand. Consumption often takes place at times when there is already a high peak demand from households (when arriving home). A household's annual electricity consumption can almost double with the use of an electric car (depending on the use of the car).¹
- In new buildings, heat pumps (electrically powered) are increasingly being used for the heat supply that further increases the peak demand. The target is to have 500,000 heat pumps installed in homes in 2020.
- At some locations in the regional grid, this already presents problems so that the grids may have to be upgraded.

Note:¹ based on an average consumption of ~0.19 kWh/km (Tesla model S, the most popular full electric model in 2017) and a distance of 13,000 km driven on an annual basis

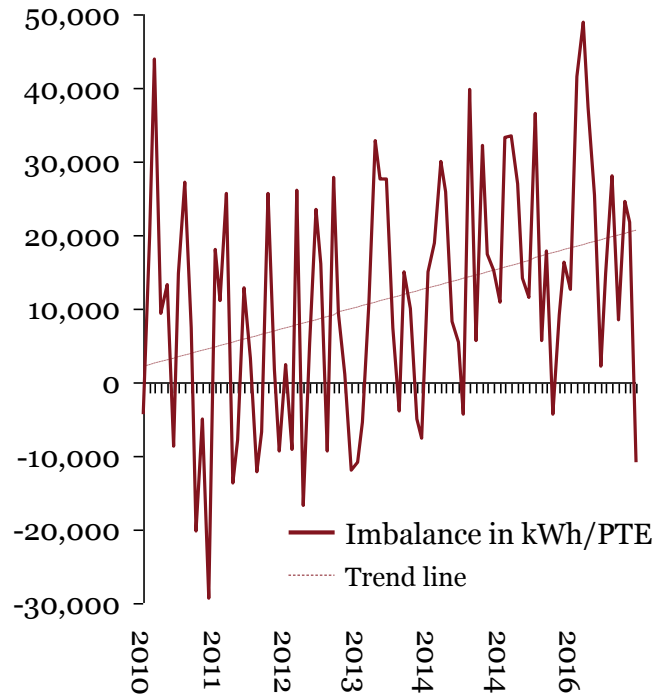
Source: Statline CBS (average household consumption, average annual number of kilometres), RDW (2017) & RVO (2017)

This creates a greater mismatch between moments of supply and moments of demand

Profile of energy consumption and solar generation during one day
Stylised example for one household in Watts



Greater imbalance in the electricity grid
In number of MWh/PTE per month







Matching supply & demand

- The generation of sustainable wind and solar energy does not match the current demand for electricity. During the day solar energy generation is high and during the night there is a lot of wind energy generation, while the demand peaks are in the early morning and in the evening. This creates a greater mismatch between moments of supply and moments of demand for electricity.
- It is expected that this increased volatility in demand and supply of electricity will make it more difficult for national grid operator TenneT to maintain the balance in the electricity grid.
- The imbalance in the electricity grid has increased in the period 2010 to 2016. Since sustainable electricity generation and the number of electric cars are still small, this will only have contributed to a limited extent. This is the expectation in the future, however.

Source: PwC analysis, TenneT (2017) & Ensoc (2016)

Due to these developments, the various players on the electricity market are facing challenges. Flexibility is required in order to ensure a clean, affordable and reliable energy supply in the future

Challenges for traditional players on the electricity market:

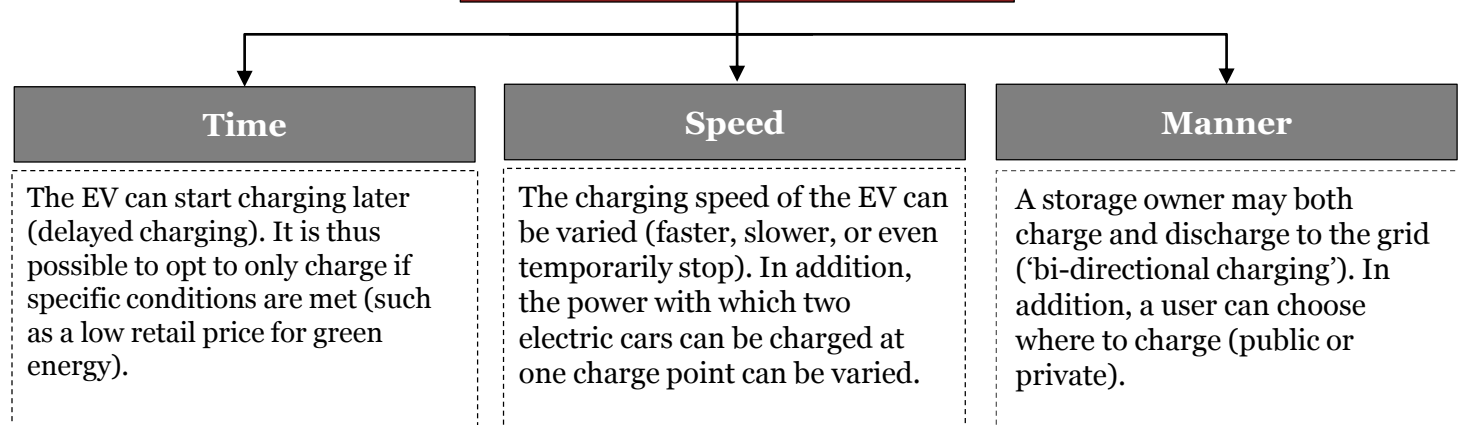
 Producer of sustainable electricity	 National grid operator	 Regional grid operator	 Supplier/Programme manager
<ul style="list-style-type: none"> Generators increase the amount of sustainable electricity generated. However, the generation of wind and solar energy occurs at times when the demand for electricity is relatively low (wind energy at night and solar energy during the day). The tariffs that the producer can receive for the generation of its renewable electricity at these times are relatively low. If the demand and supply can be more closely aligned, a better price may be realised. Storage techniques and Smart Charging can be of value here. 	<ul style="list-style-type: none"> As a result of the ambitions for electricity sustainability in the Netherlands, TenneT can in the future rely less and less on coal and gas power plants to resolve the imbalance in the grid. The imbalance must be met in the primary, secondary and tertiary reserve markets with other forms of flexibility (less/more supply or demand). Flexibility can be achieved by means of demand management or storage. 	<ul style="list-style-type: none"> The regional grid operators are increasingly faced with peak loads as a result of the charging of electric cars and locally generated solar energy. This has a repercussion on the required capacity in the grid. In certain cases, the regional grid operator will have to upgrade its grid in order to meet this new peak demand. The use of flexibility (reduced demand at peak moments or storage of generated electricity) can help reduce this problem. 	<ul style="list-style-type: none"> For the programme manager, the complexity of estimating his programme is expected to increase. When estimating their programme, they must take account of local solar energy generation and the (peak) demand from electric cars. This increased complexity could mean that programme managers (especially in the short term) are less able to comply with their programme, so they cause more imbalances with associated imbalance costs.

Smart Charging

Smart Charging can optimise the charging of an electric vehicle by aligning the time, speed, and charging method with the e-driver's preferences and prevailing market conditions

Schematic overview of Smart Charging

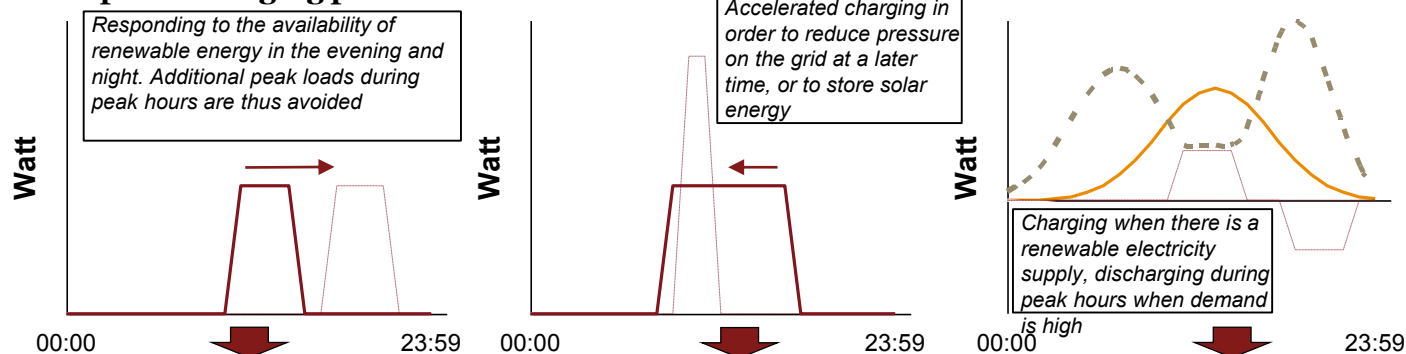
Smart Charging



Interests of e-driver and market brought together

- Smart charging can stimulate electric transport by means of a better charging experience for e-drivers (such as easy availability, timeliness of charging).
- Renewable electricity can also be optimally used for electric transport.
- Finally, Smart Charging can unlock flexibility that can be used for several purposes (see next page).

Example of charging profile



Legend






- Sun profile
- Charging profile
- Energy usage household
- Amended charging profile

Responding to preferences of E-driver and market conditions (such as the availability of renewable electricity)

Note: Flexibility can also be realised by means of demand response from other consumers and by using static storage.

Smart Charging contributes to the interests of different parties

In practice, Smart Charging can be deployed for a number of purposes:

Player	Smart Charging purposes
 E-driver	<p>Timely charging so that the e-driver's mobility requirements can be substantiated The e-driver determines the time when the battery must be full in order to meet his/her mobility requirement.</p> <p>Optimise own consumption behind the meter (by means of bi-directional charging) An e-driver can charge his car during the day using self-generated solar energy, discharge his car for the night for his own use during peak hours and, if necessary, fully charge again in the night with renewable wind energy, for example. The e-driver can thus optimise his own consumption behind the meter.</p>
 National grid operator	<p>Use of the flexibility of electric cars for reserve markets Reserve market providers can offer the flexibility of electric cars for TenneT's balance sheet maintenance by fully charging cars in the case of a surplus supply of electricity and temporarily stopping or postponing charging in the case of surplus demand. Smart Charging increases TenneT's ability to use renewable energy in order to solve the imbalance in the electricity grid.</p>
 Regional grid operator	<p>Use of flexibility to avoid grid upgrades Smart Charging can help the regional grid operator to resolve congestion in its regional grid at peak times in the grid. As a result, there is less need for grid upgrade investments.</p>
 Programme manager/supplier	<p>Use of flexibility to realise programme Programme managers can use Smart Charging to ensure that their programme is realised. This will prevent any imbalance costs arising from non-compliance with their programme. Programme managers who are both suppliers and generators can also use Smart Charging to charge cars with any surpluses (for example, from wind energy).</p>
 Charge Point Operator	<p>Load balancing to optimise the charge point power Charge Point Operators can use Smart Charging to optimise the utilisation of their charge points. By applying Smart Charging (load balancing), they can optimally distribute the available power to the charge point between the cars that are charging there, based on the characteristics of the car (charging capacity) and the e-driver's preferences.</p>

In order for Smart Charging ('SC') to work in practice, the various stakeholders in the chain must work together

The Smart Charging chain:

Manufacturer of electric vehicle

- Supplies EV to e-driver
- Determines whether EV is suitable for SC
- Unlocks data for SC (State of Charge, charging speed)



E-driver

- Orders charge point for home
- Selects charging location and charging time according to mobility requirements
- Opts for participation in SC initiative



Municipality

- Provides public charging infrastructure for e-driver
- Determines charge point requirements in invitation for tenders

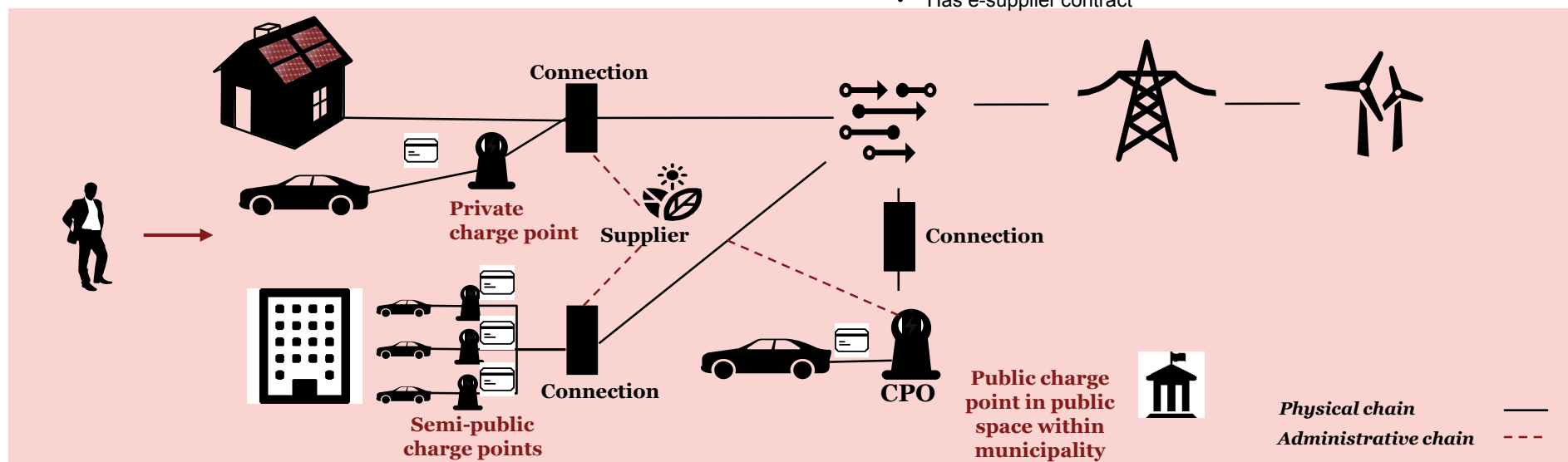
Charge Point Operator (CPO)

- Realises the charge point based on e-driver request or tender specifications of municipality or company
- Optimises use of charge point (load balancing)
- Has e-supplier contract



Regional grid operator

- Provides charge point connection
- Can use flexibility from Smart Charging to reduce or delay regional congestion



Electric mobility service provider

- Provides charging card and arranges settlement
- Possible in future role in SC by offering form of subscription



Energy supplier and programme manager

- Can use flexibility from car e-driver to perform programme responsibility



National grid operator

- Can use flexibility from car e-driver on reserve markets for grid balancing



Generator

- In the case of surplus renewable energy, store energy in car to avoid negative prices

A number of Smart Charging experiments are currently taking place in the Netherlands. They aim to scale up further but encounter institutional bottlenecks that delay or block the scaling-up

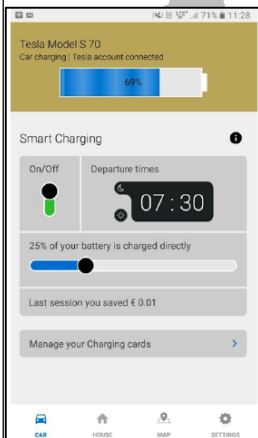
Examples of Dutch Smart Charging initiatives



Vandebron and **TenneT** are working together on a pilot project to use the flexibility offered by electric car charging sessions in order to balance the Dutch electricity grid. Vandebron supplies power by starting or stopping charging during the charging session of an electric car at TenneT's request.



Jedlix uses Smart Charging by temporarily postponing the charging of electric cars and recharging them at a later time, for example when Eneco has generated a lot of renewable electricity. In this way Jedlix helps Eneco to perform its programme responsibility. The driver indicates with the app when the car must be fully charged ('time of departure') and what the minimum charge status of the car should be.



MRA-E, Greenflux and the municipality of Alkmaar, among others, are experimenting with variable charging tariffs (in off-peak and peak hours) in a pilot project with 20 charge points.

LomboXnet



In the Lombok district of Utrecht an experiment is being conducted with the bi-directional (back and forth) charging of electricity in electric cars. The solar energy generated in this district is stored in electric cars during the day and in the night it is used to relieve the regional grid by feeding it back at times when there is a peak in demand.

Limited scaling-up possibilities

- Various Smart Charging initiatives are currently active in the Netherlands. The extent to which the initiatives experience institutional bottlenecks differs:
 - Initiatives that temporarily stop or delay charging typically experience bottlenecks that delay the further roll-out of Smart Charging.
 - Initiatives involving bi-directional charging experience barriers that can effectively stop the initiatives because the business case is very negatively affected.
- Initiatives currently being implemented within the Electricity Act's experimentation scheme can often scale up within the scope of this. Scaling-up options are limited however: a maximum of 10,000 customers while the NL target is 200,000 EVs by 2020. Furthermore, the scheme will end in 2018. Structural solutions are required to scale up Smart Charging.

Current institutional frameworks do not comply with requirements accompanying these new initiatives and may therefore impede the development of Smart Charging

Examples of institutional frameworks within which Smart Charging parties operate:

Institutional frameworks	
Electric car manufacturer	<ul style="list-style-type: none"> Manufacturers of electric cars must ensure that the techniques used in the car are applicable in combination with the charging infrastructure. For example, the car must use relevant (existing and new) communication protocols.
E-driver	<ul style="list-style-type: none"> E-drivers who generate solar energy behind the meter can offset their household's electricity consumption with their own generation of it. They then only pay energy tax on their household's net consumption.
CPO	<ul style="list-style-type: none"> In order to charge electric cars, the CPO must ensure that the charge point can communicate with the electric car (including about the State of Charge and battery's charging capacity) by making use of the same communication protocols as the car. In doing so, the parties involved must ensure that the exchanged information complies with privacy legislation.
Regional grid operator	<ul style="list-style-type: none"> The duties of the regional grid operator are laid down in the Electricity Act. This explains the frameworks within which the regional grid operator may operate. For example, its tariffs are determined by ACM.
National grid operator	<ul style="list-style-type: none"> The national grid operator's duties are also laid down in the Electricity Act and ACM determines its tariffs. In addition, the grid operator must comply with the ENTSO-E¹ rules for participation in the reserve markets.

Outdated frameworks

- Players in the Smart Charging chain must operate within institutional frameworks. Examples of institutional frameworks are legislation and regulations, technical standards and other sectoral agreements.
- The existing institutional frameworks were not designed for electric driving and Smart Charging. This may lead to risks for the development of Smart Charging and the transition to electric transport. For example, due to a poorer charging experience and higher costs for the e-driver.
- In this report we identify institutional bottlenecks and possible solutions for the most urgent and most important bottlenecks.

¹ European national grid operators from 36 countries are affiliated with ENTSO-E. ENTSO-E formulates detailed guidelines for the optimum functioning of European markets. It has, for example, established standards that bids on the reserve markets must satisfy.

Institutional bottlenecks

The identified institutional bottlenecks for Smart Charging are basically divided into three overarching themes:

Types of institutional bottlenecks



1. Market regulation issues

- The Smart Charging Market is new, thereby creating new roles and responsibilities. This leads to institutional bottlenecks because A) the new roles have not yet been incorporated into legislation and regulations and B) existing roles may need to be adjusted. In order to stimulate the further roll-out of Smart Charging, it is important that the necessary new or adapted roles and responsibilities are included in legislation and regulations. The goal is to achieve an optimal operation of the market that leads to socially optimal welfare outcomes.



2. Sub-optimum financial incentives

- The new Smart Charging Market is confronted with existing legislation and regulations that affect the charging price for the e-driver or other parties (energy tax, VAT, tariff structures, grid costs, but also electricity transmission costs). This is not designed to encourage Smart Charging and may in some cases even (inadvertently) obstruct Smart Charging. The financial incentives arising from existing legislation are not optimally designed to stimulate Smart Charging.



3. Data exchange for optimum coordination

- To enable Smart Charging, multiple parties in the chain must work together and share information with one another. At present, there is no shared vision of the data that must be shared to ensure optimum collaboration. Technical standards and information protocols that apply throughout the chain are still under development. This can result in coordination problems that slow down the further development of Smart Charging.

Reading guide

Illustrative: long list of institutional bottlenecks

1) Electric car manufacturer

- Bottleneck 1

2) E-driver

- Bottleneck 2

▪ ...

3) Municipality

- Bottleneck 8

▪ ...

4) Charge Point Operator and electric mobility service provider

- Bottleneck 10

▪ ...

5) Regional grid operator

- Bottleneck 13

▪ ...

6) National grid operator

- Bottleneck 17

7) Energy supplier and programme manager

- Bottleneck 18

▪ ...

8) Chain

- Bottleneck 20

▪ ...

Theme
Term
Impact



Explanatory note

- Based on our study, we have identified 23 bottlenecks. We have arranged these bottlenecks according to the step in the chain where this bottleneck occurs (see also the next page of this report) and evaluated them ('high', 'medium', or 'low') on the basis of the criteria 'period within which action is required' and 'impact on the development of Smart Charging'. We also indicated by means of figures the broader theme under which the bottleneck can be classified (market regulation, financial incentive, coordination problem).
- With the aid of this evaluation, we have identified the most important bottlenecks: the shortlist. These have both a high score on period and a high score on impact.
- Below we first outline all major bottlenecks (minimum score medium). We then explain the bottlenecks that must be solved immediately (shortlist) and the bottlenecks for which a solution before 2020 is desirable. We subsequently also mention bottlenecks that are particularly important for the further development of the charging infrastructure across the board.
- For a complete overview of the identified institutional bottlenecks, please refer to the appendix.

Legend

Period action start – Impact

- High: now – major negative impact
- Medium: 2018 - 2020 – limited impact
- Low: > 2020 – no negative impact

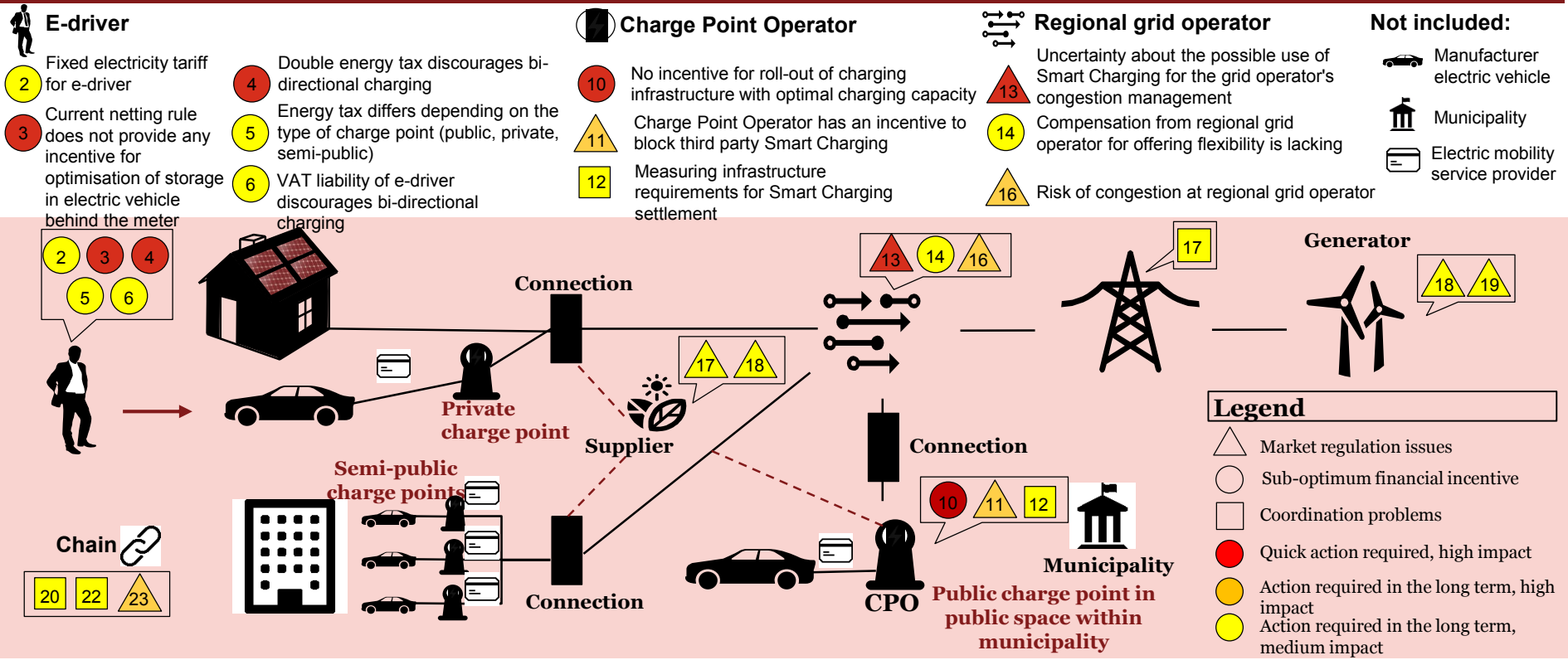
Theme

- △ *Market regulation issues*
- *Sub-optimum financial incentive*
- *Coordination problems*

Bottlenecks are experienced at several places in the Smart Charging chain

See the separate appendix to this report for a complete overview of all bottlenecks with an explanation of the assessment

Identified Smart Charging bottlenecks¹



National grid operator

- 17 ENTSO-E rules for participation in reserve markets

Energy supplier and programme manager

- 18 Supplier of electricity at e-driver's home decisive for participation in Smart Charging behind the meter.
- 19 Limited possibilities for Smart Charging at public charge points by other supplier that supplies at the charge point

Chain

- 20 Access to required Smart Charging data is lacking
- 22 Limited experience with data that must be shared for Smart Charging and compliance with privacy legislation
- 23 Uncertainty about who determines use of electric car ('who may exert pressure') and which initiative takes precedence

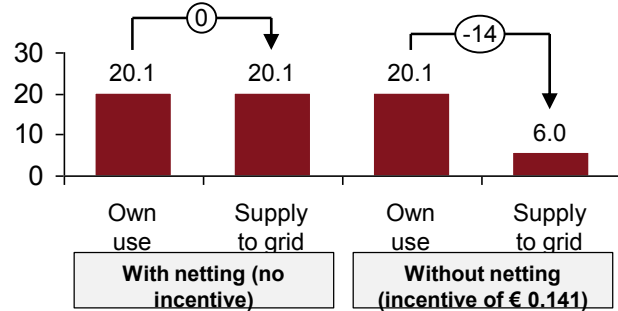
Note:¹ bottlenecks with a 'low' score on impact are not included in this summary.

Our study reveals four key bottlenecks that need to be addressed in the short term for the development of Smart Charging (1/2)

3 No incentive to optimise storage in electric vehicle behind the meter

Incentive to store electricity behind the meter

In eurocent/kWh

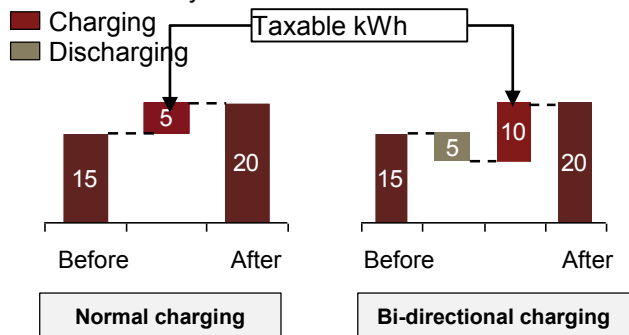


- The netting rule has stimulated the purchase of solar panels because low-volume consumers only pay for the balance of kWh that they consume from the grid on an annual basis.
- This arrangement actually allows low-volume consumers to ‘virtually’ store electricity that they generate themselves on the grid. No costs are charged for this. As a result, low-volume consumers (with a private charge point) have no incentive to optimise the self-generated electricity behind the meter, for example by storing it in their electric car for later use. This may cause a double peak in the grid: supply peak due to the generation of solar energy that is not used immediately and a demand peak if the electric vehicle is charging. The rule will be revised as of 2023¹.

4 Double energy tax discourages bi-directional charging

Energy tax in different charging situations

Power in battery in kWh



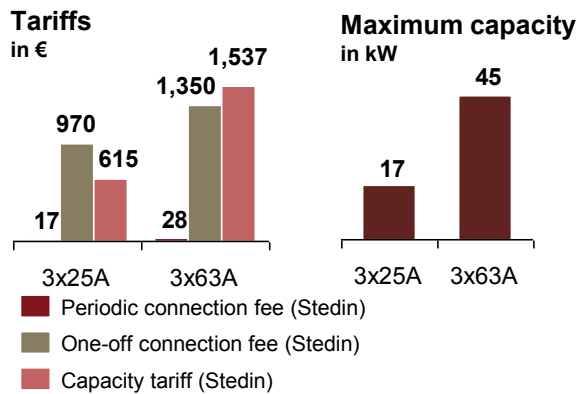
- The use of the electric car for bi-directional charging (charging and discharging the car), whereby the stored electricity from the car can be used at a later time, can lead to double energy tax.
- An e-driver must pay energy tax on all kWh with which his car is charged. This does not make it attractive for him to make his car available for bi-directional charging since energy tax has to be paid on the charged kWh every time the car is discharged after charging.
- The existing netting rule in principle prevents low-volume consumers with a private charge point paying double energy tax in the case of bi-directional charging at a private charge point. It is currently unclear to what extent this also applies to (semi-)public charge points.

Note:¹ Postponement of review of netting rule from 2020 to 2023 due to Motion by Jan Vos (Dutch Labour Party; PvdA) and Liesbeth van Tongeren (Dutch Green Left Party; GroenLinks), December 2016

Our study reveals four key bottlenecks that need to be addressed in the short term for the development of Smart Charging (2/2)

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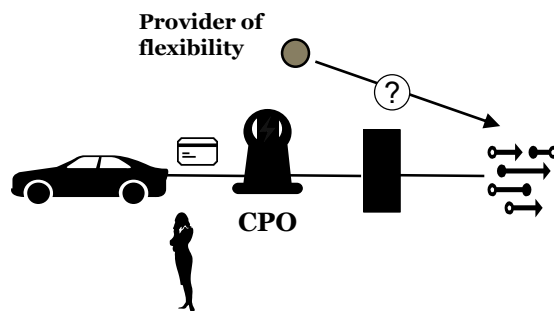
No incentive for the roll-out of charging infrastructure with maximum charge capacity for Smart Charging



- Charge point connections can have different capacities, such as: 3 x 25, 3 x 35 or 3 x 63 amps. The higher the capacity of the connection, the faster a car can be charged and the more flexibility is generated for the use of the car for Smart Charging. If charging is temporarily stopped, for example, the car can be charged on time by speeding up the charging (according to the e-driver's wishes).
- A high capacity connection is significantly more expensive than a lower capacity connection. One of the reasons for this is the difference in capacity that must be reserved on the grid in order to meet the peak load of the connection. The tariffs for the connection are determined by ACM. Because of these higher costs, mostly low-capacity connections are installed in the (semi-)public domain.

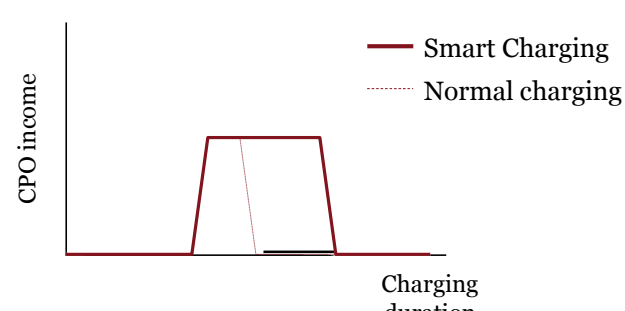
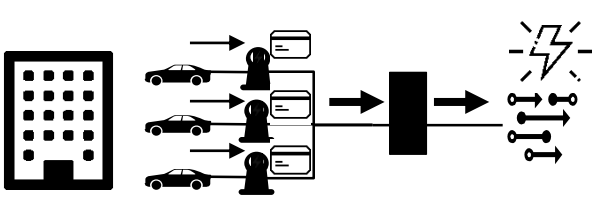
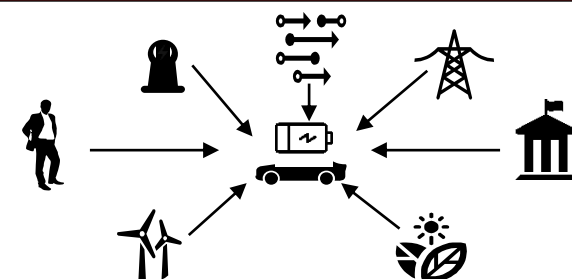
13

Uncertainty about the possible use of Smart Charging for the grid operator's congestion management



- The core task of the grid operator is the transmission of electricity to the consumer: they may not trade, generate or supply. Under current legislation (group prohibition and rules for congestion management from the Electricity Act and Grid Code), it is unclear whether they may purchase flexibility from third parties. The question is whether this is in line with the statutory duties of the grid operators. As a result, it is unclear whether they may deploy Smart Charging. Under current regulations, grid operators may only temporarily apply congestion management. They are obliged to eliminate situations of transmission scarcity as quickly as possible by investing in grid upgrades.

In addition, a number of bottlenecks have been identified that are important to solve but which can be dealt with during the period to 2020

<p>11 Charge Point Operator has an incentive to block third party Smart Charging</p> 	<ul style="list-style-type: none"> The interest of the CPO differs in some cases from the interest of the e-driver, the programme manager, regional grid operator and the national grid operator. The CPO's business model is usually based on maximising the utilisation of the (semi-)public charge point and optimising the use of available charging capacity between the two charging points on the charge point. Smart Charging initiatives by one of these other players may result in the car being kept at the charge point for a longer period. There is a risk that the CPO will intervene in the planned delayed or bi-directional Smart Charging charging session in order to optimise its use of the charge point.
<p>16 Risk of congestion at regional grid operator</p> 	<ul style="list-style-type: none"> The use of the storage capacity of electric cars for certain types of Smart Charging, which, for example, aspire to the use of reserve markets for balancing or complying with the programme responsibility could lead to congestion in regional grids. For example, when the cars that are used for this simultaneously charge (or discharge) on the same regional low voltage grid.
<p>23 Lack of clarity about who determines the use of the electric car ('who may exert pressure')</p> 	<ul style="list-style-type: none"> It is currently unclear who determines that the battery of the electric car is used for Smart Charging, and, when the e-driver has connected his electric car to several initiatives, which initiative takes precedence. The roles and responsibilities of the various parties involved in providing flexibility by means of Smart Charging are still unclear. The CPO may be concerned with load balancing (control via the charge point) while the e-driver has given the supplier permission to use the car on TenneT's reserve markets (control via the car).

Finally, a number of points have been identified that do not directly affect Smart Charging but do need to be addressed for the development of charging infrastructure.

Explanation:

Our study also reveals institutional bottlenecks that do not *directly* affect the development of Smart Charging, but which have a significant impact on further roll-out of charging infrastructure. These are often bottlenecks that lead to high costs for charging infrastructure.

Description of a number of bottlenecks for the development of charging infrastructure

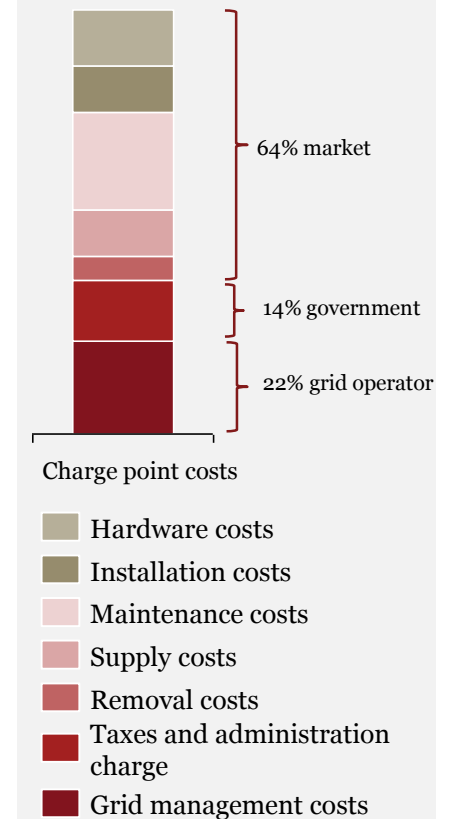
Lack of transparency for the e-driver

- The (structure of the underlying) costs of electric driving are often unclear to the e-driver. The e-driver pays a remuneration to the energy supplier (home charging) or to the electric mobility service provider (public charging), depending on the location where he/she charges, but only sees this afterwards. As a result, the costs are unclear when the e-driver wants to charge.

Processes for the realisation of municipal and grid operator charge points

- Various parties, such as municipalities and grid operators, are involved in the process of realising a charge point. They work together to improve the efficiency of processes and thus to improve the costs for realising a charge point.
- Although steps have been taken here, further efficiency in the processes and thus a cost reduction must be realised in the future to help improve the business case for public charge points.

Cost allocation between cost items on public charging infrastructure
(Annual costs per socket, per kWh)



Source: NKL (2015)

Possible solutions

In the long term, a number of structural changes to legislation and regulations must be investigated and implemented to accelerate Smart Charging and resolve various bottlenecks

Structural revisions of the legislative and regulatory framework in order to promote energy transition

Market regulation	Sub-optimum financial incentives	Data exchange for optimum coordination
<p>The Smart Charging market must be optimally designed to unlock flexibility and to encourage smart charging moments. To this end it is necessary to consider the extent to which new roles and responsibilities must be introduced and to what extent existing roles and responsibilities must be adapted to achieve optimal alignment with the desired operation of the Smart Charging market.</p>	<p>Revision of (energy) tax system - In order to accelerate Smart Charging, a complete revision of the (energy) tax system is ultimately desired. This should incorporate an incentive to reduce CO₂ emissions. In the current system, grey and green energy are taxed the same, so that it does not reflect the original regulatory nature of the energy tax. Negative financial incentives for sustainable (energy) solutions should be removed and replaced where necessary with positive financial incentives. This includes the introduction of an exemption for CO₂ neutral solutions or the use of a fixed tariff for low CO₂ solutions or a progressive tariff as the CO₂ emissions increase. A <i>level playing field</i> for Smart Charging can also be achieved in this way.</p> <p>Grid operator tariffs - The tariffs of grid operators do not currently give customers any incentive to purchase electricity from the grid at the right times, in order to avoid peak loads in the grid as much as possible. At present, the transmission tariff does not depend on the time of purchase from the grid, so that users do not take account of a possible peak load when they decide to purchase electricity.</p> <p>Supply tariffs - Electricity consumers are not encouraged to adjust their consumption to the supply of electricity by means of the retail tariff. In order to fit renewable electricity in the electricity grid, the demand must be more closely aligned to the (volatile) demand. This can be stimulated by means of a financial incentive to purchase more if there is a lot of renewable electricity available, such as by means of a variable supply tariff (part of the total retail tariff). However, this only provides a limited incentive because the tax component in the retail tariff (for low-volume consumers) currently determines a major part of the electricity tariff. A holistic approach is therefore necessary when creating the right incentives for consumers, which includes different tariff components.</p>	<p>The operation of the Smart Charging chain depends on digital data exchange (vehicle charging status, possible charging speed, time when the e-driver wants to leave, and minimum battery charge level).</p> <p>It must be determined which data should be made available to market parties in order to optimally perform their task or to develop new services and products that maximise social welfare.</p> <p>Protocols for data access and exchange must also be developed.</p>

Until then, a number of measures can be taken to accelerate the resolution of the most important Smart Charging bottlenecks

1) Optimise incentive for electric car storage of own consumption

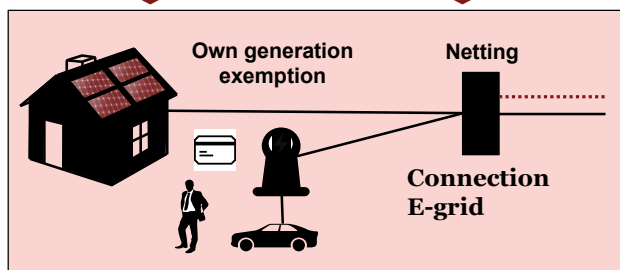
Institutional bottleneck: No incentive to optimise storage in electric vehicle behind the meter

The solution must make own consumption more financially attractive than discharge to the grid. Because no financial incentives are currently available for solutions behind the meter, the e-driver chooses to return all self-generated electricity to the grid instead of storing it in an electric vehicle behind the meter.

Existing regulations provide no incentive for storage in electric cars

Own generation exemption: no energy tax on self-generated electricity that is consumed immediately

Netting rule: energy tax on the positive balance of the purchase and discharge of electricity



1 Optimise incentive for storage in electric car for own consumption

- Electricity that the consumer generates by means of renewable energy sources is, in principle, not subject to energy tax (Own generation exemption). In addition, energy tax is currently only payable on the positive balance of the purchase and discharge of electricity on the public grid (Netting rule).
- Storage behind the meter can be stimulated by reducing the netting benefit of Section 50(2) of the Environmental Taxation Act (Wbm) in proportion to the benefit received from the self-generated electricity exemption provided for in Section 50(6) Wbm.
- The advantage of the above solution is that it is relatively easy and soon possible to realise. One disadvantage is that the solution is related to the political discussion about the adjustments to the netting rule. Furthermore, this solution does not remove the second tax bottleneck (with respect to bi-directional charging).
- It was recently stated that the Netting rule will be retained until 2023 and the new Cabinet will decide on the proposed alternatives: Feed-in grant or Investment grant. For Smart Charging it is important that the solution is designed in such a way that there is sufficient difference between the advantage of storing self-generated electricity behind the meter and the feed-in payment. This particularly appears to be a challenge with the Feed-in Grant, since this must not be too low because it must result in a cost-effective business case with an acceptable pay-back period for solar PV.

Impact of solution on stakeholders

Solution	Economic Affairs/DTA	Manufacturer of electric vehicle	E-driver	CPO	EMSP	Local government	Regional grid operator	TenneT	Generator	Supplier/PV
1	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green

The proposed solutions have an impact on the various players in the chain. This impact can be positive (green), neutral (yellow), or negative (red).

Optimising the incentive for own consumption appears to have a positive or neutral impact on the stakeholders. In addition, this solution should have a budget-neutral effect.

2) Do not qualify bi-directional charging as supply in order to prevent double energy tax

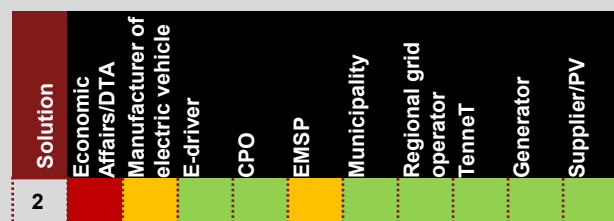
Institutional bottleneck: Double energy tax discourages bi-directional charging

The solution must eliminate the uncertainty about possible double energy tax in order to stimulate bi-directional charging. This encourages the e-driver to opt for solutions behind the meter, such as storage of electricity in an electric car.

2 Do not qualify bi-directional charging as ‘supply’

- On the basis of the current wording of the Environmental Taxes Act (Wbm), it can be argued that energy taxes must be charged on every charged (and ‘discharged’) kWh. Thus, with a constant back and forth flow of electricity in and out of the electric car, every charged kWh would be taxed, even though only a small part of this (the balance) actually remains in the electric car and is consumed by the e-driver. This results in double taxation.
- A solution would be to publish policy stating that, for energy tax purposes, a (taxable) supply does not apply if an electric car is temporarily made available as storage capacity and in this respect electricity is supplied back and forth. Instead, this should be regarded as a storage service for which no energy tax is due. On balance, energy tax is only payable on the net amount of charged electricity. Since the concept of supply in the Wbm is consistent with the Turnover Tax Act 1968, a fundamental change of the concept of supply in Section 3 of the Turnover Tax Act 1968 is not an immediate possibility. After all, this would require a change in the European VAT Directive (on which the Turnover Tax Act 1968 is based). The designation of a storage service is easier to realise.
- If the foregoing is not feasible, policy could be issued to facilitate netting for charge points (netting at the charge point), or a provision specifically included in the Wbm that energy tax is only payable on the net amount of electricity (the balance) charged via a charge point.

Impact of solution on stakeholders



The proposed solutions have an impact on the various players in the chain. This impact can be positive (green), neutral (yellow), or negative (red).

If bi-directional charging is not qualified as supply, we believe that this has a positive or neutral impact on stakeholders. Despite the fact that the absolute tax revenue for central government may be lower, this would not be a disadvantage for central government since double taxation was not budgeted.

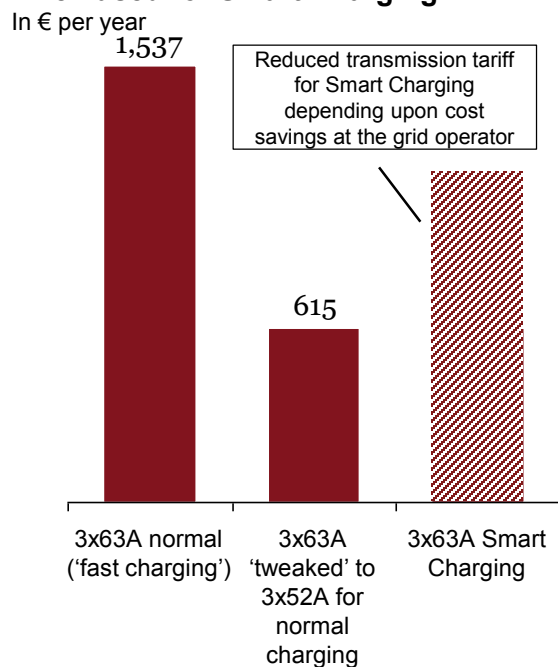
(3) Introduce reduced transmission tariff for Smart Charging use so that the costs for the consumption of the more powerful connection is lower if this leads to cost savings for the grid operator

Institutional bottleneck: No incentive for the roll-out of charging infrastructure with maximum charge capacity for Smart Charging

Smart Charging can be deployed to prevent a peak load at the regional grid operator. This can lead to lower costs for the grid operator. These costs must be reflected in the tariffs paid by the users to encourage a situation whereby the charging of the electric car is more closely aligned to the available capacity in the grid.

Illustrative: reduced transmission tariff

when used for Smart Charging*



3a

We have identified two solutions that help to solve this bottleneck in the short term:

Reduced transmission tariff when used for Smart Charging

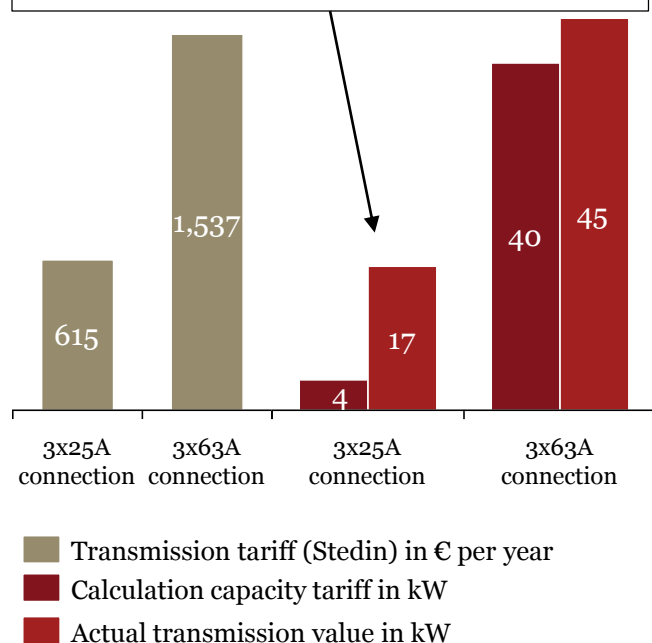
- The grid operator's regular tariffs consist of three elements: the transmission tariff (also capacity tariff and standing charge), the regular connection fee and the metering tariff. Smart Charging particularly has an impact on the costs that form the basis for the metering tariff. The transmission tariff is a fixed amount that depends upon the size of the connection.
- The transmission tariffs are determined on the basis of the cost causation principle. A connection with a greater capacity generally results in higher costs than a connection with lower capacity. This is because, for example, a grid operator needs to reserve more capacity in its grid for a connection with greater capacity, which results in a higher transmission tariff.
- However, if the connection with a greater capacity is used for Smart Charging to reduce the grid load, then this may not apply. In that case, the higher capacity connection is actually used to avoid costs and a lower transmission tariff could be appropriate. In line with the cost-causation principle, the costs that are not caused by the use of the connection for Smart Charging should also not be oncharged in the transmission tariffs.
- At times when the greater capacity connection is not used for Smart Charging (or reduction of the grid load), the connection could be tweaked, depending on the e-driver's requirements. If the e-driver wishes to charge more cheaply, the connection could be tweaked so that it does not feed through more than a standard 3x25A connection. In that case, the e-driver will pay a lower tariff for charging. If the e-driver prefers fast charging (not for Smart Charging), he pays a higher charging tariff (because his charging session causes higher costs in that case).

*Based on Stedin's regulated tariffs

(3) Determine transmission tariff for 3x25A connection on the basis of actual consumption so that the tariff difference between a 3x25A and 3x63A connection decreases and the incentive to opt for 3x63A increases

The transmission tariffs for low-volume consumers are based on an average calculation capacity

The current tariff difference between a 3x25A and 3x63A connection is partly the result of a large difference between the calculation capacity and the actual transmission value of a 3x25A connection.



3b

Determine transmission tariff on the basis of actual consumption

- The transmission tariffs for low-volume consumers (up to 3x80A connection) are not determined on the basis of actual consumption, but on the basis of an average calculation capacity set in the Tariff Code. This calculation capacity is an estimate of the expected capacity demand of these connections.
- The calculation capacity used for the 3x25A connection is 4 kW. However, the maximum capacity that can be supplied (and consumed) through this connection, also referred to as transmission value, is ~17 kW. The calculation capacity for a 3x63A connection is 40 kW, while the actual transmission value is ~45 kW. With a 3x63A connection, the difference between the calculation capacity and the actual transmission value is much less than with the 3x25A connection.
- The 3x25A connection is also used to connect private and public charge points. The calculation capacity of 4 kW is not representative of the actual consumption of a 3x25A connection to which a charge point is connected. This is expected to be close to 17 kW. The 4 kW is based on 'old-fashioned' use of the connection (before the arrival of electric cars, solar panels and heat pumps).
- This means that the transmission tariffs for 3x25A connections that are used for charge points are actually too low. If these tariffs are based on the actual costs, the cost difference (and hence the tariff difference) between the 3x25A connection and the 3x63A connection decreases, and there is sooner an incentive to opt for a higher capacity connection.
- There are two possible solutions for this:
 1. Base the tariffs for the 3x25A connection on the actual average use. This leads to an increase in tariffs for all consumers.
 2. Tariffs vary on the basis of actual use. This leads to an increase in tariffs for consumers that use more than 4 kW.

For the implementation of the proposed solutions, an amendment of the Electricity Act (3a), the Tariff Code (3b) and the Ministerial Regulation (3a and 3b) is required

3a

The introduction of reduced transmission tariffs for Smart Charging requires an amendment of the Electricity Act and the Ministerial regulation

- For the implementation of solution 3a, reference can be made to the treatment of the energy intensive industry in the Electricity Act (Section 29(7)ff elaborated in Section 29(8) to (11) and the Ministerial regulation on tariff structures and electricity conditions). The energy-intensive industry is eligible for volume adjustments on the electricity transmission tariffs. The legislator at the time substantiated this amendment with the argument that the largest customers contribute to the stability of the grid and thus to TenneT's system task:

“The purpose of the bill is to apply a volume correction to the net tariffs for energy-intensive companies to the extent that these companies contribute to the stability of the electricity grid.”¹

- A similar exception can be created for participants in Smart Charging initiatives for a reduction of grid load. After all, Smart Charging initiatives launched for this purpose also contribute to the stability of the electricity grid.

Determination of the transmission tariff on the basis of actual consumption requires an amendment to the Tariff Code and the Ministerial Regulation

3b

- For the implementation of solution 3b, Article 3.7.13a of the Electricity Tariff Code must be amended. This Article states that the transmission-dependent consumer transmission tariff for consumers with a connection with a transmission value of 3x80A or less is calculated on the basis of the calculation capacity referred to in that Article. This calculation capacity is set at 4 kW for a 3x25A connection and at 40 kW for a 3x63A connection. In addition, amendment of Article 4(2) of the Ministerial Regulation is required. This states that the total consumption per customer is set at the average consumption for each category of customers with the same maximum transmission value.

Source¹: *Parliamentary Papers II* 2013/14, 33 777, no. 3, p. 1

Impact of solutions on stakeholders

Solution	Economic Affairs/DTA	Manufacturer of electric vehicle	E-driver	CPO	EMSP	Local government	Regional grid operator	TenneT	Generator	Supplier /PV
3a	Yellow	Yellow	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Green
3b	Green	Yellow	Red	Red	Yellow	Red	Yellow	Yellow	Yellow	Green

The proposed solutions have an impact on the various players in the chain. This impact can be positive (green), neutral (yellow), or negative (red).

The introduction of a reduced transmission tariff when using Smart Charging does not have a negative impact on stakeholders.

Changing the transmission tariff on the basis of actual consumption may have a negative impact on the e-driver, the CPO and local authorities in the short term. The charging costs for the e-driver at home or at a public charge point with a 3x25A connection will increase. In addition, the CPO's business case deteriorates, so that local authorities must provide more grants in the short term. The possibilities for Smart Charging do increase, however.

(4) Modification of the task of regional grid operators in the E-legislation in line with the proposed Recast Electricity Directive to remove uncertainty about the purchase of flexibility from third parties

Institutional bottleneck: Uncertainty whether regional grid operators may reduce flexibility

Regional grid operators can use flexibility to prevent congestion in their regional grids. The use of flexibility from Smart Charging can prevent them from having to accommodate peaks in their grid by means of upgrade investments. This can lead to socially optimal welfare outcomes because the increasing costs for the electricity grid (as a result of electric charging, locally generated solar energy and heat pumps) can be held down by using Smart Charging. It is currently unclear whether regional grid operators may purchase flexibility from third parties.

4 Modification of the task of regional grid operators in line with the Recast Electricity Directive in the Electricity Act

- The European Commission is currently working on a European Directive (Recast Electricity Directive) requiring Member States to amend their regulatory framework in order to allow regional grid operators to use flexibility solutions to prevent capacity expansion of the electricity grid. Regional grid operators may purchase these solutions subject to transparent, non-discriminatory and market-based conditions.
- The European Commission has made a proposal that has still to be approved in the European Parliament. As soon as the European Parliament has granted its approval, the Netherlands is obliged to implement this Directive into Dutch law 20 days after publication in ‘The Official Journal of the European Union’. The modification of the task of regional grid operators to enable them to purchase flexibility solutions from third parties will be implemented in Section 16 of the Electricity Act (and in underlying legislation such as the Grid code).
- Until that time, the ACM could be asked for an opinion.

Impact of solution on stakeholders

Solution	Economic Affairs/DTA	Manufacturer of electric vehicle	E-driver	CPO	EMSP	Local government	Regional grid operator	TenneT	Generator	Supplier /PV
4	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Yellow	Yellow	Yellow

The proposed solutions have an impact on the various players in the chain. This impact can be positive (green), neutral (yellow), or negative (red).

The proposed solution has a neutral or positive impact on the players in the chain. As a result of the implementation of the Recast Directive, the current uncertainty in the market will be eliminated and Smart Charging can also be used for the benefit of the regional grid operator.

Appendices

Study scope and approach

Scope and approach

Scope



In this report we identify institutional bottlenecks that impede the development of Smart Charging. We assess these bottlenecks on the basis of the impact they have on the further development of Smart Charging and the period within which action is required. Based on this evaluation, we identify the most important bottlenecks for Smart Charging. For these bottlenecks, we identify solutions that can be realised within a relatively short period and that enable market and government to accelerate the development of Smart Charging. These solutions were selected following interviews and workshops with market and government parties.

For the less urgent or important bottlenecks we have not identified any solutions. However, the overview of all identified bottlenecks in the separate appendix to this report may form a good starting point for future discussions about solutions for these points.

Availability and quality of information



The study was carried out during the period from May to July 2017. We completed our fieldwork on 20 June 2017.

We have identified the institutional bottlenecks in the following manner:

- Literature research based on public data and documentation;
- Interviews with Smart Charging initiatives, market parties, government bodies; and
- Workshops with experts from the relevant sectors and public authorities concerned.

See also pages 54 to 57 of this report.

Important remarks about the scope of our work and explanation about the use of this report

This report was commissioned by the Municipality of Utrecht and Stichting ElaadNL, in collaboration with MRAE-G4/G4 and the province of North Brabant. We did not perform analyses on the gathered information that had the nature of an audit. We do not accept liability or a duty of care (either contractually or due to unlawful act (including negligence or otherwise)) to anyone but our clients the Municipality of Utrecht and Stichting ElaadNL.

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 - Websites and news reports about various local Smart Charging initiatives (Province of Brabant, MRA-E, Smart Charging living lab)

Participating parties in interviews and workshops

Interviews and written input received

- ACM
- ElaadNL
- EV-Box
- Municipality of Utrecht
- G4/MRA-E
- Jedlix/Eneco
- Netbeheer NL
- LomboXnet.
- Nissan
- Ministry of Economic Affairs
- Province of North Brabant
- Stek Advocaten
- TenneT
- Vandebron

Workshops

*PwC Amsterdam . (2017, 1 June).
Workshop Smart Charging I.*

- ElaadNL,
- Engie Infra & Mobility,
- EV-Box,
- Municipality of Utrecht,
- Municipality of Rotterdam,
- Holland Solar,
- Ministry of Economic Affairs,
- Ministry of Infrastructure and the Environment,
- MRA-E/G4,
- Netbeheer Nederland,
- NVDE,
- Province of North Brabant,
- Stedin.

*PwC Amsterdam . (2017, 21 June).
Workshop Smart Charging II.*

- Allego,
- Alliander,
- Engie Infra & Mobility,
- EV-Box,
- Municipality of Utrecht,
- Stek Advocaten,
- Ministry of Infrastructure and the Environment,
- MRA-E/G4,
- Netbeheer Nederland,
- TenneT.



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