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Policy framework for the alternative fuels infrastructure

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Summary

The European Directive 2014/94/EU of the European Parliament and the Council of 22 October 2014 "on the deployment of alternative fuels infrastructure."[1] has a twofold objective:

- To reduce reliance on oil to the greatest possible extent.
- To mitigate the adverse environmental impact of transport.

The Directive requires all member states to provide a national framework for the implementation. This document is the Dutch governments' national policy framework for the market development of alternative fuels and their infrastructure. It provides insight in the development of the market for alternative fuels in the transport sector and sets out how the relevant infrastructure is to be created.

Obligations further to the Directive and national targets

Public charging points for electric vehicles

The Directive requires the Netherlands to implement an accessible and adequate network of charging points, especially in urban and other densely populated areas, and providing compatibility with other networks as designated by the member states, no later than the end of 2020. To achieve this target, the Netherlands must install ten thousand additional charging points as agreed as part of the 'Green Deal for the Charging Infrastructure'. There will then be a total of 17,844 public charging points by the year 2020. The intention is to achieve complete nationwide coverage. In the first instance, the focus will be on Amsterdam, The Hague, Rotterdam, Utrecht and the Brabantstad network, leading to a snowball effect and more rapid implementation in other areas.

LNG refuelling points at seaports

By the end of 2025, the Netherlands is expected to provide an appropriate number of LNG (Liquefied Natural Gas) refuelling points to facilitate the movement of seagoing and inland vessels on the TEN-V core network. At present, LNG for maritime vessels is available in Amsterdam, Rotterdam and Moerdijk, where it is supplied from mobile bunkering points. The Netherlands intends to extend the bunkering facilities before 2025, introducing four new bunker vessels to serve Amsterdam, Rotterdam, Moerdijk, the Eemshaven complex, Harlingen and Den Helder. If market conditions allow, a network of fixed bunker points will be created to serve the inland navigation sector.

LNG refuelling points at inland ports

By 31 December 2020, member states are expected to implement an appropriate number of LNG refuelling points to facilitate the movement of maritime and inland vessels on the TEN-V core network. At present, there are mobile bunkering points serving Rotterdam, Moerdijk, Amsterdam and the Drechtsteden ports.
The Netherlands intends to create additional facilities at Vlissingen/Terneuzen, Den Helder and Eemshaven. The current ambition is to implement three fixed bunkering points along the TEN-T core corridor by the year 2030, although this target may be revised in line changing market circumstances. Based on a recent study to identify suitable locations, the current availability of LNG, suppliers' plans and general market developments, the Netherlands may opt to implement as many as seven fixed bunker points by the end of 2030, either in key ports or at secondary

[1] Pb. L 307/1, 28 October 2014

locations.

To ensure that additional financial resources are available for the transition to LNG, the government intends to allow the relevant parties access to European Union funding. Provincial and local authorities can also play an active part in preparing proposals and applications. For the time being, central government will continue to apply the MIA/VAMIL investment incentive arrangements to cover the creation of an LNG infrastructure for waterborne transport (G3740 on the Environmental List).

Public LNG refuelling points for heavy-duty motor vehicles

Further to their respective national policy frameworks, member states are to create an appropriate number of public LNG supply points by the end of 2025, whereby particular attention is to be devoted to the existing TEN-V core network. There are currently 19 LNG refuelling stations and plans to add a further nine. None will receive any form of government subsidy. However, LNG is subject to a more favourable taxation regime and a lower level of duty.

Public CNG refuelling points for motor vehicles

Further to their respective national policy frameworks, member states are to ensure the availability of an appropriate number of public CNG (compressed natural gas) refuelling points by the end of 2020. This is to facilitate the movement of CNG-powered vehicles in the urban and other densely populated areas. Supply points must also be located alongside the existing TEN-V core network corridor to facilitate movement throughout the Union.

Recent years have growth in the market volume of both CNG vehicles and CNG filling stations, due in part to various incentive programmes, such as the 'higher blends biogas' trial project, government subsidies for alternative fuels under the TAB scheme, and investments by regional authorities and the private sector. The number of CNG-fuelled vehicles on Dutch roads continues to rise as the adoption of natural/green gas builds pace, especially among the owners and operators of private vehicles, small commercial vehicles such as delivery vans, and buses.

In the Netherlands, the number of vehicles running on natural gas increased from 4,600 in January 2012 to over 11,000 in January 2016. At the beginning of 2016, the Netherlands had a total of 145 filling stations which supply natural gas and/or 'green' gas. This means that there is indeed a network offering nationwide coverage, and one which has kept pace with the increase in the number of CNG vehicles.

Other than those accompanying the various government and market incentive programmes, no national targets for the creation of a CNG infrastructure have been applied in recent years because a network with nationwide coverage was already in place.[2] There has, however, been some further nudging in the form of lower prices for natural gas and biogas compared to petrol or diesel. (Anyone driving 13,000 km or more per annum will save money by switching to gas.) The 'green' version of natural gas – biogas – is classified as a renewable energy source for the purposes of the EU Renewable Energy Directive. Accordingly, users can claim credits (in the form of 'Renewable Energy Units') towards their annual obligations under the Directive.

Public hydrogen refuelling points

The Directive requires only those member states which have opted to include hydrogen in their national policy framework to create an appropriate network of public refuelling points, and to do so by 31 December 2025. The aim is to facilitate

[2] https://groengas.nl/rijden-op-groengas/tanklocaties-kaart/

the circulation of hydrogen-powered vehicles. The Netherlands is among those counties which have opted to include hydrogen in the national policy framework. At present, it has two hydrogen refuelling points, one in Rhoon and the other in Arnhem. Rhoon is accessible to the public and supplies all types of vehicle, both private and commercial. The current ambition is to create a nationwide network of twenty hydrogen refuelling points by the year 2020, which will have a customer base comprising some two thousand small private and commercial vehicles, twenty heavy-duty trucks, various utility vehicles (such as refuse collection vehicles) and one hundred public transport buses. There will also be refuelling points on selected commercial premises.
Current fiscal policy incentivizes the purchase and use of hydrogen cell electric vehicles by means of an additional (income) tax liability of only 4%. Hydrogen gas itself is exempt from fuel duty. The MIA/VAMIL subsidy arrangements apply. Central government is supporting the development of hydrogen refuelling points by contributing towards the initial phase costs. It is therefore a co-financier alongside private investors and the European and regional funding agencies. The development programme is based on cooperation with all chain partners, including the suppliers and (potential) users of hydrogen-powered vehicles. The government is also acting as a launching customer, procuring hydrogen-powered vehicles for its own use. The Ministry of Infrastructure and the Environment now has four such vehicles in its fleet while the Dutch Tax and Customs Administration has one.

Infrastructure for shore-side electricity supply in maritime and inland ports
The Directive requires member states to ensure that vessels moored in the harbours of the TEN-V core network have access to a shore-side electricity supply as a matter of priority, and that similar arrangements are put in place at all other ports by the end of 2025 (except where there is insufficient demand or the costs cannot be justified by the returns, either financial or environmental). The majority of large harbour complexes, such as Rotterdam, Amsterdam, Groningen Seaports, Zeeland Seaports, Moerdijk, IJmuiden and Harlingen, have offered a low voltage (<440V) shore-side electricity supply for some time. This facility can be used by barges, fishing vessels and smaller tugs.
Rotterdam, Den Helder, Scheveningen and IJmuiden also provide a high voltage shore-side power supply for large maritime vessels. The ambition is that ten major port complexes should do so by the year 2025. For the inland shipping sector, the government wishes there to be a shore-side power supply in the 75 most important inland ports. During 2016, the government will examine ways in which those locations which do not yet offer a shore-side electricity supply, and which have not made any formal plans to do so, can meet the requirements of the Directive. Two such locations have been identified, both of which are on the TEN-T corridor. These omissions are to be rectified as a matter of urgency. With regard to the maritime sector, the government is to monitor the progress of the plans in consultation with the key stakeholders. It will also provide support to local authorities, port authorities and shipping companies in the form of:

- progress monitoring
- assistance in the submission of (European) subsidy applications
- innovative (‘smart’) funding constructions
- technical and organizations feasibility studies
- knowledge-sharing at home and abroad to avoid duplication of research.

Infrastructure for electricity supply to stationary aircraft
The Directive requests member states to consider the matter of landside electricity supplies for the use of stationary aircraft. Amsterdam Airport Schiphol has already made the necessary arrangements. There are currently no plans to install similar

facilities at other Dutch airports.
The Environmental Impact Assessment report *Working on the Future of Schiphol and the Region* (July 2007) noted that a further increase in the volume of air traffic at Schiphol could lead to emissions levels in excess of the permitted norms. The report goes on to state that the use of landside mains electricity connections and preconditioned air (PCA) systems, rather than the aircraft's own Auxiliary Power Units (APUs) or Ground Power Units (GPUs), would be an effective means of offsetting any increase in the atmospheric concentration of nitrogen oxides. The *Luchthavenverkeersbesluit* (Airport Traffic Decree; LVB) required the airport management company NV Luchthaven Schiphol to provide a minimum of 61 airside stands, each with an electricity supply and a preconditioned air (PCA) supply (both of appropriate quality) to obviate the need for an aircraft to operate its APU while on the ground. The target date was 31 December 2014. By the end of 2015, Schiphol had a total of 64 such platforms. A further three are to be added in 2016 bringing the total to 67.

Alternative fuels for public transport and urban logistics
As requested by the Directive, the national policy framework devotes attention to the use of alternative fuels in the public transport sector. The Netherlands has a total of some five thousand buses which are used to provide local, regional and inter-city services. Public transport has a major influence on local air quality. Efforts to reduce the negative environmental impact of buses have been ongoing for some time. Innovation has served to reduce the carbon emissions of the sector in two ways:

- the emissions of the buses themselves
- as a preliminary process, (part of) the logistics chain has been rendered emissions-free through the implementation of electric drive line system (also known as the 'power train'). The same system is now being adapted for use in buses, utility vehicles and vehicles used for urban distribution.

In April 2015, and following on from the 2012 'Green Deal Zero Emissions in Bus Transport', an administrative agreement was signed between central government, the Association of Provinces of the Netherlands (IPO), the metropolitan region of Rotterdam and The Hague, and the Greater Amsterdam region. It sets out the joint ambition to make all regional public transport bus services entirely emissions-free by 2030, or sooner if possible. In addition, the signatories have undertaken:

a. to purchase only zero-emission buses (as measured 'tank-to-wheel') from the year 2025.
b. to ensure that all buses used in 2025 run on 100% renewable fuels or energy, and that the production of this energy should support regional economic development.
c. to include 'well-to-wheel' CO_2 emissions per passenger-kilometre as a key selection criteria when granting public transport concessions.

Public sector authorities at all levels and market parties from throughout the chain are working closely together in pursuit of these ambitions. A workgroup with representatives of both central government and the responsible regional authorities has been set up to produce the necessary action plan and budgets.

The administrative agreement also provides for a study examining the feasibility of converting existing diesel trains (used for both passenger and freight transport) to run on electricity provided by onboard fuel cells and hydrogen. This option is most attractive for those routes which have no overhead power line, approximately 11%

of the Netherlands' total rail network.

The Green Deal for Zero Emissions Urban Logistics (`Green Deal ZES') also seeks to promote the use of alternative fuels. It was concluded in late 2014 between central government (the Ministry of Infrastructure and the Environment; the Ministry of Economic Affairs) and 54 partner organizations including local authorities, transport companies, automotive manufacturers, research institutes and representative bodies such as BOVAG, EVO, TLN, Natuur & Milieu and Rai Vereniging. All are committed to finding environmentally responsible methods of distributing goods within city centres. The objective is to implement an urban logistics system with the lowest possible carbon footprint, preferably zero emissions, by 2025.

International cooperation

Member states must observe a common framework and certain minimum requirements for the deployment of the infrastructure for alternative fuels. Article 3, para. 4 of the Directive states, "[w]here necessary, Member States shall cooperate, by means of consultations or joint policy frameworks, to ensure that the measures required to achieve the objectives of this Directive are coherent and coordinated."

Benelux Union

With a view to effective regional cooperation, the Netherlands attaches great importance to close consultation with its neighbours. In October 2015, the Benelux Union's Committee of Ministers issued Recommendation M (2015) 10, "on cooperation regarding the deployment of an infrastructure for alternative fuels." The text of the Recommendation provides for the sharing of knowledge and best practices in order to achieve the various objectives of the EU Directive throughout the Benelux region by their respective target dates (2020, 2025 and 2030). It devotes particular attention to the transnational aspects of the envisaged infrastructure.

Government Support Group

The Netherlands is also engaged in informal cooperation with other EU members states which have achieved notable progress in the development and use of alternative fuels. Again, the purpose is to promote the exchange of knowledge and to explore opportunities for a transnational deployment of the infrastructure for alternative fuels.

Administrative consultation with Flanders and Germany

There are regular meetings of officials from the Netherlands, Flanders and Germany to discuss maritime policy. These meetings also provide an opportunity to consider matters in connection with the EU Directive, to exchange best practice examples, and to discuss possible solutions to any problems that may emerge.

1 Introduction

1.1 Directive and national policy framework

In this document, the term 'the Directive' refers to Directive 2014/94/EU of the European Parliament and the Council of 22 October 2014 "on the deployment of alternative fuels infrastructure."[3]

The purpose of the Directive is twofold:
- To reduce reliance on oil to the greatest possible extent.
- To mitigate the adverse environmental impact of transport.

The Directive requires each member state to produce a national policy framework which describes the development of the market for alternative fuels in the transport sector and sets out how the relevant infrastructure is to be created. The Directive lists the aspects to be included in the national policy framework.
It also presents certain minimum requirements which the alternative fuels infrastructure must meet, together with common technical specifications for elements such as the charging points for electric vehicles, refuelling points of all types, and user information requirements.

The term 'alternative fuels' refers to:
- electricity
- hydrogen
- biofuels
- synthetic and paraffin-based fuels
- natural gas, including bio-methane, either in gas form (Compressed Natural Gas, CNG) or in liquid form (Liquefied Natural Gas, LNG)
- Liquefied Petroleum Gas (LPG)

(This list is not necessarily exhaustive.)

The Directive does not impose any requirements with regard to biofuels, since the existing fuel infrastructure can be used without major modifications. Neither does it list any specific requirements with regard to LPG because the development of the necessary infrastructure requires no additional incentivization.

Member states are expected to implement the Directive no later than 18 November 2016, i.e. they are expected to have presented their national policy framework to the European Commission by this date. Technical specifications, as listed in Annex II of the Directive, and user information requirements (Article 7) need not be included in the national policy framework but must be implemented in national legislation.

Following publication of the national policy framework, the member states are to report to the European Commission at three-yearly intervals.

The national policy framework uses the terms 'TEN-T network', 'TEN-T corridor' and 'TEN-V core network'. These are all references to the trans-European transport network in the meaning intended by Regulation (EU) No. 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines

[3] Pb. L 307/1, 28 October 2014

for the development of the trans-European transport network.[4] The European Commission actively supports projects which will improve the main transport network within the European Union. It does so through subsidies and the new financing arrangements provided by the infrastructure fund of the Connecting Europe Facility (CEF Transport/Coordination Committee of the financing facility for European connections) and the European Fund for Strategic Investments (EFSI).

The national policy framework has been produced by the Ministry of Infrastructure and the Environment in association with the Ministry of Economic Affairs. Its contents have been subject to consultation with various stakeholders, including private sector companies, industry federations, regional and local authorities, and the Ministry of Finance.

The national policy framework sets out target figures and the action needed to continue the development of the market for alternative fuels, including the deployment of the necessary infrastructure.

The purpose of the national policy framework is to present and substantiate the targets which the Netherlands has set for its alternative fuels infrastructure. These targets are based on the implementation agendas of earlier policy documents and the 'Green Deal' agreements. In short, this document presents the joint ambitions of the various stakeholders and the government. It also explains how those ambitions and the relevant targets are to be achieved.

The document builds upon a long tradition in which Dutch policy has sought to ensure that all transport modalities are as clean and efficient as possible. These objectives are set out in documents such as the Energy Agreement and the *Brandstofvisie* (Fuel Vision), both produced by the Social and Economic Council of the Netherlands (SER) and the Dutch Maritime Strategy 2015-2025[5]. Accordingly, the national policy framework holds no surprises. No new policy has been developed or adopted. Rather, this document describes policy that is already being pursued, but does so in a way which meets the reporting requirements of the Directive.

[4] Pb. L 348/1, 20 December 2013
[5] https://www.government.nl/documents/reports/2015/07/07/the-dutch-maritime-strategy-2015-2025

2 The Energy Agreement and the Fuel Vision

2.1 The Energy Agreement

The active involvement of companies and their employees in social-economic policy is enshrined in Dutch law, specifically the Social and Economic Council Act 1950 (amended). Through the Social and Economic Council (SER), the private sector takes on certain advisory and administrative tasks. It is in this context that various stakeholders and the government produced the Energy Agreement, published in September 2013.

The Energy Agreement sets out some ambitious targets in terms of mobility and transport:

- By 2050, the CO_2 emissions produced by the transport sector are to have been cut by 60% (compared to the 1990 reference level).
- From 2035, all new passenger cars sold will be (CO_2) emission-free.
- From 2050, this requirement will apply to all passenger cars on the roads.

2.2 A Vision of Sustainable Fuel: Green Deal

Over a two-year period (2014 and 2015) more than one hundred organizations were involved in refining the sections of the Energy Agreement which apply specifically to the mobility and transport sector.

The first year was devoted to producing a shared long-term 'vision' of a sustainable fuel mix for transport. It was clear that the sector faced a number of drastic changes if it was to become less dependent on fossil fuels. The importance of having a shared vision of the possibilities in the various market segments was clear. The result was the SER Vision of a Sustainable Fuel Mix, usually referred to as the *Fuel Vision*[6].

This document sets out an adaptive, multi-track strategy for the adoption of various alternative fuels by the various transport modalities. It is 'adaptive' in that it takes into account future uncertainties, recognizing that the objectives and targets of the Energy Agreement cannot be achieved with a 'one size fits all' approach. Each type of mobility has its own development path which will bring certain innovations and technological breakthroughs along the way.

Private sector companies, societal organizations and public authorities can sometimes encounter problems when attempting to make the next step towards sustainability. Central government can help to resolve those problems by entering into a 'Green Deal'. In essence, a Green Deal is a set of agreements between the government and several other parties, which can be private sector, companies, societal organizations or lower levels of government such as provincial and local authorities. Several Green Deals are now in place, supporting sustainability projects in areas such as energy, climate, water management, resource management, biodiversity, mobility, the biobased economy, construction and food provision.[7]

[6] *Een duurzame brandstofvisie met LEF*, June 2014
[7] Written communication to the House of Representatives, Parliamentary Proceedings July 2015 no. 30196-353

2.3 Consultation with regional and local authorities

Central government engages in consultation with the representative bodies of other public sector organizations: the Association of Provinces of the Netherlands (IPO), the Association of Netherlands Municipalities (VNG) and the Association of Regional Water Authorities. The talks cover various matters connected with the implementation of the Directive, the draft Environmental Planning Act, siting decisions for public or other amenities, permit regulations and enforcement measures. The production of the Fuel Vision also involved regular consultation with lower levels of government in the 'LEF' sessions. Meetings are now held on an annual or biannual basis.

2.4 Measures to encourage the use of alternative fuels in public transport and urban logistics

2.4.1 Measures which can promote the deployment of an alternative fuels infrastructure for public transport

There are some five thousand buses in the Netherlands, providing various local, regional and intercity public transport services. Buses have a major impact on local air quality. Efforts are ongoing to make all public transport cleaner and more environmentally responsible. There are two ways in which innovation will help to reduce the sector's CO_2 emissions:

- Reducing emissions of the buses themselves
- as a preliminary process, (part of) the logistics chain has been rendered emissions-free through the implementation of electric drive line system (also known as the 'power train'). The same system is now being adapted for use in buses, utility vehicles and vehicles used for urban distribution.

In April 2015, and following on from the 2012 'Green Deal Zero Emissions in Bus Transport', an administrative agreement was signed between central government, the Association of Provinces of the Netherlands (IPO), the metropolitan region of Rotterdam-The Hague and the Greater Amsterdam Region. It sets out the joint ambition to make all regional public transport bus services entirely emissions-free by 2030, or sooner if possible. In addition, the signatories have undertaken:

- to purchase only zero-emission buses (as measured 'tank-to-wheel') from the year 2025.
- to ensure that all buses used in 2025 run on 100% renewable fuels or energy, and that the production of this energy should support regional economic development.
- to include 'well-to-wheel' CO_2 emissions per passenger-kilometre as a key selection criteria when granting public transport concessions.

Public sector authorities and market parties from all parts of the transport chain are working closely together in pursuit of these ambitions. A workgroup which includes representatives of both central government and the regional authorities has been set up to produce the necessary action plan and budgets.

The administrative agreement also provides for a study examining the feasibility of converting existing diesel trains (as used for both passenger and freight transport) to run on electricity provided by onboard fuel cells and hydrogen. This option is most attractive for those routes which have no overhead power line, approximately 11% of the Netherlands' total rail network.

2.4.2 Alternative fuels infrastructure for urban distribution.
The Green Deal for Zero Emissions Urban Logistics (`Green Deal ZES') seeks to promote the use of alternative fuels. It was concluded in late 2014 between central government and 54 partner organizations, including the Ministry of Infrastructure and the Environment, the Ministry of Economic Affairs, local authorities, transport companies, vehicle manufacturers, research institutes and representative bodies such as BOVAG, EVO, TLN, Natuur & Milieu and Rai Vereniging. All will now examine environmentally responsible methods of distributing goods within city centres.

One of the main activities is the development and implementation of a `Living Lab' trial project in each local or regional authority area. On 1 January 2020, the Green Deal partners are to publish the results of the Living Lab projects, together with recommendations for further action. There will also be an advisory report which assesses the technical, economic, legal, safety and enforcement aspects of the Living Lab results, whereupon it will be possible to determine which activities are suitable for broader implementation. For example, local authorities may wish to exclude vehicles and/or traffic flows which cannot meet the criteria of Zero Emission Urban Logistics from (parts of) the city centre. They can do so provided they remain within the bounds of their legal powers.

The second purpose of the advisory report is to allow the partners to upscale the forms of Zero Emission Urban Logistics which are considered viable. This process will be undertaken over a five-year period. By 1 January 2025, all vehicle types used for inner-city logistics will be able to operate with zero emissions and in a cost-effective manner.

3 Electricity

3.1 Road transport

The Netherlands is pursuing the transition to electric propulsion in those segments which offer opportunities in this regard. The current generation of electric vehicles are seen as good but some further improvements are required in terms of range, charging time, charging infrastructure and Total Cost of Ownership. These improvements will not be seen overnight. A gradual move from plug-in hybrids to fully electric vehicles (using batteries and or fuel cells) appears to be the most likely development path, since the plug-in hybrid is now paving the way in terms of the charging infrastructure, the falling cost of electric drive lines, and consumer acceptance. The market for fully electric vehicles must nevertheless develop more quickly. Although no longer based on various niches, the consumer market has yet to pick up the necessary momentum. The prompt introduction of affordable electric vehicles in the urban setting will encourage emulation. The societal benefits of electric mobility will be greatest where significant improvements to air quality and liveability can be achieved. This is predominantly the local level, particularly in the major cities. The further development of 'smart' vehicles which support the driver's decision-making will be another significant development, as will the introduction of autonomous (driverless) vehicles.

We distinguish three categories of electric vehicle:

Term	Definition
EV	Vehicles with a (hybrid) electric drive line, which are connected to a charging point or the mains electricity supply by means of a cable and plug.
BEV	Vehicles with only a fully electric drive line (i.e. with no form of internal combustion engine), which can be connected to a charging point or the mains electricity supply by means of a cable and plug.
PHEV	All vehicles with a hybrid electric drive line plus an internal combustion engine, which can be connected to a charging point or the mains electricity supply by means of a cable and plug.

3.1.1 Infrastructure: the charging hierarchy

The Dutch government's policy on electric mobility has adopted a 'hierarchy' of vehicle charging facilities with following order of priority:

1. Primary: parking and charging on private premises
2. Secondary: Semi-public charging points operated by private sector parties, installed in public or semi-public areas such as car parks, shopping centres or industrial estates.
3. Tertiary: public charging facilities operated by public sector authorities.

3.1.2 Market model

In 2012, a market (pricing) model for the charging infrastructure was developed under government supervision. The process involved a large number of

stakeholders, including energy companies, mobility providers and user groups. The resultant market model standardizes two aspects:
- 1. A single user pass giving access to all charging points in the Netherlands (interoperability).
- 2. Payment systems which ensure that users pay for the electricity they take from the charging point.

This model is based on four roles. First there is the *charging consumer*, the driver who wishes to charge his or her electric vehicle. To do so, he is given access to a charging point. He uses a card or app to identify himself. The card is issued (on payment by the consumer) by a *service provider*. The service provider monitors the amount of electricity used by the consumer and claims the relevant payment. The service provider must coordinate activities with the *charging provider,* being the party responsible for the maintenance of the physical charging point. Each charging point also has an *infra provider,* who (on payment by the charging provider) administers the use of the charging point: which users have used how much electricity.

3.1.3 The role of public sector authorities

Central government

The development of the market model under the aegis of central government served to ensure standardization and interoperability of the payment system for electric mobility in the Netherlands. The development of the charging infrastructure itself is, in principle, a matter for the private sector. However, until the business case is solid enough to guarantee profitability for private operators, the public sector may wish to contribute. To create a realistic and effective business case, the government has initiated the Green Deal for a Public Charging Infrastructure and has set up the National Charging Infrastructure Knowledge Platform (NKL). A significant number of business cases (particularly in those areas with large numbers of drivers) are expected to enter profitability in late 2018. Most will not require support beyond 2020.

Central government is responsible for policy with regard to services alongside motorways and other major trunk routes. This policy (the *Voorzieningenbeleid*) covers three basic facilities: refuelling points (filling stations), roadside restaurants, and service stations (which combine the commercial operation of refuelling point and restaurant). Because these have been the only three types of service permitted, it was until recently not possible to install and operate a standalone charging point for electric vehicles alongside a motorway. On 10 January 2012, however, an amendment to the relevant legislation was made which defines a charging point as a ‘basic service facility’. This opened the way for operators to install (rapid) charging points alongside major roads. In order to allow further expansion of services, where not expressly prohibited by other legislation such as the *Benzinewet* (concerned with the safety of fuel transport and supply), the term ‘electricity charging point’ has now been replaced by ‘*energy* charging point’. This would include a station at which batteries are exchanged, for example.

Local authorities

If a resident, company or charging infrastructure provider approaches a local authority for permission to install a charging point on the public highway, it will usually be necessary to grant an exemption to Art. 2:10 of the *Algemene Plaatselijke Verordening* (General Municipal Bye-law). This exemption can be made conditional.
Depending on their policy and ambitions, local authorities can assume various roles

or positions: reactive, facilitating and/or incentivizing.

- A local authority which cooperates with third party requests. Its role is then limited to issuing the relevant permits and defining conditions.
- A local authority which takes the initiative of installing charging infrastructure (e.g. at strategic locations such as near the town hall, library, shopping centre, etc.). In this situation, the local authorities is both applicant and the party responsible for issuing the relevant permits.
- A local authority which provides financial support to third parties wishing to create a charging infrastructure.
- A local authority as owner and operator of municipal vehicles, whereby the fleet includes electric vehicles.
- A local authority as grantor of operating concessions and/or tendering party for the charging infrastructure in the public domain.

In 2013, with a view to facilitating a smooth transition to electric mobility, the Association of Netherlands Municipalities (VNG) developed a set of policy rules covering the charging infrastructure. These policy rules, which also set out the legislative basis on which decisions can be made, apply to public charging points and other charging infrastructure in the public domain, including Park & Ride facilities. The policy rules are intended to:

- create clarity for private individuals, companies, grid managers and infrastructure providers with regard to the criteria which the local authority will apply when considering a planning application for one or more charging points in the public domain, or the designation of parking places for the use of electric vehicles (only).
- to inform private individuals, companies, grid managers and infrastructure providers about (legal) procedures.
- to create standard criteria and procedures whereby applications relating to the installation of charging infrastructure in the public domain, to include the designation of parking places for the use of electric vehicles, will be assessed in a uniform, fair and even-handed manner: the 'level playing field'.

The policy rules do not apply to local authorities which have themselves adopted the role of tendering party or grantor of operating concessions. A separate model agreement has been produced for this category in consultation with the VNG and is included as an appendix to CROW publication 336[8]. It represents the first step towards a uniform and fully transparent approach.

3.1.4 Current market status

Electric mobility has been a focus of public-private cooperation in the Netherlands since 2009. Societal organizations, local and regional authorities, the private sector, industry federations, knowledge institutes and NGOs such as environmental groups have been brought together to form the 'Formula E Team', which is funded by central government and also acts as an advisory committee to the Ministry of Economic Affairs.

Electric mobility policy 2011-2015
The government action plan *Elektrisch Rijden in de Versnelling 2011-2015 (*'Electric Mobility steps up a gear*')* is part of a Green Deal agreement announced in 2011. Most of its projects and part-projects have now been completed or are nearing

[8] http://www.crow.nl/publicaties/oplaadpunten-elektrische-autos-openbare-ruimte

completing.
At the start of 2011, there were just 600 electric or hybrid electric vehicles in the Netherlands. By the end of 2015, there were 87,500 electric passenger cars, of which 11 per cent were fully electric. Hybrid vehicles therefore continue to represent a significant proportion of the electric mobility market. Their drivers are less reliant on a public charging infrastructure.
Significant progress has been made towards the objectives set out in the action plan with regard to rollout, a viable earnings model and innovation.[9] There have also been a number of positive side effects. The good results, both foreseen and unforeseen, are largely due to the efforts of the public-private partnership that is the Formula E-Team, as well as government policy measures (including fiscal measures). Those results include the following.

- In December 2015, there were some 90,000 electric vehicles registered in the Netherlands. This number far exceeds the action plan's target of 20,000.
- The rollout of a charging infrastructure has been subject to various incentives. As a result, approximately 18,000 public or semi-public charging points and 465 rapid charging points were created by December 2015. This places the Netherlands among the world leaders in the adoption of electric mobility.
- The earnings potential represented by electric mobility has increased significantly over the past five years. Employment opportunity in the sector increased from 600 full-time jobs in 2010 to 3,200 in 2014. Total revenue in that year was €820 million, with value added of €260 million.
- Since 2009, the Netherlands has been responsible for innovations in areas such as:
    - Interoperability: the Netherlands is currently the only country in the world which has implemented a charging structure with virtually nationwide coverage and complete interoperability.
    - Rapid charging: the Netherlands was the first country to allow private operators to install high power rapid charging points alongside motorways.
    - Vehicle2Grid/smart charging: there have been various trial projects involving smart grids for electric mobility, e.g. a scheme in which locally generated electricity is stored in the vehicle and later returned to the grid.
    - Solar-powered vehicles: the Stella Lux developed by TU Eindhoven is the world's first energy-positive family car.

A charging infrastructure with nationwide coverage
In 2009, the cities of Amsterdam, The Hague, Rotterdam and Utrecht, together with Brabantstad (an administrative network comprising Breda, Tilburg, Eindhoven, Den Bosch and the Province of Noord-Brabant) were designated 'focus areas'. The intention was to bring about a 'snowball' effect whereby adoption in other regions would be that much faster. The approach seems to have been successful. Neighbouring municipalities recognized the urgency of facilitating a charging infrastructure within the public domain. Some, notably in the Amsterdam and Utrecht regions, joined forces to gain the advantages of scale.

Rapid charging
As the number of private and semi-public charging points continued to grow, a network of public 'rapid charging points (50Kwh) was implemented alongside motorways and major trunk routes. It was made possible by a legislative amendment which allowed private parties to install and operate such services. Given the public nature of the rapid charging points, interoperability is a condition of the

[9] KWINK Groep: *Terugblik en Vooruitblik op het beleid voor Elektrisch Vervoer (*an analysis of the electric mobility action plan), The Hague, February 2016.

relevant permits. The rapid charging points can be used by suitable vehicles of any make. They create greater confidence in electric vehicles as a mode of transport that is suitable for longer, inter-city journeys and they help to solve the problem of 'range anxiety'.

There has also been a trend whereby large cities join forces with market parties to install rapid charging points alongside their main access routes. As a result, the Netherlands now has an extensive network of rapid charging points alongside the key transport corridors. This reduces pressure on the public charging points elsewhere while allowing the drivers of electric vehicles to travel the length and breadth of the country.

Number of standard charging points[10]	**2014**	**2015**	**2016 (per 31 September)**
Public (accessible 24/7)	5,421	7,395	9,844
Semi-public (accessible only at certain times)	6,439	10,391	14,376

Number of rapid charging points	**2014**	**2015**	**2016 (per 31 September)**
Public and semi-public	254	465	556

The number of private charging points is not subject to ongoing monitoring. Based on the findings of a study conducted in 2014 and the increase in the number of electric vehicles on the roads, a reasonable estimate would be 55,000 private charging points at the end of 2015.

Development of open protocols
One of the successful concrete initiatives introduced by the Netherlands to promote the rollout of the charging infrastructure is the development of open communication protocols. Stakeholders, both national and international, have collaborated to create several new communication protocols including OCHP, OCPI and OCPP. Open protocols such as OCHP and OCPI allow the drivers of electric vehicles to use a far larger number of charging points, both in the Netherlands and in other countries. Innovation and competition are encouraged, resulting in better service provision, lower prices and new services such as 'Smart Charging', 'Plug & Charge', 'Car sharing', etc. If a better and faster charging infrastructure is rolled out – supported in part by these open standards – the owners of electric vehicles can only benefit and this will further promote the adoption of electric mobility. The open protocols have now been introduced in full throughout the Netherlands. It is important that this topic is placed on the European agenda to ensure that drivers throughout the Union can charge their vehicles in a convenient and standardized manner.

3.1.5 Future market development

At present, the purchase price of an electric vehicle is significantly higher than that

[10] Source: Netherlands Enterprise Agency

of a comparable conventional vehicle. Calculating the total cost of ownership (TCO) without any subsidy component gives a more realistic impression. The TCO of an electric passenger car is still higher than that of one which runs on fossil fuels. However, several studies conclude that the difference will become negligible by the year 2025.[11] At the moment, most electric vehicles are bought by business users whose purchasing decision is influenced by the fiscal incentives announced in *Autobrief II.*

In the years ahead, it will be important to stimulate the development of the private market as well. An essential factor will be the range of electric vehicles available in showrooms: the consumer must have adequate choice. If drivers are to be persuaded to make the transition, electric vehicles must also have a greater range than is currently the case. In this respect we are on a growth path and will remain so until at least 2020. The emergence of improved (battery) technology will also do much to promote acceptance of electric mobility.

Access to a good charging infrastructure will increase the distance that drivers are able to drive in an electric vehicle. Rapid charging facilities are therefore a welcome adjunct to the standard charging points.
As stated above, the Netherlands' policy is that the rollout of the charging points is a matter for the private sector, based on market forces. Growth in the number of charging points will be determined by growth in the number of electric vehicles on the roads. Charging those vehicles should, wherever possible, take place on private premises. For the user, this is generally the least expensive option, especially where it is possible to use self-generated electricity from solar panels.
Attention must be devoted to the relationship between the charging infrastructure and the national grid. The Electricity Act allows room for experiments with new methods of grid stabilization before they are incorporated in the legislative framework. In this context, several 'Vehicle2Grid' and 'Grid2Vehicle' trials have been conducted at the local level. Further progress will be determined by developments in battery technology.
In late 2016, the government is to present its vision of the charging structure for electric vehicles as it should appear in 2035. The relevant document will examine current market developments, including rapid charging, smart charging, driverless vehicle technology, car sharing, and the car as storage medium for the grid.

3.1.6 National targets

In 2015, 7% (absolute figure 28,000)[12] of all new vehicles sold in the Netherlands came with a plug attached: 0.7% were fully electric and 6.3% hybrid. The government, societal partners and market parties wish to achieve further growth with electric vehicles accounting for at least 50% of new sales in 2025, 30% being fully electric. The partners have also set an interim target for 2020, when at least 10% of all new vehicles sold should have an electric drive line. This would represent growth of almost 100% to just under 140,000 electric vehicles but is dependent on economic and technological developments in the meantime. From 2035 onwards, all new passenger cars sold in the Netherlands must be able to operate with zero emissions.

The principle of 'the charging point follows the vehicle' applies. It falls to the market to create an appropriate number and mix (private, semi-public, public and rapid) of charging points. The least expensive option for owners is to charge their electric

[11] Brandstofvisie met LEF (Parliamentary Proceedings 2014-2015, 30196, no. 353, annex)
[12] Assuming total sales of approximately 400,000 new vehicles per year

vehicles on their own premises. Public charging points should be seen as the 'back-up solution'. Many local authorities consider a distance of 300 metres to the nearest charging point to be acceptable. In the hierarchy of charging facilities, we now see a trend whereby semi-public charging points are showing stronger growth than the public charging points.
The Green Deal for the Charging Infrastructure (June 2015) announced that central government would contribute towards the creation of approximately 10,000 public charging points, none of which will be specific to any particular vehicle or owner but can be used by anyone. The government operates an active monitoring programme to determine whether the development of the charging infrastructure is keeping pace with demand. In situations offering a positive business, government support is obviously unnecessary. Table 1 shows a summary of the Netherlands' ambitions for public charging points, based on the aforementioned Green Deal.

Number of public charging points per mid- 2016	**Number of electric vehicles in 2020**	**Total number of public charging points in 2020**
7,844	140,000	17,844

3.1.7 Measures to ensure achievement of national targets

Financial incentives
Electric vehicles (passenger cars)
The *Autobrief II* sets out the fiscal arrangements in place until the end of 2020. There are various provisions ('tax breaks') with which the government will incentivize electric mobility. The focus is on fully electric vehicles, which for business users carry an additional income tax liability of only 4% (rather than the usual 22%) up to a catalogue price of €50,000. These vehicles are exempt from motor vehicle tax (MRB) and purchase tax, benefits which also fall to private, non-business users. These arrangements will do much to achieve the target market share for electric vehicles. The development of the consumer market remains a point for attention and is currently the subject of a study commissioned by the government in response to a parliamentary motion tabled by member Ed Groot (PvdA). The motion requested the government to join the FET[13] parties in producing a structured plan to make electric mobility more attractive and more accessible to the average consumer. In response, the FET has indeed produced a plan entitled *Maak elektrisch rijden Groot* ('Make electric mobility *Great* – a play on Mr Groot's name.) The Minister of Economic Affairs outlined its contents in a written response to the House of Representatives dated 6 June 2016. The minister announced his intention to commission a number of studies before making any firm statement on the FET proposals for a purchase price subsidy on fully electric vehicles and a credit subsidy against charging costs for all new electric vehicles, including hybrids. The minister is expected to return to the matter in the spring of 2017.

The charging infrastructure
In addition to the Green Deal contribution (see below), a company wishing to create charging points for lease vehicles can apply the Environmental Investment Deduction Allowance (*Milieu Investeringsaftrek*; MIA) to offset its tax liability.
A private charging point for lease vehicles can be reported in one of two ways:

1. As 'vehicle and charging point on own premises', whereupon the lease company may claim MIA on the full investment amount provided it does not exceed €50,000.
2. As 'private lease', whereby the lease company provides a vehicle plus access to a dedicated charging point. The lease company may then claim MIA on the full investment amount provided it does not exceed €50,000.

[13] Formula E Team which includes various stakeholder organizations.

Companies may also be eligible for the MIA deduction. In the case of a charging point, the investment concerned must be greater than €2,500. Where claiming in respect of a vehicle and charging point in combination, the total investment must not exceed €50,000. Full details can be found on the website of the Netherlands Enterprise Agency.[14]

Local support
Local authorities may implement their own incentive programmes to encourage the creation of (private) charging points or the purchase of electric vehicles. For example, the City of The Hague recently introduced a purchase subsidy. Such measures are often implemented in the interests of air quality. Further information is available from the individual local and provincial authorities.

Green Deals
Electric mobility
The Green Deal for Electric Transport 2016 -2020 was signed on 14 April 2016. The partners have made the following agreements with regard to the charging infrastructure:

1. Improvement and expansion of the charging infrastructure for electric vehicles. The main objectives will be:
   - to establish a viable business case for the public charging infrastructure, doing so in consultation with the NKL
   - to make full use of the opportunities offered by the Green Deal for a Public Charging Infrastructure and to monitor progress.
   - to formulate a shared vision of the future of a 'smart' charging infrastructure, to include energy storage via electric vehicles in support of effective grid management.
2. Improvement of the storage capacity of electric vehicles in relation to the variable usage of sustainable energy and in the interests of grid stability. This will involve the upscaling of experiments and further research within the Smart Charging Living Lab programme.

The charging infrastructure
To facilitate and accelerate the rollout of a public charging infrastructure for electric vehicles, the relevant Green Deal agreement was signed on 9 June 2015 by a large number of stakeholders, including the VNG, provincial authorities, Netbeheer Nederland (the national grid management authority), various special interest groups, the Ministry of Economic Affairs and the Ministry of Infrastructure and the Environment. The Green Deal programme includes activities intended to reduce the investment costs of a charging point, such as further research and process optimization.

As part of the Green Deal, central government is to contribute a total of €5.7 million towards the implementation of the charging infrastructure. Projections suggest that this will result in the creation of approximately 10,000 public charging points. The government funding is available to all public sector authorities (at municipal, provincial or regional level) in the Netherlands which are willing to support the rollout of the public charging infrastructure and which are able to satisfy certain conditions.

The Green Deal partners have also established a knowledge platform: *Nationaal Kennisplatform Laadinfrastructuur* (NKL). It will coordinate innovation in connection with the public charging infrastructure with a view to increasing capacity and

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

coverage while reducing costs. The NKL collects and collates relevant information on matters such as the adoption of the Type 2 Combo plug and the charging protocol. The Netherlands regards this as a firm foundation on which to build develop the system, eventually introducing charging facilities with higher power capacity. The overall objectives are to fast-track development, reduce costs and ensure that electric mobility gains widespread acceptance as soon as possible.

Other Green Deals
In addition to the agreements described above, the government has entered into a number of other Green Deals in which electric mobility plays a role. They include the Green Deal for the Textile Industry, one aim of which is to increase energy efficiency in this sector by 35%. This will entail the adoption of electric vehicles. The Green Deals for electric public transport and urban distribution are discussed elsewhere in this document.

3.1.8 Observations and challenges

The rollout of the charging infrastructure for electric vehicles does not distinguish between electric transport as such and other, new sustainable energy technologies. The effective adoption of those technologies calls for them to be incorporated into the existing spatial, regulatory and legislative frameworks in an appropriate manner. Precisely what will qualify as 'appropriate' will become apparent only when the new technologies are indeed introduced. It is in this context that the Dutch government makes the following observations.
There are some potential obstacles to the effective implementation of the charging infrastructure.

- Not all areas will offer a positive business case for charging points in the public domain. It is possible that the creation of the charging infrastructure in these areas will be a government responsibility.
- It is now evident that the commercial operation of public charging points can be economically viable, particularly in the larger cities. The market parties in these areas are increasingly willing to bear the investment costs in order to establish a market share. Nevertheless, establishing a viable business case for charging points in less densely populated areas will remain a challenge.
- Another challenge is that 70% of all vehicle owners park in the public domain, usually on the road outside or close to their place of residence. It is unlikely that a charging point can be created for each and every owner. This problem will be mitigated by the further development of rapid charging technology.

3.2 Inland shipping

3.2.1 Current market status

The use of a shore-side electricity supply is commonplace among inland shipping operators. Almost the entire western European fleet has the equipment needed to 'plug in' when moored in port.
Originally the shore-side electricity supplies were implemented in the interests of comfort: they are much quieter than an onboard generator and also less expensive. In recent years, the emphasis has shifted. The key interests are now air quality and the avoidance of noise nuisance for others in the vicinity.

A shore-side electricity supply is a useful instrument with which ports can prevent or reduce local noise nuisance. It is also a means to ensure compliance with noise and emissions regulations, whereupon port facilities can be sited even in designated vulnerable areas with exceptional natural values (Natura 2000).

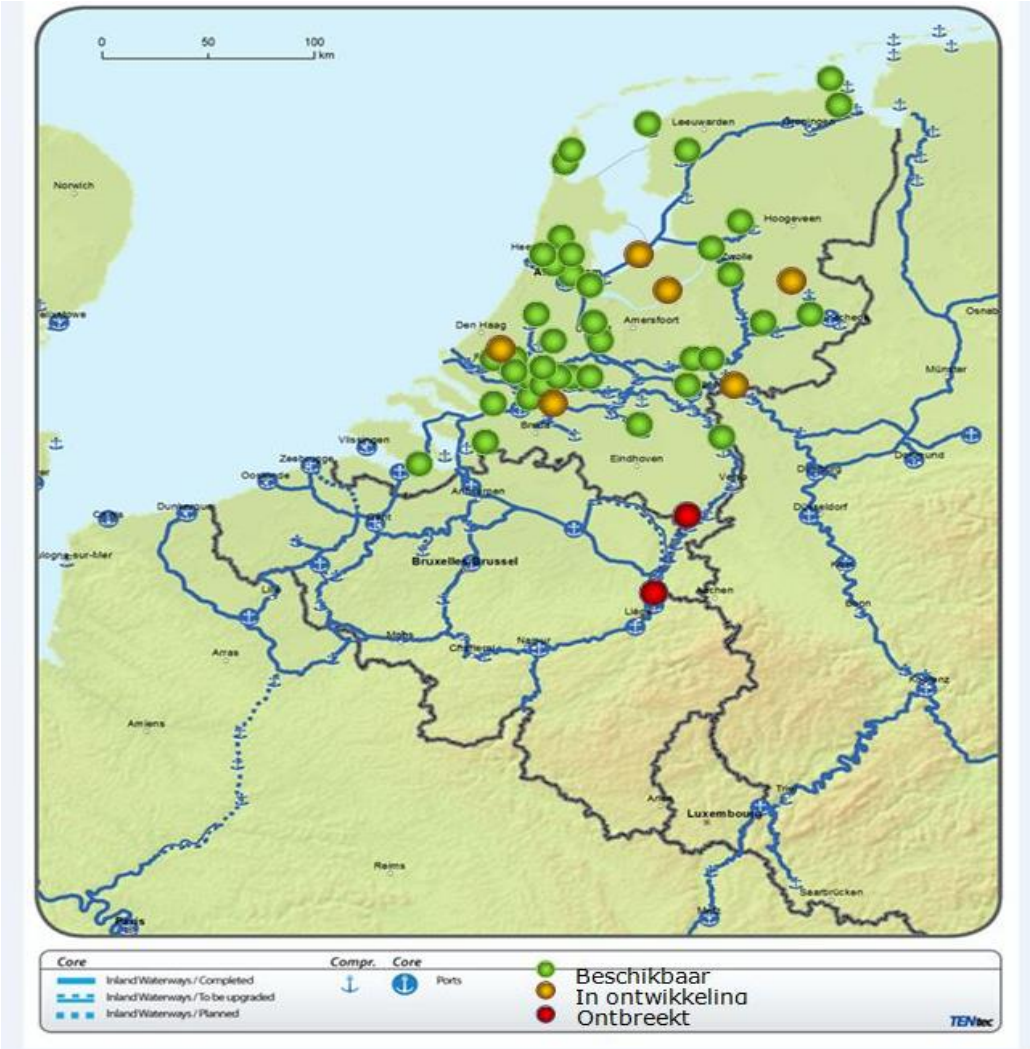
In view of the widespread availability of shore-side electricity in practically all ports where there is any demand, and given the extremely low emissions associated with it, generic policy measures are unnecessary.
The Minister of Infrastructure and the Environment will meet with sector representatives at regular intervals to discuss practical experiences, problems and recent developments in connection with shore-side electricity. Central government and the inland shipping sector will thus jointly monitor the situation. The main discussion forum is the annual meeting of the *Centraal Overleg Vaarwegen* (Central Consultation Platform for Waterways).

In 2010, Rotterdam was the first port authority to require moored vessels to use the shore-side electricity supply. Sixty per cent of ports in the Netherlands now offer the necessary facilities. Of the 75 largest inland ports, 45 offer shore-side electricity. Nationwide, a total of 553 connections are available. Of those ports which have not yet implemented shore-side electricity, approximately one third are planning to do so in the foreseeable future.

A number of ports report that they do not offer shore-side electricity because few if any vessels are moored overnight. It is not customary to use shore-side electricity at other times, even during the loading or unloading of cargo. This is because the transhipment 'window' is generally very short – a matter of a few hours. Terminals are therefore unlikely to offer shore-side electricity.

Among the ports (both maritime and inland) of the TEN-T network, Rotterdam, Terneuzen, Amsterdam, Utrecht, Nijmegen, Deventer, Bergen op Zoom, Hengelo, Moerdijk and Kampen all provided shore-side electricity (per 31 December 2015). Zwolle, Almelo and Vlissingen do not yet do so. Similarly, the two inland ports of the Maas Corridor - Maasbracht and Maastricht – have no shore-side electricity supply at this time.

The map below shows the availability of shore-side electricity connections (per 31 December 2015).



- Available
- In development
- None

3.2.2 Future market development

It is reasonable to expect a further increase in the number of ports offering shore-side electricity, and hence in the number of individual moorings with connections. However, growth will not be particularly marked since the vast majority of ports at which there is any demand already offer this facility.

3.2.3 National targets

The aim is to ensure that shore-side electricity is available in the 75 most important inland ports (as measured by transhipment volume: > 1 million tons p.a. in 2006).

Six ports have already announced plans to install shore-side electricity facilities. The overall target is 100% in the 75 most important inland ports by 2025, insofar as vessels are actually moored at those locations overnight. In those (areas of) ports

which are not used during the hours of darkness, there is little point in installing shore-side electricity facilities given the very short loading and unloading times usual in this sector.

3.2.4 Measures to ensure achievement of national targets

In addition to pursuing complete coverage, the government will attempt to introduce greater uniformity in payment systems for shore-side electricity. The systems currently in use are extremely disparate.

During 2016, the Ministry of Infrastructure and the Environment will examine how those ports which do not yet offer a shore-side electricity supply, and which have not announced plans to do so, can nevertheless meet the requirements of the Directive. Two ports which fall into this category have been identified: both are on the TEN-T corridor. The situation is to be rectified as a matter of urgency.

3.2.5 Observations and challenges

The high availability of shore-side electricity can be explained by the 'positive business case' that it represents for both the port authorities and users. A study by Delft University of Technology concludes that shore-side electricity is often cheaper than running an onboard generator.[15]

In this respect, the inland shipping sector stands in marked contrast to the maritime sector, which is able to use relatively inexpensive fuel to power generators. Inland vessels are required to use the more expensive gas oil.

For the inland shipping sector, the choice between shore-side and self-generated electricity is dependent on fuel prices, which have fallen significantly in recent years while the price charged for shore-side electricity has remained stable.(Information correct at the time of the Delft study.) Even so, the business case for shore-side electricity would appear to be positive for the vast majority of vessels.

Operators and bargemen are, however, not the only stakeholders. The business case for shore-side electricity is also favourable for port authorities and the responsible local government bodies. The costs of installing, maintaining and administering the system are relatively modest and can be readily recouped by means of a minor increase in mooring fees. In many cases, operators will still save money compared to having to operate their own generators. At the same time, there are environmental benefits: reduced emissions of NO_X, fine particulates and CO_2 emissions, and less potential for noise nuisance.

In practice, however, there are a few issues which detract from the comfort and convenience of both port authorities and vessel operators. Many disparate payment systems are in use, varying from prepayment tokens which must be inserted into a quayside, to automated payment systems based on a standard credit card or the 'ECO Card' which is now widely used in the sector.[16]

For an inland vessel which does not require energy for additional commercial

[15] De Vos, P. & R. van Gils, *Walstroom versus Generatorstroom; een studie naar de kosten*, TU Delft, 2011
[16] The ECO Card was introduced to facilitate the payment of the mandatory waste management charges introduced further to the Strasbourg Convention on the Collection, Deposit and Reception of Waste during Navigation on the Rhine and Inland Waterways 1996 (CDNI).

activities, a 28 kW supply is more than adequate to power lights and domestic appliances in crew quarters and the occasional use of a small crane. It may not be sufficient for uses such as refrigeration.

No problems exist or are foreseen with regard to the standardization of technical systems.

Further research is desirable to identify opportunities for the harmonization of payment systems for shore-side electricity. Harmonization is primarily a logistical and administrative question: the necessary technology already exists and is in widespread use in other sectors, such as parking systems.

There are two developments which may help to reduce the costs of implementing shore-side electricity supplies and the relevant payment systems:
- the combined use of shore-side connections for the existing purposes and to recharge electric-powered vessels
- the combined use of the payment systems for mooring fees and other charges.

There are several ports in which a trend towards the electrification of tour boats, water taxis and even private recreational vessels can now be seen. Electric-powered vessels require access to a power supply in order to charge their batteries. This offers opportunities for the shore-side electricity connections to be combined with (rapid) charging points, thus reducing the costs-per-user and enabling 'smart' use of the existing networks.

Although the above points fall outside the scope of the Directive, they may well help to promote the installation and use of shore-side electricity. The Dutch government will therefore support such developments, which are to be incorporated into the current policy programmes.

3.3 Maritime shipping

3.3.1 Current market status

Most of the Netherlands' harbour complexes, such as Rotterdam, Amsterdam, Groningen Seaports, Zeeland Seaports, Moerdijk, IJmuiden and Harlingen have for many years provided a low voltage (<440V) shore-side electricity supply for the use of inland waterway vessels, fishing boats and smaller tugs.

In recent years, it has sometimes proven advantageous to offer a high-voltage (>6,6kV) shore-side supply to larger maritime vessels as well. Some port authorities have invested in such facilities with a view to environmental gains and increased societal support. In some cases, government subsidies have been made available. An obstacle to the introduction and use of high-voltage shore-side electricity is the lack of flexibility. A vessel must always moor at the particular quay at which its connection is installed.

A brief description of the current situation follows.

Den Helder, Ministry of Defence dockyards
The fleet of the Royal Netherlands Navy has had access to shore-side electricity since 1916. Most ships use a low voltage connection (440V) although the more modern and larger vessels use 6.6 kV. In both cases, the line frequency is 60Hz.

In 2015, one fixed and one temporary high voltage supply line were added, with two further fixed lines now planned. The fleet's total annual electricity consumption is in the order of 50 GWh.

Rotterdam, Stena Line
In June 2012, Rotterdam became the first commercial port in the Netherlands to provide high-voltage shore-side electricity, the launching customers being Stena Line, which operates four ferries from its two permanent docks. The 6 MegaVoltAmpère (MVA) system can be classified as high voltage (11kV).
The KVNR Shipping Award 2012 was presented to Stena Line in recognition of the positive environmental effects of this move.

IJmuiden
Since 24 June 2015, IJmuiden harbour has been able to supply shore-side electricity to the trawlers operated by two companies, Cornelis Vrolijk and Parlevliet & Van der Plas. Smaller vessels such as cutters and tugs have had access to shore-side electricity for some time, but it remained uncertain whether it would be possible to connect the much larger fishing vessels. In the new system, power is run to six sunken connection points along the quayside, to which the trawlers connect by means of dual cables. Up to three trawlers can be connected at any one time.

Scheveningen
Scheveningen has provided a 'green' high voltage electricity supply since 2016. One of the two commercial harbours has 7 connection points while the other has two. A low voltage supply has been available to cutters, small fishing vessels and leisure craft for many years but the system was not capable of supply the large seagoing vessels.
The installation of new shore-side electricity facilities was undertaken as part of the national Air Quality Cooperation Programme (NSL), which involves central, provincial and local government organizations. The Scheveningen project was proposed by the City of The Hague, which also provided co-funding to supplement the NSL grant.

3.3.2 Future market development

All Dutch seaports wish to achieve greater sustainability, an ambition that is expressly stated in their respective policy documents. All have placed shore-side electricity on the agenda.

3.3.3 National targets

Targets vary by time horizon and type of vessel:

Term	**Type**
Short term (<10 years)	Ferry, RoRo, offshore, tugs, fishing, river cruise
Medium (5-15 years)	Sea cruise, shortsea, jack-up rigs
Long term (10-20 years)	Deep sea tankers and bulk carriers

Target figures	Current	2020	2025
Ports with high power shore-side electricity	4	8	10

At the end of 2015 there were four seaports offering a high power shore-side electricity (of which two were also high voltage). There are also many others which provide a low power supply. They are not included in this table due to the similarity and overlap with shore-side electricity systems for inland vessels.

3.3.4 Measures to ensure achievement of national targets

Progress will be monitored in consultation with the main stakeholders. Local authorities, port authorities and shipping companies will receive support in the form of:

- Progress monitoring
- Assistance in submitting (European) subsidy applications
- Smart financing constructions
- Research to establish technical and organizational viability of shore-side electricity systems
- Knowledge-sharing at national and international level to avoid duplication of research.

3.3.5 Observations and challenges

In many cases, the installation of shore-side electricity supplies is prompted by a desire to reduce emissions and/or noise nuisance. There may also be commercial considerations – a port must remain competitive – but shore-side electricity undoubtedly has a positive effect in terms of local emissions and noise reduction when used instead of onboard generators or large engines. Nevertheless, shore-side electricity is an interim solution for the maritime sector. The overall ambition is to create the zero-emission, totally silent ship.
The business case for any shore-side electricity project will rely on various practical, financial and technical aspects.

Practical aspects
The viability of providing a high power shore-side electricity supply will depend on several practically aspects, as well as the electricity consumption of the vessels in port. Consumption varies enormously according to the type of vessel concerned. Other considerations include how long a ship is actually moored in port (the number and duration of its 'calls') and whether it sails regular fixed routes whereby it will return on set dates. As noted above, most connections are not mobile. They can serve only the ship that is moored at a specific quay. Even the position of the (fixed) connection points on that quay is a relevant consideration.
If we examine only vessels which sail a fixed route with some regularity, we find that there are only a few segments in which the installation of shore-side electricity is viable in the short term. They are ferries/Ro-Ro, cruise ships, fishing boats, tugs and offshore suppliers. For most other segments it remains impossible to create an attractive business case because the vessels concerned are unlikely to make adequate use of the connections.

Financial aspects
Shore-side electricity is a relatively expensive option. The installation of a high-voltage system is particularly expensive. (Depending on location, it can cost between one and five million euros per connection). Ensuring adequate use is also difficult because a ship must be moored at a particular point along the quayside in order to 'plug in'; this is not always possible. As a result, the ratio of costs to returns rises yet further. The onboard systems needed to make use of shore-side electricity could add several tens or even hundreds of thousands of euros to the cost of building a vessel. A retrofit (adaptation of an existing vessel) would be even more expensive.

Given the disparity between fuel prices and electricity prices (especially when energy tax is added in), and the high costs of both the connections and modifications to ships, it is unlikely that many new connections will be realized until there are system changes (such as standardization). It must also be remembered that the commercial operation and management of a high capacity shore-side connection is itself an expensive process, with high standing charges and significant expenditure on regular inspection, certification and training.

The Netherlands is able to activate certain fiscal arrangements to promote the use of shore-side electricity. A temporary lowering of the rate of energy tax is one possibility, while tax allowances on investment further to the MIA/VAMIL regulation is another. This would increase the financial attractiveness of shore-side electricity.

It should be noted that, unlike electricity, liquid fuel used in the maritime sector is not subject to taxation. A temporary reduction in taxation on shore-side electricity would create a level playing field and a better business case for shore-side electricity projects.

On the recommendation of the European Commission and pursuant to Article 19 of the Energy Taxation Directive (2003/96/EC)[17] the Council has permitted Sweden, Germany and Denmark to reduce taxation on shore-side electricity to the minimum level permitted by this Directive, *viz*. €0.5 per MWh. This is a temporary dispensation, expected to be in place for no more than a few years. However, creating such an exception for the maritime sector is not in keeping with the Dutch government's intention of simplifying the Netherlands' taxation system. For this reason, the government will not follow the example of Sweden, Germany and Denmark by requesting derogation of the existing arrangements.

According to Article 24 of Council Directive 2008/87/EC (2003), member states may opt to bring activities or physical installations (such as ships and harbours) below the EU-ETS ceiling. This option will be examined further; to date, it has not been exercised by any member state.

It would also be possible to call on the MIA/VAMIL (Environmental Investment Allowance) scheme with respect to the installation of shore-side electricity facilities, both on the key and on a vessel. There are some cases in which tax deductibility is restricted to €7,500 but this would not apply to the physical equipment installed on board a seagoing vessel. Moreover, its installation would provide credit towards Green Award certification. If the tonnage allowance is claimed, the entitlement to MIA/VAMIL lapses.

Port authorities can introduce their own incentive measures. In Rotterdam, for

[17] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:283:0051:0070:EN:PDF

example, a vessel with shore-side compatibility scores points on the Environmental Ship Index and is entitled to reduced mooring fees.

In the case of new connections, it will remain a 'chicken and egg' problem if the only way in which shore-side electricity projects can be brought to fruition is with external funding such as subsidies under the Connecting Europe Facility (CEF) and INTERREG programmes.

Another financial aspect which deters investment in shore-side electricity projects is the fact that the greatest financial burden and risk rests on the shoulders of the port authorities, while they do not directly benefit from the returns (which in some cases cannot be expressed in financial terms anyway). A potential solution would be for the port authorities to 'sell' the electricity to the vessels moored at their quayside, or if they were allowed to reclaim the costs of the electricity they sell from the energy provider or terminal operator in repayment for the costs of the infrastructure. A further obstacle is the ownership of the connection. It might therefore be prudent to involve all parties – the entire chain of grid managers, energy suppliers, port authorities, terminal operators and shipping companies - in shore-side electricity projects at the earliest possible opportunity.

To allow effective assessment of the costs, the Ministry of Infrastructure and the Environment commissioned CE Consultants of Delft to produce an adapted, open-source costing model which is available to all.[18] The model also takes the reduction in noise nuisance and other emissions into account. Non-financial advantages, such as the fact that electricity is clean and silent, can sometimes tip the balance.

Technical aspects
The introduction of an ISO standard for High Voltage Shore Connection (HVSC) systems (ISO 80005-1, 2012) served to remove one major obstacle. The two aspects which will have the greatest impact in terms of installation are the conversion of line frequency from 50Hz to 60Hz, and the transport of high-voltage electricity from the point of generation to the dockside. Where the port is close to a populated area, high voltage electricity (>6,6kV) may well already be available within a reasonable distance. Most harbour complexes have access to electricity of various voltages. Availability is a key consideration, since the costs of transporting a high voltage supply can be significantly higher if additional transformers or substations are required.

[18] www.onshorepowersupply.org

3.4 Aviation

3.4.1 Current market status

The Environmental Impact Assessment report *Working on the Future of Schiphol and the Region* (July 2007) notes that a further increase in the volume of air traffic at Schiphol could result in the air quality norm (NO2) being breached. The report goes on to state that the use of landside mains electricity connections and preconditioned air (PCA) systems, rather than the aircraft's own Auxiliary Power Units (APUs) or Ground Power Units (GPUs), would be an effective means of offsetting any increase in the atmospheric concentration of nitrogen dioxide.

The government acted upon this recommendation and included relevant provisions in an amendment to the Airport Traffic Decree, passed on 18 September 2008 (and published in the Government Gazette no. 390, 7 October 2008).
The *Luchthavenverkeersbesluit* (Airport Traffic Decree; LVB) is an adjunct to the Aviation Act. The amended version required the airport management company NV Luchthaven Schiphol to provide a minimum of 61 airside stands, each with an electricity supply and a preconditioned air (PCA) supply (both of appropriate quality) to obviate the need to operate the aircraft's own APU while on the ground.

Airport	**Number/year**
Schiphol	64 per year-end 2015

The decree also requires the captain of an aircraft which is stationary on the apron to ensure that neither the APU nor onboard air-conditioning system are used if alternatives are available.

This requirement has been further elaborated and formalized in the Aeronautical Information Publication (AIP). Allowance is made for circumstances in which it is necessary to use the APU even when on the ground. The APU is needed to (re-) start the engines, for example, since the ground supply does not have the necessary capacity.
The AIP stipulates that the aircraft's engines must be switched off within five minutes of coming to a halt at the stand, and must not be restarted more than ten minutes prior to departure. Exceptions are permitted:

- where the use of an APU is essential for technical (maintenance) reasons
- where the ground supply and/or PCA units are out of service or not available
- where the outside temperature is below -5ºC or above 25ºC.

3.4.2 Future market development

No further developments are expected at this time. The above remarks apply specifically to Amsterdam Airport Schiphol. The situation at other Dutch airports is different. With fewer intercontinental flights, aircraft generally have a much quicker turnaround and spend less time on the apron stand.

3.4.3 National targets

At the end of 2015, Schiphol had a total of 64 platforms with landside electricity and preconditioned air. A further three are to be added in 2016 bringing the total to 67.

3.4.4 Measures to ensure achievement of national targets

Agreements have been made with Luchthaven Schiphol NV, all of which have been implemented or will be implemented in the foreseeable future.

4. Hydrogen

4.1 Road transport

4.1.1 Current market status

A National Hydrogen Platform has been established and will be responsible for the professional organization of the Netherlands' hydrogen chain. Founder members include Deltalinqs, the Port of Rotterdam Authority, Energy Valley, the Dutch Hydrogen and Fuel Cell Association (NWBA), the RAI Association, provincial authorities (as signatories to the Administrative Agreement on Zero-emission Bus Transport) the Federation of Dutch Mobility Companies, Gasunie and no fewer than 54 other private sector companies, as well as the Ministry of Infrastructure and the Environment and the Ministry of Economic Affairs.

The platform's partners are to enter into a Green Deal agreement with central government, the focus of which is joint investment in the hydrogen chain. The promotion of hydrogen-based mobility is seen as a first step. The partners acknowledge the opportunities which the hydrogen-based economy offers, and they endorse the ambitions of the Action Plan for Sustainable Fuels 2015–2020. All are keen to promote the Dutch economy (and the hydrogen economy), to achieve green growth, to help establish a robust and secure energy system, and to reduce emissions of CO_2 and other atmospheric pollutants.

It will be necessary to create a network of hydrogen refuelling points in parallel with the introduction of the first hydrogen-powered vehicles (mostly commercial) which will use those refuelling points. It will then be possible to move slowly but surely towards a convincing business case whereby supply is in line with demand. The ambition is to have 2,000 hydrogen-fuelled cars on Dutch roads by 2020. A network of twenty refuelling stations would then have an initial customer base of one hundred cars each, as well as buses, delivery vans, trucks and utility vehicles (such as refuse collection vehicles) where possible.

Planning and implementation of hydrogen refuelling stations in the Netherlands

H2 stations in the Netherlands per 2016	**H2 supply pressure**	**Target completion**
Helmond	350/700 bar	in operation
Rhoon	350/700 bar	in operation

4.1.2 Future market development

H2 stations in the Netherlands, planned, (EU) co-financing already secured	**H2 supply pressure**	**Target completion**
Arnhem	700 bar	late 2016/early 2017

The Hague	700 bar	late 2016/early 2017
Breda	350/700 bar	late 2016/early 2017

In preparation or under consideration. Private sector companies have expressed intention of investment. Proposals will also be submitted to an EU subsidy programme. Implementation is conditional on the award of the EU subsidy.

Stations proposed in EU/CEF buses call (joint submission with D, UK and F)	**H2 pressure**	**Planned completion**
Oude Tonge	350/700 bar	2018
Delfzijl	350/ 700 bar	2017

Stations to be proposed in EU/CEF call (subject to confirmation)	**H2 pressure**	**Planned completion**
Eindhoven	700 bar	2018
Venlo	700 bar	2018
Utrecht	700 bar	2018
Amsterdam/Schiphol	700 bar	2018
Rotterdam Airport	700 bar	2018
Apeldoorn/Deventer	700 bar	2018
A15 near Tiel/Geldermalsen (preliminary study ongoing)	700 bar	2018
Almelo-Hengelo-Enschede region	700 bar	2018

Hydrogen refuelling points in the Netherlands
Operational
Planned, completion early 2017
In preparation, completion early 2018
Under consideration

4.1.3 National targets

2015 to 2020:

- 20 public hydrogen refuelling stations
- 2000 cars/small commercial vehicles
- 20 trucks and utility vehicles
- 100 public transport buses, with refuelling facilities at depots

4.1.4 Measures to ensure achievement of national targets

Under fiscal policy, the purchase and use of electric fuel cell vehicles is incentivized by:

- Additional tax liability of only 4%
- No duties on hydrogen as fuel
- MIA /Vamil deductibility.

To assist local authorities and companies in planning permission procedures, the government has produced a factsheet on hydrogen refuelling stations. It is No. 35 in the Hazardous Substances series.

Central government is supporting the development of hydrogen refuelling points by contributing towards the initial phase costs. It is therefore a co-financier alongside the private investors and the European and regional funding agencies. This development programme is based on cooperation with all chain partners, including the suppliers and (potential) users of hydrogen-powered vehicles. The government is also acting as launching customer, procuring hydrogen-powered vehicles for its own use. The Ministry of Infrastructure and the Environment now has four such vehicles in its fleet and the Dutch Tax and Customs Administration has one.

4.1.5 Observations and challenges

It is not yet possible to build and operate a hydrogen refuelling station on a commercial, profit-making basis. Government and other external funding is required. In principle, it is possible to call upon the European subsidy programmes, provided the applications are submitted by Dutch stakeholders. They can do so in association with the regions which are already championing hydrogen and which, by happenstance, are well-distributed throughout the country: Amsterdam-Schiphol, Rotterdam-Rijnmond, Eindhoven-Helmond, Arnhem-Nijmegen, The Hague, Utrecht, Groningen (the North-Germany corridor) and perhaps also Breda (Antwerp corridor) and Maastricht (A2 corridor). It may also be appropriate to collaborate with the neighbouring countries: Germany, Belgium and Luxembourg.
The sector has expressed the ambition of supplying entirely renewable hydrogen at some point in the future. This desire is based on consumer demand for the most sustainable form of energy. The Dutch government is helping the sector to explore ways in which it can achieve this ambition.

5. CNG (Compressed Natural Gas)

5.1 Road transport

5.1.1 Current market status

A CNG vehicle can operate on either natural gas or 'green' biogas because these fuels have an identical molecular structure. The average purchase price of a new CNG car is 25,500 euros, which is some 2,000 to 4,000 euros more expensive than a car which runs on petrol and about 1000 more than one with a diesel engine. However, the buyer can recoup the difference at the fuel pump because it is significantly cheaper to fill up with CNG than with either of the more conventional fuels. One calculation suggests that anyone who drives more than 13,000 km per year will save money by switching to a CNG vehicle.

Recent years have seen a significant increase in the market volume of both vehicles and refuelling stations, partly due to a number of incentive programmes announced by central and regional government, such as the Higher Blends Biogas trial and the TAB subsidy for filling stations offering alternative fuels. There has also been investment by the market itself.

In December 2014, Dutch consumers could choose from 27 models of passenger car which had been manufactured specifically to run on CNG. The basic engine technology of a CNG vehicle is no different from that of a petrol-driven vehicle. Most CNG cars therefore have a (small) auxiliary petrol tank to ensure that the driver is never stranded if he runs out of gas when not in the vicinity of a CNG refuelling station. Drivers can also use their CNG car in regions or countries which do not yet have CNG refuelling points at all. CNG vehicles can therefore be used anywhere, which is an important point for business users.

The number of CNG vehicles in the Netherlands continues to grow. It would seem that using natural gas or green gas is gaining in popularity, especially among the users and operators of passenger cars, light commercial vehicles (delivery vans) and buses.
Between January 2012 and January 2016, the number of vehicles in the Netherlands which run on natural gas increased from 4,600 to over 11,000.

At the start of 2016 there were 145 filling stations supplying natural gas and/or green gas. The network for this type of alternative fuel may therefore be said to have nationwide coverage.

5.1.2 Future market development

Despite recent growth, natural gas is likely to have only a limited market share in the passenger car and light commercial vehicle segments. Manufacturers have gradually introduced new models but the choice remains restricted compared to traditional petrol and diesel vehicles. A manufacturer's willingness to continue developing new gas-fuelled models will depend on the success of CNG in the specific markets on which that manufacturer is active.

The use of gas has also seen significant growth in the public transport segment. There are approximately 5,000 buses in use in the Netherlands, of which some 680 run on gas. This is the result of significant investments made by various regional authorities and transport operators in recent years.
Green gas and CNG have also managed to gain a substantial market share (4%) in the taxi segment. Green gas and all-electric vehicles are becoming increasing attractive alternatives to diesel. The final choice will depend on region, the availability of a refuelling or recharging infrastructure, the required range and a cost comparison.

Another engine technology which is currently being brought to maturity is 'dual fuel', also known as bi-fuel. Here, the vehicle has an internal combustion engine which can run on diesel, gas or a combination of both. This technology is particularly suitable for commercial vehicles and trucks. The main advantage is that a company which already owns a diesel-powered vehicle does not need to replace it but can have the engine adapted. The vehicle's CO_2 emissions will then be cut by up to 50%.

5.1.3 National targets

Other than those accompanying the various government and market incentive programmes, no national targets or specific objectives for the creation of a CNG infrastructure have been applied in recent years because a network with nationwide coverage was already in place.[19]

5.1.4 Measures to ensure achievement of national targets

There are no specific incentive measures to encourage the creation of a CNG infrastructure because, as noted above, a network with nationwide coverage already exists. There is however some nudging in the form of lower prices for gas compared to petrol or diesel. One calculation suggests that anyone who drives 13,000 km per year will save money by switching to gas.

The 'green' version of natural gas – biogas – is classified as a renewable energy source for the purposes of the EU Renewable Energy Directive. Accordingly, users can claim credits (in the form of 'Renewable Energy Units') towards their annual obligations under the Directive.

5.1.5 Designation of urban agglomerations, other densely populated areas and networks in which CNG refuelling points are to be implemented (in line with market demand)

The Netherlands does not intend to designate any regions or areas for the deployment of a CNG infrastructure since a network with nationwide coverage has already been put in place.

5.1.6 Observations and challenges

Like LPG, and to an even greater extent electric mobility, the rate of adoption of

[19] https://groengas.nl/rijden-op-groengas/tanklocaties-kaart/

CNG will largely depend on the government's incentive policy, to include fiscal arrangements such as the imposition of energy tax. At present, however, owners of CNG and LPG passenger cars pay a higher rate of Motor Vehicle Tax (MRB) than they would had they opted for a conventional petrol-driven vehicle.

Although 'alternative', CNG remains a fossil fuel. As such, it must be seen as a 'transition fuel' on the way to the attainment of the long-term climate and energy objectives. The sustainable version of CNG – biogas or green gas – offers even greater potential and, until the year 2030 or thereabouts, can play a significant part in reducing mobility-related CO_2 emissions in a cost-efficient manner.

6. LNG (Liquefied Natural Gas)

6.1 Road transport

6.1.1 Current market status

Liquefied Natural Gas is the latest type of gas-based fuel to be introduced worldwide. The liquefaction process involves cooling natural gas to a temperature of -162°C which reduces its volume by a factor of 600. It is possible to store a far greater quantity of gas in liquid form than if it is allowed to remain in a gaseous state. A vehicle fitted with LNG tanks therefore has a far greater range than an otherwise identical vehicle running on CNG. This makes LNG particularly suitable for longer distances and heavier-duty transport. Its energy density is 60% of that of diesel.

LNG usage	**(per end 2015)**
Trucks	350
LNG refuelling stations (operational)	19
LNG refuelling stations (planned) 23	9

The Green Deal 'LNG Rhine and Wadden' was agreed in 2012. The purpose is to promote the use of LNG in all (heavy) transport segments: maritime, inland shipping, fishing and road transport (trucks). The intention is that LNG usage should have achieved enough critical mass by 2020 to allow further, independent development.

The key points of this Green Deal are:

1. Identification and study of generic conditions (investment climate, legislation) which should be created to promote the substitution of LNG for oil derivatives, and to promote the further development of the potential of LNG.
2. Investment, on both the supply and demand sides, in two regions: the Wadden region and the entire Rhine navigation corridor from Rotterdam to Basel, to include Amsterdam and Vlissingen. A number of demonstration projects will be undertaken by road transport and shipping companies. The remainder of the programme will be based ono the results of these projects. The findings and a discussion of the first stage (investigation of required conditions; see above) will enable the investment volume and timeframe to be established, subject to further agreements between the government and the private sector partners.
3. Communication and strategic stakeholder management, to ensure that all share a common vision of the economic and environmental importance of LNG. This will encourage further cooperation at national and regional level.
4. BioLNG: the development of liquefaction plants for biogas. To facilitate the transition to fully sustainable fuels, it is important to identify and exploit the full potential of liquefied biogas.

It is now possible to import LNG from Qatar and elsewhere via the GATE terminal in Rotterdam, created and operationalized by Gasunie and Vopak. It can then be used as a transport fuel for road and waterborne transport, an arrangement known as 'small scale LNG'.

6.1.2 Future market development

LNG is establishing a firm toehold in the heavy-duty and long distance transport segments, not only in Europe but worldwide. China alone now has some 240,000 LNG vehicles, while road transport operators in the USA, Australia and several South American countries have been using LNG for some time. Like CNG, Liquefied Natural Gas is a fossil fuel. It nevertheless accounts for a significant reduction in nitrogen, sulphur, fine particulates and noise emissions compared to conventional oil derivatives. In the transport sector, LNG is also likely to reduce CO_2 emissions (by some 15% based on a well-to-wheels analysis).

There is still progress to be made in terms of standardization (gas pressure, gas quality), external safety and the technology which determines the cost and competitiveness of vehicles and, more especially, the storage tanks. To a certain degree, the development of LNG for transport will follow that of an LNG infrastructure for other uses, such as in the domestic and industrial settings. However, the transport application also requires its own specific infrastructure which will be subject to certain quality requirements. Increasing the 'greening' potential of this alternative fuel will also call for the promotion of BioLNG (offering a WtW reduction of 80% to 100%).

Given the right conditions and effective cooperation, the Dutch LNG market could grow to reach 2 to 3 million tons by 2030. This would offer a reduction in CO_2 emission equivalents of over 1 Mton per annum, while fine particulates would be cut by 400 to 600 tons per annum provided there is no methane slip during combustion. The Fuel Visions gives the target numbers for LNG trucks as follows:

The volume target of 2.5 million tons is based on the ambitions of the various stakeholders, as stated in the Green Deal LNG Rhine and Wadden. LNG would then replace some 10% to 15% of the diesel usage in the transport sector. The figure of 2.5 million tons has been used to support the safety analysis, environmental assessment and costs-returns analysis for LNG.

Within the Well-To-Tank (WTT) analysis, the calculated impact of transporting fuels is based on the distance from Qatar to Rotterdam. In the case of gas that is imported via pipelines, the calculation is based on an equal split between gas from Norway and that coming from Russia.

Although representative average values have been used in this study, there remain some uncertainties. In particular, methane emissions during the conversion and distribution of natural gas (whether in liquid or gaseous form) must be taken into account.

The prices of the various energy sources have been estimated according to the likely situation in 2025. The price of natural gas is subject to particular uncertainty. Because it has a marked influence on the outcomes of the study, calculations are based on a high price and a low price, in line with the methodology of the PWC with

regard to the economic impact of natural gas. The main estimates relating to emissions and the costs associated with the purchase or conversion of vehicles are based on vehicle technology as it is expected to stand in 2020. The cost analysis will be greatly affected by the level of taxation on both energy sources (fuels) and transport modalities (vehicles). This study therefore applies a cost analysis with taxes and one without. The taxation rates applied are those current in 2015.

The degree to which LNG will gradually be replaced by bio-LNG depends largely on the content and implementation of the post-2020 Renewable Energy Directive and the member states' implementation of the emissions trading system based on Renewable Energy Units.

6.1.3 National targets and objectives

The Green Deal LNG Rhine and Wadden presents target figures for the deployment of LNG.

See para. 6.0.3 for figures relating to fuelling stations and trucks.

6.1.4 Measures to ensure the achievement of the national targets

Safety and environmental requirements for the introduction of LNG are being formulated further to the Green Deal. The government will support that introduction by means of a temporary low rate of fuel duty.

6.1.5 Measures to promote the deployment of infrastructure for alternative fuels for public transport

The relevant market parties are already investing in the necessary infrastructure to support the heavy-duty road transport sector. The Dutch government has therefore not implemented any specific incentive measures in this regard.

6.1.6 Observations and challenges

The results of the analyses allow the following general conclusions to be drawn with regard to the costs, as seen from the perspective of the end user.
In all scenarios except the GTL route, vehicles and vessels built to run on natural gas or its derivatives will be more expensive than the reference models. The additional investment costs will in some (but not all) cases be offset by lower fuel costs.
In the case of road transport, there is a significant disparity between the level of taxation applied to the various fuels and energy sources. CNG, LNG, hydrogen and electricity benefit from a lower level of taxation per energy unit than diesel and petrol. This also serves to compensate the higher investment costs.

A comparison of the costs level including all taxation reveals that the per-kilometre costs of natural gas can be lower than the reference situation in some cases, even though the total costs excluding taxation are higher. Fuels used for shipping and aviation are not subject to taxation.

An LNG refuelling station has relatively large risk contours but various measures can

be taken to restrict the risks. The Netherlands then offers a sufficient number of safe locations for this type of installation. There are currently 19 refuelling points spread throughout the country, providing adequate coverage for heavy-duty road transport in the early stages of the market rollout.
The transport of LNG by road demands special attention. Because LNG will replace diesel but not LPG, its transport on the designated road routes (the 'basic network') in addition to that of LPG will increase the risk level of some road segments beyond the existing maximum limits. Unless measures are taken, the likely volume of LNG cannot be absorbed by the basic network. Further research is required. We recommend the use of the RBM II risk assessment model to supplement and refine the risk calculations used in the current study. The identification of specific LNG accident and effect scenarios, an examination of specific failure frequencies for critical components of an LNG installation and the improvement of the current effects model are likely to provide more realistic risk level assessments. These measures should therefore be further investigated.

The central transhipment point will be the LNG terminal in the Port of Rotterdam. A second, smaller facility at Eemshaven is under consideration.

For reasons of external safety, transport by water is the preferred option for the distribution of LNG to inland refuelling points.[20] The government wishes to create a network of multimodal bunkering points located alongside waterways. This will serve to restrict the transport of LNG by road. LNG can then be distributed to users from the bunkering points. If market conditions allow, a more extensive network of bunkering points could be considered.

The further development of LNG usage for road transport in Europe will be influenced by the following factors:

- European cooperation
- Standardization: it is important that pressures are harmonized so that LNG trucks can refuel in any member state
- Clear and straightforward procedures for the construction of refuelling stations
- A harmonized planning methodology for the deployment of the LNG Infrastructure
- Measures to address methane emissions.

[20] Under current legislation, the storage and transshipment of LNG is permitted only in closed harbour basins (not along the main transport corridors).

6.2 Inland shipping

6.2.1 Current market status

There is close cooperation between the Dutch government and the relevant market parties with a view to promoting the public and private interests. In the Dutch Maritime Strategy 2015-2025, the government and private sector have expressed the intention to pursue an adequate international legislative framework to support the safe, environmentally responsible and sustainable development of waterborne transport and the ports infrastructure. At both national and international level, the government is an active champion of the use of alternative fuels, striving to remove any legislative obstacles that may exist. The implementation of the Directive (which calls for governments to 'direct and coordinate') is not expected to entail any significant additional financial burden for the Dutch government. The private sector will develop the LNG infrastructure itself, while the government will facilitate market initiatives, particularly those relating to the creation of bunkering points, wherever possible.

Locations for mobile bunkering points serving inland vessels have been designated in Amsterdam, Rotterdam and Moerdijk. Local authorities responsible for inland ports elsewhere in the country may opt to create mobile bunkering points should the market situation allow or demand. In late 2015, a fixed multimodal bunkering station for both trucks and inland vessels was implemented in Doesburg. Zwijndrecht/Drechtsteden now has a mobile bunkering point for inland vessels only. Several market parties are known to be planning further bunkering stations.

At present, the number of vessels which run on LNG is relatively small. Between 2010 and 2014, only five vessels opted to convert to an LNG propulsion system. Based on recent reports and the current market situation, however, approximately forty inland vessels with an engine running on LNG are expected to be in use by 2020.

Based on a market analysis undertaken during production of the SER Energy Agreement, potential LNG users in this sector show low willingness to invest, even where there is a positive business case. The investment required to build or retrofit a vessel to run on LNG is seen as too high. The analysis further shows a lack of knowledge and awareness with regard to LNG technology. While this market situation persists, the use of mobile bunkering points will be preferable to building permanent bunkering points.

6.2.2 Future market development

The Netherlands has ten key ports serving the inland waterborne transport sector: Rotterdam, Amsterdam, Utrecht, Nijmegen, Moerdijk, Bergen op Zoom, Vlissingen/Terneuzen, Almelo, Hengelo and Deventer. To determine the number of LNG bunkering points required to facilitate the movement of vessels (both maritime and inland) on the TEN-T core network, the Expertise and Innovation Centre for Inland Shipping (EICB) was commissioned to perform a study. This study took variables such as fuel consumption and fuel prices into account, based on the market situation in 2014. As a result, the price levels applied were somewhat higher than those applicable at the beginning of 2016. If the deterioration of the market

situation for LNG continues, it may be appropriate to revise the findings.
The study reveals that a transition to LNG would be economically interesting for at least three hundred inland vessels. Potential locations for bunkering points were then identified based on the (most) regular routes of these vessels.

At this time, there is not enough economic justification for creating permanent LNG bunkering points in the Overijssel ports of Almelo and Hengelo. Demand is also likely to be limited at Utrecht and Bergen op Zoom, where any requirement can continue to be met by means of mobile facilities. The situation might be markedly different if a combined refuelling point for both waterborne vessels and road transport vehicles were to be created. The ports in which demand justifies the creation of permanent bunkering points are Rotterdam, Amsterdam, Moerdijk, Nijmegen, Vlissingen/Terneuzen and the Drechtsteden ports.

Suppliers of LNG report that they are planning to implement permanent bunkering points at Nijmegen, Lelystad, Eemshaven, Harlingen, Den Helder and Rotterdam. There are at present no known plans to do so at Vlissingen or Terneuzen. The final location of bunkering points will depend in part on the availability of LNG in other member states.

6.2.3 National targets and objectives

For reasons of external safety, transport by water is the preferred option for the distribution of LNG to inland refuelling points.[21] The government wishes to create a network of multimodal bunkering points located alongside waterways. This will serve to restrict the transport of LNG by road. LNG can then be distributed to users from the bunkering points. If market conditions allow, a more extensive network of such bunkering points could be considered.

To facilitate the movement of vessels on the TEN-T core network, the intention was to have mobile bunkering points at least four locations. These have now been implemented at Rotterdam, Moerdijk, Amsterdam and the Drechtsteden points. In addition, the Netherlands now wishes to introduce further mobile bunkering facilities in Vlissingen/Terneuzen, Den Helder and Eemshaven.

Based on current market developments, the Netherlands further wishes to implement at least three fixed bunkering points on the TEN-T core network before the year 2030. Ideally, they will replace the mobile bunkering points or will be at the locations identified as most suitable by the EICB study. There is already a permanent bunkering point at Doesburg; a further facility at Rotterdam is the preferred choice. In a scenario in which a sufficient number of vessels make the transition to LNG and there is multimodal use of bunkering points alongside waterways, it will be appropriate to create even more permanent bunkering points. Suppliers have already indicated a willingness to invest in such facilities, with Nijmegen cited as a potential location.

Based on the results of the location study, the current availability of LNG and the plans of the suppliers, the Dutch government intends to create seven permanent bunkering points before the end of 2030, provided market circumstances permit. Some or all such bunkering points will be in the key ports of the main transport networks.

[21] Under current legislation, the storage and transshipment of LNG is permitted only in closed harbour basins (not along the main transport corridors).

	2030 inland shipping
Target no. mobile bunkering points	6
Target no. permanent bunkering points	7

Policy to promote the use of LNG will seek to remove obstacles by supporting the development of standards and legislation at European level. The government will also undertake active communication with lower levels of government in order to disseminate knowledge and best practices. The ambition of having fuelling stations which are used by both waterborne vessels and road transport vehicles is an important element of policy. The government has actively supported the establishment of the National LNG Platform, which brings together stakeholders in the inland shipping and maritime sectors. All can then access up-to-date information about current market developments and the LNG bunkering infrastructure.

In order to ensure that additional financial resources are available for the transition to more sustainable fuels such as LNG, the Dutch government intends to allow the relevant parties access to European Union funding. Provincial and local authorities can also play an active part in preparing proposals and applications. For the time being, however, central government will continue to adhere to the terms of MIA/VAMIL insofar as it relates to the creation of an LNG infrastructure for waterborne transport (G3740 on the Environmental List), together with relevant facilities further to F 3310 (sustainable vessels) and B3320 (sustainable energy and drive systems).

6.3 The maritime sector

6.3.1 Current market status

A market analysis examining the use of LNG as an alternative fuel was conducted in 2014 to support the production of the SER Energy Agreement. It revealed that the factors which influence the decision to use LNG in the maritime shipping sector are extremely complex, involving commercial, operational, technical considerations, as well as some prompted by (international) law.

Stricter controls to minimize airborne emissions from ships were introduced on 1 January and apply throughout the Sulphur Emission Control Areas (SECA). The Netherlands intends to reduce its sulphur emissions yet further by 2020, which calls for part of the fleet to make the transition to alternative fuels such as LNG of gas oil. The International Maritime Organization (IMO) has also introduced Regulation 13, which restricts emissions of nitrogen oxides in a 'NECA' zone extending throughout the North Sea and Baltic regions. This is also likely to encourage the transition to LNG.

In the current market situation, the investment costs for alternative technologies (such as scrubbers) are significantly lower than those associated with the use of LNG. Bunkering of maritime vessels is currently undertaken at designated points, at

which either mobile bunkering vessels or LNG tankers are deployed. LNG bunkering vessels are the preferred options. LNG suppliers report the intention of having only one LNG tanker come into service in 2017 in order to meet any rapid upturn in demand.

6.3.2 Future market development

Users report that the business model for LNG is less positive in the case of maritime vessels than in the inland shipping sector. One reason is that the price of LNG at the end 2015 compared less than favourably with that of conventional alternatives, even low-sulphur diesel oil. Because it is possible to use scrubbers to reduce emissions below the norms, even regular bunker oil can be used. It is expected that maritime vessels which spend over 70% of their sailing time in a SECA area will be more inclined to invest in LNG technology. At present, the number of vessels for which conversion is viable remains unknown, due to the very complex business case.

6.3.3 National targets

Based on current market developments, the Dutch government intends to implement four bunkering vessels to serve the TEN-T core network before 2025. These vessels will supply LNG in Amsterdam, Rotterdam, Moerdijk, Eemshaven, Harlingen and Den Helder. Maritime vessels fuelled by LNG can already make use of mobile bunkering points in Amsterdam, Rotterdam and Moerdijk.

One market party reports the intention of implementing a bunkering vessel in 2017. If enough commercial vessels make the transition to LNG, the number of bunkering facilities is likely to rise accordingly, with permanent onshore stations replacing at least some of the mobile bunkering points.

	2025 maritime
Target no. bunkering vessels	2
Target no. bunkering points	4

6.3.4 Measures to ensure achievement of national targets

Policy intended to encourage the use of LNG in the maritime sector will focus on removing obstacles by actively supporting the development of standards and legislation at both European level and in the context of International Maritime Organization (IMO). The government will also undertake active communication with lower levels of government in order to disseminate knowledge and best practices. The government has actively supported the establishment of the National LNG Platform, which brings together stakeholders in the inland shipping and maritime sectors. All can then access up-to-date information about current market developments and the LNG bunkering infrastructure.

In order to ensure that additional financial resources are available for the transition

to more sustainable fuels such as LNG, the Dutch government intends to allow the relevant parties access to European Union funding. Provincial and local authorities can also play an active part in preparing proposals and applications. For the time being, however, central government will continue to adhere to the terms of MIA/VAMIL insofar as it relates to the creation of an LNG infrastructure for waterborne transport (G3740 on the Environmental List).

6.3.5 Observations and challenges

At present, few European countries (with the exception of Norway) show any marked demand for LNG for maritime use, although cautious growth can now be seen in the short sea segment. The sector itself regards LNG as a promising interim solution. However, the business case is not yet positive enough whereby the adoption rate remains low. It is possible that the business case will be improved by the more stringent environmental requirements of the SECA and NECA areas. Another option is support by means of international subsidies.

7 International cooperation

Member states are bound by a common framework and must observe certain minimum requirements for the deployment of an alternative fuels infrastructure. Article 3 para. 4 of the Directive expressly states that "[w]here necessary, Member States shall cooperate, by means of consultations or joint policy frameworks, to ensure that the measures required to achieve the objectives of this Directive are coherent and coordinated."

Benelux Union
With a view to effective regional cooperation, the Netherlands attaches great importance to close consultation with its neighbours. In October 2015, the Committee of Ministers issued Recommendation M (2015) 10, "on cooperation regarding the deployment of an infrastructure for alternative fuels." The text of the Recommendation provides for the sharing of knowledge and best practices in order to achieve the various objectives of the EU Directive throughout the Benelux region by their respective target dates (2020, 2025 and 2030). The Recommendation devotes particular attention to the transnational aspects of the envisaged infrastructure.

Government Support Group
The Netherlands is also engaged in informal cooperation with other EU members states which have achieved notable progress in the development and use of alternative fuels. Once again, the purpose is to promote the exchange of knowledge and to explore opportunities for a transnational deployment of the infrastructure for alternative fuels.

Administrative consultation with Flanders and Germany
There are regular meetings between officials from the Netherlands, Flanders and Germany to discuss maritime policy. These meetings also provide an opportunity to consider matters in connection with the EU Directive, to exchange best practice examples, and to discuss possible solutions to any problems that may emerge.

States Representative Group of the Fuel Cell Hydrogen Joint Undertaking.
The Netherlands has joined other European member states to consider all aspects of hydrogen and its adoption as an alternative fuel. Our country is, for example, a member of the States Representative Group of the Fuel Cell Hydrogen Joint Undertaking, a public-private partnership between the EU and the hydrogen industry.