Ministry of Economic Affairs

Vision on the charging infrastructure for electric transport

Policy agenda looking ahead to 2020

For smart and clean transport

Contents

Summary

On the way to smart and clean transport: various scenarios

There are two obvious major movements of relevance to the vision on the charging infrastructure, namely the further development of electric transport (cars, vans and buses) and the move towards smarter and increasingly autonomous mobility. Uncertainties related to the pace and direction of the transitions to a low-carbon economy and autonomous mobility remain high. Ecofys and Eindhoven University of Technology were asked to carry out a scenario study examining the key variables related to the development of charging infrastructure in order to provide clarification, direction and substantiation. This vision is based on elements of that scenario study. A policy agenda (chapter 7) which provides a perspective for action until 2020 has been formulated to enable the implementation of this vision.

Core of the vision

Optimal accommodation of smart electric transport in the Netherlands

The objective is to ensure that the charging infrastructure accommodates the development of electric transport in the Netherlands. This means making sure that adequate charging infrastructure is available so as to avoid hindering the rise in the number of electric vehicles.

Capitalising on economic opportunities

Electric transport has developed rapidly in the Netherlands. As a result, the Netherlands is currently the international frontrunner as regards electric vehicles, including buses and heavier means of transport, and the infrastructure for them. This creates many opportunities for businesses, and we intend to capitalise on these on an international level through economic missions and by means of programmes like Partners for International Business with Germany, the USA and India, which positions this sector in promising markets abroad.

On the way to a profitable business case

In the years ahead, we will work towards a situation where the business case for charging infrastructure is profitable. This will also require the government to change its role in respect of the development of charging infrastructure for electric transport. In the present incentivising phase, efforts are being made through, among other things, the Green Deal for Publicly Available Charging Infrastructure, to achieve a further cost-price reduction through innovation, efficiency improvements and encouraging rollout and scaling up. The Green Deal will ensure that public infrastructure can develop further over the next few years, even without direct government incentives.

A national network in a European context

From an international perspective, the Netherlands has a well-developed national network. This network will have to continue to grow if it is to accommodate the rise in the number of electric vehicles. It is also important that interoperability is guaranteed and that drivers of electric vehicles are able to travel throughout Europe in a manner that is appealing to them. This is guaranteed in the Netherlands, but is not yet the case in Europe. That is why Dutch parties are making efforts to achieve this at the European level as well.

Smart and flexible charging infrastructure within an increasingly sustainable energy system

Smart and flexible solutions are required in order to reduce costs for network reinforcements in the future and facilitate cost-effective development of the energy network. Electric transport is one of the possibilities which could play a key role here. The efforts being made in relation to smarter and more flexible energy networks are described in the Energy Agenda.

Advantages of smart, clean and autonomous transport

The move towards autonomous and electric transport offers opportunities for the government's ambitions pertaining to mobility, the economy, climate and environment. The rise of electric transport means there is a need for public charging stations, in particular for people who are unable to recharge at home or at work. Increase in scale will be a challenge for the energy network, which will face both an energy transition and a mobility transition. Smart charging in smart grids is therefore a solution which may save costs.

At regional level too

As and when the transition to electric vehicles demands, the spatial aspects related to charging infrastructure, such as parking, will also be a key area for local authorities to address. Regional authorities have an important part to play here because issues related to charging infrastructure, including spatial issues, arise mainly at local level.

The role of the government

Through the Charging Infrastructure Green Deal, the central government is providing incentives to ensure that the business case is profitable. The central government also has a part to play when it comes to promoting innovation, eliminating obstacles, and providing the right market stimuli and incentivising legislation. The facilitation of cooperation in this area also remains necessary.

Market model and the 'charging tree' ('ladder van laden') are used as the basis
The market model for charging infrastructure for electric transport developed in 2012 in collaboration with a large number of parties remains the basis for the further development of charging infrastructure. The 'charging tree' also provides a clear framework; see chapter 3.8. The number of charging points and the location is in line with the quantity of cars. In other words, there are no fixed goals for the quantity of charging points. It is first and foremost a matter for the market to create a suitable mix (private, semi-public, public and fast-charging) in the quantity of charging options.

Agreements under a Green Deal or Green Deals
The central government set up the National Knowledge Platform for Public Charging Infrastructure (NKL) in 2014 to ensure that the business case becomes profitable. The NKL is the central point of contact for innovation related to public charging infrastructure. The NKL estimates that the business case for public charging infrastructure will be profitable by 2020. This means that, in the years ahead, the focus will be on implementing the actions as agreed in the Green Deals. This is in line with the expectations that the major increase in the number of electronic vehicles will take place after 2020 and it is also anticipated that the market will then be able to accommodate the greater demand for charging infrastructure itself.

1 Introduction

1.1 Green Deal

In the Electric Transport Green Deal 2016-2020, it was agreed with the parties involved[1] that a vision on the charging infrastructure in the Netherlands would be developed. This vision is to address various aspects, including new technological developments, regulations, interoperability and making the business case sound. These elements are revisited in the policy agenda for the vision through the Green Growth interventions[2]: incentivising market stimuli and legislation and regulations, knowledge and innovation, international efforts and organised collaboration. The market players and the government need a feel for the direction in which the charging infrastructure will develop further. The developments described in chapter 4, originating in the scenario study conducted by Ecofys and Eindhoven University of Technology and other reports, show that this market is in flux.

The vision was created on the basis of input from the Green Deal partners and various other parties consulted. Two well-attended stakeholder sessions were arranged for this purpose.

On the way to smart and clean transport
There are two obvious major movements of relevance to the vision on the charging infrastructure, namely the move towards a low-carbon economy and the move towards smarter and more autonomous mobility. The objectives in the area of climate change demand sustainable mobility, as described in the Sustainable Fuel Vision of 2014. Furthermore, ICT applications will make new mobility concepts for shared cars and autonomous transport possible. These will also have implications for the charging infrastructure, such as the need for specific forms of charging, such as charging stations or fast charging.

[1] Formule E-Team, ANWB, AutomotiveNL, BOVAG (association of motor car, garage and allied trades) the Bicycle and Automotive Industry Association, Netbeheer Nederland, Natuur & Milieu (Nature and Environment), Groene Zaak, the Dutch Organisation for Electric Transport (DOET), the Energie-Nederland Association, the Association of Dutch Car Leasing Companies (VNA), the Association of Dutch Municipalities (VNG), 3TU (Twente, Delft and Eindhoven Universities of Technology), the Dutch Renewable Energy Association (NVDE), the MRA (a partnership involving the province of Noord-Holland, the province of Flevoland, the City of Amsterdam, the Almere local authority, and the Amsterdam City Region), North Brabant and North Holland Provinces

[2] Mid-term review of Green Growth, Parliamentary paper number 33043-42

1.2 *Scenario study*

Uncertainties related to the pace and direction of the transitions to a low-carbon economy and autonomous mobility remain high. Much is already possible with the present state of the art, but social acceptance will ultimately determine the success of transitions to a large extent. Ecofys and Eindhoven University of Technology were asked to carry out a scenario study examining the key variables related to the development of electric transport and the charging infrastructure in order to provide clarification, direction and substantiation. Elements of that scenario study form a basis for this vision and are discussed in chapter 4.

1.3 Definitions

Jargon is often used in the world of electric transport. The main acronyms and definitions used in this document are set out below.

Term	Definition
EV	Collective term for all vehicles with an electric power train, or hybrid electric power train, and a plug-in connector
BEV	Battery Electric Vehicle, the term for vehicles with a fully electric power train (with no combustion engine) and a plug-in connector
PHEV	Plug-in Hybrid Electric Vehicle, the collective term for all vehicles with a hybrid-electric power train (with a combustion engine and electric motor) and a plug-in collector
E-REV or REEV	Extended-range electric vehicles or range-extended electric vehicles. A range extender is a small combustion engine which runs on petrol or diesel and recharges the battery. As a result, the car can travel much further than it would be able to using the battery alone. Unlike a hybrid car, where the propulsion comes from both the battery and the combustion engine, the range extender simply recharges the battery.
ITS	Intelligent transport systems (ITS) is an international collective term for the application of information and communication technologies in vehicles and transport infrastructure to make transport safer, more efficient, more reliable and more environmentally friendly.

2 Ambitions and relevant policy areas

Looking ahead to 2035, there are various ambitions and objectives (at both central government level and EU level) which have an impact on the development of charging infrastructure for electric transport. A number of key frameworks influencing that development are set out below.

2.1 Energy Agreement 2035

The Social and Economic Council of the Netherlands (SER) Energy Agreement contains agreements for the mobility and transport sector, with a view to increasing the efficiency of travel and transport and realising mobility on a sustainable basis. One ambition is to have all new passenger vehicles sold by 2035 be zero-emission capable.

2.2 European objectives in the area of transport and CO_2 for 2030 and 2050

Targets have also been set at European level. The European targets for the transport sector are laid down in the Transport White Paper, which is seen as a compass for future traffic and transport policy. The following main elements are relevant to passenger vehicles and vans:

- A 20% reduction in greenhouse gas emissions by 2030 relative to 2008.
- Growing transport and supporting mobility while reaching the 60% emission reduction target.
- Developing and deploying sustainable fuels and propulsion systems.
- Halve the use of conventionally-fuelled cars in urban areas by 2030 and phase them out completely by 2050
- Achieve essentially CO_2-free city logistics in major urban areas by 2030.

A medium-term CO_2 target has also been established. All non-ETS SECTORS (agriculture, built environment and transport) must, on average throughout the EU, reduce CO_2 emissions by at least 30% by 2030 (on the basis of 2005). The transport sector must contribute substantially to this. The Netherlands proposes to achieve average maximum CO_2 emissions of 70 g/km in 2025 and then a further reduction to an average of 35 g/km in 2030.

2.3 EU ambitions regarding health and air quality

There are also European frameworks and goals to tackle air pollution. The goal is to halve the number of premature deaths as a result of air pollution by 2030. Member States are given individual targets for the reduction of emissions of sulphur dioxide, nitrogen oxide (Nox), volatile organic compounds, ammonia and particulate matter. For 2030, there are far-reaching reduction obligations which are intended to result in a substantial improvement in public health in Europe. Cities in particular have encouraged the provision of charging infrastructure for electric transport in recent years, based on the objective of improving air quality.

2.4 Economic aspects of accessibility and mobility

Mobility is to a large extent determined by spatial choices. Where do we live, where do we work and where do we spend our free time? Mobility facilitates economic activity, gives people the opportunity to participate in society, is important to the choices of location that people and companies make, and contributes to economic potential and prosperity. The Netherlands has traditionally had a good starting position in the area of mobility and transport.

Economic growth may be a result of investments in accessibility, but, conversely, may lead to greater mobility and associated accessibility bottlenecks and, potentially, other negative external effects.

Mobility and accessibility need a transport infrastructure. It is often difficult to recover investments in a transport network. A collective good is achieved, however, which contributes to the economic structure. The transport and energy infrastructure has the character of a network, where the components of that network often become more beneficial when used in conjunction with one another. Expectations are that it will become stronger as the electrification of mobility increases.

2.5 Traffic safety and safety in public spaces

The Netherlands has ambitious goals in the area of traffic safety. The government is responsible for ensuring that people feel secure in public spaces and can move about safely. The Netherlands has one of the world's best traffic safety records. Cars have already become much safer in recent years, partly thanks to technical innovation. Autonomous vehicles could have a major impact on traffic safety and parking pressure.

2.6 A coherent vision

The government's role is to consider the development of electric transport and its infrastructure in conjunction with the goals and ambitions in the policy areas of economy, mobility, health and safety. This vision is the first step in that direction.

3 Picture of the present situation

3.1 Result of the policy of recent years

The relevant European policy framework until 2020 is formed by the source-based policy for vehicles, the Deployment of Alternative Fuels Infrastructure Directive, the Renewable Energy Directive and the Fuel Quality Directive. The latter two Directives require Member States and oil companies to use 10% renewable energy and to have reduced CO_2 emissions within the entire fuel chain by 6% by 2020 (relative to 2010). The source-based policy for vehicles requires that, by 2020, an average of 95% of all vehicles must meet the 95-gram standard. With these European policy frameworks, a start has been made with the implementation of the energy transition and realisation of the CO_2 reduction in the transport sector.

3.2 The Netherlands as an international frontrunner

Thanks to the incentivising policy and tax-related measures, electric transport in the Netherlands has developed rapidly. The improvements in technology and the sharp fall in the cost of batteries have also made electric vehicles an increasingly more attractive alternative to cars that run on petrol, diesel or gas in recent years. This development has also resulted in a sharp rise in the number of recharging points and improvements in recharging technology. As a consequence, the Netherlands is now an international frontrunner in the area of electric driving and the infrastructure for it. In 2015, the Netherlands occupied 2nd place in the global EV fleet (BEV and PHEV) rankings for market share, and 4th place in absolute figures, behind the USA, China and Japan. Norway was in 5th place. The Netherlands is also in the top five in the rankings based on the number of new registrations[3].

3.3 The number of electric cars in the Netherlands is rising steadily

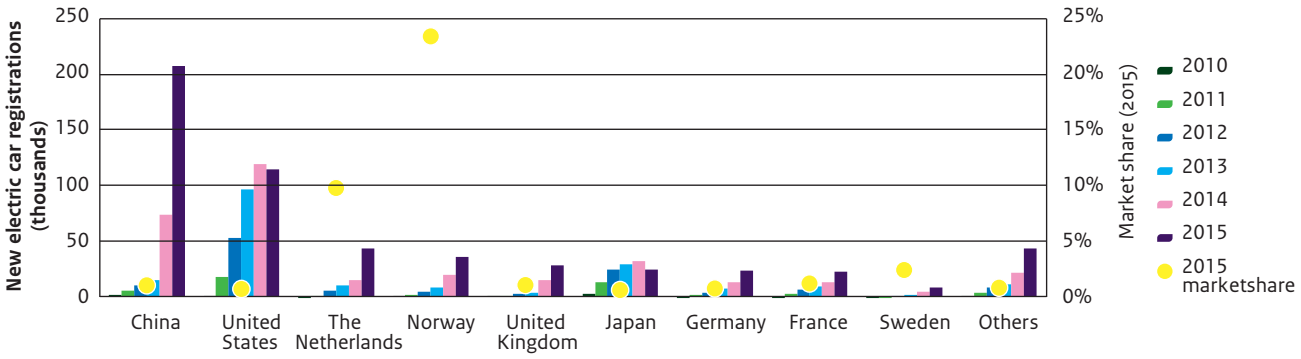
In November of 2016, there were more than 100,000 electric vehicles on the road in the Netherlands. Passenger cars make up the vast majority (approximately 95%) of today's electric vehicle fleet. Of these, roughly 12,000 are fully electric, and more than 86,000 are hybrids. The PHEVs and E-REVs jointly make up more than 80% of the electric fleet.

3.4 The charging infrastructure in the Netherlands is keeping pace

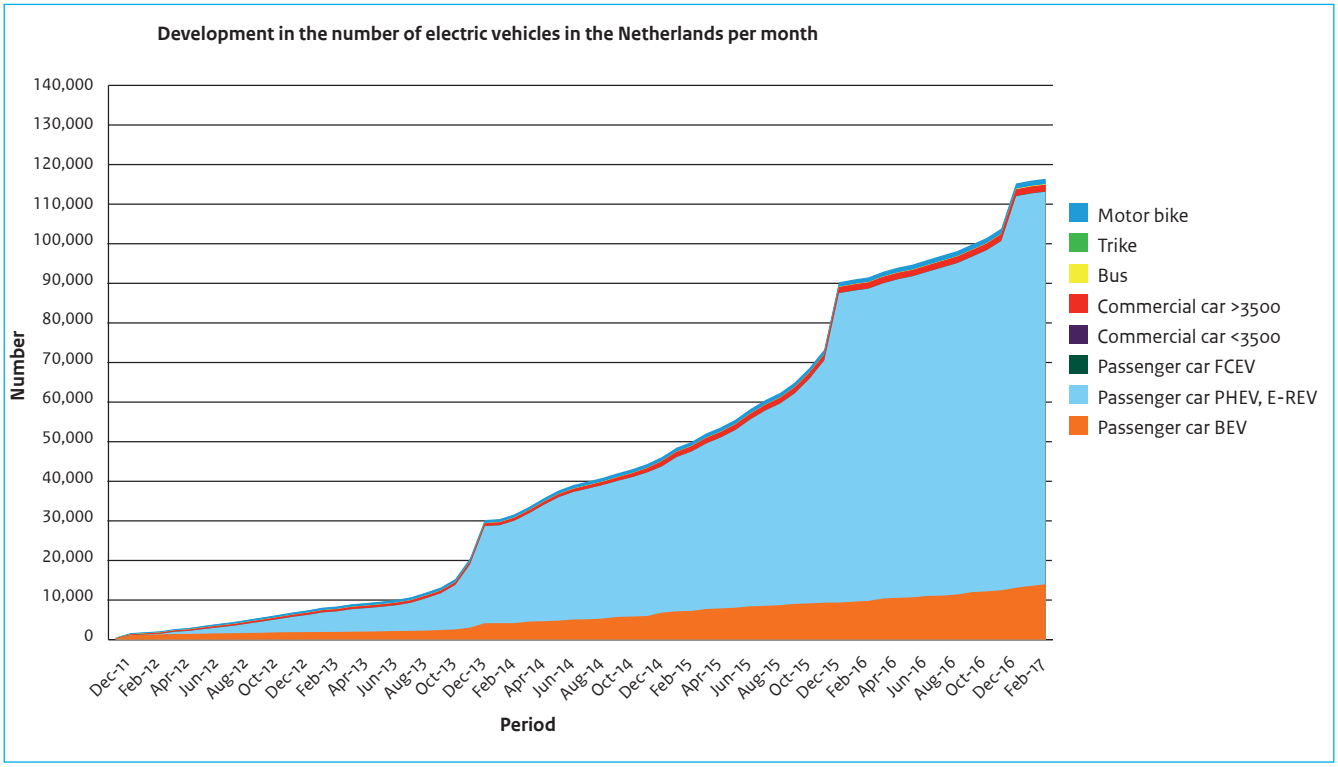
Amsterdam, The Hague, Rotterdam, Utrecht and Brabantstad (administrative network involving Breda, Tilburg, Eindhoven, Den Bosch and the Province of North Brabant) were designated as focus areas in 2009. The idea behind the focus on those areas was that a snowball effect would be created, and this indeed proved to be the case. Adjacent municipalities are finding that they need to facilitate charging points in public spaces as a matter of urgency, including municipalities in the Amsterdam and Utrecht regions, which are working together on the rollout of charging infrastructure.

[3] Global EV Outlook – OECD/IEA 2016

EV sales and market share in a selection of countries and regions, 2015



Key point: The two main electric car markets are China and the United States. Seven countries have reached over 1% EV marketshare in 2015 (Norway, the Netherlands, Sweden, Denmark, France, China and the United Kingdom).



3.5 Active municipalities, regions and provinces

A large number of municipalities, urban and metropolitan regions and provinces have invested substantially in the development of electric transport in recent years. Those authorities have achieved the policy objectives and installed charging infrastructure locally. In some cases, they have incentive programmes for electric vehicles and have joint projects, whether or not with European funding. Those authorities share their knowledge, work together and, through substantial investment, have installed charging points, often also being guided by the price for recharging. As a result, there is now a network of charging points where the local authority exercises control over its public space whilst allowing the market to develop.

3.6 Advent of fast charging

A network of publicly accessible private fast charging points (50 kWh) has been set up between the major cities on the main road network. This development was made possible by amending the Facilities Policy and thereby allowing market players to operate fast charging points on the main road network. Owing to the public nature of this development, the licensing conditions contain a provision stipulating that these fast charging points must be interoperable. These fast charging points must be able to charge cars irrespective of their make and the service provider. The network of fast charging points helps to reduce what is known as range anxiety. The Netherlands now has a network of fast chargers on the major corridors enabling drivers to drive throughout the Netherlands on electric power alone.

3.7 Charging points according to type and figures

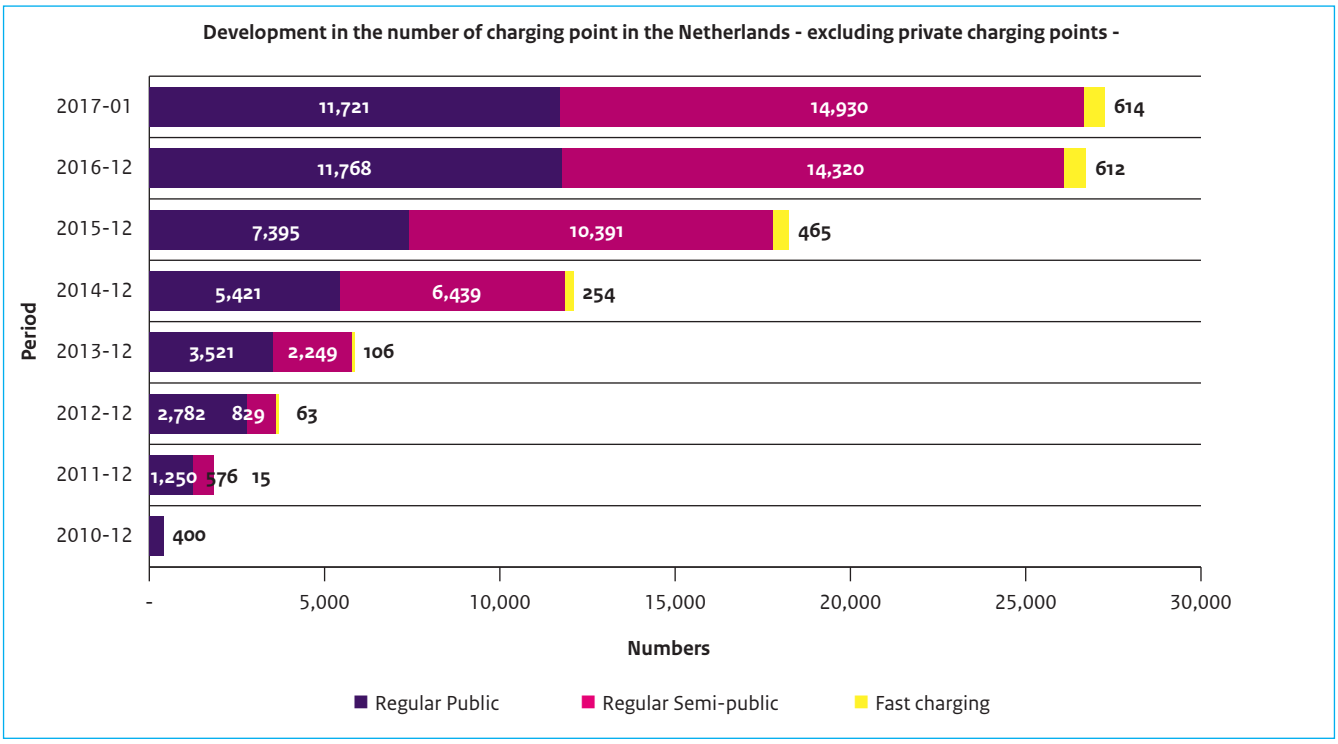
The RVO.nl website provides up-to-date information on new charging points in the Netherlands. EV drivers can also find virtually all publicly and semi-publicly available charging points in the Netherlands on the oplaadpalen.nl website.
Not all charging points are always accessible to all electric vehicles. RVO.nl identifies the following categories based on the location and accessibility of the charging stations.

1 - Public charging points are accessible 24 hours a day and seven days a week. They are the standard charging points in public spaces.

2 - Semi-public charging points are accessible to all, but there may be restricted public access to them because of parking or opening times. Examples include charging points in underground car parks, at hotel and catering establishments or service stations. There may be restrictions on use, such as the requirement to make use of the associated facilities.

3 - Fast charging points are so far mainly regarded as a way of bridging long distances when charging while parked is not possible. Fast charging takes place at a higher capacity. Fast chargers are usually found at specially designed sites in strategic positions, like next to the motorway. There are now more than 600 fast charging points in the Netherlands.

4 - Private charging points are points installed on a private site and connected to a private electricity supply. These charging points are often not accessible to electric cars other than those belonging to the owner of the charging point (although they may sometimes be accessible). They may also be charging points which the employer has installed for those of his employees who own an electric car. In general, car manufacturers offer a home charging station when an electric car is purchased.



Charging points[4]	31-12 2014	31-12 2015	31-12 2016
Public (publicly accessible 24/7)	5,421	7,395	11,768
Semi-public (with restricted public access)	6,439	10,391	14,320
Fast charging points	254	465	612
Private charging points	28,000	55,000	72,000
Total			98,700

3.8 Basic principles of the Dutch policy for infrastructure for charging

3.8.1 Charging tree

The central government uses the 'charging tree' for infrastructure in the electric transport policy. The basic principle of that policy is *'paal volgt auto'* (demand-driven positioning of charging points). The charging tree comprises:

1. Principally, EV drivers who park and charge on their own premises (work and home).
2. Thereafter, the emphasis is on semi-public charging facilities (i.e. private facilities in parking areas near stations, shopping centres and on business premises).
3. Ultimately, public charging facilities should meet the need for charging services.

The underlying idea here is that the costs of charging mean it makes sense for EV drivers to recharge mostly on their own premises, at home and at work. Using publicly accessible charging stations is more expensive because the installation costs, investment and variable costs of the charging point are greater. The publicly accessible charging point is not linked to a specific car. Using publicly accessible charging facilities is the last resort, with many municipalities considering a distance of 300 metres to the charging point to be acceptable.

The Netherlands Enterprise Agency is monitoring the extent to which the development of the charging infrastructure in the Netherlands is keeping pace with demand. The charging tree shows that there is a trend in the Netherlands where private and semi-public charging points are growing faster than public charging points.

In principle, it is a matter for the market to use what is known as the market model to create a suitable mix (private, semi-public, public and fast-charging) in the quantity of charging options.

3.8.2 Market model

In 2012, Innopay, under the direction of the central government, developed a market model for the payment for use of charging infrastructure. This was done in collaboration with a large number of parties, including energy companies, mobility providers and interest groups. The market model standardises two matters:

1. The ability to 'charge' with electricity at all charging stations in the Netherlands using a single card (interoperability).
2. The ability to charge for a user's consumption of electricity.

[4] The figures for private charging points are an estimate based on research and extrapolation based on registered EVs.

The market model has four roles:
The charging point customer - the user of the electric vehicle who wishes to recharge his vehicle. To this end, he is provided with access to a charging point by means of a card or an app. The user identifies himself at the charging point with his card or app.
A service provider – the supplier of the card (in return for payment by the charging point customer). This party keeps a record of the quantity of electricity purchased by the user and charges the user for it. To this end, the service provider liaises with
The charging point operator – a party which ensures that a charging point is accessible and that the point is capable of supplying electricity to the user's vehicle.
An infrastructure provider – keeps records (in return for payment by the charging point provider) of which users have purchased electricity at a specific charging point and how much they purchased.

The key starting points for the central government when this market model was developed, and which still apply, were:
- Freedom of choice in respect of the relationship with other players (simple to switch providers)
- Competition: dynamic and competitive market with transparent admission criteria)
- Convenience: simplicity and uniformity
- Cost effectiveness: optimise for SME admission
- Future-proof: able to respond flexibly to technological changes
- Self-regulating and requiring no amendment of legislation and regulations
- The government will act as facilitator, regulate and help start the process

3.9 Target figures

When we examine the development in the numbers of EVs, we see that in 2015 7% of all new cars sold (28,000 cars)[5] in the Netherlands had a plug-in connector, with 0.7% of them being completely electric and 6.3% PHEVs. It is stated in the Green Deal Electric Transport 2016-2010 that the Dutch government, jointly with social partners and market players, will aim for a growth in the share of electric vehicles such that, by 2025, 50% of new cars sold will be electric, of which 30% will be completely electric. The parties also aim to ensure that, by 2020, at least 10% of all new cars sold have an electric power train. Depending on the economic and technological developments, this will amount to about 140,000 EVs in 2020. After 2035, all new cars sold will have to be zero-emission capable. As stated earlier, it is up to the market to create a suitable mix (private, semi-public, public and fast-charging) in the quantity of charging options. In Ecofys's scenario study, estimates are made of what can be expected in relation to the number of points. With the Charging Infrastructure Green Deal (June 2015), the central government made a substantial contribution to the arrival of about 10,000 public charging points now and in the years ahead.

[5] Working on the assumption of approximately 40,000 new cars sold a year

3.10 The charging station business case

The charging infrastructure's business case is an important aspect of its market development. The National Knowledge Platform for Public Charging Infrastructure (NKL) has recently published an overview of the costs of public charging infrastructure in 2013, 2016 and 2020[6]. These figures were established based on knowledge and a wide-ranging review by stakeholders. The overview shows that the business case developed positively in the period between 2013 and 2016. For instance, the costs of charging stations have fallen by 30%, the average sale price per kWh has risen by 12% and consumption at public stations has increased by 70%. The drop in costs was caused in particular by the standardisation of the positioning process, an increase in scale and lower maintenance costs. However, the figures show that the business case is not yet sound in 2016. Expectations are that the business case will on average be sound before 2020. The parties involved in the Green Deal for electric transport are working on the assumption that no further specific government interventions in order to boost the rollout of electric transport will be necessary after 2020[7]. An overview of the various cost components in the business case can be found in the NKL publication. Consumption per charging station in terms of time partly determines whether or not a business case is sound.

3.11 The central government's role

What, then, is the role of the various authorities at present? With the development of the market model, the payment structure for driving vehicles powered by electricity in the Netherlands was standardised and made interoperable. This means that the development of charging infrastructure is, in principle, a matter for the market. However, while the private business case remains unprofitable, the present practice is for the Central Government and the municipalities to contribute to it. To achieve a sound business case, the Central Government therefore initiated the Publicly Accessible Electric Charging Infrastructure Green Deal in 2015, and the Charging Infrastructure National Knowledge Platform (NKL) was founded. As stated, the NKL expects an increasing number of business cases to be sound by 2020.

3.11.1 *The Facilities policy*

The central government is responsible for the Facilities policy for facilities at the side of national motorways. The Facilities policy applicable to service areas at the side of national motorways distinguishes between three basic facilities: fuel stations, roadside restaurants and service stations (the latter offers the opportunity to operate a fuel station and a roadside restaurant). Since only these three types of facility were permitted, the independent operation of

[6] http://nklnederland.nl/uploads/files/Verslag_workshop_Benchmark_Kosten_Publieke_Laadinfrastructuur_2016.pdf

[7] http://www.greendeals.nl/wp-content/uploads/2016/04/GD198-Elektrisch-Rijden-2016-2020.pdf

a solitary energy charging point was not possible. The Facilities policy applicable to service areas at the side of national motorways was amended on 10 January 2012, with the result that the energy charging point was also considered to be a basic facility. This enabled the development of solitary charging points and fast charging points at the side of national motorways. To allow the provision of other future energy facilities for vehicles at service areas, provided such is not contrary to the Motor Fuels Retail Outlets (Auction) Act, the more general term 'energy charging point' is used rather than the more limited term 'electric charging point'. It also covers a station for the exchange of batteries.

3.12 The role of municipalities

Depending on their ambitions and policy, municipalities may take up several roles or positions – reactive, facilitating and incentivising[8]. If a resident, company or provider of charging infrastructure contacts a municipality asking for a charging station to be installed on or at the side of a road near his house or business, an exemption from Section 2:10 of the General Municipal Bylaw will be required in nearly all cases. In the rules attached to the exemption, a municipality may impose requirements on the applicant and/or manager of the charging station. Examples of roles include:

- A municipality which cooperates with requests made by third parties. In that case, the municipality is merely the authority granting an exemption or licence (APV) and laying down a traffic order or traffic orders.
- A municipality which itself takes the initiative to ensure charging infrastructure is put in place (e.g. at a number of strategic locations within the municipality, like at the town hall, library, shopping centres, etc.). In that case, the municipality is the applicant and also the authority granting an exemption or licence (APV) and laying down a traffic order or traffic orders.
- A municipality which provides a subsidy so that charging infrastructure can be put in place for dwellings and/or businesses.
- A municipality which owns the municipal fleet which also comprises electric vehicles.
- A municipality which acts as an authority granting a concession or contracting authority for the charging infrastructure in public spaces on or at the side of the road.

3.12.1 *Policy rules*

In 2013, the Association of Netherlands Municipalities (VNG) drew up policy rules for charging infrastructure for electric vehicles to ensure the clear-cut and smooth development of charging infrastructure for electric transport. Those policy rules, which also contain the legal framework, are applicable to public charging stations and other recharging infrastructure in public spaces on or at the side of the public motorway, including public Park & Ride sites. The purpose of the policy rules is:

- To provide private individuals, companies, network operators and providers of charging infrastructure with clarity regarding the criteria and conditions under which the municipality will cooperate with the installation of charging infrastructure in public spaces and allocation of parking spaces for the recharging of electric vehicles.
- To inform private individuals, companies, network operators and providers of charging infrastructure of the procedure or procedures, including legal procedures, to be followed.
- To allow applications for the installation of charging infrastructure and allocation of parking spaces for the recharging of electric vehicles to be assessed and dealt with in a similar and comparable way.

The policy rules are not intended for municipalities which are themselves authorities granting concessions or contracting authorities. A model agreement has been prepared in collaboration with the VNG for those municipalities (annex in the CROW [Knowledge Centre for Traffic, Transport and Infrastructure] 'Charging points for electric cars in public spaces' guidelines', publication 336). The first step towards homogeneity is thus guaranteed.

3.12.2 *Local support*

At local level, there may be different schemes aimed at providing incentives for the installation of (private) charging points or electric transport. Such measures are being initiated in the four major cities for air quality purposes. For instance, the Municipality of The Hague has recently introduced a four-month purchase subsidy for electric cars (budget of € 300,000). And in Amsterdam there is a subsidy for the purchase of electric commercial vehicles.

[8] VNG – sustainable mobility

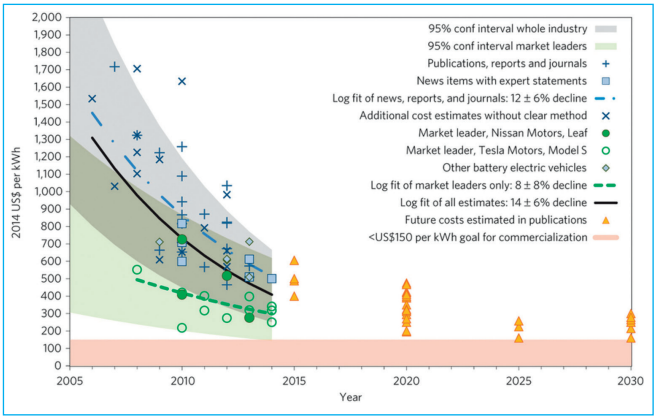
4 Trends and developments looking ahead to 2035

4.1 Electric cars are increasing in popularity

At present, worldwide sales of EVs amount to less than one percent. New cars account for 3.4% of sales in the Netherlands in 2016 (up to and including October). Although the total quantity is small, the worldwide sales of electric cars have risen sharply in recent years. This is in part thanks to support from governments, but is mainly the result of falling battery prices and increased interest on the part of consumers. Another reason is the increased supply of affordable cars with an acceptable battery range. Worldwide sales rose by more than 60% in 2015 alone.[9] The present range of electric cars on offer remains rather limited. However, nearly all car manufacturers have announced that they will be joining the market with electric models in the years to come. In addition, various countries are encouraging the move towards EVs. For instance, China recently introduced a quota for manufacturers, which is set to rise in percentage terms in the years ahead. Expectations are that an increasing number of (affordable) models will enter the market in the coming years.

4.1.1 *Partly because battery costs are falling rapidly*

Propulsion is cheaper in an electric car than in a car that runs on traditional fuel. Despite the aforementioned fall in battery costs, batteries currently account for 30% to 50% of the costs of an electric car[10]. Coupled with the often still limited distance that can be driven, this is one of the key bottlenecks for the market development of the electric car. A lower battery price changes this picture because it reduces investment and enables the manufacturer to expand the range of electric vehicles. Battery prices are currently falling dramatically[11], having gone from an average of 800 euros in 2010 to about 200 euros per kWh in 2016. This is the result of an increase in scale, improvements in battery chemistry and substantially improved battery management systems. The main cost item of the electric car has therefore decreased in size substantially over the last four years and expectations are that costs will fall further still.



4.2 Total Cost of Ownership (TCO) is developing positively

The TCO is an important aspect of the question as to when electric cars will make a breakthrough. The TCO shows the total cost of ownership and use of a car for the duration of ownership. When electric cars become cheaper than conventional cars for the duration of the car's lifespan, owners will switch to them for economic reasons. The Netherlands Environmental Assessment Agency has already reported on this[12]. At present, based on a 6-year period of ownership, the costs of an electric car are roughly 3,000 to 8,000 euros greater for private individuals than those of a comparable car run on petrol[13]. This is mainly because of the big (and uncertain) difference in depreciation charges. Bloomberg New Energy Finance published a report this year indicating that there would be a 'turning point' in about 2022[14], with Rabobank setting the date at roughly 2023[15]. Ecofys's scenario study has a comparable range. However, all the predictions are surrounded by high uncertainty because development depends on many factors.

[9] McKinsey & Bloomberg NEF – An integrated perspective on the future of mobility 2016

[10] Multi-year forecast for electric transport Ecofys 2016

[11] Rapidly Falling Costs of Battery Packs for Electric Vehicles – Nykvist and Nilsson Nature 2015

[12] Driving under electric power in 2050: implications for the environment – PBL 2012

[13] Groot Motion Review – PBL 2016

[14] Global EV sales outlook 2040 – Bloomberg New Energy Finance 2016

[15] The electric car: a convenient truth – Rabobank's vision on the electric car in 2016

4.2.1 But the total cost of ownership is not the be-all and end-all

The TCO is an important element in the commercial market. However, the TCO plays a limited part in a private individual's decision to purchase, as he or she is mainly guided by the (high) purchase price of an electric vehicle. (On average, the difference at present is about 10,000 euros). The private individual in particular may be influenced by other factors not expressed in monetary terms, like comfort and the great importance of a good driving distance.

4.3 Autonomous driving is well underway

The Netherlands intends to become the frontrunner in the area of autonomous cars and serves as a test bed for them[16]. The Knowledge Institute for Mobility Policy (KiM) developed a number of scenarios for this in 2015[17]. The development of autonomous driving is divided into various layers (see the box below). New cars in 2016 may have level-2 systems, for example, like adaptive cruise control or systems which help the car keep to its lane (lane assist). There are also some level-3 cars on the road (including the Tesla model S). The term autonomous car often means the development to levels 4 or 5, where the car is capable of making decisions completely autonomously. The car industry has announced bold ambitions in this area over the past year. For instance, Ford announced in August this year that it plans to start producing autonomous cars on a large scale as from 2021. And Tesla is already fitting all the cars it produces this year with hardware intended to allow to allow fully autonomous driving (level 5) within a few years. It is also well-known that technology companies such as Apple and Google are making substantial investments in this development[18].

The development of autonomous transport has the potential to have a major impact on demand for mobility or even to be a game changer[19], but precisely how it will develop and the effects thereof are difficult to forecast. The Ecofys scenario study does examine this, though, see 4.11.

4.4 Fast chargers are becoming ever faster

A distinction is often made in charging infrastructure based on the speed at which a vehicle can be charged (charging capacity). Although a large number of different charging capacities are provided, we can distinguish between roughly three types of charging points at the moment:

		Maximum capacity now
Charging at home or at work	AC	3.4 - 11 KW
Charging using a public facility	AC	Usually 11 kW to 22 kW
Fast charging	DC	44 kW to 120 kW

Fast charging will become ever faster in the years to come. Fastnet announced this year that it has adapted its charging infrastructure to enable it to support the move towards 150 kW. The European Ultra-E[20] project, which will see a network of 25 fast chargers with a capacity of up to 350 kW be built in the Netherlands, Belgium, Germany and Austria in the next two years, is evidence that even faster speeds are possible. The evolution of the need for higher charging capacities is more or less on a par with the move towards larger batteries, unsurprisingly, considering a larger battery requires a greater charging capacity while the charging time remains the same. The car's battery and the charging system must be closely aligned.

4.4.1 Fast charging places higher demands on the grid

Fast charging requires a lot of power. That is why a heavy draw on the power grid is inevitable. The greater the number of vehicles being charged and the greater the capacity used, the greater the demands on the grid. The capacity demanded and the costs thereof make the clustering of fast chargers at strategic locations a logical development. The degressive tariff system (the tariff drops as consumption rises) may also encourage this.

4.5 Wireless charging

Various companies are now experimenting with the wireless charging of electric cars. Through electromagnetic fields, the current is transferred to the car. The field starts charging when the electric car is parked at the charging point. Rotterdam has technology which allows electric cars to be recharged wirelessly. Together with various companies, the city has developed a charging plate. The car drives over an induction plate located in the road surface of a parking space. Charging can be started with the aid of an app. This technology is still in its infancy, but wireless charging has now been introduced in Formula E cars. For the moment, it is not clear when the consumer market will be able to use this technology, because the cars will also have to have the induction technology installed in them. The cars used for the pilot in Rotterdam had to be converted first.
In addition to wireless charging in parking spaces, work is also being carried out on technologies which will enable electric cars to be charged whilst being driven. Electromagnetic fields which can be used to transfer the current to electric cars while they are in motion will be installed in the road surface. Theoretically, this technology could soon allow vehicles to travel much longer distances running fully on electric power. However, the innovative nature of this technology makes it impossible to predict whether and when wireless charging will make a breakthrough.

[16] Large-scale tests of autonomous cars – Letter to Parliament 31 305 no. 210 2014

[17] Autonomous vehicles and the traffic and transport system of the future – KiM 2015

[18] Connected Car – PWC 2016

[19] IBO Flexibility in Infrastructure Planning – Central government 2016

[20] EU Connecting Europe Facility

Autonomous transport levels

0 – Not at all autonomous: The driver does all the work.
1 – Driving assistance: The vehicle can assist with steering and, in some cases, also assist with speed. However, the driver still has control over the vehicle.
2 – Partly autonomous: In some circumstances the vehicle can take over steering and speed control. However, the driver remains in control of the car.
3 – Provisionally autonomous: The vehicle does the steering, sets the speed and monitors the road. The driver is, however, obliged where necessary to take over control of the car.
4 – High level of autonomy: The vehicle can in fact drive itself without any assistance, even if the person does not respond to a request to take over control.
5 – Completely autonomous: The vehicle can do everything the human driver can do and more.

4.5.1 Opportunity charging

Opportunity charging has been developed mainly for the charging of electric buses, but may also be an attractive option for other vehicles[21]. Charging the vehicle at the various stop points or end points means that a large battery is not required and this generally takes less of a toll on the power grid. Charging takes place wirelessly during the journey or during breaks in the journey, with the aid of an induction system or a pantograph. This technology is currently being tried out and the Dutch company Heliox provides solutions here.

4.6 Charging is becoming smarter: smart charging

Smart Charging is a collective term for smart, innovative technologies which enable optimum charging of electric cars through the smart use of electricity supply and demand. The fact is the power grid must remain constantly in balance. As such, there is value to be had in being able to quickly make upward or downward adjustments. Electric cars lend themselves to this particularly well. In addition, capacity demand can be distributed over time or among installations smartly, creating no draw, or less of a draw, as a result, for example.

4.6.1 Flexible charging

A heavy demand is placed on the power grid when many people start charging their cars at the same time. In many cases, power grids will have to be expanded or reinforced. If charging sessions are scheduled on a flexible basis, the need to expand the power grid will be less urgent and social costs can be saved. Where uncontrolled (simultaneous) charging of ten electric cars in a particular area can cause problems, smart charging will allow as many as 150 cars to be charged[22]. Electric cars therefore have the potential to play an important part in the short-term electricity market. There is a demand for capacity which can be adjusted upwards or downwards rapidly in this market. Since electric cars spend a large amount of time stationary and connected to the power grid, they can create value when charging is flexible[23]. Cars can also play a role in maintaining the frequency balance of the electricity system (the primary reserve). This is already happening now on a small scale.

There are several reasons why electric cars are capable of offering flexibility.

- Electric cars can collectively demand or supply a great deal of electricity. In a recent study[24] by Movares, commissioned by ElaadNL, it is worked out that by the end of the 2020s electric cars will briefly be able to demand a collective charging capacity of several gigawatts (comparable with a number of gas-fired power stations).
- The total energy demand of a fleet of electric cars is sufficiently great as to be able to contribute to the electricity markets. (Movares: One million electric cars represent the equivalent of 2.5% of the Dutch electricity demand.)
- Such flexibility can be made available almost immediately and there are no start-up or disconnection costs.

Cars can be smart-charged only if they are connected to charging points which are designed for Smart Charging. Nearly all new public charging points now feature this option. The Province of Brabant has now fitted all its charging points with the necessary equipment as part of what is known as the Smart Charging Living Lab, an initiative led by ElaadNL and the regional grid operator Enexis.

4.6.2 Vehicle to grid (V2G)

The ability to provide flexibility in the short-term electricity market is increasing further still now that electric cars are also able to feed electricity back to the grid (vehicle to grid). The potential synergy benefits gained through cost savings in respect of short-term maintenance of the balance may be significant when the vehicle-to-grid system is used (the estimated values in a study carried out for Denmark are in excess of 1,000 euros per EV). It is unclear whether these estimates could also be representative of the situation in the Netherlands. The potential benefits of avoiding or deferring investments in peak load capacity may be significant.

[21] An exploratory study into the opportunities and potential for induction charging – APPM 2015

[22] Enexis 'Smart charging'

[23] What's driving tomorrow's electricity grid – DNV GL EFS 2015

[24] The value of flexible charging – Movares 2016

In the Netherlands, Utrecht's Lombok district has been experimenting with this on a relatively large scale, as several major players, including the municipal authority, the provincial authority, Stedin, Renault, Nissan and GE, are working on a wholly sustainable, self-supporting energy system. Here, houses with solar panels generate electricity and then store it for the most part in the batteries of electric cars. The striking feature of this system is that the energy in the cars can be supplied back to dwellings, ensuring that energy is always available. The battery of one electric car can supply an average household with enough electricity for two weeks.

4.6.3 Savings in the face of rising grid costs through a smart and integrated

Expectations are that costs will be saved by recharging electric cars in a smart and demand-driven way[25]. That saving on costs results from:

- The reduction of the peak load and, consequently, the avoidance or deferral of investments in power grids. The fact is that grid operators will increasingly find themselves faced with the question of whether distribution grids and possibly transmission grids, too, will have to be reinforced because of, among other things, the rollout of electric transport.
- The contribution made to accommodating short-term fluctuations in electricity supply and demand in short-term markets and balancing markets (like frequency maintenance).

A recent study carried out by Ecofys[26] for Netbeheer Nederland also shows that electric cars could potentially play an important part in a smart energy system. The developments and investments in increasingly smarter charging infrastructure systems will ultimately contribute towards a cost-efficient energy network in the long term.

The smart charging of electric cars at times when there is little demand for electricity therefore has the potential to make charging cheaper. Movares calculates that the basic price for electricity (not including taxes and transport costs) to charge electric cars could fall by 35% to 60%. This boils down to 2.5% per kilowatt hour (2016 prices).

4.7 Charging infrastructure is set to become part of a smart grid

The charging infrastructure for electric transport is not alone in becoming smarter. The energy infrastructure in its entirety is becoming increasingly smart through the use of ICT. Between 2011 and 2016, twelve test beds in the Netherlands experimented with smart grids within the Intelligent Grids Innovation Programme (IPIN). There are now 250 parties in the Netherlands which are working on smart grids and smart energy systems. With their Urban Energy TKI (Top Consortia for Knowledge & Innovation), the Energy Top Sector is working on investing in and scaling up smart grids and smart energy systems. The TKI is managing 50 active projects. Companies, grid operators and the government have jointly invested approximately €100 million in pilots. Expectations are that the parties will continue to invest in the years ahead.

4.8 Driving on solar power

The synergy advantages go beyond just the financial benefits presented above. Combining electric transport and renewable energy may also result in the accelerated growth of EVs and renewable energy, in particular photovoltaic solar energy. Although this effect has not been quantified, many stakeholders and frontrunners in the field of smart grids indicate that this could certainly be a substantial synergy advantage. The local consumption of self-generated energy has the advantage that it delivers something which is immediately tangible for consumers, namely their own 'personal' sustainable energy supply[27].

There is a trend towards local initiatives and a willingness to go green, where EV owners wish to charge their cars using green electricity and are therefore more inclined to purchase solar panels. In time, it may also prove financially attractive to own both an EV and solar panels because putting self-generated solar energy to good use could shorten the payback period of a photovoltaic solar energy installation.

The local consumption of energy could also prove more efficient for the grid because the energy does not have to be transported over long distances. By matching local weather forecasts for sun and wind for sustainable generation with the charging needs of the e-driver, charging schedules of local electric cars could be arranged such that maximum use is made of locally generated energy for charging.

[25] Cheaper electricity thanks to the smart charging of EVs – CE Delft 2015

[26] Value of Congestion Management – Ecofys 2016

[27] Sustainable charging using solar power – RVO.nl 2016

4.9 Valet and social charging

Valet charging is a parking service for electric cars and this is also being experimented with as a solution for the installation of additional charging stations. An operator arranges the actual recharging of the cars and users can pass on their requirements through an app. Smart software ensures account is taken of the number of cars, available charging stations and time at which the owner needs the car back.

Social charging connects users of charging stations with each other. Drivers of electric cars check in and out of a charging station through a charging station app. This makes them remotely accessible to drivers who also wish to recharge later in the day and makes it easier for neighbours, colleagues or strangers to share (public) charging stations with each other. Drivers of electric cars are less anxious about charging, charging stations are put to more efficient use and fewer parking spaces for electric cars are required. The NKL has already launched an initiative aimed at using alternative charging solutions such as these in municipalities as pilots.

4.10 More sustainable

Research carried out by the Netherlands Organisation for Applied Scientific Research (TNO)[28] shows that where predominantly grey power is used, an electric car still has a CO_2 emission rate which is approximately 30% lower relative to a car run on petrol. With full use of green electricity, a CO_2 emission reduction of 70% is possible. Furthermore, wholly electric vehicles emit no nitrogen or particulate matter. Such vehicles therefore make a positive contribution to air quality, which is particularly important in cities.

This has been an important reason behind the investments made by cities in charging infrastructure in recent years. Electric vehicles also reduce the noise nuisance of traffic because electric engines are silent. The positive effect is at its greatest at low speeds, when tyre noise is not predominant. According to TNO, the particulate matter wear-and-tear emissions (tyre and brake wear) of electric vehicles is about 25% lower than for conventional vehicles. This is because most of them have regenerative braking systems.

4.10.1 *Charging using green power*

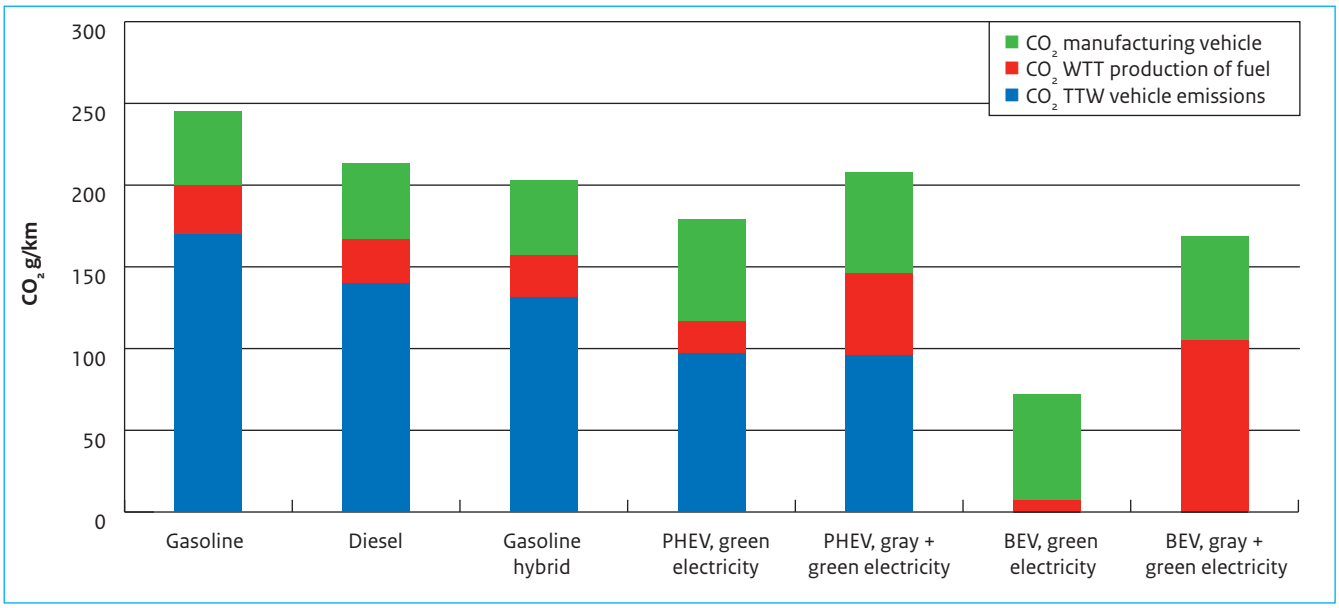
Electric transport contributes towards Dutch ambitions in the area of CO_2 reduction. To be able to compare the CO_2 emissions of electric vehicles with conventional vehicles it is important to work on the basis of data obtained from practical use. The chain involving fuel production and vehicle manufacture and recycling/scrapping should also be included since emissions also take place during those phases. One such well-to-wheel analysis for mid-range vehicles was conducted in 2015 by TNO. The results are shown in the following figure.

A CO_2 reduction of 70% is already possible now. The development of electric transport is still in its infancy. Expectations are that the energy efficiency of electric vehicles will improve further still. It is expected that more and more renewable sources will be used to produce electricity. If the current pace is maintained, more than half of the electricity will be renewable electricity between 2025 and 2030[29]. An important step in this direction has been made with the Energy Agreement. In practice, most service providers currently provide green power at public charging stations. Nederland Elektrisch has produced a pamphlet[30] for employers to encourage use of the electric power provided by hybrids.

[28] Energy and environmental aspects of electric passenger vehicles – TNO 2015

[29] National Energy Study – ECN, PBL 2016

[30] EV guide 'Sturen op Stekkeren' (Plug in and drive) – Nederland Elektrisch 2016



4.11 Electric transport is on the rise and autonomous electric transport is having an impact

Ecofys's scenario study shows that the development of electric transport continues in all the scenarios that were outlined. This is because in all the scenarios the TCO of EVs is more favourable than that of conventional vehicles. This picture is also in line with the aforementioned reports produced by Rabobank and Bloomberg. Depending on the scenario selected, the dates calculated for the turning point range from before 2020 to after 2025. However, as noted earlier, the TCO is not the be-all and end-all for this development.

The Ecofys study also states clearly that the development of autonomous electric transport has the potential to have a major impact on the mobility system as a whole, because it will mean fewer cars in circulation, for example. The autonomous 'E-taxi' is developing a favourable TCO because it covers many electric kilometres. In scenarios involving a rapid rollout of autonomous driving, this also has an impact on the public infrastructure required (relatively less).

In all scenarios, the rise in electric transport means there is a continued need for public charging facilities, particularly for people who are unable to charge their cars at home or at work. Some of those public charging facilities will comprise charging points for parked vehicles or charging points on streets, and some fast charging points. The researchers indicate that it is impossible to estimate on the basis of current knowledge what the ratio will be between fast charging versus charging while a vehicle is parked because this could depend on preferences which have not yet been properly researched.

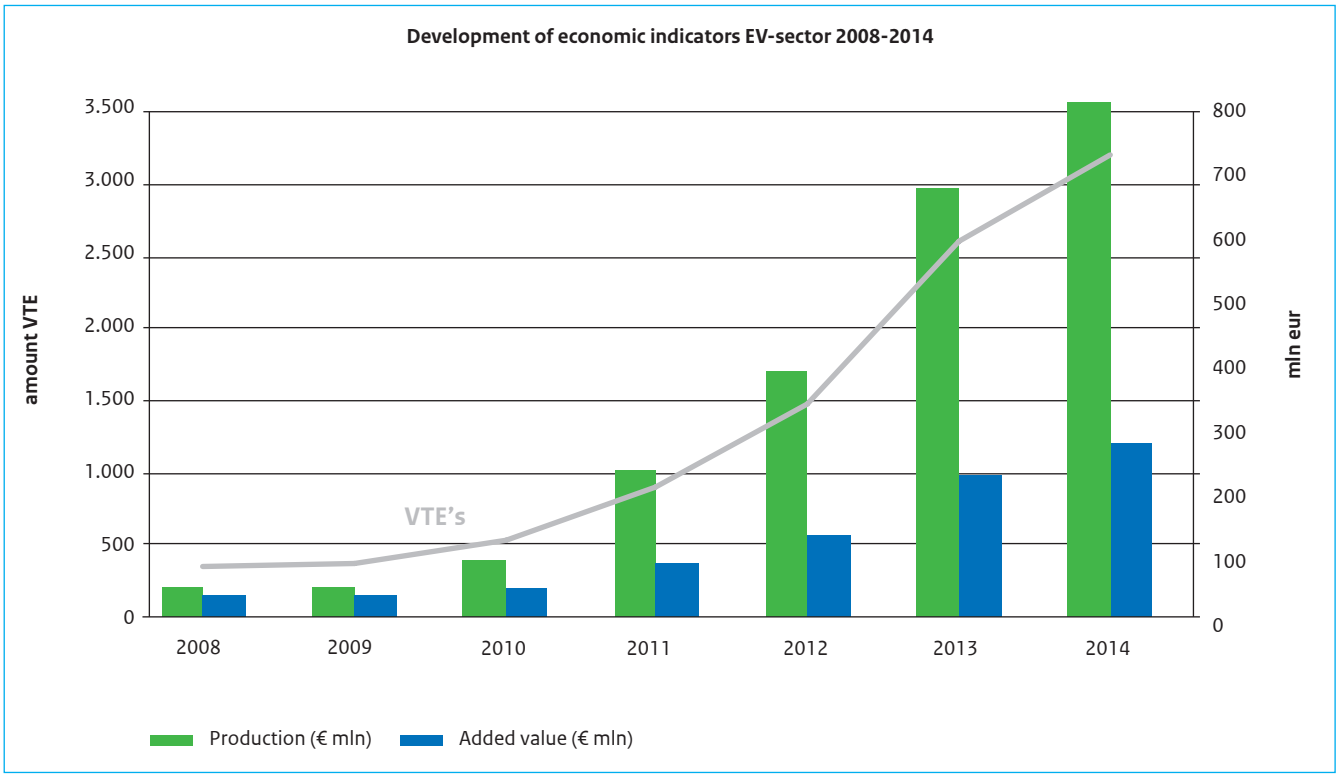
Until 2020, the scenarios do not differ greatly from each other. The big differences arise after 2020 and depend on the variables in the scenarios. This means that the current investments in public charging facilities are wise because in the basic scenario this charging infrastructure is needed in order to be able to meet the expected demand. The Green Deal's efforts aimed at making the business case for public charging sound by 2020 also dovetails well with this, because the market will then be able to accommodate the demand for charging infrastructure itself. Ecofys did not go into any regional differences in charging requirements in the study.

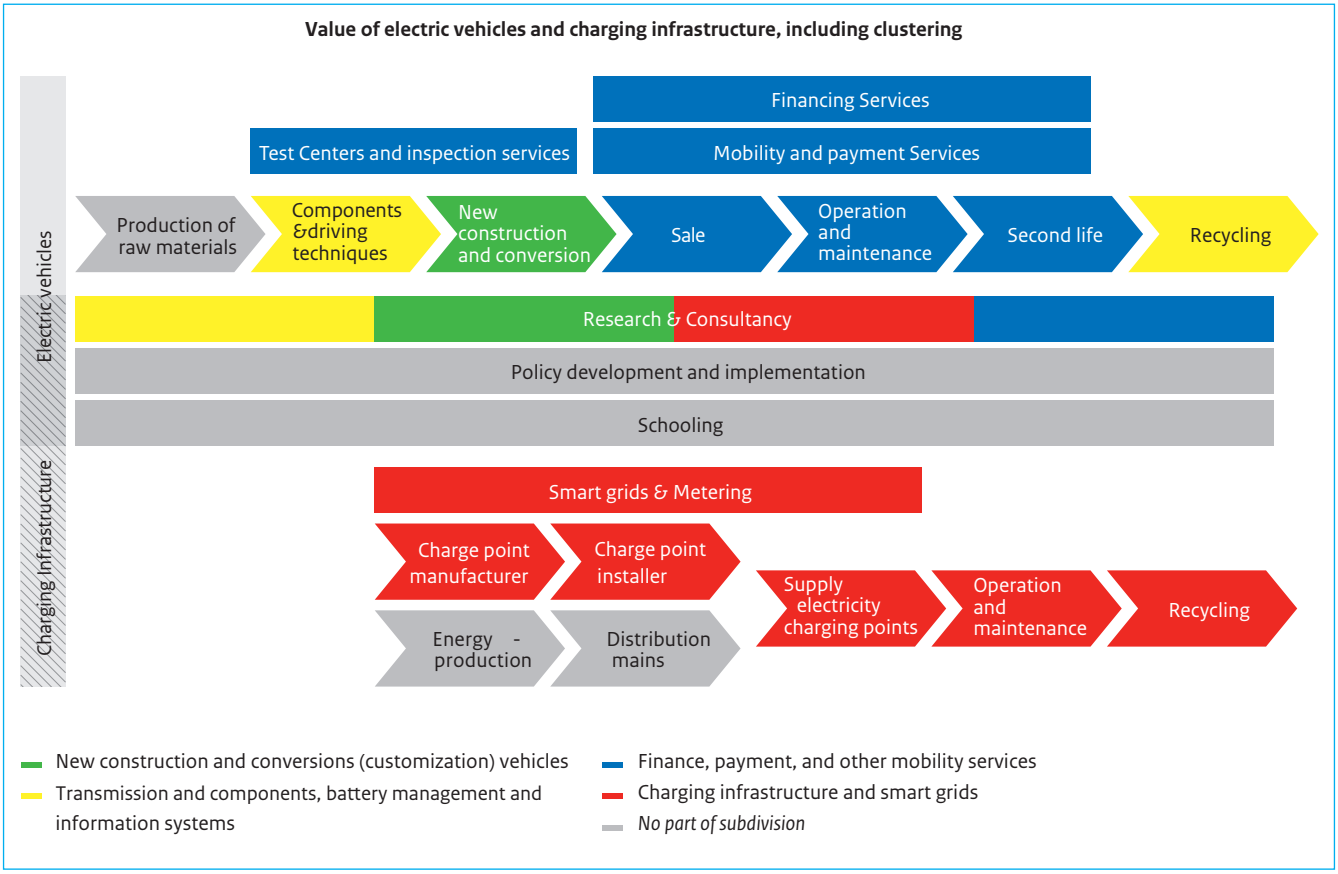
5 Opportunities for the Netherlands

The Netherlands Enterprise Agency (RVO.nl) commissioned a study last year to identify the economic opportunities for the Netherlands in the area of electric transport. The 'Capitalising on the Earning Potential of Electric Transport' research report shows that, in 2014, electric transport produced an estimated 3,200 jobs. In 2014, employment in this sector grew by 25% compared with 2013. Companies in the electric transport sector accounted for 820 million euros in production and 260 million in added value for the Dutch economy in 2014.

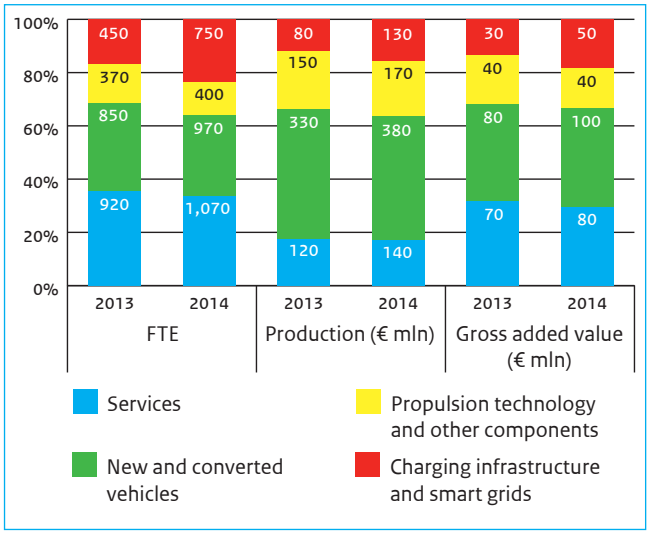
In percentage terms, the biggest growth in employment has been achieved in the charging infrastructure and smart grids cluster in recent years. Investments were made in particular in charging infrastructure and related services. For instance, a few public funds and private equity companies invested in the charging station industry.

The below figure shows the economic scale of the EV sector, measured in terms of the development of employment (in FTEs), production and the gross added value. Employment is direct employment in the value chain.





The above figure shows the value chain of the EV sector and also displays the market clusters (colours) and the key areas. In this chapter, we will set out the opportunities identified for each market sector and zoom in mainly on the relationship with charging infrastructure.



Breakdown of economic indicators by market segment (Source: CBS Statistics Netherlands)

5.1 Newly-built and modified (customised) vehicles: opportunities for buses

The newly-built (customised) vehicle market cluster has grown strongly. For instance, the bus builder VDL has started producing electric buses, in part owing to the active role played by some provinces in inviting tenders for zero-emission bus transport, and developments abroad. The start-up Ebusco is also doing well. Ten fully electric Ebusco buses have recently been put into use in Utrecht.

Electric buses appear to have found a permanent place in bus concessions in the Netherlands and throughout the world. For instance, electric buses are now also used in London and Paris. It is now possible to extend the concession period for public transport to 12 to 15 years. This favours electric buses because the vehicles and infrastructure can be written down over a longer term, thus making the Total Cost of Ownership comparable with conventional buses.

Investments are also being made in the development of electric trucks. This is a sector where the Netherlands traditionally performs well so there are potential earning opportunities here. In part thanks to the sharp fall in the price of batteries, the development of electric buses and lorries appears to be accelerating. Tesla recently announced that it plans to start activities in this area, too[31].

[31] Master Plan, Part Deux – Tesla 2016

The development of buses in urban areas will undoubtedly place heavy demands on the local infrastructure. For instance, buses in Utrecht already make use of smart charging to avoid the need to upgrade grids. This knowledge and experience in the area of smart solutions could also be marketed internationally.

5.2 Charging infrastructure and smart grids

The rollout of charging infrastructure in the Netherlands is progressing well. The number of charging points on private, semi-public and public sites burgeoned last year. Market players such as Fastned and Tesla are principally involved in the rollout of fast chargers.

The companies involved in the semi-public area come mainly from outside the EV sector. Ikea, for instance, is installing charging points at all its branches, and Lidl is installing fast chargers for customers. As for charging points in public spaces, a number of collaborating municipalities and regions have issued invitations to tender for more than 4,000 charging points. In many smaller municipalities, parties such as Allego are rolling out charging points. Allego and Fastned are also expanding further into Europe.

Various charging station manufacturers are operating abroad, including EV-Box, Fastned and The New Motion. International charging, roaming, is another trend. Expectations are that it will become increasingly easy also to charge your vehicle abroad using the same service provider. Dutch companies will link up with the European roaming platform e-Clearing.net, so that charging abroad in Europe is a straightforward procedure. At present, more than 100,000 customers and 18,000 charging points are connected on this platform through nine international partners (including some of the abovementioned companies and EVNetNL).

5.3 Financing, payment, mobility and other services

Shared cars are relatively efficient, which means relatively less infrastructure is needed for the number of transport movements. The number of shared cars is rising. There are shared electric cars for companies, institutions and citizens in Sittard-Geleen, and 65 electric cars functioning as shared cars in Terschelling. Car2Go has expanded from 300 to 500 vehicles in Amsterdam, and has also adjusted their operating area, meaning that the vehicles can be used even more efficiently.

Providers of shared cars, lease companies, insurers, municipalities, companies, interest groups and the central government have teamed up to work together in the area of car-sharing. The Car-sharing Green Deal, which those parties intend to use to expand car-sharing into a network of 100,000 shared cars (not specifically electric) by 2018, was concluded in June 2015. Furthermore, Uber began using 50 completely electric cars in London this year. It is possible that, should it prove successful, this will be expanded to include other countries, too. Private leasing is also an emerging trend and appears to be a good way of making electric cars available to private individuals because the TCO advantages are expressed in the lease price.

5.4 Power train technologies, components, battery management and information systems

A number of research and pilot projects are being conducted in relation to power train technologies, range extenders and energy management systems (EMS). Although parties like E-traction are growing in terms of scale and are in the production phase with wheel hub motors, for example, the numbers involved remain limited. In early 2015, the Dutch company Star Engines developed an innovative mobile generator which converts petrol into electricity to charge electric cars (in emergencies), and increasing range considerably. Battery management and information systems are still in the development phase. TNO and Eindhoven University of Technology are conducting many research projects, but there are no commercial products and projects as yet. Some are being marketed through DAF and NXP. The Netherlands is a frontrunner in the development of driver guidance systems (navigation), although this is not directly related to electric vehicles or charging infrastructure. It is, however, a development which is relevant to locating available charging points or booking them, for example. It also increases ease of use for the consumer.

The central government plans to facilitate the development of autonomous vehicles. It also intends to ensure that the Netherlands remains among the international frontrunners in this area. That is why it is our country's ambition to increase its position as a test bed in this area further still. At present, the Netherlands is already very advanced in the area of communications between vehicles, the process known as 'cooperative driving'. Although this does not specifically concern EVs only, the development provides opportunities for application in autonomous vehicles. In early 2015, the exemption rules for autonomous cars and lorries were amended to allow large-scale testing on the public motorway. This offers even more opportunities for businesses to experiment with this specifically in the Netherlands.

6 Vision and promising prospects

Below is an outline of the prospect of a future-proof charging infrastructure, based on the ambitions, the present situation and market developments, the identified opportunities for the Netherlands and Ecofys's scenario study.

6.1 Optimum accommodation of smart electric transport in the Netherlands

It is essential that the charging infrastructure for electric transport accommodates the development of electric transport as effectively as possible as we move towards 2035. This means having sufficient charging infrastructure so as to avoid hindering the increase in the number of electric vehicles. The available charging infrastructure should not be an obstacle to the majority of people wishing to drive an electric vehicle. In this context, 'optimum' also means that that infrastructure should be implemented in a cost-effective way and become part of the future smart energy system. The social benefits are paramount here.

6.2 Capitalising on economic opportunities

Electric transport has undergone rapid development in the Netherlands. As a result, the Netherlands is currently the international frontrunner in the area of electric driving and the infrastructure for it, including for buses and heavier means of transport. We hope to capitalise on the opportunities this offers to businesses, including at international level.

6.3 On the way to a profitable business case

In the years ahead, we will work towards a situation where the business case for charging infrastructure is profitable. This will also require the government to change its role in respect of the development of charging infrastructure for electric transport. In the initial phase, charging stations were installed mainly by network companies and large towns and cities. After all, someone had to make the first move. In the subsequent phase, the central government concentrated on developing the present market model, which has created clarity with regards to the various roles in this innovative field. In the present incentivising phase, efforts are being made through, for instance, the Publicly Available Charging Infrastructure Green Deal, in order to achieve a further cost-price reduction through innovation, efficiency improvements and encouraging rollout and upscaling. This should ensure that public infrastructure can develop further over the next few years, even without direct government incentives. The NKL estimates that this will be the case before 2020. This means that, in the years ahead, the focus will be on implementing the actions as agreed in the Green Deal or Green Deals.

6.3.1 Where the central government still has a role to play

The central government set up the NKL with a view to ensuring that the business case becomes profitable. The central government also has part to play when it comes to promoting innovation, eliminating obstacles, and providing the right market stimuli and incentivising legislation. The facilitation of cooperation in this area also remains necessary. Local and regional authorities have an important role here because issues related to charging infrastructure, including spatial issues, arise mainly at local level.

6.4 A national network in a European context

At present, the Netherlands has a well-developed national network. This network will have to continue to grow if it is to accommodate the rise in the number of electric vehicles. Since the business case is not profitable, the government is providing support for this through the Green Deal. It is important that interoperability is guaranteed and that drivers of electric vehicles are able to travel throughout Europe in a manner that is appealing to them. This is not yet the case and that is why efforts are being made to organise this at the European level. In the process, the central government is creating enabling conditions for companies to continue to innovate in technologies relating to the charging infrastructure. The initial steps in that direction were taken by Germany and the Netherlands when a cooperation agreement between e-Violin and e-Clearing.net on roaming was signed in Germany on 21 November 2016 in the presence of Minister Kamp.

6.5 Smart and flexible charging infrastructure within an increasingly sustainable energy system

Smart and flexible solutions are required in order to facilitate a cost-effective development of the energy network. Electric transport is one of the possibilities that has the potential to start playing a key role here. The ambitions pertaining to smarter and more flexible developments, which may also be relevant to electric transport and its charging infrastructure, are described in this year's Energy Agenda. The efforts made in that direction will be dealt with in further detail there.

6.6 Which facilitates smart, clean and autonomous transport

There are various developments in the area of mobility, electrification and digitisation, coupled with the development of new and sustainable forms of mobility. Ecofys's scenario study shows that the move towards autonomous and electric transport offers opportunities for the government's ambitions pertaining to mobility, the economy, climate and environment. In part, it is also an organic development which could move rapidly if the economic conditions are right. However, it will be a big challenge for the energy network, which is facing both an energy transition and also a mobility transition. The spatial aspects entering the equation will also be an important focus area for local authorities as these transitions progress.

7 The central government's Policy Agenda looking ahead to 2020

The central government's 'no regret' policy agenda aimed at implementing the charging infrastructure by 2020 is outlined below to show how the ambitions set out in the previous chapters are to be realised.

7.1 Incentivising market stimuli

Stimulus measures incorporating price incentives and schemes are intended to encourage the charging infrastructure market to develop further. Various car manufacturers offer a home charging point when an electric car is purchased. The provision of a home charging point is making a substantial contribution to the development of charging infrastructure for electric transport. The central government is also providing a variety of market stimuli.

7.1.1 *The central government's contribution to 'Publicly Accessible Electric Charging Infrastructure'*

As part of the 'Publicly Accessible Electric Charging Infrastructure' Green Deal, the central government has made a contribution totalling 5.7 million euros available to local and regional authorities for the implementation of charging infrastructure for the period 2016-2018. Expectations are that it will be used to implement a total of about 10,000 public charging points. The central government's contribution is available to all local and regional authorities (municipality, province or region) in the Netherlands which are prepared to encourage the rollout of publicly accessible charging infrastructure and which meet the preconditions set. Local and regional authorities have to prove that they themselves are making an equal financial contribution to the rollout by means of invitations to tender (for a contract or concession) or through another channel, and that they are assured of a contribution by private parties.

7.1.2 *Environmental Investment Tax Scheme (MIA) for charging infrastructure*

The Environmental Investment Tax Scheme enables businesses to make investments in environmentally-friendly technologies which are advantageous to their tax positions. With this scheme, the Ministry of Infrastructure and the Environment is encouraging environmentally-friendly investments. The MIA along with the VAMIL (Random Depreciation of Environmental Investments) tax schemes are giving an important boost to investments in environmentally-friendly operating assets. In the case of both MIA and VAMIL, these are sustainable investments which generate greater environmental benefits than are required by law. There are two ways of ensuring that a private charging point for lease cars on a company's own site is covered by the MIA:

1. In the case of a 'car and charging point on a company's own site', where the total investment is less than €50,000, the entire amount qualifies for the MIA for the lease company.
2. In the case of a private lease where the lease company provides the customer with a car and a charging point and the total investment is less than €50,000, the entire amount qualifies for the MIA for the lease company.

Businesses may also apply for the MIA. An application may be made specifically for the charging point if the investment is greater than € 2,500, or for an electric car, provided the total amount remains below € 50,000. There are also other opportunities for electric vehicles, including commercial vehicles. See RVO.nl's website[32].

The annual amendment of the Environmental List means that we can react quickly to new sustainable technologies. The idea is to devote more attention to communications regarding the tools already available so as to raise the target group's awareness of this scheme.

7.1.3 *Temporarily reduced energy tax rate for charging points*

In response to the Van Weyenberg/Grashoff motion, the government is reducing the energy tax rate for electricity used in public charging stations for the period 2017-2020[33].

This reduced energy tax rate means that charging station operators will temporarily have to pay less tax for each kWh supplied. This temporary reduction in energy tax on electricity used in public charging stations may improve the business case for a public charging station.

[32] http://www.rvo.nl/subsidies-regelingen/miavamil/onderwerpen-toegelicht/e-auto

[33] Parliamentary papers II 2016/17, 34 545, no. 2.

7.1.4 Energy tax in respect of electricity storage

Various parties have pointed out that double the amount of energy tax is paid in situations where the electricity is stored with a party other than the one generating it. The energy agenda due to be published at the end of this year will deal with the levying of energy tax in respect of electricity storage in more detail.

7.1.5 Netherlands Investment Agency (NIA)

In some cases, funding proves to be a stumbling block for the creation of charging infrastructure. The Netherlands Investment Agency (NIA) ensures optimum alignment of Dutch projects with the funding options provided by the European Fund for Strategic Investments (EFSI). The NIA is therefore considering whether it can act as a mediator in linking parties so that the funding required can be obtained.

7.2 Organised collaboration

Collaboration helps in gathering of the requisite knowledge and exchanging knowledge within and between networks, so that specific, joint results can be achieved that will enable infrastructure to be implemented. This is why the government plans to provide networks of this kind with light-handed and temporary support, where relevant.

Green Deals are an example of such support. By adopting this interactive approach, the government aims to provide scope for innovative and sustainable initiatives originating in the community. To achieve this aim, it is eliminating bottlenecks in legislation and regulations, creating new markets, providing sound information and creating conditions for the best possible joint ventures. Through clear mutual agreements, participants can work on specific results, with each party involved having its own area of responsibility. In recent years, various Green Deals have been concluded in which charging infrastructure for electric transport plays an important role (see below). The aim is to continue this approach and improve collaboration and the exchanges taking place between those involved in these deals.

7.2.1 Formule E-Team

The Formule E-Team (FET) was created by the central government in 2010 in order to promote developments concerning electric transport. The FET is a public-private partnership between the business community, knowledge institutions and the government. The FET ensures that development of electric driving in the Netherlands continues and that it is line with developments abroad and opportunities for green growth. The agreements and ambitions are laid down in the abovementioned Electric Transport Green Deal 2016-2020. The FET is undertaking these activities in consultation with the central government and with the support of the Netherlands Enterprise Agency (RVO.nl). The FET's approach comprises recommendations, networks, knowledge transfer and the provision of support for projects or creation of temporary working groups.

By signing the Green Deal, the Formule E-team also committed itself to initiating a number of activities aimed at encouraging and facilitating electric transport further. Working groups, including the Charging Infrastructure working group, are linked to these activities. It has been agreed that the Association of Dutch Municipalities will act as the coordinator here. The working group's aim is to eliminate bottlenecks to enable a suitable network of charging points to be implemented.

Based on information from the National Knowledge Platform for Public Charging Infrastructure (NKL), the FET will monitor market developments and the existing and future cost trend of the business case for the charging station for the term of this Green Deal. It is stated in the Charging Infrastructure Green Deal that an interim evaluation will be prepared in early 2017 and that a final evaluation will be performed in mid-2018.

7.2.2 Green Deal – Electric Transport 2016-2020

As stated, the Electric Transport Green Deal 2016-2020 was signed on 14 April 2016. The parties formulated the following goals in respect of charging infrastructure:

1. Improving and expanding the charging infrastructure for EVs. This mainly involves:
   - the realisation of a sound business case – in cooperation with the National Knowledge Platform for Public Charging Infrastructure (NKL);
   - making the most of the Publicly Accessible Electric Charging Infrastructure Green Deal and monitoring progress;
   - formulating a shared vision about the future of the smart charging infrastructure, by managing the balancing and/or congestion of the grid, using electric cars for energy storage.
2. Improving the storage capacity of electric vehicles in relation to the variable use of renewable energy and grid stability. Scaling up experimentation and research through the Smart Charging Living Lab.

7.2.3 Green Deal – Publicly Accessible Electric Charging Infrastructure

On 9 June 2015, the Association of Netherlands Municipalities, the provinces, Netbeheer Nederland and interest groups, together with the Ministry of Economic Affairs and and the Ministry of Infrastructure and the Environment signed the Publicly Accessible Electric Charging Infrastructure Green Deal to encourage the rollout of publicly accessible charging infrastructure for EVs. This Green Deal lays down actions which will ensure that the costs of charging stations fall as a result of joint research and process optimisation, for example. The central government's contribution (7.1.1) and the foundation of the aforementioned National Knowledge Platform for Public Charging Infrastructure (7.3.1) are part of the Green Deal.

7.2.4 Administrative Agreement on Zero-Emission Buses

On 15 April 2016, the Administrative Agreement on Zero-Emission Buses was signed as a follow-up to the Zero-Emission Bus Transport Green Deal (2012). In the Administrative Agreement, the parties agree that they will jointly pursue the following ambition: for regional bus transport to be completely emission-free by 2030, or

earlier if possible. To achieve the stated ambition, the parties have agreed to pursue the following goals:

- By no later than 2025, all new buses must be emission-free (tank-to-wheel). The year was chosen as a common goal, but authorities granting a concession may, of course, act in advance of that date if that suits their tendering calendar or where they would be replacing their fleets anyway.
- By 2025, new buses will be using 100% renewable energy or fuel which, with a view to economic development, should be generated regionally as far as possible.
- Public transport concessions will have the best possible scores for well-to-wheel CO_2 emissions per passenger-km (the best possible scores are yet to be specified)[34].

7.2.5 Zero-Emission City Logistics Green Deal

The purpose of the Zero-Emission City Logistics Green Deal is to ensure that parties jointly develop and scale up activities at least until 1 January 2020, with each party having its own responsibilities and tasks, in order to accelerate the move towards Zero-Emission City Logistics.

One of the chief activities needed to achieve this is for each municipality or region to develop and implement Zero-Emission City Logistics Living Labs. On 1 January 2020, the Green Deal will provide an overview of the results of the efforts made by the Parties and a recommendation based on the results of the Living Labs. The recommendation will test the results in respect of technical, economic, legal, security and enforcement aspects and indicate which forms are capable of broad application. That recommendation could mean proposals being made to the effect that local authorities should impose phased restrictions within the limits permitted by the law in respect of access to the city centre, or parts of it, for vehicles and forms of energy which do not meet the requirements of Zero-Emission City Logistics.
The second goal involves the Parties scaling up the feasible forms of Zero-Emission City Logistics in the period between 2020 and 2025 based on that recommendation, with the ultimate goal of making cost-effective Zero-Emission City Logistics a reality for all types of vehicle used in city logistics in the participating cities[35] with effect from 1 January 2025.

7.2.6 City Deals

Following the example set by the Green deals, we now also have what are known as City Deals. There are various City Deals (in existence and in the preparation stage) which also feature charging infrastructure for electric transport as a topic. With City Deals, concrete cooperation agreements are laid down between cities, the central government, local and regional authorities, companies and social organisations. The deals are intended to result in innovative solutions for social issues and contain measures aimed at reinforcing the economic ecosystem of the urban region or regions. In the 'Urban Accessibility City Deal' due to be established, the emphasis is on new transport concepts in an urban environment. In addition to bicycles and intelligent transport systems, electric transport is also part of this City Deal.

7.2.7 Regions and the energy agenda

In the months ahead, partly in response to the Energy Agenda due to be published shortly, we will be carrying out further work with various regions on setting out the Energy Transition in concrete terms. They will also be asked to pay express attention to the development of charging infrastructure for electric transport. The central government will be organising a consultation with the VNG, Association of Provincial Authorities (IPO), NKL and FET in the next few months in order to proactively discuss regional issues concerning charging infrastructure.

7.3 Knowledge and innovation

Innovations, knowledge development and the dissemination and exchange of knowledge are the key to an efficient and cost-effective rollout of charging infrastructure for electric transport. Through the business community and top sector policy, the innovative capacity of the business community, knowledge institutes and local authorities is exploited to enable work to be carried out on creating a smart, inexpensive charging infrastructure which can be marketed globally.

7.3.1 NKL – National Knowledge Platform for Public Charging Infrastructure

The National Knowledge Platform for Public Charging Infrastructure (NKL) was founded in 2014 with the support of the central government in order to increase knowledge-sharing among parties. The NKL is a partnership of organisations which are involved in the public charging of electric transport in the Netherlands. The NKL has a team of scientific experts and is the central point of contact for innovation concerning public charging infrastructure, whose goal is to increase the electric charging share and reduce the costs for public charging infrastructure. The NKL's activities include increasing knowledge-exchange, research and support for initiatives, including those which will enhance the position of the Netherlands in the area of EVs internationally. Those activities are to be performed in a way that contributes to efficient functioning of the market and ensuring that the Netherlands occupies a strong position as competitor and exporter in the area of knowledge, technology, innovation and trade. Since its formation, the NKL has set up and implemented 20 projects. Specific products include nine basic sets containing agreements for charging infrastructure which every municipality or region can use, the online knowledge desk[36] for municipalities, and the charging infrastructure cost analysis benchmark.

[34] Administrative Agreement on Zero-Emission Regional Public Transport by Bus, March 2016

[35] Rotterdam, Amsterdam, Arnhem, Delft, Groningen, Haarlem, Maastricht, Nijmegen, Tilburg, Utrecht.

[36] nklnederland.nl/kennisloket/

7.3.2 Top sectors and innovative charging infrastructure

At present, charging infrastructure for electric transport is addressed in a variety of ways in the Top Sectors of Energy, High-Tech Systems and Materials (HTSM) and Logistics. Autonomous transport is an important topic in the HTSM Top Sector and is also addressed indirectly in the Logistics Top Sector through the network. Flexibility, smart grids and grid reinforcement are central topics in the Urban Energy TKI.

7.3.3 Energy Top Sector – Urban Energy TKI

Within the Energy Top Sector, electric transport is addressed primarily in the programme and projects of the Urban Energy (UE) TKI. The infrastructure for charging and discharging electric vehicles and the energy infrastructure (electricity grids) are linked to each other and overlap one another. With, among other things, the move towards the decentralisation of energy supply (substantially more local, sustainable generation) and the advance of electric transport, today's electricity grid will no longer suffice. This means intelligent solutions are required to make the electricity grid more flexible and to mitigate or avoid costly reinforcements.
The Dutch electricity system is very reliable and for the time being is also able to feed power back into the grid. If the growth in solar power in particular, along with heat pumps and electric transport, becomes substantial, flexible solutions will be needed to ensure a stable electricity supply. Electric transport and heat pumps with storage capability will provide this. A sharp increase in the number of electric vehicles, combined with the substantial increase in the storage capacity of batteries and fall in prices for battery packs, may mean that investments in the order of billions in reinforcing the grid infrastructure can be avoided.

Various projects in the area of electric transport, some through the MIT scheme, are being carried out within the Urban Energy TKI. They include, for example, projects related to integrated EV charging points (charging points integrated into lampposts), smart and flexible charging and smart grids to keep the power supply in balance, and a project to avoid grid reinforcement.

7.3.4 High-Tech Systems and Materials Top Sector

With the HTSM Top Sector, the topics of electric and autonomous vehicles are part of the automotive roadmap. With social challenges related to emissions, congestion and safety, including traffic safety, green and smart mobility, are important focus areas of this roadmap. On this basis, public-private research projects related to electric driving and autonomous and cooperative driving qualify for a TKI allowance. In addition, on the basis of this roadmap, SMEs are encouraged through the MIT scheme to collaborate and innovate in respect of these topics. The umbrella organisation AutomotiveNL organises workshops and networking events for this. Within the HTSM Top Sector, the automotive sector has accesses to resources for strategic fairs, which put the topics of electric transport and ITS (Intelligent Transport Systems) on the international agenda. The HTSM top team is also working with the NFIA on strategic acquisitions for the automotive sector.

7.3.5 Logistics Top Sector

Within the Logistics Top Sector, the city logistics action line and the Zero-Emission City Logistics Green Deal (ZES) are of primary importance. The parties are carrying out research to find out how to put the emission-free provisioning of city centres into practice. The goal is to realise optimum emission-free logistics by 2025. The challenge facing the city is to transport more with fewer movements and fewer emissions. Participants in the ZES Green Deal do not just test new practical logistical solutions, but also combinations of new technologies, public-private partnerships and amended regulations. The Logistics Top Sector is helping with the development of innovative city logistics, in part because it could be a good Dutch export product. The Top Sector has now assigned a substantial part of the resources at its disposal to the implementation of this Green Deal.

7.3.6 Multi-year R&D innovation programme

At present, a number of parties, including Eindhoven University of Technology and AutomotiveNL, are working on a multi-year R&D innovation programme for Electric Transport. By using a multi-year approach which links together the HTSM, Energy, Logistics and Creative Industry top sectors, they hope to accelerate the innovation related to the electrification of the vehicle fleet and to maintain and expand upon on the present economic advantage.

The plan contains three segments, one of which includes infrastructure and charging infrastructure and smart grids. The Netherlands has a number of suppliers in the area of charging infrastructure that play an important role in this transition around the world. Establishing a link between the grid and the EV fleet in particular poses research and innovation challenges. Various ongoing projects related to smart grids in the Netherlands are involved in this.

7.4 Incentivising legislation and regulations

The central government is working on incentivising legislation and regulations in order to promote the energy transition and the transition to electric driving. An important framework for the market has been created with the market model described in chapter 3. With the implementation of the European Deployment of Alternative Fuels Infrastructure Directive, the government is working on the enabling conditions which will allow uniform recharging throughout the European Union

7.4.1 Implementation of the EU Deployment of Alternative Fuels Infrastructure

The implementation of this Directive is an important step towards further standardisation of the charging infrastructure for electric transport. The purpose of the Directive is to foster the functioning of the market by implementing communal technical specifications for alternative fuels infrastructure in the European Union and thus to promote the deployment of, for example, the charging

infrastructure for electric vehicles. Users of this infrastructure must be able to charge their vehicles throughout the EU. The Directive sets requirements for recharging and refuelling points for LNG, CNG, hydrogen and also electricity. Standardisation benefits interoperability and consumers' interests. It is easier for consumers and the business community because in the longer term, economies of scale will ensure a cost-effective rollout.

The Directive is being implemented by means of a decree and a policy framework, with implementation set to be completed at the end of this year. Its implementation also covers the technical standards relating to sockets and connectors, as well as the provision of information for the consumer. The technical requirements for charging points for electric motor vehicles apply to the publicly accessible stations, and they will be specified in more detail in the explanatory notes to the decree. The Minister for the Environment will send the national policy framework to the House of Representatives this year.

7.4.2 Incorporating solutions for obstacles in legislation and regulations

As agreed in the Electric Transport Green Deal 2016-2020, the central government is engaged in identifying and, where possible, incorporating solutions for legislation and regulations that are obstructing the development of electric driving. A wide-ranging process aimed at identifying obstacles, including any applicable to charging infrastructure, has taken place. The National Knowledge Institute for Charging Infrastructure and the Formule E-Team working groups are playing a key role in the gathering of messages from market players and as a sounding-board for the problem-solving processes set in train by the central government.

7.4.3 Charging infrastructure and the built environment

Private owners of electric vehicles are heavily dependent on access to charging points at collective parking spaces, for example at blocks of flats, offices and business premises. To ensure that project developers and managers of buildings make sufficient charging points for electric vehicles available to the vehicle users, consideration must be given to the extent to which current regulations, for example, the Buildings Decree and apartment rights, are an adequate mechanism for this purpose.

The EU Energy Performance of Buildings Directive is being revised at the moment. The revised version may include requirements concerning the minimum number of charging points at parking spaces of new buildings and the (significant) alteration of existing buildings. It seems sensible to devote more attention to charging infrastructure for electric transport in the built environment since relatively small investments will be involved and the costs for subsequent installation could be substantial.

The Road Transport report by the Social and Economic Council of the Netherlands (SER) Fuel Vision states that people living in a flat with an Owners' Association (VVE) are allocated space in the collective parking space. The Association of Netherlands Municipalities (VNG) points out that it knows of many situations where the owner of the electric car is prepared to bear the costs himself, and therefore has found no support for this initiative within the Owners' Association. The Sustainable Electric Road Transport report and the Association of Netherlands Municipalities therefore recommend that every electric car driver is given the right to a charging point. In Spain and California, that right is even included in legislation. In consultation with the Ministry of the Interior and Kingdom Relations, we will examine how to eliminate these obstacles and what can be done to encourage the installation of charging infrastructure in the built environment.

7.4.4 Amendments to the regulatory framework to make the electricity system more flexible

The key measures which need to be taken to improve the flexibility of the electricity system, established on the basis of input from stakeholders, are fleshed out in the Energy Agenda due to be published later this year. They are:

- Dynamic supply prices for low-volume users;
- The aggregator's role;
- Creating greater flexibility by adjusting the tariff structure.

7.5 International engagement

The Formule E-Team's International Steering Group has developed an International EV assessment framework to enable the business community to be provided with more targeted support and to help them with their international activities. Priority countries (A countries) are those countries where there is already significant EV activity involving Dutch companies, and which have an interesting EV market or where the government operates an incentive policy. Category A is subdivided into two variants:

- Category A – existing: very promising and much Dutch activity already. This includes Germany, the Scandinavian countries (Norway, Sweden, Denmark and Finland), the United Kingdom, France and the United States (in particular the states of California, Connecticut, Maryland, Massachusetts, New York, Rhode Island, Oregon and Vermont).
- Category A – new: very promising but little activity as yet. This includes Canada (Quebec), India (New Delhi and Mumbai) and China.

Events and tools, like Holland E-Mobility House at fairs, on missions and matchmaking events, are used proactively for Category A.

There are also Category B countries: countries where there is already some EV activity involving Dutch companies or where rapid growth of the EV market is expected soon. Such countries include Japan, South Korea, Singapore, Turkey and the Czech Republic. Tools are used on a reactive basis here, only when specific opportunities crop up.

7.5.1 Development of open standards

A sound and accessible charging infrastructure for EV drivers is a key precondition for a transition to electric driving. The aim is to ensure that anyone may use it regardless of who their own service provider is – and not just in the Netherlands, but in other countries, too. Work is being carried out in the Netherlands on open ICT protocols whereby the EV driver, service provider and charging point operator agree mutual identification, communication and settlement with each other. The development of this protocol was launched in the Netherlands[37] and has now been picked up internationally by numerous companies.

To facilitate international roaming for drivers using their own charging card, it is important that ICT protocols are standardised. The Netherlands is aiming for open protocols which can be used, for example, on a peer-to-peer basis. For companies, this will create greater clarity, meaning that infrastructure can be rolled out faster and more effectively. It also benefits the EV driver, who will also be able to travel abroad using his own charging card.

7.5.2 Electric Mobility Europe

Within Electric Mobility Europe, fourteen European countries and regions are working together with the European Committee and the European Green Vehicles Initiative Association on a call for project ideas. Together, they have amassed 23 million euros to fund innovation projects which will encourage the rollout of electric transport in urban areas. The Netherlands is contributing 3 million euros to the call. Dutch proposers are financed through the Technology Foundation (STW).

The 2016 Electric Mobility Europe Call was published in November of this year and supports projects which are geared towards one or more of the following areas:

1. System integration (transport, urban and sub-urban areas)
2. Integration of urban freight and city logistics in e-mobility
3. Smart Mobility concepts and ICT applications
4. Public Transport
5. Consumer behaviour and societal trends

7.5.3 Interreg Europe

Interreg is also encouraging cooperation in Europe in the fifth period for greater innovative capacity and a better environment. The programmes reduce the economic differences between regions and Member States. Interreg consists of various programmes, subdivided based on the size of the cooperation area and regions in Europe. Within the Thinking Growth (NSR) or Innovation (NWE), also in CO_2 reduction (NWE) or Green transport and mobility (NSR) priorities of the Interreg North Sea Region (NSR, 157 million) and North West Europe (NWE, 370 million) programmes, there are plenty of opportunities for projects which will ensure the further optimisation and rollout of charging infrastructure or combine it with the storage or distribution of electricity.

A good example is the recently approved SEEV-city (NSR) project which combines electric transport, renewable energy and smart energy management. There is also ample scope for mobility projects which will contribute towards a more sustainable Europe in the years ahead.

7.5.4 Partners for International Business (PIB)

The purpose of this tool is to position Dutch top sectors in promising markets abroad, using the contribution provided by the Dutch government, Dutch companies and knowledge institutions and through a structured approach.

USA

In October 2016, a large group of businesses signed the Partners for International Business agreement at the residence of the Consul-General in San Francisco. The agreement is entitled Smart Mobility Solutions for Connected, Clean and Autonomous Transportation Needs (S4C) and was signed during the STORM World Tour 2016 of the University of Eindhoven.

The businesses belonging to S4C are Tacstone, APPM, Alliander/Allego, TomTom, NXP, Brainport, EV4LLC, e-Traction, EVBOX, Itility, Greenlots and EVCharge4U. The following organisations also signed the agreement: Eindhoven University of Technology, Ohio State University/Center for Automotive Research/City of Columbus, UCDavis, TNO, and the Province of North Holland. The PIB is aimed at smart mobility solutions, and charging infrastructure features among them.

Southern and Western Germany

The Southern and Western Germany E-Mobility PIB will respond to the opportunities currently available over the next three years. For instance, the rollout of a fast charging network and charging infrastructure in city centres are current opportunities which some Dutch participants are grasping. The use of shared electric cars and sustainable city logistics and mobility are also topics of interest in many regions in Germany. Within the topic of sustainable city logistics and mobility, participants will concentrate on heavier and light electric vehicles (LEVs).

Northern Germany – From Amsterdam to Berlin

The From Amsterdam to Berlin E-Mobility PIB is geared towards the rollout of publicly accessible charging infrastructure along the imaginary line from Amsterdam to Berlin. The aim is to have 1,500 public charging points installed by parties within the NL e-cluster. Furthermore, projects aimed at urban distribution using electrically-powered vehicles are also being started within the PIB. Sustainable urban logistics and mobility is also a topic of interest in Germany, in particular in Berlin, Hanover, Bremen and Hamburg. Within the topic of sustainable city logistics and mobility, participants will concentrate on heavier electric vehicles.

[37] ELaad.nl o.a. OCPP, OCPI

India

The India PIB is aimed specifically at fast charging. The signatories are Asia Electric, Heliox, The New Motion and The New Motion Snellaad (Fast Charging). The goal of the PIB is the further development of and innovation in Dutch EV-related products and services, in particular charging infrastructure and charging services. A further goal is to market Dutch charging technology and services for electric vehicles in India, where economic diplomacy is used to further market access, solve problems and eliminate obstacles to trade for the Dutch companies from the EV sector in the Indian market for charging technology and charging services for electric transport.

Austria

The Austria PIB has recently been approved. It involves a group of Dutch companies and knowledge institutes which seek to expand cooperation with, and opportunities in, Austria. The PIB is specifically geared towards electric transport and the associated opportunities in the tourism sector, smart charging and the integration of electric transport with renewable energy. The programme will run for three years and was initiated by Emodz. Other partners include DEOdrive, Dutch INCERT, EV-Consult, Greenflux, Breda University of Applied Sciences, Hytruck and Emoss. As far as charging infrastructure is concerned, this group is focused on smart charging and feeding power back to the grid.

7.5.5 *Electric Vehicle Initiative (EVI)*

The Netherlands is a member of the Electric Vehicle Initiative (EVI). The EVI is partnership between countries (governments) whose goal is to accelerate the adoption of electric vehicles worldwide. The EVI's declared ambition is to have 20 million EVs (fully electric, plug-in hybrids and fuel cell-electric) on the road worldwide by 2020. The intention is to exchange information during an open discussion and to address shared bottlenecks. Canada, China, Germany, France India, Italy, Japan, Korea, the Netherlands, Norway, Portugal, Spain, the United Kingdom, the United States, South Africa and Sweden are members. Each year, the EVI publishes, among other things, the Global EV Outlook[38] and it is also the initiator of various EV-Casebooks[39]. The United States (Department of Energy) chairs the EVI and the secretariat is run by the International Energy Agency.

7.5.6 *HEV-TCP*

The Netherlands is a member of the Hybrid and Electric Vehicles Technology Collaboration Programme of the International Energy Agency (formerly IA-HEV). The goal of the HEV-TCP is to promote international research and exchange information on everything to do with electric transport: implementation, technology, energy, etc. This can provide an insight into international developments and impact as regards standardisation, for example. Many activities take place within tasks or projects. The Netherlands is currently a participant in tasks involving the dissemination of knowledge and EV developments, and of specific tasks involving induction charging, electrification of logistics vehicles, the economic impact of electric transport and the environmental impact of EVs. Belgium, Canada, Germany, Denmark, Finland, France, Ireland, Italy, Korea, the Netherlands, Austria, Portugal, Spain, Turkey, the United Kingdom, the United States, Sweden and Switzerland are members, and Japan and China are candidates for membership or engaged in formalising membership. Each year, the HEV-TCP publishes a yearbook[40] which contains a great deal of information about EV developments in the member countries.

7.6 Evaluation

The government will monitor developments in the Charging Infrastructure market. As stated in the Charging Infrastructure Green Deal, an evaluation will take place in 2018. The NKL and the FET's Charging Infrastructure working group will also provide the central government with relevant information.

[38] http://www.cleanenergyministerial.org/Portals/2/pdfs/EVI-Global_EV_Outlook_2016.pdf

[39] http://www.cleanenergyministerial.org/Portals/2/pdfs/EV_City_Casebook_LR.pdf

[40] http://www.ieahev.org/assets/1/7/2016_IA-HEV_BOOK_web_(1).pdf

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