National Case Study Reort #5

The rollout of public charging infrastructure for electric vehicles in the Netherlands: Innovation and Infrastructure

An ex-post analysis

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Abstract

Accelerating the impact of transformative climate change mitigation policies (TCCMP) requires a timely evaluation of current policies. Evaluating such policies poses a number of challenges. This paper presents a framework to evaluate individual TCCMPs by combining elements from the Technological Innovation Systems (TIS) literature and the literature on TCCMPs. The framework is used to assess Dutch public policies for the rollout of (semi)public charging infrastructure for electric vehicles in the period 2009-2020 using document studies and expert interviews. During this period the Netherlands became a clear frontrunner in high quality public charging infrastructure. The experts identified 61 obstacles that were encountered and, in their opinion, policies of the central government contributed to solving about half (29) of them. These obstacles and the policies used to solve them are structured using the new Adjusted-TIS framework and the linear innovation model. The results suggest that the policies of the central government are insufficient to understand the rapid rollout of (semi)public charging infrastructure in the Netherlands. Large municipalities and a foundation called Elaad were at least as important.

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List of abbreviations

A-TIS	Adjusted Technological Innovation Systems
BEV	Battery electric vehicle
CCM	Climate change mitigation
CPO	Charge point operator
DOET	Dutch Organisation for Electric Transport
ECA	European Court of Auditors
EEA	European Environment Agency
EU	European Union
EV	Electric vehicle
EZK	Ministerie van Economische Zaken en Klimaat [Ministry of Economic Affairs and Climate]
FET	Formule-E Team
GHG	Greenhouse gas
I&M	Ministerie van Infrastructuur en Milieu [Ministry of Infrastructure and Environment]
I&W	Ministerie van Infrastructuur en Waterstaat [Ministry of Infrastructure and Water Management]
IEA	International Energy Agency
kWh	Kilowatt-hour
MSP	Mobility service provider
NAL	Nationale Agenda Laadinfrastructuur
NKL	Nationaal Kennisplatform Laadinfrastructuur [National Knowledge Platform for Charging Infrastructure]
NL	The Netherlands
PHEV	Plug-in hybrid electric vehicle
PR	Public relations
R&D	Research & Development
RVO	Rijksdienst voor Ondernemend Nederland [The Netherlands Enterprise Agency]
TCCMP	Transformative climate change mitigation policy
TIS	Technological Innovation Systems
VNG	Vereniging van Nederlandse Gemeenten [Association of Dutch Municipalities]

Executive summary

This report studies the rollout of (semi-)public charging infrastructure for electric vehicles in the Netherlands in the period 2009-2020. In 2009 the Netherlands had, like other European countries, virtually no public charging infrastructure. By 2020 the Netherlands was a clear frontrunner. In 2020 nearly one in every three (semi)public charging points in the EU was located in the Netherlands, and these charging points were of a high quality and installed and operated in a cost-effective way. This study analyses the role of the Dutch central government in this rollout.

Through desk research, 11 expert interviews, and a detailed analysis of several key policy documents, obstacles encountered during this rollout are identified. These obstacles and their solutions are mapped using the linear innovation model and the Adjusted-Technological Innovation Systems framework (A-TIS). This A-TIS framework is specially designed for this study by combining insights from the TIS literature (Hekkert et al., 2007; Janssen, 2019) and the literature on transformative climate change mitigation policies (Haddad et al., 2022; Gorlach et al., 2022). This framework helps to overcome some problems common to evaluating individual transformative (climate) policies. The research period encompasses three phases of the linear model of innovation (Godin, 2006), being the development of a proof of concept (years 2009-2012), bringing the innovation into commercial use through pilots and demonstrations (2012-2015), and upscaling (2015-2020). These phases also roughly corresponded with different phases in the programmatic policy making approach used by the central government.

Results

In the first period, 2009-2012, obstacles were removed that had obstructed entrepreneurial activities relating to public charging infrastructure before this period. The most important obstacle was related to overcoming a lock-in effect, in which a lack of public charging infrastructure hindered the adoption of EVs and *vice versa*. The foundation Elaad was crucial for solving one side of this lock-in, by installing the first 3,000 public charging points in the Netherlands. The policies of the central government were mainly aimed at solving the other side of this lock-in, by stimulating EV adoption. It did this through providing financial incentives (tax cuts) to reduce the total costs of ownership of EVs relative to the cost of ownership of combustion engine vehicles. The central government also made a €65 million investment in the EV sector in the Netherlands, mainly in an attempt to stimulate the economy during the Great Recession. While the central government acknowledged the importance of public charging infrastructure for EVs during this period, it made few policies directly relating to it.

In the second period, 2012-2015, the obstacles for the rollout mainly related to a lack of basic infrastructure and (informal) institutions to enable a sufficiently large market for public charging infrastructure. Policies of the central government helped to facilitate solutions to these obstacles, e.g., by supporting research on how to structure the market for public charging infrastructure.

However, much of the innovation power came from self-regulation by companies and large metropolitan municipalities.

In the third period, 2015-2020, the obstacles start to show regional variation. In some (urban) areas the market for public charging infrastructure became quite mature whereas in other (rural) areas almost no public charging infrastructure was present. In this period the central government facilitated the rollout of public charging infrastructure by (smaller) municipalities, among others through (limited) financial support, but the main work was done by the municipalities themselves.

In the final period, 2020 and beyond, some of the obstacles that were long foreseen started to manifest. These obstacles relate to the exponential growth of EVs and the wider electrification of the economy, creating issues around human resources and the capacity of the electricity grid. During this period it also became clear that the ambitions of the central government regarding EVs have shifted from economic concerns (in 2009) to mitigating climate change. Bringing EVs to lower income households and the phasing out of combustion engine cars slowly becomes more important in policy documents.

Summary of conclusions

Based on the 11 expert interviews, which together had around 127 years of work experience in the EV sector, 61 obstacles to the rollout of charging infrastructure were identified that started to manifest itself during the research period. In the opinion of the experts, the policies of the central government played some role in solving approximately half (29) of these obstacles. We conclude that the central government was important, and at some stages crucial, to the rollout of charging infrastructure. It played an indirect or facilitating role in the rollout of public charging stations, building the required Adjusted-Technological Innovation System necessary for public charging. Nonetheless, the policies of the central government alone do not seem to explain the rapid rollout of high quality public charging infrastructure in the Netherlands. Other public sector organizations, most notably Elaad and large municipalities, played a more direct role in this rollout and experts see them as more important than the central government.

Lessons learned

The case study offers a number of interesting reflections on transformative climate policies:

Consider to involve the public sector in private sector activities in the early stages of a transformative innovation

The conventional wisdom is that public sector organisations should refrain from activities that can be performed by the private sector. This case study presents an interesting counterexample. It suggests that in the start-up phase of rolling out a new technology, the public sector should be actively involved in activities that can, in principle, be performed by the private sector. A public sector organization (in this case Elaad) was heavily involved in rolling out the first 3,000 charging points in the Netherlands. This approach had three important advantages, when compared to, e.g., using a public tender. First, it effectively circumvented market failures related to innovation,

e.g., relating to fundamental uncertainty and network externalities. This was done, e.g., by taking risks and setting technological standards. Second, it credibly showed that public sector organizations could also perform this task, thus creating an additional incentive for private sector companies to perform well at this task. Third, by being involved in the initial rollout of public charging infrastructure, the public sector acquired the necessary know-how to manage the further rollout of public charging infrastructure, e.g., by providing the know-how needed to write tenders and guidelines. Such know-how reduces the information asymmetry between the public and private sector thus reducing the risk of regulatory capture.

Use tenders in combination with sub-national governments as an effective innovation strategy

Public tenders and (large) municipalities played a key role in the rapid rollout of high quality charging infrastructure in the Netherlands. The importance of public tenders and municipal government for innovation are well documented (Chicot and Matt, 2018; Mukhtar-Langren et al., 2019). However, the way these two variables can interact has received little attention: Tenders for public charging infrastructure in the Netherlands were initially predominantly written by large metropolitan municipalities, at slightly different moments in times. Tenders used by one municipality were subsequently (informally) shared with other municipalities. E.g., the tender used by the municipality of Amsterdam was used as a starting point for the tender used by Rotterdam. This setup allowed best practices to be copied easily while also allowing sufficient space for experimentation and tailoring to local needs.

Let legislation follow innovation and use self-regulation in the early stages of innovation

In this case study (national) legislation followed innovation. The central government did not regulate requirements for charging infrastructure, e.g., with regard to safety and interoperability, but relied on self-regulation. It facilitated this self-regulation through, e.g., supporting research that generates guidelines and by creating networks. In addition to this, some municipalities also made following (certain) guidelines a requirement in their tenders for public charging infrastructure. As a result of this approach the Netherlands did not only avoid the costly, risky and time-consuming process of developing national regulation for a product that is still being developed, but it also succeeded in realizing full interoperability as the first country in the world. It seems that this approach of self-regulation and incorporating guidelines as tender requirements was successful for three reasons: First, self-regulation can be an especially effective policy instrument in the precompetitive or grow-market phase of the rollout of a new technology since in this phase firms still have an incentive to cooperate with one another: By working together firms can create a much larger market for the innovation (see also Stefanadis, 2003). Second, by using guidelines as requirements in public tenders, firms were given an additional incentive to follow them while leaving sufficient space for experimentation. Third, because the public sector had experience with installing public charging infrastructure, it had sufficient knowledge to develop adequate standards.

Avoid resistance by rolling out transformative innovations in areas that have few incumbent industries

The presence of a certain industry within a country or region is often seen as a prerequisite for innovation in a sector within that area, in line with technological-push and market-pull models of innovation (Meissner and Kotsemir, 2016). Initially Dutch policy makers also saw the absence of an automobile industry as an obstacle for taking a leadership role in the EV industry (Squarewise, 2010). However, in hindsight the absence of a big automobile industry in the Netherlands can be seen as an advantage. The absence of a big automobile industry meant less resistance.

Cost effective innovation by focusing on (non-financial) TIS-functions and public-private cooperation

This case study confirms that the central government can stimulate innovation without direct subsidies and limited direct policies. It can do this by improving the technological innovation system surrounding a technology. By increasing demand (mainly through tax advantages for EVs), creating new networks (establishing the FET and public-private partnerships in the form of the Green Deal approach), and providing directionality (clearly committing to the electrification of road transport) the central government can achieve a lot while incurring little costs.

Organise compensation for first-mover disadvantages related to innovations in crucial infrastructure technologies with large network externalities

The Netherlands was a frontrunner in rolling out high quality public charging infrastructure. However, some of the experts currently (anno 2022) worry that the Netherlands will suffer additional costs as a frontrunner because of EU legislation that would require retrofitting Dutch public charging points. These worries are an example of a (potential) first-mover disadvantage, which creates a disincentive for innovation. This risk on a first-mover disadvantage is especially large for technologies relating to crucial infrastructure that also have large network externalities, even beyond national borders, such as public charging infrastructure. The need to regulate such technologies is great, because they provide crucial public goods, have strategic importance, and need to be useable across national boundaries. Furthermore, in the absence of regulation, economies of scale and network effects will tend to favor the creation of an inefficient market with monopolistic or oligopolistic characteristics (i.e. a market with a single or only a few dominant firms). To stimulate innovation the EU could make policies that guarantee that firms or member states that suffer a first-mover disadvantage are compensated. Such policies would be especially effective for technologies that have a great risk of being regulated, such as crucial infrastructure technologies with strong network externalities.

1. Introduction

In 2016, road transport accounted for roughly 25% of greenhouse gas (GHG) emissions in the European Union. Light commercial vehicles, i.e. passenger cars, accounted for 41% of these emissions or 11 percentage points of total emissions (Todts, 2018). Projections of the European Environmental Agency (EEA) suggest that domestic transport emissions will increase until 2025 without additional measures to decarbonize road transport (EEA, 2022). Key policy measures for reducing GHG emissions in the road sector include the phasing out of petrol and diesel cars (with no new vehicles of this type being sold after 2035) and the promotion of electric vehicles (EVs). EVs are seen as the dominant technology to replace petrol and diesel vehicles.

EVs require a (semi-)public charging infrastructure. Without it, citizens that cannot charge at home cannot drive electric vehicles. This is a substantial part of the EU population, e.g., in the Netherlands, around 70% of citizens cannot charge at home (NAL, n.d.). Furthermore, without public charging infrastructure, the distance an electric vehicle can travel is limited by its battery size. For models introduced in 2020, vehicles can travel between 300 – 550 km before charging (Kok et al., 2021: p. 73). Travelling beyond this range requires public charging infrastructure (ECA, 2021: p. 8). Finally, a higher availability of public charging infrastructure is associated with higher EV adoption, although the direction of causality is difficult to establish (Münzel et al., 2019).

From an economic perspective government intervention in the market for public charging infrastructure can be justified on three different grounds. First, because public charging infrastructure is a novel technology, it is plagued by the market failures associated with innovation. Second, it is characterized by strong network externalities and the associated market failures. Third, public charging infrastructure can reduce market externalities created by the technology it can help to replace, namely combustion engine vehicles.

Many countries are actively pursuing policies to promote (semi-)public charging infrastructure. These efforts are carried out by national governments, sub-national governments (e.g., municipalities) and supranational governments, including the European Union. The list of countries that have policies to support the rollout of public charging infrastructure includes most countries of the European Union, the United States, Great Britain, China, India, Japan and many others (IEA, 2021).

The Netherlands is regarded as among the most successful countries in bringing (semi-)public charging services to its citizens (Hall and Lutsey, 2017). It has a large quantity of public charging points: in 2020 the Netherlands had 4 EVs per public charging point, whereas the EU average was 9 EVs per charging point (Kok et al., 2021). Electric vehicle drivers in the Netherlands also indicate they are satisfied with public charging infrastructure (Duurkoop et al., 2021: 25-28). Public charging infrastructure in the Netherlands also has some interesting high quality, such as interoperability and good data protection. It appears that these achievements in quantity and quality are reached in a cost-effective way. As of 2019 the Dutch government believes it is no longer necessary to subsidize the installment or operation of public charging infrastructure (EZK,

2019b). Some (large) Dutch municipalities already earn (modest) profits on auctioning the rights to sell public charging services in their jurisdictions (interviews, 2022).

Research question

The rapid development of public charging infrastructure in the Netherlands was not expected at the start of the rollout in 2009. Based on factors such as the number of jobs in the automobile industry, urbanization, and fossil fuel import dependence, the US, Japan and Germany were seen as highly promising countries for the introduction of EVs, whereas the Netherlands only had an average score (Squarewise, 2010). Possible explanations for the unexpectedly rapid rollout include the Netherlands' small size, its consensus-based 'polder' culture, and the effective use of public policies. This report focuses on this last factor. It investigates *to what extent Dutch public policies from the central government resolved (potential) obstacles to the rollout of (semi-)public charging infrastructure in the Netherlands between 2009 and 2020.* Answering this question can also uncover lessons for other countries to speed up the rollout of their public charging infrastructure and transformative innovations more generally.

This report evaluates the rollout of public charging infrastructure by conceptualizing it as the introduction of an innovative technology that can reduce GHG emissions. This conceptualization makes it possible to draw upon the Technological Innovation Systems (TIS) literature (Hekkert et al., 2007; Janssen, 2019) and the literature on transformative climate change mitigation policies (Haddad et al., 2022; Gorlach et al., 2022; More et al., 2021) to design an evaluation framework. This newly designed framework can be applied to a much wider range of climate change mitigation policies. Through this more general framework some of the difficulties associated with evaluating climate change mitigation policies are overcome (Janssen, 2018).

2. Case study design

2.1. Background

This section describes the relationship between charging infrastructure and EVs and gives an overview of the main actors in the charging infrastructure rollout and market. It starts by defining some key terms.

It is common to distinguish between two types of electric vehicles, namely battery electric vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). PHEVs are vehicles with a hybrid-electric power train (with a combustion engine and electric motor) and a plug-in connector. BEVs are vehicles with a fully electric power train (with no combustion engine) and a plug-in connector (EZK, 2016). In this report, the term 'Electric Vehicle (EV)' refers to both PHEVs and BEVs.

EVs require (a network of) charging stations. Charging stations can be either private, semi-public, or public. Public charging stations are located in public spaces, most often found at the street side, and are always accessible. Semi-public charging stations are accessible only at certain times and subject to restrictions on use, such as the requirement to make use of an associated car park, hotel, or shopping centre (ECA, 2021: p. 17). One charging station can consist of one or more charging points (ECA, 2021: p. 8). The charging of an EV can happen either quickly or slowly. Charging an EV battery through slow charging takes several hours, adding around 16-32 km of range per hour of charging. With fast charging it takes around 20-30 minutes to charge the EV battery to 80%. Slow charging mainly happens when the owner of the vehicle is doing something else, whereas fast charging mainly happens at service stations, e.g., along highways (Mastoi et al., 2022; EEA, 2016: p. 27). Currently (semi-)public charging stations are mainly used by light and medium duty vehicles, i.e. passenger cars. Charging stations for heavy duty vehicles, e.g., trucks, and light electric vehicles, e.g. electric bikes, are being developed. This report mainly focuses on slow charging stations because they represent the bulk of charging points in the Netherlands and focuses on light and medium duty vehicles, because they were the main users of charging infrastructure during the research period.

Public charging infrastructure is crucial for enabling electric driving by citizens that cannot charge their vehicle privately, and to extend the distance electric vehicles can travel (ECA, 2021). In the future, (public) charging infrastructure might also play an important role in providing grid stability by allowing vehicles to charge when electricity is in abundance, e.g. during the day when solar panels generate energy, and transfer electricity from the car to the grid when there is peak demand for electricity, e.g., on exceptionally cold days. This is an element of SMART charging.

The development of public charging infrastructure is closely entwined with that of EVs. EV adoption determines the demand for charging services. This demand depends not only on the number of EVs, but also on the size of batteries and the different charging technologies these EVs enable (e.g., battery swapping; magnetic induction charging; etc.). Simultaneously, the

availability of charging services determines EV adoption (Münzel et al., 2019). This interdependence has led to a lock-in effect or a chicken–egg problem. Some research suggests that public charging infrastructure might be a more effective policy instrument to stimulate EV adoption than EV purchase subsidies, but this effect might only play a role at the very start of the EV adoption process (Li et al., 2017).

Despite their mutual interdependence, EVs and charging infrastructure are two different technologies, as made evident by the different firms operating in both areas. EV manufacturing is done by companies such as *Tesla, Volkswagen* or *BYD Auto*. Services surrounding charging infrastructure in the Netherlands are provided by firms such as *Engie Charging Stations, Shell Recharge, LastMile solutions* or *Fastned* to name a few.

Stakeholders in the rollout of public charging infrastructure

Different actors play a role in the rollout of public charging infrastructure. End consumers want to charge their electric vehicles. For this they can go to a public charging point. These points are installed by a supplier/installer and are subsequently operated by a charge point operator (CPO). The consumer pays the CPO through a mobility service provider (MSP).

Public charging points are placed in public spaces, most often directly next to the road. Different governments are responsible for different roads. The Dutch central government is responsible for highways whereas municipalities are responsible for the smaller (municipal) roads. Fast charging often happens adjacent to highways, making the central government responsible for providing the necessary permits. Slow charging predominantly happens in residential areas and commercial centers, which are mainly accessible through municipal roads, making municipalities responsible for providing the necessary permits in these areas. Charging points are connected to the electricity grid, for which grid operators are responsible.

See below for a short explanation of every stakeholder (based on Boekema et al., 2010; Huygen et al., 2018):

- End consumers: the end consumers of public charging points are the electric drivers who need to recharge their EV at a charging point.
- Charging infrastructure suppliers/installers: this refers to the businesses that sell and/or install charging points. E.g., the companies Venematech or EV solutions.
- Charge Point Operators (CPOs): The CPO exploits public charging points and collects its revenues. The CPO is not necessarily the owner of the charging point: for example, it may occur that a municipality owns the charging point, while the CPO holds the rights to exploit it. E.g., the companies Joulz or Allego.
- Mobility Service Providers (MSPs): MSPs provide payment and subscription services to the end consumers, and act as an intermediary player between the end user and the CPOs. E.g., the companies New Motion or Maingau.

- Local government: this refers to individual municipalities, as well as the national Association of Dutch Municipalities (VNG). Municipalities are heavily involved in the rollout of public charging infrastructure, as these charging points are by definition placed in the public domain, most often roads, which are often regulated by the municipality.
- Grid operators: the Dutch grid operators are involved in connecting charging points to the electricity grid. They play a facilitating role in the market for public charging points. E.g. Stedin or Liander.
- Central government: the most relevant actors within the central government are the ministry of Economic Affairs & Climate (EZK) and the ministry of Infrastructure & Water Management[1] (I&W). The Netherlands Enterprise Agency (RVO), which is an agency under the ministry of Economic Affairs, is also included as a relevant actor.
- EV producers: this refers to the industry producing electric vehicles. At the start of the research period there were no major car companies producing electric passenger cars in the Netherlands. Currently, there are two (somewhat) smaller companies: a Tesla factory and a Lightyear company headquarters.
- Consultancy: EV-related consultancy firms that advice companies and/or government.
- Other: this category is used to refer to any other actors that cannot be specifically grouped into a type of stakeholder, but were nevertheless relevant in the rollout of public charging infrastructure in the Netherlands. E.g., the National Knowledge Platform for Charging Infrastructure (NKL).

2.2. Research question

In 2009 the Dutch central government initiated major policies to support electric driving, which also included some policies to stimulate the rollout of public charging infrastructure. In 2020 around one in every three public charging points in the EU was located in the Netherlands (Kok et al., 2021). The bulk of charging points in the Netherlands are slow charging and meant for light and medium duty vehicles and are therefore the main focus of this report. Despite the impressive development in charging infrastructure, it is unclear to what extent Dutch public policies by the *central government* contributed to this success nor what lessons other (European) countries can draw from it. To shed light on this the main research question is:

To what extent did Dutch public policies from the central government resolve (potential) obstacles to the rollout of (semi-)public charging infrastructure in the Netherlands between 2009 and 2020?

The research question is answered through desk research, expert interviews, and analysis of policy documents. To categorize the different obstacles for the rollout of charging infrastructure,

[1] Formerly also called the ministry of Infrastructure & Environment, or the ministry of Transport, Public Works & Water Management.

this research draws on the Technological Innovation Systems (TIS) literature (Hekkert et al., 2007; Janssen, 2019). The TIS framework is modified using the literature on transformative climate change mitigation policies (Haddad et al., 2022; Gorlach et al., 2022; More et al., 2021). In this way an Adjusted Technological Innovation Systems (A-TIS) framework is developed that is more suitable to evaluate individual climate change mitigation policies. The framework is used for two purposes. First, it is used to structure and analyze expert interviews. In these interviews 11 experts have been interviewed about obstacles to the rollout of public charging infrastructure and the extent to which policies by the central government helped to resolve these obstacles. These interviews provide insight into the output of the policies of the central government: To what extent were obstacles removed with the help of policies of the central government according to experts. A key limitation of this approach is that it can only show the opinions of experts and thus involves considerable subjectivity. Second, the study investigates four important policy documents using the A-TIS functions. By studying these documents, we gain insight into how obstacles, policies and A-TIS functions interacted over time.

To track development throughout time, this report will focus on 4 periods: 2009-2012; 2012-2015; 2015-2020; and beyond 2020. The period beyond 2020 (the years 2021 and 2022) lays outside of the research period and is only covered marginally. This division in periods maps on to the three stages of the linear model of innovation (Godin, 2006): It consists of the development of a new idea, e.g. establishing a proof of concept and experimentation (invention); bringing the invention (gradually) into commercial use through pilots and demonstrations (innovation); and subsequently upscaling it (diffusion). Because the government used a programmatic approach based on a variant of this model, it also maps well onto the different periods in policy making (I&M and EZK, 2009).

2.3. Relevance for transformative climate policy

Policy evaluation is crucial for developing effective transformative climate change mitigation policies (TCCMP) for two reasons (Schoeneveld and Jordan, 2019; More et al., 2021): 1) Given the urgency of the climate challenge, timely policy monitoring is important; 2) Because TCCMPs are different from 'regular' policies (Haddad et al., 2022) and a relatively recent phenomena, there is ample scope for learning.

However, evaluating TCCMPs poses a number of challenges. First, the real effects of policies often take several years to materialize (Janssen, 2019: 82). Waiting to evaluate TCCMPs until their effects manifest will take more time than the climate change problem allows for. Second, transformative policies are aimed at systemic change. This involves (positive) spillovers between companies/sectors and also the exnovation (or phase-out) of currently used technologies. Such spillovers and phase-outs make it difficult to find appropriate counterfactuals that are necessary to quantitatively estimate the impacts of policies (Janssen, 2019: 82). Third, TCCMPs are embedded in large policy programs aimed at grand societal challenges, e.g., the European Green Deal. These programs include a large number of different policies that interact with each other and often overlap. This poses challenges for the way individual policies can be evaluated. E.g., the Dutch policies to stimulate electric driving are part of a much broader policy plan to reduce GHG emissions by 49% in 2030 (EZK, 2019) and it is unclear which share of this reduction must be achieved by electric driving. The reduction in GHG emissions by electric mobility will also depend on developments in other sectors, e.g., the replacement of fossil fuels by renewables for electricity generation.

This case study tackles these problems by combining insights from the TIS literature (Hekkert et al., 2007; Janssen, 2019) and the transformative climate change mitigation policy literature (Haddad et al., 2022; Görlach et al., 2022). This results in a novel framework that can be used to evaluate policies that aim to develop (the uptake of) a green innovation that needs to replace carbon-based technologies. The framework is demonstrated by applying it to the rollout of public charging infrastructure in the Netherlands during the period 2009-2020.

2.4. Methodology used in case study

2.4.1. Evaluation framework

Several transformative approaches to climate change mitigation can be distinguished (Loorbach et al, 2017). According to the politically dominant socio-technical approach, transformative climate change mitigation is mainly a matter of substituting carbon-based technologies with non-carbon based technologies, e.g. technologies that use renewable energy, on a (transformative) large scale. Because this approach conceptualizes climate change mitigation as the introduction of a large number of interlocking innovations, the evaluation of climate policies can be done by drawing on the Technological Innovation Systems (TIS) literature.

The TIS literature studies the development and diffusion of emerging sustainable technologies and products. The main idea behind this literature is that the determinants of technological change can be found in the broad social and economic structure surrounding innovations, the Technological Innovation System (or TIS). A TIS. Is defined as "a set of networks of actors and institutions that jointly interact in a specific technological field and contribute in the generation, diffusion and utilization of variants of a new technology and/or new product" (Markard and Truffer, 2008, p.611). Actors within a TIS engage in a wide variety of activities the lead to the emergence of key innovation processes or system functions. Hekkert et al. (2007) have defined these system functions by mapping the activities that take place during the emergence and diffusion of technologies and products. See Table 1 for an overview of TIS functions. The TIS literature offers a well-developed basis for understanding how technology matures. In addition, the TIS framework can been employed to identify barriers for technology diffusion and provide policy advice (Wieczorek and Hekkert, 2012; Janssen, 2019: 82).

Table 1: TIS functions (based on Hekkert et al., 2007; Janssen, 2019)

TIS function	Explanation
Entrepreneurial activities	The new (experimental and risky) activities entrepreneurs undertake which result in new products/services or adjustments to the production process
Knowledge development	Activities aimed at learning
Knowledge exchange	Activities aimed at sharing knowledge between actors
Guidance of the search	Activities that make it clear what specific wants and requirements the technology needs to satisfy
Market formation	Activities that help to bring together demand and supply
Resource mobilization	Activities that help to ensure sufficient financial, human or raw resources

Creating legitimacy and counteracting resistance to change	Activities aimed at increasing support for the innovation or at removing impediments related to formal or informal institutions

The necessary depth, breadth and speed (Fazey et al., 2018; Termeer and Metze, 2019; Haddad et al., 2022) of the climate change challenge makes it possible to finetune the TIS functions. The past years have seen convergences on the defining characteristics of the climate change problem, and this has consequences for the types of technological innovations that are required to mitigate it. See Table 2 for an overview of the characteristics of the transformative climate change mitigation problem. The characteristics of in depth, system-wide and urgency in the table refer to transformative change in generally, whereas the characteristic relating to greenhouse gases relates to climate change as a particular transformative change.

Table 2: Characteristics of the climate change problem and climate change mitigation policy

Characteristics of the climate change problem	Explanation
In depth (Fazey et al., 2018; Termeer and Metze, 2019; Haddad et al., 2022)	First order change aims to do things better within the existing institutional logics and taken-for-granted frames of reference. In-depth change or second-order change aims to radically transform existing practices by breaking through prevailing mindsets, norms, and interests (Termeer and Metze, 2019).
System-wide (Fazey et al., 2018; Termeer and Metze, 2019; Haddad et al., 2022)	System-wide change is not limited to specific products, single firms, or isolated neighborhoods. Rather it is multi-sectoral and multilevel (Termeer and Metze, 2019).
Urgency (Fazey et al., 2018; Termeer and Metze, 2019)	To mitigate climate change, behavioral changes much happen within certain time frames, such as those set out in the Partis Climate Agreement (Termeer and Metze, 2019).
Excessive greenhouse gases in the atmosphere	The main driver of climate change are greenhouse gases

The specific characteristics of the climate change mitigation (CCM) problem put additional constraints on technological development and thus on the TIS functions. This leads to a reconceptualization or adjustment of three of the TIS functions. First, the technologies necessary for climate change mitigation require more cooperation between actors than only *knowledge exchange*. The TIS function *knowledge exchange* is thus reinterpreted as *new networks and coordination mechanisms*. For instance, having conferences or workshops might suffice for knowledge exchange but for the rollout of charging infrastructure, it was also necessary to have

a body to coordinate activities within the entire sector. Second, the technologies necessary for climate change mitigation require a more long-term and specific direction of technological development than only *guidance of the search*. The TIS literature is well aware of competition between technologies (Hekkert et al., 2007; Bergek et al., 2015) but assumes a certain technological neutrality, i.e., it assumes that the competition between technologies will (eventually) select the best innovation. However, in the area of climate change mitigation this assumption is problematic since it requires carbon-based technologies to be replaced, putting additional requirements on *guidance of the search*. The TIS function guidance of the search is reinterpreted as *directionality*. Third, the technologies necessary for CCM require much broader acceptance than regular technological innovation. This puts additional requirements on the fairness and inclusiveness of technological change. In addition to this it also requires a wider change in informal and formal institutions, i.e., in the customs and laws of countries.

This report also adds an additional criterion to the list of TIS functions, namely exnovation. Exnovation is not a TIS function. However, because the phasing out of carbon technologies is the main driver of CCM, it is included as an additional criterion (Bergek et al., 2015). Column 2 of Table 3 lists the categories used to assess both the policy formulation and policy output.

Table 3: Reinterpreting TIS functions in the light of climate change mitigation technologies

TIS function	Reinterpretation of TIS functions ('adjusted TIS functions')	Explanation for reinterpretation
Entrepreneurial activities		
Knowledge development		
Knowledge exchange	Creating new connections and knowledge exchange (Haddad et al., 2022)	CCM requires more cooperation than 'normal' innovation, this goes beyond knowledge sharing and towards coordinated action.
Guidance of the search	Directionality (see also Haddad et al., 2022)	CCM requires a shared (long term) vision. It is necessary to make sure that all activities are going towards the same goal (see also Weber and Rohracher, 2011).
Market formation		
Resource mobilization		
Creating legitimacy and counteracting resistance to change	Inclusiveness and acceptance + suitability of (formal and informal) institutions (Haddad et al., 2022)	The size of the transformation puts additional requirements on fairness/inclusiveness. It also implies a bigger change in (formal and informal) institutions.

	Phasing out/exnovation (Bergek et al., 2015; Görlach et al., 2022)	Normally the competition between various technologies is left to the market. For CCM it is necessary to phase out carbon-based technologies at a certain speed.

The Adjusted TIS (A-TIS) functions have been linked to questions to identify which obstacles were encountered during the rollout of public charging infrastructure. See Table 4 for these questions. After identifying an obstacle, interviewees were asked if policies of the (central) government helped to overcome it. In this way a list of obstacles was generated together with the opinion of the expert on it about the extent to which policies of the central government helped to overcome it.

Note that this report frames this exercise as a policy evaluation. This is an intuitive but also rather normative frame. This exercise can also be framed in more descriptive terms, namely as a categorization of obstacles encountered during the rollout of public charging infrastructure in the Netherlands and how this interacted with policy making by the central government.

Table 4: A-TIS obstacle questions

A-TIS function	Question to identify obstacles
Entrepreneurial activities	Why were entrepreneurial activities not initiated? Why did entrepreneurial activities did not take off?
Knowledge development	Why were certain questions not answered? Why are certain topics not researched?
New networks and coordination mechanisms (shortened to 'new networks and coordination mech.')	Why did certain groups not interact productively? Why was knowledge not shared?
Directionality	Why was it unclear in what direction the development of an innovation should go? Why was there no shared vision?
Market formation	Why were consumers not willing/able to buy the (innovative) product or suppliers not willing/able to supply it?
Resource mobilization	Why were there insufficient resources available to develop (a certain aspect of) an innovation? Which resources were insufficiently available to develop the innovation?
Inclusiveness and acceptance + suitability of formal and informal institutions (shortened to '(un)suitability of institutions'	Which formal or informal institutions hinder the development of the innovation? Why is there resistance against the innovation?
Phasing out/exnovation	Which measures/circumstances lower the (opportunity) costs of the incumbent technology when compared to the innovation?

2.4.2. Selection and evaluation of policy documents

The framework introduced in the previous paragraph is used to evaluate policy formation and policy output. The evaluation of policy formation is based on the following documents: Mobiliteitsbeleid (V&W and EZK, 2009) ; Elektrisch Rijden in de Versnelling: Plan van aanpak 2011-2015 (EZK and V&W, 2010); Visie op de laadinfrastructuur voor elektrisch vervoer: Beleidsagenda richting 2020 Voor Slim en Schoon vervoer (EZK, 2016); Het Klimaat Akkoord (EZK, 2019b). These documents are selected because they contain the main policies of the national government on charging infrastructure and were shared with parliament. To evaluate the documents Table 5 has been used.

Table 5: Table used to evaluate policy documents

Nr	A-TIS Function	A-TIS function is referred to?	Potential obstacle(s) is identified?	Which government measures are taken to remove obstacle?
1	Entrepreneurial activities			
2	Knowledge development			
3	new networks and coordination mech.			
4	Resource mobilization			
5	Market formation			
6	Directionality			
7	(un)suitability of institutions			
8	Phasing out/exnovation			

2.4.3. Selection of interviewees and evaluation of policy output

Previous reports by Boekema et al. (2010) and Huygen et al. (2018) include lists of stakeholders that are relevant to the (public) charging infrastructure market in the Netherlands. Based on these lists, an updated list of potentially relevant actors is compiled, as shown in Table 6. See section 2.1 for a descriptive overview of the different stakeholders.

Based on this list of potentially relevant stakeholders, experts representing these categories were approached for semi-structured interviews. Possible candidates to interview were only approached if:

- they had working experience for at least one of the relevant stakeholders in the 2009 – 2020 period
- Had worked for at least 5 years in the EV sector
- Worked in a position from which they had a good overview of the rollout of public infrastructure (i.e., worked on the tactical or strategic level within organizations).

Table 6. List of relevant actors, based on previous research by Boekema et al. (2010) and Huygen et al. (2018), as well as the number of interviewees categorized by stakeholder type.

Boekema et al. (2010)	Huygen et al. (2018)	Final list	Number of interviewees that had worked for this stakeholder
Local government	Local government	Local government	2
End consumers	Electric drivers/end users	End consumers	1
EV producers	EV producers	EV producers	1
Charging infrastructure suppliers	Charging point producers	Charging infrastructure suppliers/installers	1
Grid operators/energy suppliers	Grid operators & electricity suppliers	Grid operators/energy suppliers	1
Charging suppliers	Charge Point Operators (CPOs)	Charge Point Operators (CPOs)	1
-/-	Mobility Service Providers (MSPs)	Mobility Service Providers (MSPs)	1
Ministry of Transport, Public Works & Water Management, and the Ministry of Economic Affairs	-/-	Central Government	3
Support services	-/-	-/-	-/-
-/-	-/-	Consultancy	4
-/-	-/-	Other	2

In the final column of Table 6 all interviewees are grouped into the before-mentioned categories. This is done based on any relevant position held by the interviewee in the 2009 – 2020 period. Note that some interviewees have worked for multiple organizations in this period, and are thus assigned to more than one stakeholder category. For every stakeholder type, at least one expert has been interviewed. Furthermore, in the 'Other' category, staff members from the Dutch Organisation for Electric Transport (DOET) have been interviewed. DOET aims to represent the

entire sector of electric transport in the Netherlands, and includes member organizations from multiple other stakeholder categories, such as EV producers, charging infrastructure suppliers, CPOs, and consultancy.[2]

It should be mentioned that no people have been interviewed that worked for the National Knowledge Platform for Charging Infrastructure (NKL) or participated directly in the 'Formule-E Team' (FET), even though these are relevant organization for the rollout of public charging infrastructure. However, we did interview experts that worked at partner organizations from the NKL or at organizations that were members of the FET.

Semi structured interviews

In total eleven people were interviewed who had worked a total of 127 years in public charging infrastructure, and the interviewees had on average more than 11 years of EV-related experience. The aim of each interview was to gain insight into the extent the interviewee thinks that Dutch public policies helped to resolve (potential) impediments for the rollout of public charging infrastructure during the research period. Interviewees were given the space to mention their own obstacles. However, when they were done with this, the interviewers asked follow-up questions that zoomed in on the A-TIS functions they had not yet mentioned (see appendix A for the layout of the semi-structured interviews). To support the memories of interviewees a short (one page) timeline was sent to them in preparation for the interview one to two days before the interview. The timeline showed the development of the number of EVs, the number of public charging infrastructure points, key policy documents, key policy goals, and key policy instruments over the period 2009-2020. See appendix B for this timeline.

Interviews were conducted in Dutch and lasted between 45 minutes and 75 minutes, with most interviews lasting 1 hour. Interviewees were asked if they consented to the interview to be recorded. All interviewees agreed with this and were recorded. However, one recording failed due to issues with the recording equipment. After each interview an interview report was made and shared with the interviewee with the request to correct mistakes in the interview report. The interviewees were, without exception, open and enthusiastic in sharing their experiences about the rollout of charging infrastructure in the Netherlands. That this rollout is generally considered a success, probably helped in fostering this constructive attitude.

[2] Source: https://doetdoet.nl/leden-partners

3. Results

3.1. Case findings

This chapter describes the rollout of public charging infrastructure in five sections. Sections two to five discuss in some detail the rollout of public charging infrastructure and the role that the central government played during each time period. The first section discusses how the Netherlands compared to other countries and gives a broad overview of this rollout using quantitative sources.

3.1.1. Description of the rollout of public charging infrastructure 2009 – 2020

The development of new (battery) technologies since the 1990s has drastically reduced the costs and increased the speed and range of electric vehicles, with the first mass-produced hybrid electric car being introduced in the Netherlands in 2000. This period is also characterized by rising concerns about carbon emissions and fossil fuel dependency. However, sales of plug-in hybrids and fully electric cars only really accelerated after 2010. In 2010 only 760 new EVs were registered in the EU whereas in 2012 this increased to 9052 (Thiel et al., 2015: appendix). It has been growing ever since, reaching 1.4 million in 2020. This period coincides with the introduction of many more EV models on the European market and a more active government role in stimulating electric driving, with the first major policy plan in the Netherlands being introduced in 2009 (I&W and EZK, 2009).

In 2009 public charging infrastructure for electric vehicles was largely non-existent in Europe, including the Netherlands. Around a decade later, at the end of 2020, the Netherlands had the most (regular) public charging points of any European country, both in absolute numbers, per capita, and per electric vehicle (Table 7). Its performance with regard to fast charging points was also good (Table 8), having the greatest number of fast charging points per capita of any EU country (note that Norway is not in the EU).

Table 7: Public charging points at the end of 2020 in different EU countries

Country	Public charging points	Per million inhabitants	Number of EVs per public charging point
Netherlands	64236	3683	4
Norway	13547	2518	24
France	42000	623	9

Germany	37213	447	13
EU	199250	445	9
UK	27222	406	13
Italy	12150	204	7

Source: 2021 Kok et al. (2021)

Table 8: Public fast charging points at the end of 2020 in different EU countries

Country	Fast charging points	Per million inhabitants
EU	24987	56
Germany	7456	90
UK	6248	93
Norway	5172	962
France	3751	56
Netherlands	2429	139
Spain	2128	45

Source: Kok et al (2021)

The exceptional growth in the number of public charging points in the Netherlands has not led to public charging points of an inferior quality. A large-scale and fairly representative survey conducted in 2020 with 1,637 EV drivers in the Netherlands found that they rate regular public charging points as more than sufficient and fast charging points as good (Duurkoop et al, 2021: 25-28). These results indicate that EV drivers in the Netherlands are generally satisfied with public charging points. Respondents named a lack of available public (fast) charging points, defective charging points, and a lack of price transparency as the most important weaknesses of public charging (Duurkoop et al, 2021: 25-28).

To the best of the authors' knowledge, there are no in-depth international comparisons on the *quality* of public charging infrastructure. The literature does suggest that the Netherlands is a frontrunner with regard to interoperability and standardization. These innovations increase the quality of public charging infrastructure in the Netherlands by, for instance, allowing customers to charge at every available charging station (Hall and Lutsey, 2017: p. 23). The performance in quantity and quality of charging stations in the Netherlands is realized without disproportionally large public investments. It is common for governments to partly fund charging infrastructure

(Hall and Lutsey, 2017: 28). However, from 2012 onwards some large municipalities in the Netherlands were able to realize public charging infrastructure without additional public investments (interviews, 2022). During this period the costs for installing and operating a public charging point dropped significantly (see Table 9).

Table 9: Development of costs of installing and operating charging points from 2013 to 2018 in euros.

	Numbers based on a 3x 25 Ampere charging pole with 2 sockets					
	Year	**2013**	**2016**	**2017**	**2018**	**2025 (estimation)**
Installation costs	***Total***	*4655*	*3655*	*3110*	*3270*	15% decrease
	Price of charging pole	2000	1400	1330	1330	
	Determine location	700	550	320	350	
	Prepare charging location (prepare parkingspace and permit)	700	450	380	450	
	Costs to connect to grid	655	655	690	750	
	Costs to place	600	600	390	390	
Operational costs (excl. Energy) per year	***Total***	*835*	*610*	*580*	*510*	5% decrease
	Costs grid connection	210	210	210	190	
	Communication costs	125	75	50	70	
	Insurance	25	25	25	25	
	Maintance/repairs	450	275	270	190	
	Customer service	25	25	25	35	
Costs and revenues per kWh	Costs for buying energy (euro)	0,06	0,06	0,06	0,07	
	Energy tax (euro)	0,1	0,1	0,05	0,05	100% increase
	Depreciation (years)	5	7	9,2	9,2	
	Revenue per kWh (euro)	0,25	0,28	0,27	0,25	

	Quantity sold (kWh/day)	5	8,5	8,6	9,9	50% increase

Source: NKL, 2018

This section has described how the Netherlands started in 2009 from a similar position as most other countries, having no charging infrastructure and very few electric vehicles. In 2020, the Netherlands was a frontrunner in public charging infrastructure. Four stages can be discerned in the rollout of public charging infrastructure in the Netherlands. The first period, roughly from 2009 – 2012, is characterized by experimentation. During this period the proof of concept was established. The second period, roughly from 2012-2015, can be characterized as the pilot phase. The third period, roughly from 2015-2020, is characterized by upscaling and standardization. This process continued further in the fourth period, after 2020. Below we discuss these four periods. Each section starts with a short quantitative and qualitative description of what happened during the period, discusses the role of the central government in this period based on policy documents and finally looks at policy output by listing the obstacles that occurred during the period.

3.1.2. The period 2009 – 2012: Proof of concept and experimental phase

The rollout of public charging infrastructure in the Netherlands began in 2009. During the period 2009-2012 the number of public charging points in the Netherlands increased from nearly zero in 2009 to 2,782 public charging points and 63 fast charging points in 2012 (Table 10). Already in this early phase the Netherlands took a leading position in the number of public charging points when compared to other EU countries. These first public charging points were very expensive to install, around 12,000 euros (Hall and Lutsey, 2017: p. 26), but by 2013 these costs had fallen sharply to around 5,000 euro (Table 9). In this period the number of EVs in the Netherlands increased to 6,528 (Table 10).

Table 10: Number of (semi) public charging points and EVs in the Netherlands per year

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Public charging points	400	1250	2782	3521	5421	7395	11768	15288	20228	27773	39968	51423
Semi-public hcharging points	-	576	829	2249	6439	10391	14320	17587	15633	21749	23618	31451
Fast chargers	-	15	63	106	254	465	612	755	1116	1252	2027	2577
Total (semi) public charging points	*400*	*1841*	*3674*	*5876*	*12114*	*18251*	*26700*	*33630*	*36977*	*50774*	*65613*	*85451*
BEV	-	-	1910	4069	6545	8985	12679	20619	43173	104435	171635	241838
PHEV	-	-	4348	24760	37158	76469	96071	96964	94618	91557	97730	137556
Total EVs	*-*	*-*	*6258*	*28829*	*43703*	*85454*	*108750*	*117583*	*137791*	*195992*	*269365*	*379394*

The reference date for charging points is 31-12 of each year. For EVs it is 30-4.

Source: Kok et al., 2022

The placement of the first 3,000 charging points was initiated by a foundation called Elaad, often working in close cooperation with municipalities (Kwink, 2016: p. 19). Elaad is a foundation that is funded by grid-operators which in this way fulfilled their legal obligation to invest in R&D (interviews, 2022). Dutch municipalities are large shareholder in grid operators. The installations of these first 3,000 public charging points were often used as public relations events, with celebrations for every 10th, 100th, 1,000th etc. charging station (see Figure 1).

During this period the central government also requested that traditional fuel stations along highways install and operate fast charging points. However, this request was left unanswered .

Figure 1: Pictures taken at the opening of the 500th public charging station in the Netherlands
Source: Elaad https://elaad.nl/opening-500ste-publieke-oplaadpunt-is-mijlpaal-voor-elektrisch-rijden-in-nederland/

The role of the central government

Ambitions and role

In July 2009, the ministers of the Ministry of Transport and Water Management and the Ministry of Economic Affairs informed the Dutch parliament about their policy plans for electric vehicles. Their ambition was to turn the Netherlands into an 'exemplary country' and international testing ground for electric driving, and to use these experiences to, eventually, scale up electric driving towards a large-scale market introduction (I&M and EZK, 2009: p.2). By stimulating electric driving the central government hoped to contribute to: 1) the energy independence of the Netherlands; 2) strengthening the economy; 3) improving the living environment. EVs can help with this third aim by reducing carbon emissions, improving air quality, and reducing noise pollution. In this document €65 million in expenditures were planned, mainly financed through funds that are meant to combat the economic crisis. This €65 million does not include fiscal incentives for EVs (I&M and EZK, 2009: p. 10-11).

The central government saw itself as having a facilitating role in introducing electric driving in the Netherlands (I&M and EZK, 2009: p. 1-2). In this stage the central government finds it too early to commit to ambitions for the number of EVs or charging stations in the Netherlands in later years (I&M and EZK, 2009: 13).

Main policy instruments

In this document (I&M and EZK, 2009) the following main policy instruments are introduced:

- Fiscal incentives for EVs and, to a lesser extent, (private and public) charging points. In addition to the already established exemption for EVs from certain vehicle taxes, the document also discusses the further lowering of taxes on leased EVs. Furthermore, additional tax credits are given to private investments in EVs or in charging infrastructure.
- Establish the *Formule E-Team* (FET). The FET will function as a connection between various actors involved in the development of electric driving in the Netherlands. The FET is tasked with "encouraging and connecting" various EV-related initiatives, and giving advice to private and public parties, all in order to stimulate the rollout of electric driving.
- Organize and finance testing grounds for EVs. Use of a tender system, experiments and demonstration-projects are subsidized. These projects will also be evaluated, and any lessons learned are communicated to all EV-related parties.
- Together with local governments, the central government will act as a *launching customer* for EVs.
- Co-financing EV-related research and product development.

Policies relating to the rollout of public charging infrastructure

In this document the central government acknowledges the necessity of public charging infrastructure for EVs. However, they have few policy plans in this specific area. They acknowledge the fundamental uncertainties surrounding the future of charging infrastructure and they enthusiastically welcome initiatives relating to charging infrastructure coming from other organizations. These other organizations include the municipality of Amsterdam, Elaad and the Dutch railroads (I&M and EZK, 2009: p. 6-7). However, they postpone making more concrete policy plans to a later date.

This policy document states that public charging infrastructure is a necessary condition for widespread EV adoption. As such, it can benefit from some of the policy measures that are mainly aimed at promoting EVs, such as the establishing of the FET or fiscal incentives. Furthermore, by increasing the uptake of EVs the Dutch central government plays an indispensable role in increasing the demand for charging infrastructure. However, policies specifically aimed at public charging points are limited to R&D.

Although the policies of the central government in this document only play an indirect role in promoting charging infrastructure, these indirect measures do play an important role in improving the technological innovation system surrounding charging infrastructure: Reducing the price of EVs removes obstacles relating to the A-TIS function of market formation; creating the FET team removes obstacles relating to the A-TIS function of creating new connections and required coordination mechanisms; and by committing substantial resources to developing EVs the central

government provides some directionality. See appendix C for a more detailed evaluation of this policy document in relation to the TIS functions.

Policy output

Table 11 shows the obstacles stated by the experts during the interviews categorized per A-TIS function. It also includes a small description on how the obstacle was solved and an overview of the number of experts that were of the opinion that the policies of the central government helped to overcome this obstacle. Note that the solution of these obstacles did not necessarily take place before 2012. E.g., the formulation of clear common goals by various actors was solved through the Green Deal approach, that only took off in the next period (2012-2015). Below the table a more detailed explanation is given for some obstacles.

The obstacles mentioned under the A-TIS function 'lack of entrepreneurial activity' explains why innovations in the area of public charging infrastructure did not take off earlier in time. A lack of demand for charging infrastructure is an important reason for this, which is also partly covered by the A-TIS function 'market formation'. With regard to A-TIS function '(un)suitability of institutions' the obstacles mainly relate to informal institutions: People had to become convinced about the usefulness and necessity of charging infrastructure. In this initial stage the formal institutions, i.e. laws and regulations, gave sufficient room for a small scale rollout of charging infrastructure.

The interviewed experts mention 17 obstacles that started to manifest before 2012. For 5 obstacles, the interviewees are of the opinion that policies of the central government did not help to solve them. For the other 12 obstacles, at least one of the experts was of the opinion that the policies of the central government partly helped to solve the obstacle. The Table confirms that during this period, the policies of the central government unambiguously helped to increase the supply of EVs and with this the demand for charging services. It also confirms the importance of Elaad in this phase of the rollout.

Table 11: Obstacles to the rollout of charging infrastructure that started to manifest before 2012

			Policies helped to overcome obstacle (number of experts)		
A-TIS function	**Description obstacle/impediment**	**Obstacle (partly) removed through**	**Yes#**	**Partly#**	**No#**
Entrepreneurial activities	Lack of need for innovation because too few EVs available in the Netherlands.	Lobby from Formule E team at car manufacturers; promising fiscal advantages	1	0	0
Entrepreneurial activities	Inertia in beginning with placing public charging infrastructure.	Elaad starting to place (the first 3000) public charging points	0	0	2
Entrepreneurial activities	Lack of need for innovation due to abundance of carbon fuels.	Need to reduce petrol consumption in NL due to earthquakes and geo-political concerns	0	1	0
Entrepreneurial activities	Insufficient knowledge on how to implement SMART charging.	Research co-financed by government. Research is still ongoing	0	1	0
New networks and coordination mech.	No organization existed to represent the EV sector and/or allow this sector to come together.	Founding of the Formule-E team (FET).	1	0	0
Directionality	Uncertainty through the absence of a plan or blueprint on how to rollout public charging infrastructure.	Programmatic approach by the central government and the FET	1	1	0
Directionality	No formulation of clear common goals and actions for both government and non-government organizations.	Using Green Deal approach	1	1	0
Market formation	Insufficient demand for charging infrastructure due to insufficient EVs.	The central government stimulated EV driving	5	0	0
Market formation	No profitable business case for charging infrastructure.	Business case improved due to economies of scale (also related to tender system), making the placing process more efficient, product innovation, subsidies of	0	6	0

		municipalities and (to a lesser extent) the central government and the European Union. The NKL was used to do additional research on this and diffuse this knowledge			
Market formation	Size of market too small because plugs required for charging differ between EVs	Agreement on standard charging plugs	0	2	0
Resource mobilization	Insufficient (private) investments in charging infrastructure because of too much insecurity about EVs.	Government signalling that EVs will be the future	0	1	0
(un)suitability of institutions	Insufficient enthusiasm about charging infrastructure.	Making the placing of every X-th public charging point a small public celebration / PR-event	0	0	1
(un)suitability of institutions	Disbelief about the idea of charging electric vehicles (slowly) on the public street.	By placing charging points and seeing that it works. Slow charging an EV is less like fueling a car and more like charging a phone.	0	1	0
(un)suitability of institutions	Scepticism or insufficient enthusiasm of local politicians about placing charging infrastructure.	Founding of the NAL, reducing uncertainty, requiring municipalities to place charging infrastructure.	0	0	3
(un)suitability of institutions	Powerful (veto) players (oil and car manufacturing companies) are slowing down entrepreneurial activities	No car manufacturers in the Netherlands. Later on car manufactures see that EVs can be profitable	0	0	3
(un)suitability of institutions	Vehicles occupying a charging point while not charging.	Not yet solved	0	0	2
Phasing out/exnovation	The prices of combustion engine vehicles are too low when compared to electric vehicles.	Fiscal advantages EV drivers; subsidies.	2	0	0
# Number of experts stating that policies of central gov. helped/partially helped/did not help to overcome this obstacle					

3.1.3. The period 2012 – 2015: Pilot and demonstration phase

In the period 2012-2015 the number of charging points increased 2.5 fold, resulting in a total of 7,395 public charging points in 2015. Fast charging points increased seven-fold, resulting in 465 fast charging points. The number of EVs increased thirteen-fold between 2012 and 2015 to 85,454 vehicles. The installation costs for public charging points decreased sharply, from €4,655 in 2013 to €3,655 in 2016. Similarly, the operating costs per year also decreased, from €835 to €610 (see Table 9).

Elaad was responsible for installing the first 3,000 charging points. However, at the start of this period, around 2012, private companies threatened to sue Elaad: the placing of charging points by Elaad was considered unfair competition because Elaad was funded by grid operators. In reaction to these threats, Elaad stopped installing public charging points (Kwink, 2016: p. 19). This role was subsequently taken over by private companies such as Allego, Engie Charging or Vattenfall InCharge. Quite often these companies are related to energy suppliers rather than grid operators, and thus this task shifted from (semi)public sector organizations to private sector organizations.

Public charging points are installed at the request of companies or municipalities. When charging points are installed on the request of companies, the role of municipalities is limited to providing permits. These permits are valid for a certain period, around 10 years, and the municipality can set minimum standards. When charging points are placed at the request of municipalities, this is predominantly done through tenders involving several thousand charging points within a certain jurisdiction (and it often involves more than one municipality). Two main types of tenders are distinguished: tenders based on a 'concession model' [in Dutch: concessiemodel] or an 'assignment model' [in Dutch: opdrachtmodel]. The former model gives one or more companies the (exclusive) right to install and operate charging infrastructure within a certain jurisdiction for a certain time period, often around 8 to 10 years. The latter model gives only the right to install charging points to one or more companies whereas the municipalities themselves are responsible for the operation and thus potential financial gains and losses. Through permits and tenders, municipalities can set conditions for public charging points, e.g. relating to following certain safety standards or a maximum price per kWh (NKL, 2019; interviews, 2022). Both because the demand for charging was much larger in cities, but also because large municipalities have the human and financial resources to manage such processes, these tenders almost exclusively took place in large municipalities during this time period (Kwink, 2016: 24). These large municipalities were often designated as 'focus areas' or sandboxes (in Dutch: proeftuinen) for electric driving by central and decentral governments.

After a legislative change in 2011, the Ministry of Infrastructure and Waterworks used a lottery in 2012 to distribute 15-year permits to build and operate fast charging stations at all 245 service locations along Dutch highways. Only one company, called Fastned, opted for all 245 service

locations. Other organizations, such as MisterGreen, opted only for several locations. If several companies opted for the same service location, a lottery determined the winner. One important condition in these permits was that the winner of the lottery had to show (substantial) progress in realizing the fast charging stations at a certain service location within 1.5 year after receiving the permit (Lubbers, 2014; Kerkhof and Zante, 2021).

The role of the central government

Ambitions and role

In October 2011 the Ministry of Economic Affairs, the Ministry of Internal Affairs and the Ministry of Transport and Water Management sent the Dutch parliament a letter containing their policy plans based on public-private cooperation aimed at green growth. This is called the 'Green Deal' approach and mobility is a focus area within this approach. Attached to this letter were plans to form Green Deals with various organizations to stimulate electric driving. Although being presented as part of the Green Deal approach, the main policies of the central government are described in a separate (attached) document, called: Elektrisch Rijden in de versnelling (EZK, 2011), Plan van Aanpak 2011-2015 [Electric Driving Gearing up: Plan of Action 2011 – 2015] in which plans are made for €9,000,000 of additional spending.

According to this plan the central government assumes the role of enabler and troubleshooter for EVs: "we maken het mogelijk zodat anderen het kunnen doen en we ruimen problemen uit de weg." (EZK, 2011: p. 17-18) [We make it possible to enable others to do it and we remove obstacles.] The goal of the policy plan is to create the conditions that are required for a successful scaling-up of electric transport in the Netherlands. The plan is based on three pillars, being: 1) The use of focus areas (Dutch: 'focusgebieden') on which policies are focused to achieve measurable ambitions relating to EVs; 2) The plan aims to intensify efforts to introduce EVs in promising market segments; 3) The plan aims to improve the overall earning potential of the Dutch EV-sector. The plan includes the ambition to have 20,000 EVs and 10,000 public charging stations in the Netherlands in 2015 (EZK, 2011: p. 4 and p. 20). With the knowledge of hindsight these ambitions seem rather low, since at the end of 2015 there were around 85,000 EVs and 18,000 (semi) public charging points, but this also illustrates how fast and unexpected the increase in EVs and charging infrastructure has been.

Main policy instruments

In this document the following (major) policy instruments are introduced:

- Fiscal benefits for EVs. A continuation of tax exemptions for cars that emit less than 50 grams of CO2 per km, meant to encourage electric and 'semi-electric' vehicles. Subsidies on investments in EVs and charging infrastructure are also continued.
- Encourage the development of charging infrastructure in so-called focus areas. Focus areas are allocated €3 million in funds. The developments in the focus areas will be monitored, and lessons learned are communicated to other areas.

- The subsidizing of innovative charging techniques (such as SMART charging).
- Increase the technical safety requirements for EVs.
- The central government will act as a lead customer for EVs and charging infrastructure.
- Increase international cooperation (in an EU context) on electric driving and charging.

Policies relating to the rollout of public charging infrastructure

This policy document (EZK, 2011) is mainly aimed at stimulating EVs. Stimulating the rollout of charging infrastructure largely depends on other organizations, such as large municipalities and Elaad. This is somewhat unsurprising because the central government (again) sees for itself mainly a facilitating role. Nonetheless, when compared to the policy plan for the period 2009-2012, the activities of the central government relating to charging infrastructure are growing. This growth in policies of the central governments is generated by three different developments. First, the central government has observed (new) nationwide obstacles and has made an effort to solve them. This includes obstacles relating to the unprofitable business case of charging infrastructure and a lack of clarity about market roles (EZK, 2011: p. 3). Second, the central government sees itself as a key player in increasing international (EU) cooperation on charging infrastructure (EZK, 2011: p. 16). Third, the central government is responsible for the highways in the Netherlands. As a consequence, it is natural for them to have increased involvement in rolling out public (fast) charging infrastructure along these roads, partly because they are responsible for providing the necessary permits (EZK, 2011: p. 8).

In this *Plan of Action* (EZK, 2011) the central government developed additional policies aimed at charging infrastructure. Besides R&D (A-TIS: Knowledge development) they now also include policies aimed at using soft power to facilitate certain market roles and international cooperation (A-TIS: new networks and coordination mech. and A-TIS (un)suitability of institutions). In addition, there are also some policies aimed at mobilizing human and financial capital, the latter through innovation subsidies (A-TIS resource mobilization). However, in this document the most important policies were aimed at encouraging EVs, which indirectly played a key role in improving the technological innovation system surrounding charging infrastructure. See appendix D for a more detailed evaluation of this policy document in relation to the TIS functions.

Policy output

Table 12 shows the obstacles identified by the experts for the period 2012-2015. The experts identified 24 obstacles that started to manifest in this period. None of these obstacles relate to the A-TIS function of 'Entrepreneurial activities'. This is so because after the rollout of public charging infrastructure started there is no indication that entrepreneurial activities stagnated. E.g., the number of people working in the EV sector and its added value to the economy have been growing at an increasing rate since 2009 (Reitsema et al., 2021). During the 2012-2015 period much of the basic infrastructure and (informal) institutions were starting to take form, slowly solving obstacles relating to the division of labor between various actors and a lack of

means/infrastructure to share information. Because of this, many obstacles in this period relate to the A-TIS functions of "new networks and coordination mech." and "(un)suitability of institutions". For instance, the infrastructure to enable interoperability was starting to take shape in this period, be it in the rather ad-hoc form of Excel sheets. The central government did not force these developments through regulation but rather facilitated them, e.g., through research or bringing organizations together. Because in this period the installation of public charging infrastructure shifted from (semi-)public towards private sector organizations, obstacles surrounding the business-case of public charging infrastructure become more prominent, as reflected in the obstacles relating to market formation.

The experts are of the opinion that the central government did not play any role in solving 10 of these obstacles. Often municipalities and the Dutch consensus-culture played an important role in solving these obstacles.

Table 12: Obstacles to the rollout of charging infrastructure that started to manifest in the period 2012-2015

			Policies helped to overcome obstacle (number of experts)		
A-TIS function	**Description obstacle**	**Obstacle (partly) removed through**	**Yes#**	**Partly#**	**No#**
Knowledge development	The process for placing charging points is inefficient/expensive due to insufficient knowledge/expertise within a single organization about this process and/or insufficient knowledge sharing between organizations.	Founding of Nationaal Kennisplatform Laadinfrastructuur (NKL) and process optimization through improving coordination between different agencies and allowing firms to do additional tasks (relating to the electricity grid)	0	3	1
Knowledge development	No organization can supply basic objective information about electric vehicles and charging due to a lack of credibility or because it is too expensive	RVO provides objective basic information on EV adoption and various other crucial factors, such as safety	2	0	0
Knowledge development	Insufficient opportunities for learning (i.e. data) available to determine which locations are most appropriate for public charging infrastructure	Better match between supply and demand for charging points due to learning of companies and planning of municipalities, a.o. through using models to predict where charging points should be placed.	0	1	2
Knowledge development	Municipal civil servants lack knowledge to write (good) tenders for charging infrastructure	Elaad and consultancy firms providing additional (technical) information	0	0	1
New networks and coordination mech.	No system/infrastructure for sharing basic data about charging infrastructure, e.g., on location of charging points or whether or not a charging point is occupied.	First done rather informally by companies themselves, later professionalized and done by specialized companies.	0	3	0
New networks and coordination mech.	Companies were unable and/or unwilling to enable interoperability (roaming).*	Companies voluntarily designed and signed a code of conduct. Municipalities did make following this code of conduct a requirement in tenders for public charging infrastructure.	0	6	1
New networks and	Unclear market roles for firms (i.e. not clear who should do what in order to guarantee that	Research report commissioned by ministry of Economic Affairs and the ministry of Infrastructure & Water Management suggests possible ways to structure the market. Subsequently,	1	1	0

coordination mech.	consumers could charge EVs for a fair price and suppliers would be able to make a fair profit).	municipalities require a certain market structure in tenders/permits for charging infrastructure and market organizations voluntarily committed to the most optimal model for consumers.			
New networks and coordination mech.	Lack of a clear division of labor between different levels of government, grid operators and the market.	The division of labor largely grew organically, partly due to existing legislation relating to roads. The appropriateness of this division of labor was later on confirmed by research. Note that with the increasing importance of charging infrastructure anno 2022 a better and more formal division of tasks is necessary.	0	2	0
New networks and coordination mech.	Unclear what is the best method for municipalities to be involved in organizing charging infrastructure supply (using tenders or through the market).	Hybrid models are used, but the tender system is being seen as superior.	0	1	2
New networks and coordination mech.	Insufficient structures available for transnational knowledge exchange.	Participating in several EU and international workgroups, conferences and etc., either as cities or as countries.	1	1	2
Directionality	Too much optimism about technological progress (e.g. beliefs that the costs of EVs will fall very fast; hydrogen technologies will surpass EVs)	By providing objective basic information and the government showing a strong commitment to EVs	0	0	1
Directionality	Individual organizations not wanting to join the shared vision due to a negative effect on their business.	Operating in a growth market, the Dutch consensus culture, and municipalities putting requirements in tenders that force companies to change their behavior	0	0	1
Market formation	Unfair competition because a public organization (and not a private company) was rolling out charging infrastructure.**	Private companies threatening to sue Elaad. This threat was sufficient for Elaad to stop these activities	0	0	1
Market formation	Expectations and needs of consumers are insufficiently taken into account when installing or operating charging points (a lack of focus on the end users of charging infrastructure)***	Through placing high requirements on charging infrastructure by municipalities in tenders	0	0	1
Market formation	Individual charging points (in low demand areas) generate insufficient revenues to be profitable.	Use of a tender system. By granting the rights to all charging points within a certain area, unprofitable points can be compensated for by very profitable points	0	0	1

Market formation	Too much emphasis on price in tenders for the suppliers of charging points coming at a cost of quality and/or sustainability.	Not yet solved	0	0	2
(un)suitability of institutions	Insufficient public awareness about EVs and public charging infrastructure.	Using celebrities (such as prince Maurits) in the FET and treating every Xth charging point as a PR event	1	2	0
(un)suitability of institutions	No customs or formal regulations to determine roles of firms and governments	Voluntary agreements made on market roles and organic growth of division of labor between governments	1	3	0
(un)suitability of institutions	It takes too long to place a charging point due to permit requirements.****	Partly solved by municipalities anticipating on which locations charging points will be needed (strategic placement of charging points)	0	1	4
(un)suitability of institutions	Worries about the physical safety of charging points (i.e. fire).	Legislation ('Bouwbesluit') and setting up guidelines.	3	0	0
(un)suitability of institutions	Worries about privacy issues (data security).	Setting up guidelines for data security in a public-private cooperation. Municipalities subsequently demand that companies follow these guidelines in tenders.	0	2	0
(un)suitability of institutions	Negative media coverage on electric vehicles (fire safety; rich EV drivers; hybrids 'eating' subsidies).	Image of EVs seems to be improving. Mainstreaming and lack of (newsworthy) incidents play a role.	0	0	2
(un)suitability of institutions	Not possible to check whether or not charging infrastructure meets requirements set in, e.g., tenders.	Elaad has developed facilities that allow municipalities to check the quality of charging infrastructure	0	0	1
(un)suitability of institutions	Irritations or small-scale resistance related to parking spaces, light emitted by charging points, etc.	Not yet solved	0	0	5

Number of experts stating that policies of central gov. helped/partially helped/did not help to overcome this obstacle

Additional explanation for selected obstacles

***Companies were unable and/or unwilling to enable interoperability (roaming).**

Interoperability, also known as *roaming*, entails the ability for electric drivers to charge and pay at any public charging point. Interoperability requires, among other, a standardised charging plug, as well as standardised payment protocols. In the Netherlands, interoperability was

achieved early and it is the only country to have achieved this. Interviewees contribute this success mostly to the voluntary cooperation between market players and because municipalities made it a requirement in tenders. There were no legal requirements for companies to set up a system of interoperability. The central government did play a facilitating role, for example through providing meeting spaces to market players, as well as being involved in the founding of eViolin. eViolin is an organisation of CPOs and MSPs which focuses on the promotion of interoperability.

**** Unfair competition because a public organization (and not a private company) was rolling out charging infrastructure.**

ElaadNL is an organisation of multiple grid operators in the Netherlands. As municipalities are large shareholders in grid operators, ElaadNL can be seen as a (semi) public organization. Around 2009, ElaadNL started installing charging infrastructure and realized 3000 charging points. However, there was the criticism that the installing of charging points was not the responsibility of the grid-operators, and should instead be left to private companies. When some commercial companies threatened to sue on this issue, ElaadNL ceased to rollout charging infrastructure.

***** Expectations and needs of consumers are insufficiently taken into account when installing or exploiting charging points (a lack of focus on the end users of charging infrastructure).**

When implementing new technologies technological considerations can crowd out the required attention for end-consumers. The expectations and needs of the end-consumers were taken into account by municipalities. 'Quality' aspects that may be relevant to consumers include the location of charging points, the uptime of a charging point, the rate at which maintenance is provided, or the quality of the customer service. By placing high requirements on infrastructure quality in tenders, municipalities aimed to meet the needs of consumers.

****** It takes too long to place a charging point due to permit requirements.**

The process of realizing a charging point can be completed within 10 weeks. In 2021 this process took (in some municipalities) still more than 6 months. This has negative consequences for the revenues of CPOs, and it means that EV-owners have to wait longer before they can charge their EV near their home. As the charging points are located on public terrain, municipal permit requirements are often a factor in slowing down this process.

3.1.4. The period 2015 – 2020: Upscaling phase

In the period 2015 – 2020, the number of public charging points increased fivefold, to 39,968 in 2020. The number of fast charging points increased fourfold, to 2,027 in 2020. The number of EVs increased threefold, to 269,365 EVs. Note that this period is two years longer than the previous period. The costs for installing public charging points decreased from 3,655 to 3,270 euros in 2018. The costs of operating public charging points also decreased, from 610 to 510 euros per point per year. The last data on this is from 2018 but the expectation is that both installation and operating costs decreased a bit further during the remainder of this period.

During the 2015-2020 period some smaller municipalities, outside of the focus areas, also become more actively involved in rolling out charging infrastructure. However, in many areas public charging services are not available. During this period the rollout of public charging infrastructure is standardized and professionalized. The Nationaal Kennisplatform Laadinfrastructuur [National Knowledge Platform for Charging infrastructure, NKL] plays an important role in this 'pre-competitive' phase by designing standards, facilitating communication between different parties and providing objective information about prices for charging infrastructure.

During this period the central government facilitates cooperation between different (government and non-governmental) parties in the area of charging infrastructure using the so-called *Green Deals* approach. In this approach 'deals' are made between the central government, local governments, and various non-governmental organizations. They are based on voluntary participation and link specific aims to actions of one or more organizations that have signed the deal. The green deal approach is an important instrument for the central government to organize and execute plans to improve sustainability. The Green Deals are aimed at removing specific (often non-financial) obstacles and aim at concrete results. These deals also subsidize the placing of charging infrastructure via municipalities for 5,700,000 euros.

The role of the central government

Ambitions and role

In December 2016 the Ministry of Economic Affairs informs parliament about its vision for public charging infrastructure in the Netherlands up to 2020 (EZK, 2016). This vision is described in: *"Visie op de laadinfrastructuur voor elektrisch vervoer: Beleidsagenda richting 2020 Voor Slim en Schoon vervoer"* [Vision on the charging infrastructure for electric mobility: Policy towards 2020 for Smart and Clean transportation]. During the previous period the Green Deal approach was developed further and as a result this vision is flanked by two Green Deals, namely the Green deal "Openbaar toegankelijke elektrische laadinfrastructuur" [Green deal public charging infrastructure] (EZK and I&W, 2015) and Green deal "elektrisch vervoer 2016-2020" [Green deal electric mobility 2016-2020] (EZK and I&W, 2016).

In the Vision for Charging Infrastructure the central government reaffirms the importance of (public) charging infrastructure for EVs (EZK, 2016: p. 3). It also reaffirms the importance of EVs for reducing GHG emissions, its importance for improving the quality of the living environment, and the potential of the EV sector as a driver of economic growth (EZK, 2016). The role of the central government is described in more detail than in previous documents. It states that, after the realization of clearer market roles and interoperability, the rollout of public charging infrastructure is a market matter. However, because the business case for charging infrastructure is not yet profitable, the central government still is of the opinion that it has a task in bringing down these costs. Besides this, the central government sees itself as having a role in stimulating innovation, removing obstacles, providing the right market incentives and good regulation (EZK, 2016: p. 11 and 22).

Main policy instruments

In this document and the related Green Deals the following main policy instruments are introduced:

- Founding of Nationaal Kennisplatform Laadinfrastructuur (NKL), whose primary purpose it is to reduce the costs of charging infrastructure through research. The parties signing the Green Deal agree to actively contribute to the efforts of the NKL.
- Provide 5.7 million euro in subsidies to municipalities for co-financing charging infrastructure.
- (Temporarily) lowering the energy tax for charging infrastructure.
- A continuation of the aim to shift the government's vehicle fleet towards EVs.
- Implementing EU directive on the deployment of Alternative Fuels Infrastructure.

Policies relating to the rollout of public charging infrastructure

As already implied in the name, the *Visie op de laadinfrastructuur voor elektrisch vervoer* is more focused on charging infrastructure than the previous policy documents discussed in this report. The central government claims it played a role in creating an efficient, competitive, self-regulating and future-proof market for charging infrastructure, with freedom of choice for users, and considers this task completed and scales down policy efforts in this area. However, although it reduces efforts in this area it develops more policies aimed at generating a profitable business case for charging infrastructure. It thus shifted its efforts from A-TIS functions relating to networks and institutions towards the A-TIS function of market formation. See appendix E for a more detailed policy evaluation of the Green Deals.

Policy output

The experts identified 11 obstacles that started to manifest in the period 2015-2020. For 7 of these obstacles, the policies of the central government did play some role in solving them. In this

period the obstacles encountered start to depend on the region. In large metropolitan municipalities the rollout of charging infrastructure is going well and the market is more mature (Hall and Lutsey, 2017: p. 18). Here, obstacles relate to, e.g., a lack of price transparency. However, in rural areas public charging infrastructure is less profitable and very little or no public charging infrastructure is present. To help smaller municipalities that are lagging behind in the rollout of charging infrastructure, the NAL is created in 2020 (see the period *beyond 2020* for more on the NAL).

Table 13: Obstacles to the rollout of charging infrastructure that started to manifest in the period 2015-2020

			Policies helped to overcome obstacle (number of experts)		
A-TIS function	**Description obstacle**	**Obstacle (partly) removed through**	**Yes#**	**Partly#**	**No#**
New networks and coordination mech.	Many municipalities did not actively participate in rolling out charging infrastructure (whereas some municipalities were very active), which had consequences for the degree to which there is a nationwide charging network.	Founding of the Nationale Agenda Laadinfrastructuur (NAL)	0	5	1
New networks and coordination mech.	Failing inter-ministerial cooperation leading to discontinuity in policy	Not yet solved	0	1	1
Market formation	Charging infrastructure is unprofitable in large (rural) areas due to lack of demand.	In large cities this problem is solved. In smaller (rural) areas this can still be a problem. Partly solved through NAL	1	3	0
Market formation	Insufficient supply of charging infrastructure due to exponential growth of EVs.	Not yet solved	1	2	0
Market formation	Lack of price transparency on costs of charging (at the same charging point customers might pay different prices, depending on their card).	Not yet solved. However, in the *Klimaat Akkoord* (2019) plans are made to solve this issue.	0	0	1
Market formation	Unfair competition between traditional gas stations and the operators of fast charging stations because the latter cannot sell food or other basic services.	Not yet solved. However, a court case from 2021 suggests that (fast)charging stations should have this possibility.	0	0	1
Market formation	Charging infrastructure is not always suitable for large vehicles.	Not yet solved.	0	1	0

Market formation	No market for spare parts of charging infrastructure, recycling of charging points is not possible.	Not yet solved	0	0	1
Resource mobilization	Lack of municipal civil servants (to manage tenders and other tasks relating to charging infrastructure).	Not yet solved, the NAL does help. However, municipalities are still not adequately compensated for the additional civil servants they need for these (new) tasks.	0	2	0
(un)suitability of institutions	Rigid legislation hindering SMART charging.	Attempts are being made to change the law	1	0	0
(un)suitability of institutions	No requirements for realizing charging infrastructure at new buildings.	European Energy Performance of Buildings Directive requires (pre-cabling for) charging stations to be installed at certain building projects	0	0	3
Phasing out/exnovation	The number of fossil fuel-based cars is still growing (although it has become less as a percentage of the total car fleet).	Not yet solved. From 2030 (NL) or 2035 (EU) onwards all newly sold vehicles will have to be 100% zero-emission.	0	0	1

Number of experts stating that policies of central gov. helped/partially helped/did not help to overcome this obstacle

3.1.5. Beyond 2020

In June 2019 the Dutch government presented its *Klimaatakkoord* [Climate Accord] to parliament. This accord includes the proposed policy measures of the Dutch government but also agreements with other organizations (EZK, 2019a). This plan aims to reduce GHG emissions by 49% in 2030 compared to the emissions in 1990, and preferably reduce them by 55%. These ambitions are partly based on (expected) EU emissions targets (EZK, 2019B: p. 7). The *Klimaatakkoord* aims to be an integrated approach, based on five sectors but with attention for sectoral interdependence (p. 16). One of these sectors is mobility, and the electrification of road transport plays a prominent role in this sector.

For the mobility sector, the Dutch government strives towards a cost-efficient path towards transport without emissions in 2050. The central government aims to make all newly sold cars from 2030 onwards zero-emission. As such, the phasing-out of combustion engine vehicles is more prominently a part of the plan, with the central government lobbying for more stringent EU laws and implementing more stringent norms on a national level when possible. In line with this broader approach the *Klimaatakkoord* also includes policies to rethink the way taxes are levied on road transport (EZK, 2019B: p. 46). Renewable electricity generation is also featured much more prominently in this document (EZK, 2019B: p. 49) when compared to the previously discussed policy documents (e.g. EZK, 2016). Fairness and the accessibility of electric cars for citizens with less disposable income are also put onto the policy agenda (EZK, 2019B: p. 60), with policies being formulated to stimulate the secondhand market for electric vehicles (EZK, 2019B: p. 62).

For charging infrastructure, the central government aims to realize 1.8 million charging points, which can be either private, public or semi-public. The aim is that: "het laden van je elektrische auto moet even makkelijk zijn als opladen van je mobiele telefoon." [Charging your electric vehicle should be as easy as charging your phone.] These more mission-orientated and also quantitative targets, both on the level of GHG emissions and public charging infrastructure, add to the A-TIS function of directionality.

The government (both central and sub-national) assumes that no direct financial support is necessary for the installment and operating of charging infrastructure (EZK, 2019B: p. 58). However, the central government does lay out substantial policies. One of the most important new policy measures is the founding of the *Nationale Agenda Laadinfrastructuur* (NAL). In this organization municipalities, provinces and grid-operators work together to ensure that the charging infrastructure keeps up with the (exponential) growth in electric vehicles. This organization is especially important to help smaller municipalities, that lag behind in the rollout of public charging infrastructure. This policy measure thus contributes to the A-TIS function of creating new connections and required coordination mechanisms.

The central government will also establish a national access point for uploading (basic) data on charging infrastructure and pursues various legislative reforms. Legislation will be adjusted to allow for differentiated parking tariffs by municipalities; to ensure a sufficient supply of public

charging points; and requires municipalities to make plans for public charging infrastructure and update these regularly. In this case it thus seems that legislation follows innovation, rather then the other way around. The appendix F also includes a more detailed policy evaluation of the *Klimaatakkoord.*

Policy output

The experts identified 8 obstacles that started to manifest after 2020. In this period, obstacles relating to the EU become more important. These obstacles relate both to a lack of regulation and overregulation. E.g., a lack of regulation about inter-operability is seen as an obstacle, whereas the fear of regulation with regards to, e.g., mandatory payment terminals on charging points is seen as an obstacle. Another group of obstacles relate to the exponential growth and, to some extent, the broader electrification of the Dutch economy. This rapid increase in activities is causing obstacles relating to shortages of human capital and grid capacity (A-TIS resource mobilization).

Table 14: Obstacles to the rollout of charging infrastructure that started to manifest in the period 2015-2020

			Policies helped to overcome obstacle (number of experts)		
A-TIS function	**Description obstacle/impediment**	**Obstacle (partly) removed through**	**Yes#**	**Partly#**	**No#**
New networks and coordination mech.	Lack of European standard to allow for inter-operability between Member States.	EU is working on legislation/standards	1	1	1
Market formation	Maximum price per kWh in tenders for operators of charging points (which is no longer realistic with current electricity prices).	Not yet solved	0	0	3
Resource mobilization	Insufficient capacity on the electricity grid.*	Not yet solved. However, in anticipation of this problem the government and private sector companies have invested in R&D (SMART charging)	1	4	0
Resource mobilization	Lack of human capital (installation technicians).	Not yet solved, central government does stimulate education	0	5	1
(un)suitability of institutions	Plans for more stringent EU policies, such as mandatory payment terminals.	Not yet solved.	0	0	5
Phasing out/exnovation	Too slow phasing out of combustion engine vehicles by EU.	Lobby for more stringent EU laws.	0	3	0
Phasing out/exnovation	The tax breaks on electric vehicles and electricity are reduced to compensate for the lack of government revenues due to reduced tax base of fossil fuel vehicles.	Not yet solved. Plans are to slowly increase taxes on EVs and/or electricity, which will increase tax revenues but also makes electric driving more expensive.	0	0	1
Phasing out/exnovation	The relative price of electric driving worsening when compared to traditional driving due to government subsidies on fossil fuels.	Not yet solved.	0	0	3

Number of experts stating that policies of central gov. helped/partially helped/did not help to overcome this obstacle

Additional explanation for selected obstacles

***Insufficient capacity on the electricity grid.** The demand for electricity increases with the number of EVs. With the exponential growth in the number of EVs and their battery capacity, in addition to the more general electrification of the economy, the electricity grid has insufficient capacity. This was in 2010 a theoretical issue which has materialized in 2022, resulting in firms not receiving permits to connect to the electricity grid in some areas of the Netherlands. 'Smart charging' is a technique in which EVs for example only charge at times when the total electricity demand is low, thus reducing the strain on the electricity grid. This technique is seen as the go-to solution for grid capacity problems. The central government has financed several R&D projects on smart charging.

3.2. Validity of findings

Findings in this report are validated by cross-checking if information of the following sources matches:

- A description of the period, e.g., 2009-2012, using mainly grey literature and basic quantitative data about electric driving.
- A description and assessment of policy documents of the central government from the same period.
- Interviews with experts that focus on policy output. After every interview a report was written which was sent to the interviewee for validation.

In total, the 11 experts identified 61 obstacles. Of these obstacles, 21 were only identified by a single expert. This is a significant share of the obstacles and illustrates that different actors experience different obstacles. However, when an obstacle is only mentioned by a single expert, it also becomes more difficult to draw generally conclusions about it. By increasing either the length of the interviews or the number of interviewees it is possible to reduce the share of obstacles that are only mentioned by a single expert.

For only 2 of the 61 identified obstacles, the experts had opposing opinions on whether the policies of the central government helped solving it, i.e., one or more experts saying the government *did* help to solve it whereas other experts said it did not. These two obstacles both relate to the EU, which might indicate that interviewees were less knowledgeable about the EU and how EU and Dutch policies interact. Experts often had different views on whether the central government unambiguously helped to (not) solve an obstacle or partly solved it.

The researchers had to reformulate the statements of experts in order to fit it in the A-TIS framework. For example, if an expert stated that the "government helped in clarifying market roles", the researchers had to reformulate this into an obstacle: "unclear market roles for firms". Subsequently (very) similar obstacles mentioned by different experts were merged. This process of reformulation again involves subjectivity is thus a limitation.

At the start of the study, we worried that obstacles from the first and second period would not be remembered. However, the experts identified many obstacles from the first two periods, indicating that this risk probably did not materialize.

4. Conclusions and future work

4.1. Conclusions on the methodology

In 2009 EU countries, including the Netherlands, had virtually no (semi)public charging infrastructure for EVs. In 2020 nearly 1 in every 3 (semi)public charging points in Europe were located in the Netherlands. This report investigated how the policies of the central government played a role in the rapid rollout of high-quality (semi)public charging points in the Netherlands.

The entire research period, from 2009 – 2020, is characterized by a continuous growth in entrepreneurial activities relating to public charging infrastructure. Public charging points grew in number and quality, and also the number of people working in this sector grew rapidly. Experts identified 61 obstacles to the rollout of public charging infrastructure during the research period. These obstacles were clustered using Adjusted Technological Innovation Systems functions (which were introduced in section 2.4) and the (linear) innovation process. In the opinion of experts, central government policies played some role in solving approximately half (29) of these obstacles.

In the proof-of-concept phase, running from 2009 to 2012, the obstacles were removed that had obstructed entrepreneurial activities before this period. The most important obstacle related to overcoming a lock-in effect, in which a lack of public charging infrastructure led to a lack of EVs and *vice versa*. The foundation Elaad was crucial for solving one side of this lock-in, by installing the first 3,000 public charging points in the Netherlands. The policies of the central government were mainly aimed at solving the other side of this lock-in effect, by stimulating EV adoption. It did this through providing financial incentives (tax cuts) to reduce the total costs of ownership of EVs relative to combustion engine vehicles. The central government also made a €65 million investment in the EV sector in the Netherlands, mainly in an attempt to stimulate the economy during a recession. While the central government acknowledged the importance of public charging infrastructure for EVs during this period, it made few policies directly relating to it (with the exception of some knowledge development).

In the pilot and demonstrate phase, 2012-2015, the obstacles to the rollout mainly related to a lack of basic infrastructure and (informal) institutions to allow for a sufficiently large market for public charging infrastructure to come about. Many obstacles in this period relate to the A-TIS functions of "market formation", "new networks and coordination mech." and "(un)suitability of institutions" and the policies of the central government helped to facilitate solutions to these obstacles, e.g., by commissioning research on how the market for charging infrastructure could be organized. These obstacles to some extent reflect the fact that during this period, commercial organizations started installing public charging infrastructure, making cost considerations more important. With support of the central government the National Knowledge Platform for Charging Infrastructure (NKL) was founded in 2015 to investigate how these costs could be lowered.

Installing new charging points mainly happened in large metropolitan municipalities using various procedures, but eventually the dominant procedure became the use of tenders. During this period the central government, through the Ministry of I&W, also distributed permits for fast charging infrastructure along highways using a lottery.

In the upscaling phase, 2015-2020, the obstacles start to show regional variation because different regions are in different phases of the innovation process. In some (urban) areas the market for public charging infrastructure is quite mature and obstacles relate to, e.g., increasing price transparency, whereas in other (rural) areas almost no public charging infrastructure is present. These obstacles correspond to the A-TIS function of market formation. To stimulate the rollout of public charging infrastructure in areas that are lagging behind and in which charging infrastructure is less profitable, the NAL is founded in 2020. This is also the first period in which the central government directly co-financed charging infrastructure through municipalities.

In the final period, 2020 and beyond, obstacles relate to under regulation by the EU and a fear of overriding EU regulation. Obstacles relating to the exponential growth of EVs and the wider electrification of the economy also start to manifest, creating issues around human resources and grid capacity (the A-TIS function of resource mobilization). Since 2009 the ambitions of the central government regarding EVs have shifted from economic concerns to mitigating climate change. Fairness and the phasing out of combustion engine cars also becomes more important in policy documents. In this period, it is expected the smaller municipalities will start playing a more important role in the rollout of public charging infrastructure.

To summarize, the central government was important, and at some stages crucial, to the rollout of (semi)public charging infrastructure. It did this by building the necessary Adjusted Technological Innovation System for public charging infrastructure, e.g., by providing directionality, by building networks, and by stimulating EV adoption and thus the demand for public charging infrastructure. Nonetheless, the central government played primarily an indirect or facilitating role in this rollout. It thus seems unlikely that the policies of the central government by themselves can explain the rapid rollout of high-quality public charging infrastructure in the Netherlands. The private sector and other public sector organizations, most notably Elaad and large municipalities, played a more direct role in this rollout and experts see them as more important than the central government. The experts also mentioned the lack of large car manufacturers and the Dutch consensus culture as important explanations for this rapid rollout.

That the policies of the central government were not central to the rollout of public charging infrastructure is by no means a value judgement about the functioning of the central government. There are no signs that, during the research period, the central government wanted (or needed) to play a bigger role in this rollout. By taking a backseat in this rollout the central government might have contributed to the effectiveness and efficiency of the rollout.

4.2. Conclusions and recommendations for transformative climate policies

A single case study is insufficient to draw general conclusions or make general recommendations. However, the case study does offer a number of interesting reflections:

Consider to involve the public sector in private sector activities in the early stages of an innovation

The conventional wisdom is that the public sector should refrain from activities that can be performed by the private sector. This case study presents an interesting counterexample. It suggests that in the start-up phase of rolling out a new technology, the public sector should be actively involved in activities that can, in principle, be performed by the private sector. A public sector organization (i.e. Elaad) was heavily involved in rolling out the first 3,000 charging points. When private sector companies threatened to sue, it stopped with these activities. This approach had three important advantages, when compared to, e.g., using a public tender. First, it effectively circumvented market failures related to innovation, e.g., relating to fundamental uncertainty and network externalities. Second, it credibly showed that public sector organizations could also perform this task, thus creating an additional incentive for private sector companies to perform well at this task. Third, by being involved in the initial rollout of public charging infrastructure, the public sector acquired the necessary know-how to manage the further rollout of public charging infrastructure, e.g., by providing the know-how needed to write tenders and guidelines. Such know-how reduces the information asymmetry between the public and private sector thus reducing the risk of regulatory capture. Note that this requires a good connection between various public sector organizations, in this case Elaad and municipalities. Also note that the heavy initial involvement of public sector organizations at the initial stage of the rollout did lead to problems later on relating to the maintenance of the first public charging points.

Use tenders in combination with sub-national governments as an effective innovation strategy

Public tenders and (large) municipalities played a key role in the rapid rollout of high-quality charging infrastructure in the Netherlands. The importance of tenders and municipal government for innovation are well documented (Chicot and Matt, 2018; Mukhtar-Langren et al., 2019). However, the way these two variables can interact has received little attention: Tenders for public charging infrastructure in the Netherlands were initially predominantly written by large metropolitan municipalities, at slightly different moments in times. Tenders used by one municipality were subsequently (informally) shared with other municipalities. E.g., the tender used by the municipality of Amsterdam was used as a starting point for the tender used by Rotterdam. This setup allowed best practices to be copied easily while also allowing sufficient space for experimentation and tailoring to local needs.

Let legislation follow innovation and use self-regulation in the early stages of innovation

In this case study (national) legislation followed innovation. The central government did not regulate requirements for charging infrastructure, e.g., with regard to safety and interoperability, but relied on self-regulation. It facilitated this self-regulation through, e.g., supporting research that generates guidelines and by creating networks. In addition to this, some municipalities also made following (certain) guidelines a requirement in their tenders for public charging infrastructure. As a result of this approach the Netherlands did not only avoid the costly, risky and time-consuming process of developing national regulation for a product that is still being developed, but it also succeeded in realizing full interoperability as the first country in the world. It seems that this approach of self-regulation and incorporating guidelines as tender requirements was successful for three reasons: First, self-regulation can be an especially effective policy instrument in the precompetitive or grow-market phase of the rollout of a new technology since in this phase firms still have an incentive to cooperate with one another: By working together firms can create a much larger market for the innovation (see also Stefanadis, 2003). It seems that policymakers made effective use of this window of opportunity for self-regulation. Second, by using guidelines as requirements in public tenders, firms were given an additional incentive to follow them while leaving sufficient space for experimentation. Third, because the public sector had experience with installing public charging infrastructure, it had sufficient knowledge to develop adequate standards.

Avoid resistance by rolling out transformative innovations in areas that have few incumbent industries

The presence of a certain industry within a country or region is often seen as a prerequisite for innovation in a sector within that area, in line with technological-push and market-pull models of innovation (Meissner and Kotsemir, 2016). Initially Dutch policy makers also saw the absence of an automobile industry as an obstacle for taking a leadership role in the EV industry (Squarewise, 2010). However, in hindsight the absence of a big automobile industry in the Netherlands can be seen as an advantage. The absence of a big automobile industry meant less resistance.

Cost effective innovation by focusing on (non-financial) TIS-functions and public-private cooperation

This case study confirms that the central government can stimulate innovation without direct subsidies and limited direct policies. It can do this by improving the technological innovation system surrounding a technology. By increasing demand (mainly through tax advantages for EVs), creating new networks (establishing the FET and public-private partnerships in the form of the Green Deal approach), and providing directionality (clearly committing to the electrification of road transport) the central government can achieve a lot while incurring little costs.

Organize compensation for first-mover disadvantages related to innovations in crucial infrastructure technologies with large network externalities

The Netherlands was a frontrunner in rolling out high quality public charging infrastructure. However, some of the experts currently (anno 2022) worry that the Netherlands will suffer additional costs as a frontrunner because of EU legislation that would require retrofitting Dutch public charging points. These worries are an example of a (potential) first-mover disadvantage, which creates a disincentive for innovation. This risk on a first-mover disadvantage is especially large for technologies relating to crucial infrastructure that also have large network externalities, such as public charging infrastructure. The need to regulate such technologies is great, because they provide crucial public goods, have strategic importance, and need to be useable across national boundaries. Furthermore, in the absence of regulation economies of scale and network effects will tend to favor the creation of an inefficient market with monopolistic or oligopolistic characteristics (i.e. a market with a single or only a few dominant firms). To stimulate innovation the EU could make policies that guarantee that firms or member states that suffer a first-mover disadvantage are compensated. Such policies would be especially effective for technologies that have a great risk of being regulated, such as crucial infrastructure technologies with strong network externalities.

Study widely adopted climate innovations as merit goods (rather than innovations)

This report analyzes the rollout of (semi) public charging infrastructure in the period beyond 2020, 11 years after the start of the rollout, still as an innovation. Using an innovation perspective is partly justified, since the further rollout will pose additional challenges that require innovative solutions, e.g., relating to the limited capacity of the electricity grid and SMART charging. However, because public charging infrastructure is already market ready and quite widely adopted, one might question if it still should be analyzed as an innovation. This is especially the case because themes that are not traditionally associated with innovation, such as the phasing out of other technologies and social fairness, are becoming increasingly important. Furthermore, policy instruments that are generally seen as effective in the early stages of innovation, such as tax cuts for EV drivers, are now threatening to substantially decrease government resources and thus necessitate the use of different policy instruments. In this phase, 2022 and beyond, it might be more interesting to study public charging infrastructure as a merit goods rather than an innovation. Studying later stages in the rollout of climate change innovations as merit goods has received very little attention in the academic literature.

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Annex

Annex A

Layout semi-structured interviews

1. *Introduction*
    a. Welcome
    b. Ask permission for recording the interview.
    c. Explain the research project, the interview and how the results of the interview will be used. The purpose of the interview is to investigate to what extent the policies of the Dutch central government contributed to (preemptively) removing obstacles for the roll out of public charging infrastructure in the period 2009-2020.
    d. Introduction of interviewers and interviewees.

2. *General questions*
    a. What is the current state of public charging infrastructure in the Netherlands?
    b. What obstacles have occurred during the roll out of public charging infrastructure in the 2009 – 2020 period?
    c. How did the central government contribute to solving these obstacles?
    d. What differences have there been in the roll out of public charging infrastructure in the Netherlands, compared to other countries?
    e. Were there any innovations related to public charging infrastructure that were not fully developed, even though they should have been?

3. *TIS-functions*

The invention of a new technology alone is often not enough to implement this new technology on a large scale. According to academic literature, the environment (or system) around a new invention must perform certain functions in order to allow the new technology to grow. Seven different functions are distinguished.

I will mention these functions. If you recall any obstacles relating to these functions, please share them.

1. A lack of resources like financing and human capital
2. Inappropriate or excessive laws or regulations

3. Resistance from society
4. A lack of common vision. For example, one actor wants to go one direction, while another actor wants to go a different direction.
5. A lack of knowledge. In other words, involved actors did not know what to do to solve a certain problem.
6. Flawed networks. In other words, people/actors did not know each other, or refused to share knowledge with each other.
7. The market for charging infrastructure was not functioning properly.

4. *Substitution effects/exnovation*
   Electric vehicles are seen as the replacement for vehicles using fossil fuels.
   a. Did the increase in the number of electric vehicles lead to a lower number of vehicles using fossil fuels?
   b. To what extent did public policy contribute to the replacement of fossil fuel vehicles by electric vehicles?

5. *Role of the EU*
   During 2009 – 2020, the EU has made policy that affects road-transport in the Netherlands. We are interested in the relation between European and Dutch public policy.
   a. Has the EU or European policy played a role in accelerating the roll out of public charging infrastructure in the Netherlands? European policy can for example include standards, policy ambitions, subsidies.
   b. Was the influence of the EU during the early phase (2009) different than the influence during a later phase (2020)?
   c. Did European policy contribute to removing obstacles for the roll out of public charging infrastructure in the Netherlands?
   d. Has Dutch public policy influenced European policy?

6. Closing
   a. Thank you for participating in this interview.
   b. Do you have any further questions or suggestions for us?
   c. Explain how the post-interview process will proceed.

Annex B

Timeline provided to interviewees (in Dutch)

	Jaar			
	2009	**2012**	**2015**	**2020**
Fase uitrol EVs	Proeftuinen	Opschalen	Verdere uitrol	Richting een volwassen markt
Aantal elektrische voertuigen[3]	Weinig	6.600	88.000	292.600
Aantal (semi)publieke laadpunten[4]	Zeer weinig	4.000	18.250	65.000
Belangrijke beleidsdocumenten	Mobiliteitsbeleid	Plan van Aanpak Elektrisch rijden in versnelling	Green Deal Openbaar toegankelijke elektrisch laadinfrastructuur en Green Deal Elektrisch Vervoer	Klimaat akkoord
Centrale ambities rijksoverheid	"Centrale ambitie van dit plan is om Nederland in de periode 2009–2011 tot gidsland en internationale proeftuin voor elektrisch rijden te maken."	"Het kabinet wil Nederland ontwikkelen tot een aantrekkelijke testlocatie voor elektrisch rijden, zodat Nederlandse bedrijven en kennisinstellingen optimaal kunnen profiteren van de economische kansen op dit gebied."	"Partijen hebben als ambitie dat in 2025 50% van de nieuw verkochte auto's een elektrische aandrijflijn en stekker heeft en dat minimaal 30% daarvan ... volledig elektrisch is. Voor 2020 is de ambitie dat 10% van de nieuw verkochte personenauto's een	Ons transport veroorzaakt een kwart van de uitstoot. Het streven is dat uiterlijk in 2030 alle nieuwe auto's emissieloos zijn.

[3] Op basis van *Elektrisch rijden (op)weg* van de Rijksdienst voor Ondernemend Nederland (2021). Betreft zowel hybride als volledig elektrische voertuigen
[4] Op basis van *Elektrisch rijden (op)weg* van de Rijksdienst voor Ondernemend Nederland (2021).

			elektrische aandrijflijn en stekker heeft.”	
Selectie van gebruikte beleidsinstrumenten	- Fiscale voordelen (bijtelling; MRB; BPM; VAMIL; MIA)[5] - Oprichting Formule E-Team - Organiseren en financieren proeftuinen EVs - Overheid fungeert als *launching customer*	- Fiscale voordelen (bijtelling; MRB; BPM; VAMIL; MIA) - Ontwikkelen marktmodel laad en betaaldienstverlening - Borgen voertuig veiligheid middels aanpassen regelgeving, incident management en opleiding. - Overheid fungeert als *lead customer* - Versterken samenwerking binnen EU en internationaal	- Fiscale voordelen (bijtelling; MRB; BPM; VAMIL; MIA) - Co-finacieren openbare laadinfrastructuur - Problemen omtrent wetgeving die inzet EVs belemmerd oplossen - Medeoprichter Nationaal Kennisplatform Laadinfrastructuur - Imago EVs bevorderen	- Fiscale voordelen (bijtelling; MRB; BPM; VAMIL; MIA) - Inzetten voor strengere EU emissienormen voertuigen - Duurzaamheid wagenpark bedrijven meenemen bij aanbestedingen. - Via regelgeving (omgevingswet en bouwbesluit) borgen van aanbod publieke laadpunten - Inzichtelijk maken prijsverschillen duurzame en niet duurzame voertuigen.

[5] Verlaagd inkomstenbelasting (IB) bijtelling; motorrijteugenbelasting (MRB); belasting personenauto’s en motorrijwielen (BPM); willekeurige afschrijving milieu-investering (VAMIL); milieu investeringsaftrek (MIA)

Annex C

Document: Mobiliteitsbeleid, BRIEF VAN DE MINISTERS VAN VERKEER EN WATERSTAAT EN VAN ECONOMISCHE ZAKEN, vergaderjaar 2008-2009

General remark: The document starts with discussing why the central government wants to stimulate EVs, what are obstacles for a large scale roll out of EVs and subsequently introduces a number of policy instruments. The policy document does not make a clear one on one connection between policy instruments and obstacles. The policy document is written from the perspective of stimulating the adaptation of electric vehicles rather than charging infrastructure. However, it does give us some clues on how to deal with charging infrastructure.

To summarise this document with regard to charging infrastructure:

It establishes that charging infrastructure is necessary for the roll out of EVs. However, it does not yet presents a vision on and barely any concrete plans for stimulating the roll out of charging infrastructure. It does acknowledges that the (central) government has a role to play in the roll out of charging infrastructure and observes that this roll out is closely related to implementing smart grids.

Evaluating TIS functions

Nr	Function	Function is referred to	Potential obstacle(s) is identified	*Adequate* government measures are taken to remove obstacle? If not, does the central government expect other actors to solve the obstacle?
1	Entrepreneurial activities	Yes, policy document mentions that electric driving long looked unfeasible. However, the government	Obstacles are mentioned below.	

		now sees entrepreneurial activities surrounding EVs and wants to facilitate them.[6][7]		
2	Knowledge development	Policy document mentions that it is unclear what sort of charging infrastructure is necessary.[8] It also mentions that a lot is unclear about the general degree in which EVs might become mainstream.[9] Stress on the electricity grid may become a problem in the future.	Knowledge gap relating to required charging infrastructure. Knowledge gap relating to smart charging.	Not immediately clear. Postponed to a later document.[10] Taskforce SMART Grids is formed
3	Creating new connections and required coordination mechanisms	Yes, policy document mentions that no single actor is able to make EVs a success and that there is need for an advisory body that includes actors from all sectors/industries that are necessary to make EVs a success.[11] In additional a Taskforce Smart	Policy documents acknowledges the need for coordination, break deadlocks, and stimulate exchange between representatives of	Creating of an official advisory board, called the Formulate E Team.[13]

[6] We zien in binnen- en buitenland veel initiatieven voor elektrisch personen- en goederenvervoer. Regelmatig wordt het kabinet benaderd door onder andere (samenwerkingsverbanden van) energiebedrijven, autofabrikanten en medeoverheden die met elektrische auto's aan de slag willen. Dat momentum wil het kabinet benutten door kansrijke marktinitiatieven te ondersteunen, om zo de marktintroductie van de elektrische auto te versnellen.
[7] Elektrisch rijden leek lange tijd onbereikbaar, maar het bedrijfsleven ziet nu perspectief ontstaan voor een interessante businesscase.
[8] Welke laadinfrastructuur is noodzakelijk? Daaromtrent zijn nu nog verschillende scenario's in debat, variërend van vooral snelladen (in 10 à 15 minuten) bij de gebruikelijke tankstations tot vooral langzaam laden.

[9] Bovenstaande belemmeringen en onzekerheden maken tot besluit dat de daadwerkelijke acceptatie van elektrische auto's door en daarmee de koopbereidheid van gebruikers – zowel particulier als zakelijk – op dit moment ongewis is.
[10] Het onder aanjaging en regie van het Formule E-team in Nederland introduceren van elektrische auto's borgt een gecoördineerde, maar bovenal ook gefaseerde programmatische aanpak, waarbij stap voor stap de juiste dingen op het juiste moment worden gedaan en zo lang mogelijk flexibiliteit wordt behouden.
[11] Niemand kan elektrisch rijden in zijn eentje tot een succes maken. Goed samenspel tussen partijen over meerdere jaren is noodzakelijk. Om dit samenspel in de komende jaren te sturen, patstellingen te doorbreken en de betrokkenheid en verantwoordelijkheid van alle partijen daarbij tot uitdrukking te brengen, neemt het kabinet het initiatief voor een nationaal Formule E-team

[13] Het oprichten van een Formule E-team, met een krachtige en gezaghebbende voorzitter en leden uit sectoren die onmisbaar zijn voor het succesvol introduceren en uitrollen van elektrisch rijden. De opdacht van het team is vooral het aanjagen van de marktontwikkeling en het wegnemen van belemmeringen.

		Grids is started to facilitate cooperation between actors involved in the electricity grid. Relating to charging infrastructure it mentions that it welcomes the initiatives that are being undertaken by municipalities (Amsterdam), grid operators and NS/prorail. It mentions that coordinating the initiatives is important.	different sectors and industries. It notes that coordinating the initiatives for charging infrastructure is important to assure that charging infrastructure is mutually compatible.[12] Smart grids	It is not mentioned how the first initiatives in realizing charging infrastructure will be coordinated. Taskforce Smart Grids will be founded.[14] The central government sees itself as having a 'regierol', especially with regard to bringing together the different actors concerned with large scale buying of (electric) vehicles.[15] It is unclear if this regierol and bringing together of actors really materialized.
4	Resource mobilization	Yes, policy document mentions that the electricity grid might need improvement to support large scale rollout of charging infrastructure.[16]	Yes, overload of electricity grid might become an obstacle *in the future*.	Taskforce Smart Grids will be founded.

[12] Afstemming van initiatieven [voor laadinfrastructur] is een aandachtspunt, onder andere om versnippering in (typen) oplaadpunten te voorkomen.

[14] Het kabinet start daarom (in nauwe verbindingmet Europese activiteiten) een Taskforce Smart Grids, waarin overheid, toezichthouders, onderzoekers, netwerkbedrijven, klanten en infraindustrie zijn vertegenwoordigd.

[15] Het rijk vervult een regierol op het vlak van het bij elkaar brengen van de juiste partijen. In het bijzonder betreft dit het bevorderen van de totstandkoming en het faciliteren van inkoopconsortia voor de aanschaf van elektrische voertuigen onder gunstige voorwaarden.

[16] De energievoorziening is een aandachtspunt. Er ligt zowel randvoorwaardelijk als inhoudelijk een relatie met intelligente netten. Bij grote aantallen elektrische auto's moet het tijdstip van opladen geregeld worden. Want als alle voertuigen tegelijkertijd worden opgeladen ontstaat er een piek in de vraag naar elektriciteit die, zeker overdag, de beschikbare capaciteit te boven gaat. De beheerste ingroei van elektrische auto's in het wagenpark maakt overigens dat de benodigde tijd voor de ontwikkeling beschikbaar is. ... Het kabinet neemt het initiatief tot een samenwerkingsverband waarin netbeheerders, onderzoeksinstellingen, de NMa en de overheid participeren.

5	Market formation	Yes, insufficient supply of (public) charging infrastructure because of a bad business case.[17] Note that this obstacle is not explicitely mentioned in the document. The government also stimulates the demand for public charging infrastructure by increasing EV adoption.[18]	The government will give tax incentives for public charging infrastructure.	The central government stimulates the construction of charging points through fiscal stimuli.[19] The government will stimulate EV adaptation through, among other, fiscal stimuli.[20] In additional it will guarantee a level playing field for companies and other firms that want to enter the EV market.[21]
6	Directionality	The policy document acknowledges the importance of realizing a certain 'basic charging infrastructure'	The government acknowledges that much is uncertain around EV adaptation and charging infrastructure and thus strives towards a programmatic approach.	The government strives towards a programmatic approach that is attunted to the different phases in introducing a

[17] Het rijk stimuleert de aanleg van de voor elektrische voertuigen noodzakelijke (laad- en energie)infrastructuur, inclusief de benodigde aanpassing van de bestaande elektriciteitsinfrastructuur.

[18] De businesscase van elektrische auto's wordt gekenmerkt door een relatief hoge aanschafprijs vanwege de accu (kosten ongeveer € 8 000 à € 10 000 bij grootschalige productie) en relatief lage variabele kosten doordat stroom verhoudingsgewijs goedkoop is en elektrische auto's minder onderhoud vergen.

[19] Vanaf dit jaar zijn voorts de investeringen in openbare oplaadpunten voor voertuigen, ter stimulering van de aanleg van de voor elektrische auto's noodzakelijke infrastructuur, in de VAMIL en de MIA ondergebracht. De investeringsaftrekpercentages voor elektrische voertuigen en oplaadpunten worden nog dit jaar opgehoogd naar het maximum toelaatbare niveau binnen het staatssteunkader

[20] Op fiscaal gebied is er een uitgebreid palet aan stimuleringsmaatregelen waar de elektrische auto van profiteert. Verder zal het rijk werken aan duidelijkheid over de behandeling van de elektrische auto in het systeem van kilometerbeprijzing.

[21] Het stimuleren van marktwerking en het creëren en bewaken van een levelplaying field voor bestaande bedrijven en toetreders zijn hieraan gekoppeld.

		in the short term but postpones a real vision on it to later.[22],[23] Electric driving is seen as important to reduce our dependency on fossil fuels, strengthen the Dutch economy, reduce co2 emissions and improve the living environment.[24] However, alternatives to EVs are explicitly taken into consideration.[25]		new innovation in a market.[26] It also aims to stay flexible and remain open to alternative technologies (see note nr. 20).

[22] Welke laadinfrastructuur is noodzakelijk? Daaromtrent zijn nu nog verschillende scenario's in debat ... . Overigens laat het voorgaande onverlet dat er binnen afzienbare termijn een zekere basis laadinfrastructuur moet worden aangelegd om elektrisch rijden mogelijk en aantrekkelijk te maken.

[23] Het kabinet acht de tijd voor het formuleren van een kwantitatieve ambitie voor elektrische auto's in 2020 pas echt rijp, als de fase van de proeftuinen rond 2011/2012 is afgerond en er mede op grond daarvan beter zicht is op de daadwerkelijke perspectieven van elektrisch rijden en de mate waarin de belemmeringen en onzekerheden concreet kunnen worden opgelost.

[24] Elektrisch rijden helpt enerzijds bij het verminderen van onze afhankelijkheid van eindige voorraden fossiele brandstoffen en olieproducerende landen; Elektrisch rijden kan onze economie versterken en is gunstig voor het vestigingsklimaat, onze internationale concurrentiepositie en de werkgelegenheid. Een groeiende markt voor elektrische auto's is derhalve een instrument bij het bestrijden van de economische crisis; **Klimaat**: Elektrisch rijden draagt bij aan het bereiken van de CO2 kabinetsdoelstellingen voor de verkeerssector in het kader van Schoon en Zuinig1 en de Innovatieagenda Energie2.; **Luchtkwaliteit**: Auto's die elektrisch rijden stoten geen luchtverontreinigende stoffen uit zoals fijn stof en Nox. ; **Geluid**: Elektrische auto's zijn stil en helpen zodoende de leefbaarheid van ons land vergroten, wetende dat geluidhinder thans nog op tal van plaatsen aan de orde is in Nederland

[25] Dit plan gaat over elektrische auto's, maar we verliezen andere perspectiefrijke ontwikkelingen nadrukkelijk niet uit het oog. Dit betreft andere vormen van elektrisch vervoer, zoals de huidige opmars van de elektrische scooter en elektrische fiets. Deze helpen het pad effenen voor (de acceptatie van) elektrische auto's. Dit betreft voorts rijden op waterstof en rijden op biogas en hogere blends biobrandstoffen.

[26] Het onder aanjaging en regie van het Formule E-team in Nederland introduceren van elektrische auto's borgt een gecoördineerde, maar bovenal ook gefaseerde programmatische aanpak, waarbij stap voor stap de juiste dingen op het juiste moment worden gedaan en zo lang mogelijk flexibiliteit wordt behouden. De kansen van elektrisch rijden zijn te groot om er onvoorzichtig en ondoordacht mee om te gaan en ons te vroeg vast te leggen op zaken die nu nog onzeker en in de nabije toekomst wellicht achterhaald zijn. Anderzijds zal op essentiële onderdelen voldoende richting moeten worden gegeven om de markt aanknopingspunten te geven voor investeringen en productontwikkeling. ... Gekoppeld aan vier voorziene marktontwikkelingsfasen in de periode van 2009 tot na 2020, voorziet het kabinet vier programmastadia: Dit plan van aanpak markeert, samenhangend met initiatieven en andere plannen uit de samenleving, de start van de programma-opbouw.

7	(un)suitability of institutions	Resistance is foreseen because of uncertainty[27]. "Als de overheid financieel bijdraagt aan de totstandkoming van laadpunten, zal worden gestreefd naar de voorwaarde dat deze worden voorzien van groene stroom contracten."	Fundamental uncertainty.	Many government actions are aimed at establishing a proof of concept.[28]
8	Phasing out/exnovation	Not mentioned.		

[27] Voor grootschalige marktintroductie van elektrische auto's zal nog een aantal (in elkaar grijpende) belemmeringen en onzekerheden moeten worden overwonnen. Consumenten zullen de keuze voor al of niet elektrisch rijden niet alleen van het kostenplaatje laten afhangen. Autorijden is ook emotie. Daarom is brede acceptatie van elektrisch rijden van belang. Daarbij zal op termijn de beschikbaarheid van een breed aanbod van aantrekkelijke modellen een noodzakelijke voorwaarde zijn.

[28] De projecten zullen vooral gericht zijn op een «proof of concept» voor elektrisch rijden via: ... Bewijzen en demonstreren: onderbouwing leveren voor de bruikbaarheid van elektrische auto's in de dagelijkse praktijk bij verschillende inzetprofielen, waaronder bijvoorbeeld de stadsdistributie

Annex D

Document: Elektrisch Rijden in de versnelling, Plan van Aanpak 2011-2015

General remark and summary of this document with regard to charging infrastructure: This document is an outline of the policy plan of the central government for 2011-2015, in the context of electric transport. The government assumes the roles of 'enabler' and troubleshooter. The main goal of the policy plan is to create the conditions that are required for a successful scaling-up of electric transport in the Netherlands. The plan lists various regions that will be the focus of policy efforts. These are the so-called 'focus areas' (Dutch: 'focusgebieden'). Furthermore, the plan aims to intensify efforts to introduce EV's to promising market segments. Finally, the plan aims to improve the overall earning potential of the Dutch EV-sector. With respect to charging infrastructure, the plan additionally also strives for standardization and improved international cooperation.

Evaluating TIS functions

Nr	Function	Function is referred to	Potential obstacle(s) is identified	*Adequate* government measures are taken to remove obstacle? If not, does the central government expect other actors to solve the obstacle?
1	Entrepreneurial activities	Yes, document acknowledges importance of innovative businesses[29]. Document also sees opportunity to create a	The absence of innovativeness would damage the international position of the Netherlands, and result in the import of less EV's[31].	Document assumes that the developed market model will guarantee innovation[32].

[29] (p4) Gezamenlijke overheidsactiviteit voor elektrisch rijden, snelle uitrol van infrastructuur en een innovatief bedrijfsleven ondersteund door kennisinstellingen en de overheid blijft essentieel.
[31] (p4) Dit speelveld verandert voortdurend en fabrikanten van elektrische voertuigen zullen in de komende jaren overtuigd moeten blijven van de interessante concurrentiepositie van Nederland, anders worden de nog steeds schaarse voertuigen eerst aan andere landen geleverd en zal de doelstelling van een grootschalige internationale proeftuin niet worden gehaald.
[32] (p13, Ontwikkeling marktmodel) [Met het ontwikkelde marktmodel uit bijlage 2] wordt concurrentie en innovatie geborgd.

		'testing ground' for innovation in the Netherlands.[30]		Furthermore, the document wants to encourage innovation in charging technology through existing (EU) programmes[33]
2	Knowledge development	The knowledge position of businesses in the Netherlands is considered to be strong[34].	'Policy knowledge' is required so that municipalities can efficiently implement charging points[35], and that the central government can effectively direct policy efforts[36].	Standard procedures for municipalities will be developed[37]. Government aims to draw lessons from the designated 'testing grounds'[38]. Government aims to improve European R&D cooperation, one of the ways this will be accomplished is through the development of the Strategic Transport-technology Plan (STTP)[39].
3	Creating new connections and required coordination mechanisms	Yes.	Cooperation between market players, government, and other parties is required, so that the electric transport sector may assume a 'firmer' place in	Together with stakeholders, the government will set up at least 5 action programmes, in order to allow the scaling up of the EV market[42].

[30] De opschaling van elektrisch vervoer geeft Nederland een interessante kans om als proeftuin voor innovaties een sterke concurrentiepositie in te nemen.
[33] (p13) Stimuleren van kansrijke innovatieve laadtechnieken (zoals snelladen, battery swapping en inductieladen) via bestaande (EU-)programma's
[34] (p9) De Nederlandse industrie heeft een goede positie opgebouwd op het gebied van batterijmanagement, laadmogelijkheden en decentrale elektrische aandrijving. De kennisbasis op het gebied van snelladers, vermogenselektronica en elektriciteitsnetten is zeer sterk.
[35] (p13, stichting E-laad) Voordat een gemeente besluit om een laadpunt te realiseren is een besluitvormingstraject binnen de gemeente nodig. Om dit proces voor gemeenten te stroomlijnen en te voorkomen dat gemeenten hier stuk voor stuk veel werk in moeten steken…
[36] (p15) Bestuurskundig onderzoek [is van belang]: hoe kan de overheid haar inzet het beste organiseren?
[37] (p13) … zullen in samenwerking met de VNG standaardprocedures ontwikkeld worden voor het besluitvormingsproces van oplaadpunten.
[38] (p15) Ook is het borgen van leerervaringen uit proeftuinen belangrijk. Het rendement van proeftuinen hangt namelijk af van de mate waarin er lering getrokken wordt uit de ervaringen in verschillende demonstraties, en deze lessen uitgewisseld worden, zodat nieuwe projecten/partijen er optimaal gebruik van kunnen maken.
[39] (p16, Versterking van de samenwerking in EU-verband) [Nederland zet zich de komende vier jaar in voor] Het stimuleren van innovatie door betere samenwerking op het gebied van R&D. De komende periode staan het 8e Kaderprogramma en de ontwikkeling van het Strategisch Vervoerstechnologieplan (STTP) centraal dat verschillende R&D initiatieven op EU-niveau efficiënter samen moet brengen.
[42] (p8, Actiepunten) Samen met de direct betrokken stakeholders tenminste 5 actieprogramma´s afsluiten om de opschaling in de kansrijke marktsegmenten - distributie, zakelijke markt, collectief vervoer, bedrijfsvoertuigen en overheid - te realiseren.

			the Dutch market[40]. Dutch businesses have also expressed the wish for further intra-sector cooperation[41].	Subsidies of €26 million are present that businesses can use for (international) cooperation[43]. Any experiences/lessons drawn from the 'focus areas' will be distributed by the government so that other areas may learn from it as well[44]. The Dutch government aims to join various EU-projects, including: Electromobility+, CARS 21, and Green E-motion. These projects all involve European cooperation on EV-issues[45]. The government also aims to intensify the bilateral exchange of knowledge and best practices[46].
4	Resource mobilization	Yes, both financial resources as well as personnel requirements.	The document states that financial support may be required for high-risk innovation projects[47].	The government is developing an 'innovation fund', aimed at improving the accessibility of credit for innovative projects. This includes innovations for charging infrastructure[49]. Another measure taken to improve credit

[40] (p3) De markt voor elektrisch rijden bevindt zich zeker tot 2015 nog in een prille en kwetsbare positie. Door een slimme samenwerking tussen marktpartijen, kennisinstellingen en overheid kan elektrisch vervoer een steviger plaats in de markt innemen.
[41] (p10) Bedrijven in het elektrisch vervoer hebben zoals aangegeven behoefte aan meer onderlinge samenwerking bijvoorbeeld om tot een technologisch platform en proof of concepts te komen als show case naar OEM's en voor een sterke positionering van de Nederlandse industrie.
[43] (p11) Ook is het mogelijk met subsidie een verkenning naar (internationale) samenwerking te doen. Het budget bedraagt in 2011 € 26 miljoen en wordt via twee tenders toegekend. De eerstvolgende tender is op 1 november 2011.
[44] (p7, Kennisdeling naar de rest van Nederland) De rijksoverheid zal de projecten in de focusgebieden volgen, zodat belemmeringen geanalyseerd kunnen worden en waar nodig tot acties zullen leiden. Deze ervaringen uit de focusgebieden worden gebundeld en breed verspreid onder de andere gebieden.
[45] (p16, Versterking van de samenwerking in EU-verband) [Nederland zet zich de komende vier jaar in voor:] Aansluiting zoeken bij relevante EU-projecten en initiatieven zoals: […]
[46] (p17, Kennis en best practice uitwisseling) De komende periode zullen kennisoverdracht en best practice uitwisseling worden geïntensiveerd via bilaterale bezoeken en uitwisseling in EU en IEA-verband.
[47] (p10, Financiering innovatieve bedrijven) Kansrijke innovatieprojecten met een hoog risicoprofiel o.a. op het gebied van elektrisch vervoer hebben soms ondersteuning nodig bij de financiering.
[49] (p10, Financiering innovatieve bedrijven) Onderdeel van het nieuwe bedrijfslevenbeleid is de ontwikkeling van een Innovatiefonds waarmee succesvolle innovaties zich terugbetalen en middelen weer ter beschikking komen om nieuwe initiatieven te financieren. […] Met innovatiekredieten, borgstellingen aan financiële intermediairs en participaties in investeringsfondsen verbetert dit Innovatiefonds de toegang tot kapitaal voor bedrijven die investeren in vernieuwingen.

			The document also acknowledges the structural need for skilled technicians[48].	accessibility, is the further promoting of the Dutch market among foreign investors, especially towards investors from China and the USA[50]. The government will notify stakeholders about relevant EU-subsidies[51]. In order to improve the supply of human capital, the government encourages vocational schools to specialize in the relevant technical studies. Cooperations between schools and businesses are also seen as a way to improve the quality and quantity of outgoing students[52].
5	Market formation	Yes[53]. The intent is expressed to help develop the market for electric	The document sees the absence of a market model and business case as an obstacle to public charging	The government has developed a model for the market structure of charging infrastructure[57]. The further development of this structure is left to the market parties,

Overheid en bedrijfsleven zullen voor de financiering van nieuwe koplopers-, HTAS-, infrastructuur en dienstenprojecten samen optrekken waar mogelijk op basis van de bestaande proeftuinen, consortia en clusters.

[48] (p11, Verbetering aansluiting onderwijs-arbeidsmarkt) De sector heeft, net als diverse andere industriële sectoren, een structurele behoefte aan goed geschoold technisch personeel.

[50] (p11, Benutting economische diplomatie) De economische kansen van Nederland worden versterkt door […] het uitdragen van het gunstige vestigingsklimaat voor buitenlandse investeringen (hoofdkantoren, samenwerkingsprojecten, productielocaties) met name vanuit wereldkoplopers zoals China en de VS. […] Het Formule E-team heeft in november 2010 geïnvesteerd in de contacten met China. In samenwerking met NFIA, TWA's, ambassades, bedrijfsleven en kennisinstellingen worden contacten met landen als China, VS, Zuid-Korea en Japan, de komende tijd verder aangehaald.

[51] (p16) Extra aandacht verdient eveneens het actief benutten van EU-subsidies en relevante fondsen. Informatie over Europese mogelijkheden wordt actief verspreid onder de partijen.

[52] Binnen het beroepsonderwijs worden instellingen uitgedaagd zich meer te specialiseren door middel van Centers of Excellence en Centra voor Innovatief Vakmanschap. Begin 2011 heeft het kabinet het voorstel van het Automotive Centre of Expertise (ACE) gehonoreerd. Hogeschool Arnhem-Nijmegen en Fontys gaan samen met het bedrijfsleven de kwaliteit en kwantiteit van de uitstromende studenten verbeteren en inzetten op open innovatie, ondernemerschap en kennisvalorisatie om samen met bedrijven duurzaam nieuwe kennis te ontwikkelen en toe te passen. Ook het centrum voor innovatief vakmanschap op de HighTech Automotive Campus in Helmond, waar samen met bedrijven het MBO wordt versterkt, wordt ondersteund.

[53] (p4) Met name op het gebied van marktvorming kan het Rijk faciliterend en kaderstellend een bijdrage leveren. Dat rechtvaardigt een stevige inzet de komende jaren.

[57] (p13, Ontwikkeling marktmodel) Op initiatief van het Rijk is een model ontwikkeld van hoe de marktstructuur van laden en betalen er uiteindelijk uit zou moeten komen te zien. Dit model wordt toegelicht in bijlage 2.

		transport on national, provincial, and municipal level[54].	infrastructure[55]. A 'healthy' market is seen as a requirement for the implementation of electric transport[56].	while the government aims to maintain a supervisory and facilitating role[58]. In the 'focus areas', the government will cooperate with partners, in order to identify relevant local parties and to market EV's[59]. The government is also working on making agreements on the interoperability of charging infrastructure[60]. A number of fiscal policies is implemented/continued, in order to support the demand for electric vehicles[61]. The 'Sustainable Government Operations' (DBR) programme includes the installations of charging points at all buildings operated by the central government[62].

[54] (p11, Bevordering marktontwikkeling) De overheid helpt om de markt voor elektrisch vervoer tot ontwikkeling te brengen zowel nationaal, provinciaal als op gemeentelijk niveau.
[55] (p3) Er bestaan nog belemmeringen m.b.t. ondermeer : a. de ontwikkeling van de laadinfrastructuur, het ontbreken van een marktmodel en een business case voor publieke laadpunten en innovatieve laadvormen;
[56] (p12, 5.2) Beide, de beschikbaarheid van de laadinfrastructuur èn een gezonde markt van laden en betalen, zijn randvoorwaardelijk voor het succesvol opschalen van elektrisch vervoer.
[58] De marktpartijen zullen gezamenlijk de markt verder opzetten en aangeven hoe en op welke termijn zij naar dit eindbeeld toewerken. Het Rijk zal hier toezicht op houden en het proces faciliteren.
[59] (p6) Het rijk gaat met elk van de [focus-]gebieden in gesprek over de waaier van activiteiten. Samen met de partners wordt geïdentificeerd welke lokale partijen een actieve rol kunnen en moeten spelen, welke marktsegmenten van belang zijn en wat de potentie van opschaling daarvan is, wat de noodzakelijke infrastructuur is en op welke wijze die wordt uitgerold, hoe EV zichtbaar gemaakt kan worden bij kansrijke doelgroepen en hoe het verdienpotentieel in de regio gestimuleerd kan worden.
[60] (p13) Afspraken over interoperabiliteit zijn een voorbeeld van een issue met hoge prioriteit. Dit gefaseerde proces zal naar verwachting op 1 januari 2013 afgerond kunnen worden.
[61] Page 12, Fiscale maatregelen
[62] (p15, Overheid als lead customer) Binnen de Rijksoverheid bestaat reeds een aantal concrete initiatieven. Het Programma Duurzame Bedrijfsvoering Rijk (DBR), bijvoorbeeld, ondersteunt elektrisch rijden door het mee te nemen in de verduurzaming van de bedrijfsvoering van de rijksoverheid. Eén van de activiteiten is de aanleg van oplaadpunten voor elektrische voertuigen bij, in principe, alle gebouwen van het Rijk.

6	Directionality	Yes[63].	No obstacle is explicitly mentioned, although the need to express ambition is implied (see column to the right).	The document underlines the ambition of the government to reach 200,000 EV's by 2020[64]. The government plans to come together with relevant actors, in order to: express the ambitions for 2015; find out what obstacles are present; identify which party is responsible for which task; find out what kind of government support is desired[65][66]. In the context of EU-policy, the Dutch government strives for the standardization of charging infrastructure[67], as well as the lowering of CO2-norms for cars[68]. Both of these measures can be seen as providing directionality to relevant market players.

[63] (p10, Samenwerking stimuleren) Met een gezamenlijke visie en een duidelijk plan van aanpak kunnen acties gezamenlijk en gecoördineerd worden uitgevoerd. Het kabinet geeft deze samenwerking van overheid, bedrijfsleven en kenniswereld een centrale plaats in het bedrijfslevenbeleid en dus ook in dit plan van aanpak.
[64] Wil elektrisch vervoer daadwerkelijk van betekenis kunnen zijn, is grootschalige inzet nodig. In 2020 zou het reeds kunnen gaan om ca 200.000 elektrische auto's, in 2025 om een volwassen markt van ca 1 miljoen auto´s. In dit plan van aanpak wordt dit aantal als stip aan de horizon vastgehouden
[65] (p6) Per [focus]gebied willen we een concrete afspraak maken, waarin de samenwerkende partijen vastleggen wat de ambitie is voor 2015 (in elk geval in soorten en aantallen voertuigen en in aantal laadpunten), wie waarvoor verantwoordelijk is, wat wanneer geleverd wordt, wie welke inbreng/bijdrage levert (mensen en middelen), en welke ondersteuning door het rijk noodzakelijk en gewenst is.
[66] (p8) Net zoals bij de focusgebieden willen we per kansrijk marktsegment samen met de belangrijkste partijen [c]oncrete afspraken maken, waarin de samenwerkende partijen vastleggen wat de ambitie is voor 2015 in aantallen voertuigen, welke belemmeringen weggenomen moeten worden wie waarvoor verantwoordelijk is, wat wanneer geleverd wordt, wie welke inbreng/bijdrage levert (mensen en middelen), en welke ondersteuning door het rijk noodzakelijk en gewenst is.
[67] (p16, Versterking samenwerking in EU-verband) Nederland zet zich de komende vier jaar in voor: Standaardisatie van laadinfrastructuur (stekker, communicatieprotocollen, betalingssystemen etc). De CEN Cenelec streeft ernaar om eind 2011 de lopende discussie rondom standaardisatie en de oplevering van een gezamenlijke EU-standaard af te ronden.
[68] (p16) Het Europese bronbeleid in de vorm van CO2-normen voor auto's en bestelwagens, omdat dit een belangrijke drijvende kracht is voor nul-emissie voertuigen aan de aanbodzijde van de markt. Door aanscherping van de huidige norm voor auto's (130 g/km) in 2015 naar 95 g/km in 2020 ontstaat door de combinatie met een boetesysteem een toenemende prikkel voor autofabrikanten om lage of nul-CO2-emissie voertuigen in hun aanbod op te nemen en op de Europese markt te verkopen. Dit wordt versterkt als de 2020-norm in 2025 verder kan worden aangescherpt, naar bijvoorbeeld 70 g/km.

7	(un)suitability of institutions	The importance of public acceptance is mentioned[69], although this is not explicitly related to the acceptance of charging infrastructure.	The document underlines the importance of communication and the management of expectations towards consumers and the public[70].	Communication towards consumers and the general public will be mostly done by parties in the Formule-E Team. The role of the central government is therefore limited[71].
8	Phasing out/exnovation	No.	N/A	N/A

[69] (p16, Grensoverschrijdende samenwerking) Dit zal bijdragen aan het draagvlak bij de consument, wat noodzakelijk is bij een grootschalige uitrol van elektrisch vervoer.
[70] (p17, Communicatiestrategie) Communicatie is cruciaal in de opschaling van elektrisch rijden, net als het daarbij behorende verwachtingenmanagement bij specifieke doelgroepen en het grote publiek. Het ontsluiten van betrouwbare en objectieve informatie over de actuele en toekomstige gebruiksmogelijkheden van elektrisch rijden is van belang om verwachtingen te managen, doelstellingen te halen en onnodige teleurstellingen te voorkomen.
[71] De stakeholders en partners uit het Formule E-Team spelen een belangrijke rol en zorgen voor een goede informatieoverdracht naar hun achterban. […] Communicatie via de stakeholders en de partners uit het Formule E-Team […] zal zo veel mogelijk lopen via hun eigen kanalen.

Annex E

Document: Green deal toegankelijkheid publieke laadinfrastructuur & Green deal elektrisch vervoer 2016-2020

General remark and summary of this document with regard to charging infrastructure: This document takes the form of a deal between the central government, decentral governments and various foundations (i.e. non-government organisations). It connects specific aims relating to public charging infrastructure to actions of one or more of the organisations that have signed this deal. This actions mainly relate to research, cost reductions (through subsidies but also research) and reducing red tape. One year later another Green Deal was signed for Electric Vehicles. With regard to charging infrastructure it includes plans to increase public awareness and public support for EVs (and charging infrastructure), to have certain organizations work together and coordinate activities, and to do research together.

Evaluating TIS functions

Nr	Function	Function is referred to	Potential obstacle(s) is identified	*Adequate* government measures are taken to remove obstacle? If not, does the central government expect other actors to solve the obstacle?
1	Entrepreneurial activities	Yes, policy document acknowledges that main goal is to remove obstacles for (profitable) commercial	Main obstacle is related to business case of charging infrastructure. (See previous footnote) It also acknowledges that to do so experiments are needed with different forms of entrepreneurship.[73]	Yes, see below.

[73] Partijen onderkennen dat de markt voor laadinfrastructuur nog volop in ontwikkeling is en dat ook andere organisaties het initiatief willen nemen voor plaatsing van laadpalen in de (semi)publieke ruimte, zoals werkgevers en autoleveranciers. Partijen willen daarom voldoende ruimte laten om te experimenteren met andere vormen van initiatiefnemerschap voor aanleg en exploitatie van infrastructuur teneinde de business cases te optimaliseren waarbij de algemene doelstellingen van deze Green Deal leidend blijven.

		exploitation of charging infrastructure.[72]		
2	Knowledge development	Yes, document states that by research costs of charging infrastructure can be reduced.[74]	Lack of knowledge may lead to higher costs of charging infrastructure (see previous note). More research is necessary about SMART charging.[75]	Create 'pre-competitive' research organization with as main aim to reduce the costs of charging infrastructure (NKL).[76] The 'pre-competitive' knowledge generated by this organization is freely available to everyone.[77] This organization is only partly organized by the central government. Various living labs are organized.[78] Note that this research is only (very) partly financed by the central government.

[72] Partijen willen met deze Green Deal ... de belemmeringen voor openbaar toegankelijke elektrische laadinfrastructuur wegnemen, waardoor rendabele commerciële exploitatie van laadinfrastructuur na deze periode mogelijk wordt.
[74] openbaar toegankelijke elektrische laadpunten op de (zeer) korte termijn nog niet rendabel te exploiteren zijn, en dat door bevordering van onderzoek en ontwikkeling (...) een rendabele business case mogelijk wordt
[75] Onderzoeken SMART laden: NBNL, ElaadNL, EN en DOET onderzoeken hoe slim laden ofwel het gecoördineerd laden van elektrische auto's de totstandkoming van rendabele openbaar toegankelijke elektrische laadinfrastructuur kan bevorderen.
[76] Partijen hebben de ambitie en verwachting dat met behulp van een kennisplatform ... voor openbaar toegankelijke elektrische laadinfrastructuur de aanleg- en exploitatiekosten per laadpaal substantieel kunnen worden verlaagd. ... Het doel van dit kennisplatform is in een periode van drie jaar te bereiken dat publiek laden zoveel goedkoper wordt dat er sprake is van een sluitende business case. ... Partijen werken in het kader van het Nationaal Kennisplatform Laadinfrastructuur (NKL) samen aan precompetitief onderzoek, gericht op het realiseren van een positieve businesscase voor de laadinfrastructuur en gericht op het bundelen, verrijken en verspreiden van wetenschappelijk onderzoek op dit terrein.
[77] De kennis die wordt opgedaan in het NKL is vrij toegankelijk
[78] Netbeheer Nederland en haar leden zetten zich actief in voor een aantal Living Labs en in het bijzonder het initiatief om een Living Lab Slim laden te vormen.; VNG zal via haar leden deelnemen aan verschillende Living Labs. ; etc.

				Research on SMART charging is organized.[79] Note that this research is only (very) partly financed by the central government.
3	Creating new connections and required coordination mechanisms	Yes, lack of cooperation (and knowledge sharing) leads to higher costs.[80] Note that these Green Deals are in its core also a measure to increase cooperation and coordination.[81]	On various different areas potential for better cooperation is identified, such as SMART charging[82], charging infrastructure in general[83], between decentralized governments and others[84]. Not always sufficiently clear exactly how this increased cooperation is realized. Generally, it is done through working groups or coordination groups.	Improving cooperation through mainly working groups, coordinator groups and through a new organization (NKL). See previous notes. Data sharing is a part of this.[85]. Note that these Green Deals themselves are also an instrument to increase cooperation.[86]
4	Resource mobilization	Yes, lack of money to fund charging infrastructure	Yes, lack of money to fund charging infrastructure	The central government allows for a subsidy given to decentral governments to finance charging infrastructure.[87]

[79] Onderzoeken SMART laden: NBNL, ElaadNL, EN en DOET onderzoeken hoe slim laden ofwel het gecoördineerd laden van elektrische auto's de totstandkoming van rendabele openbaar toegankelijke elektrische laadinfrastructuur kan bevorderen.
[80] Among others: Bevordering en versterken van de onderlinge samenwerking van Partijen door middel van een kennisplatform.
[81] Green Deals bieden bedrijven, burgers en organisaties een laagdrempelige mogelijkheid om samen met de overheid te werken aan groene groei.
[82] Bevordering en versterken van onderlinge samenwerking tussen netbeheerders, energieleveranciers en laadpuntexploitanten op het terrein van slim laden (smart charging).
[83] Bevordering en versterken van de onderlinge samenwerking van Partijen door middel van een kennisplatform.
[84] VNG trekt samen met Netbeheer Nederland de werkgroep Laadinfrastructuur en stelt een plan van aanpak hiervoor op.
[85] Zij delen data over het slim laden op basis van beschikbare duurzame elektriciteit en stellen kennis over de economische haalbaarheid en de klantacceptatie op het gebied van laadinfrastructuur ter beschikking.
[86] Green Deals bieden bedrijven, burgers en organisaties een laagdrempelige mogelijkheid om samen met de overheid te werken aan groene groei.
[87] De Rijksoverheid maakt het na inwerkingtreding van deze Green Deal mogelijk dat mede-overheden via een transparante procedure om een eenmalige financiële bijdrage in de kosten van de realisatie van openbaar toegankelijke elektrische laadinfrastructuur kunnen verzoeken. De Rijksoverheid is bereid in de jaren 2015 t/m 2018 hiervoor in totaal maximaal € 5,7 mln. beschikbaar te stellen.

5	Market formation	Yes, insufficient supply of charging infrastructure due to high costs.[88] Note that an insufficient demand for charging infrastructure is not really mentioned in these Green Deals. However, by stimulating EV adaptation additional demand for charging is generated.	See previous.	Central aim of all measures is to reduce costs of public charging infrastructure and through this increase the supply of charging infrastructure.[89]
6	Directionality	Yes	Common reference points are established.	The Green Deals establish common points of departure for all involved, e.g., with respect to aims.[90] For some specific actions additional reference points are established.[91]
7	(un)suitability of institutions	Yes, both in terms of red tape[92] and a lack of public awareness and/or support for EVs.[93]	Excessive red tape and lack of public awareness and/or support for EVs.	The central government will make an effort to reduce red tape.[95] Several more specific laws are mentioned the stifle

[88] Partijen zetten zich door middel van deze Green Deal in voor de totstandkoming van voornoemd innovatief op kostenreductie gerichte stimuleringsprogramma en van een financieringsstructuur voor de uitrol van openbaar toegankelijke elektrische laadinfrastructuur.
[89] Partijen zetten zich door middel van deze Green Deal in voor de totstandkoming van voornoemd innovatief op kostenreductie gerichte stimuleringsprogramma en van een financieringsstructuur voor de uitrol van openbaar toegankelijke elektrische laadinfrastructuur
[90] Partijen willen met deze Green Deal in samenwerking met en in het FET gedurende een periode van drie jaar, ingaande op de dag van inwerkingtreding van deze deal, de belemmeringen voor openbaar toegankelijke elektrische laadinfrastructuur wegnemen, waardoor rendabele commerciële exploitatie van laadinfrastructuur na deze periode mogelijk wordt.
[91] Partijen onderschrijven het model van aanleg en exploitatie van openbare toegankelijke elektrische laadinfrastructuur dat in 2012 door NBNL, DOET, EN en Rijksoverheid gezamenlijk is ontwikkeld1, en zetten zich ervoor in dit model met ingang van 1 juli 2018 zonder verdere ondersteuning en marktconform te laten functioneren.
[92] zich inspannen om al in 2016 belemmerende wet- en regelgeving die aan de EV transitie in de weg staan, te inventariseren en oplossingen in procedure te zetten;
[93] de communicatie en het imago van EV bevorderen, mede op basis van het werkplan opgesteld door werkgroep Communicatie;
[95] zich inspannen om al in 2016 belemmerende wet- en regelgeving die aan de EV transitie in de weg staan, te inventariseren en oplossingen in procedure te zetten;

		An additional item is that there were no clear rules on how to deal with maintenance and exploitation of the initially (in first phase) placed public charging points.[94]	No rules on how to deal with maintenance and exploitation of the charging points placed in the first phase.	innovation, including naming organization that will make proposals on how to change these laws.[96] Various organizations pledge to increase awareness and support for EVs. A specially working group is founded to coordinate these efforts[97] Some new rules are being thought of on how to deal with maintenance and exploitation of first charging points.[98]
8	Phasing out/exnovation	No		

With regard to evaluation and policy flexibility:

Partijen zullen jaarlijks over de uitvoering en werking van deze Green Deal rapporteren aan de Stuurgroep binnen het FET.

Begin 2017 zal een tussenevaluatie worden opgesteld door het FET; Medio 2018 zal door het FET een eindevaluatie worden verricht en een verslag daarvan worden opgemaakt.

Partijen spreken de wens uit om de afgesproken activiteiten te volgen op hun voortgang met als doel om tussentijds te kunnen bijsturen indien noodzakelijk. Daarbij zal de in opdracht van IenM ontwikkelde

[94] Er dient een oplossing te worden gevonden voor de financiering van de exploitatie van de tot dusver door E-laad geplaatste laadpalen ('installed base').
[96] NBNL doet nader onderbouwde voorstellen voor aanpassing van de Elektriciteitswet 1998, de ministeriële regeling Tariefstructuren en Voorwaarden en/of de Tarievencode Elektriciteit teneinde differentiatie in aansluit- en transporttarieven mogelijk te maken. ; NBNL en marktpartijen zullen in overleg met de Minister van Economische Zaken de mogelijkheden verkennen voor een aparte aansluitcategorie voor laadpunten in de daarvoor relevante wet- en regelgeving. ; NBNL doet een voorstel aan de ACM voor aanpassing van de Netcode Elektriciteit met betrekking tot de overstroombeveiliging.
[97] de communicatie en het imago van EV bevorderen, mede op basis van het werkplan opgesteld door werkgroep Communicatie ; Partijen werken mee aan de gezamenlijke interne en externe communicatie op het gebied van EV in Nederland met als doel de gehele markt te inspireren. ; ANWB is trekker van de werkgroep Consumentenmarkt en ANWB participeert in de werkgroep Communicatie.
[98] Er dient een oplossing te worden gevonden voor de financiering van de exploitatie van de tot dusver door E-laad geplaatste laadpalen ('installed base').

monitoringsmethode voor de duurzame brandstofvisie worden gebruikt en toegepast.

Annex F

Document: Klimaatakkoord 2020-2030

General remark and summary of this document with regard to charging infrastructure: The Dutch 'Climate Accord' contains many measures from a variety of organizations with the aim to reduce Co2 emissions in 2030 by 49% when compared to 1990. The actions taken by the central government are (also) described in the *Klimaat plan* [Climate Plan]. The main measures for charging infrastructure are centered among stimulating lagging municipalities to start placing charging infrastructure. For this purpose the NAL is founded which facilitates cooperation, research and to some extent cooperation.

Evaluating TIS functions

Nr	Function	Function is referred to	Potential obstacle(s) is identified	*Adequate* government measures are taken to remove obstacle? If not, does the central government expect other actors to solve the obstacle?
1	Entrepreneurial activities			
2	Knowledge development	Yes	Some research is needed to make charging infrastructure resilient to future developments[99]	The innovation requests from the NAL are taken up in the innovation agenda for mobility.[100]

[99] Het toekomstbestendig maken van laadinfrastructuur door in te zetten op innovatie.

[100] De innovatieopgaven die voortkomen uit de Nationale Agenda Laadinfrastructuur op te nemen in de Kennis en Innovatie Agenda Mobiliteit.

3	Creating new connections and required coordination mechanisms	Yes	To achieve a national covering of charging infrastructure various organizations, mainly municipalities, need to better coordinate their activities.[101] More cooperation and knowledge sharing are needed with regard to basic information about charging infrastructure, including smart charging.[102]	A new organization is founded to facilitate the coordination and integration of activities surrounding the roll out of charging infrastructure.[103] Establish a national access point for uploading (basic) data on charging infrastructure.[104] To improve smart charging a special task group is formed.[105]

[101] Gemeenten, Provincies, Rijksoverheid, netbeheerders, bedrijfsleven en brancheorganisaties hebben gezamenlijk een Nationale Agenda Laadinfrastructuur opgesteld. De afspraken in deze agenda leiden tot een landelijke dekking van (snel)laadpunten en voorzien in de laadbehoefte van het groeiende aantal elektrische voertuigen. De uitvoering van de Nationale Agenda Laadinfrastructuur zal met provincies en gemeenten worden vertaald in regionale mobiliteitsplannen, waarin opgenomen de lokale behoeften voor laadinfra.

[102] Het verbeteren van de informatievoorziening over de locatie en beschikbaarheid van laadpunten, laadprijstransparantie, gebruik van open protocollen in de laadketen en een open laadmarkt.

[103] Samenwerkingsregio's in te richten en te versterken. De samenwerkingsregio's zorgen samen met gemeenten voor de uitrol van laadinfrastructuur in de regio. De samenwerkingsregio's ondersteunen gemeenten bij het opstellen en uitvoeren van een integrale visie en beleid.; In gebieden waar nog geen passende governance structuur is, wordt deze ontwikkeld. Samenwerking van overheden in deze regionale programma's is cruciaal (en equivalent aan de Regionale Energiestrategieën (RES).; Afspraken over laadinfrastructuur en (de voorbereiding op) de uitrol van laadinfrastructuur te borgen in de Regionale Energiestrategie (RES), de omgevingsvisie en het omgevingsplan.; Gemeenten en regio's te ondersteunen met handreikingen en tools.

[104] De inrichting van een nationaal toegangspunt voor data over laadpunten, waarmee *service providers* en laadpaalexploitanten uiterlijk 1 augustus 2019 hun statische en dynamische basisinformatie over alle (semi-)publiek toegankelijke laadpunten uitwisselen. Het betreft o.a. basisinformatie over de locatie en de beschikbaarheid van de laadpunten en de prijzen van het laden.

[105] Samen te werken aan de ontwikkeling en internationale adaptatie en standaardisatie van open protocollen, waaronder protocollen voor *smart charging* en de integratie van EV's met het bredere energiesysteem en de gebouwde omgeving. Uiterlijk 1 augustus 2019 wordt een werkgroep protocollen en open markt opgericht om dit aan te jagen.

4	Resource mobilization	Yes	Lack of human resources to install charging infrastructure. Lack of financial resources to fund the NAL. A lack of grid capacity to charge electric cars.	Assisting in providing technical training to work with EVs and install charging infrastructure.[106] The central and decentralized government will estimate the expected costs of the NAL and agree on its funding.[107] Try to better manage grid capacity through SMART charging.[108]
5	Market formation	Yes	Consumers have insufficient information about price of charging EVs (in comparison to carbon fueled cars).	Participate in a consortium to develop a methodology to compare prices.[109]

[106] Partijen (BOVAG en RAI Vereniging) zorgen in samenwerking met de Rijksoverheid dat eind 2019 universele technische trainingen voor het kunnen en mogen werken aan elektrische voertuigen en hoogspanning beschikbaar zijn voor derden en dat ze gebaseerd zijn op de normen NEN 9140 Veilig werken aan e-voertuigen, NEN 3140 'Bedrijfsvoering van elektrische installaties, Branchenorm Veilig werken aan Elektrische voertuigen (EV) en Hybride elektrische voertuigen (HEV) in garagewerkplaatsen.

[107] Daarnaast is mogelijk ondersteuning nodig voor innovaties, procesbegeleiding, monitoring en evaluatie. De komende twee maanden zal daarom samen met de ondertekenaars van de Nationale Agenda Laadinfrastructuur in kaart gebracht worden wat de uitvoeringskosten zijn voor de implementatie van de agenda. Volgens de decentrale overheden zijn volgens een eerste inschatting circa 5 miljoen euro aan uitvoeringskosten per jaar gemoeid met de Nationale Agenda Laadinfrastructuur.

[108] Het inzetten van *smart charging* om te zorgen voor een stabiel elektriciteitsnetwerk waarin optimaal gebruik gemaakt kan worden van hernieuwbare energie en de voordelen daarvan voor EV-rijders.

[109] Partijen (Laad- en tankinfrastructuur partijen en (alternatieve) brandstofleveranciers) komen in samenwerking met de Rijksoverheid tot een invulling van het Nederlandse plan voor de Europese verordening over de methode voor informatievoorziening aan de consument over onderlinge prijsverschillen tussen fossiele en verschillende alternatieve brandstoffen. De Rijksoverheid neemt hiertoe in het kader van de *Program Support Action (PSA) on Price Comparison* van de Europese Commissie deel aan een consortium met acht andere Europese lidstaten om nadere uitwerking te geven aan de toepassing van de nieuwe Europese methodologie voor prijsvergelijking. De toepassing van deze methodologie voor prijsvergelijking (per eenheid) bij tankstations wordt medio 2020 verplicht voor alle Europese lidstaten, voortvloeiend uit de Europese richtlijn infrastructuur alternatieve brandstoffen.

6	Directionality	Yes	Increasing direction by formulating clear missions.	Missions are formulated on charging infrastructure, which should include 1.8 charging points in 2030 and charging should be as easy as charging your phone.[110]
7	(un)suitability of institutions	Yes	Changing (national) legislation Putting additional requests on decentral legislation/tenders. Help developing EU legislation Make public charging points more visible through (trafic) signs. Increasing public awarness of EVs and charging points.	Adjusting legislation to allow for differentiated parking tariffs by municipalities.[111] Adjusting legislation to ensure a sufficient supply of charging points.[112] Municipalities are legially required to make plans relating to charging infrastructure.[113] Making agreements relating to tenders and protocols surrounding safety[114] and also open markets.[115]

[110] En de randvoorwaarden moeten op orde zijn: het laden van je elektrische auto moet even makkelijk zijn als opladen van je mobiele telefoon. ; Voor personenvervoer wordt een laadbehoefte voorzien van 1,8 miljoen (semi-)publieke en private laadpunten in 2030.

[111] De Rijksoverheid dient in 2019 het wetsvoorstel in om per 1 januari 2021 of zoveel eerder als mogelijk gedifferentieerde parkeertarieven wettelijk mogelijk maken. De gemeenten zullen in hun parkeerbeleid een afweging maken over het inzetten daarvan in combinatie met andere maatregelen om het effect hiervan zo groot mogelijk te maken.
[112] De Rijksoverheid zal via de instrumenten van de Omgevingswet (bijvoorbeeld via normering) en eventueel het bouwbesluit zekerheid bieden over voldoende aanbod van publieke laadpunten in gemeenten en de snelheid van realisatie daarvan.
[113] In regio's en gemeenten eind 2020 plaatsingsbeleid inclusief uitrolplanning voor publieke laadinfrastructuur vast te stellen. Het plaatsingsbeleid wordt elke twee jaar geactualiseerd.
[114] Naast de afspraken over het rijkswegennet (zie de Nationale Agenda Laadinfrastructuur, bijlage op www.klimaatakkoord.nl) spreken de Rijksoverheid, het Interprovinciaal Overleg (IPO)/de Vereniging van Nederlandse Gemeenten (VNG) en leveranciers van energiedragers voor vervoer ook voor het onderliggende wegennet af om in de concessieverlening op tankstations de tank- en laadinfrastructuur voor duurzame energiedragers voor vervoer te versnellen. Met betrokken partijen, decentrale overheden en het NEN maakt de Rijksoverheid de benodigde aanpassingen op het gebied van veiligheid. Partijen zorgen voor een heldere en eenduidige informatievoorziening naar de consument voor alle hernieuwbare brandstoffen op en rond het wegennet en bij publiektoegankelijke tank- en laadinfrastructuur conform vereisten uit de AFID-richtlijn.
[115] Ten behoeve van een open en competitieve markt van laaddiensten, altijd in contracten voor aanleg en exploitatie van laadpunten afspraken vast te leggen over interoperabiliteit, het toelaten van klanten van andere providers op de laadpalen en toepassing van neutrale en open protocollen.

				Make a traffic sign to signal public charging points along highways.[116] Help in (potentially) developing EU legislation through leading an EU project on charging point information sharing.[117] Helping to organize public information campaigns.[118]
8	Phasing out/exnovation	Yes	Try to increase speed of phasing out carbon cars on the EU level. Prepare for the decrease in government revenues caused by a smaller taxbase on carbon cars.	Lobby on EU level for more stringent regulation for phasing out carbon cars.[119] Make plans to reform the car-tax.[120]

[116] Vóór de zomer van 2019 te komen tot één effectief, goed in te passen pictogram voor alternatieve brandstoffen op borden langs de (snel)weg, dat voldoende duidelijk is voor rijders van elektrische voertuigen.
[117] De Rijksoverheid stelt capaciteit ter beschikking voor het trekkerschap van het EU-project18 dat gericht is op het verbeteren, harmoniseren en ontsluiten van informatie over de locatie en de beschikbaarheid van laadpunten en de prijzen van laden voor elektrisch vervoer. In datzelfde project wordt gewerkt aan unieke identificatiecodes voor laadpalen en laadcontracten, gericht op soepele internationale betalingen. Het project zal mogelijk resulteren in Europese regelgeving in de komende jaren.
[118] Partijen (de leden van het Formule E–Team) starten in 2019, naast de eigen communicatie, een centrale campagne over de mogelijkheden, voordelen van en ervaringen met elektrisch rijden gericht op de juiste doelgroep(en) en met gerichte boodschap(pen) die (voor)oordelen van elektrisch rijden onder de aandacht moeten brengen.
[119] Nederland werkt intensief samen met andere landen om elektrisch vervoer te stimuleren (bijvoorbeeld in het kader van het *Electric Vehicle Initiative* (CEM – EVI) en het internationale partnerschap voor e-mobiliteit). Ook zoekt Nederland afstemming over Europese normeringen zoals bijvoorbeeld de aanscherping van Europese CO2-normering voor personen- en bestelauto's en zwaar vrachtvervoer. Als gevolg van EU-regelgeving kan Nederland niet zelfstandig CO2-normen opleggen. Als een voertuig in een EU-lidstaat een typegoedkeuring heeft verkregen, dan mag dit voertuig in de hele EU verkocht worden, dus ook in Nederland. ; Partijen (Rijksoverheid en Formule E-Team17) spreken af dat de Rijksoverheid de inzet voor stringentere EU-normen onverminderd doorzet en samen met koploperlanden optrekt om elektrisch vervoer te stimuleren en maatregelen daarover af te stemmen. Dit is in lijn met het streven van het kabinet om vanaf 2030 alleen nog emissieloze personenauto's te verkopen.
[120] Het huidige systeem van autobelastingen bestaat uit een mix van belasten van bezit en belasten naar gebruik van fossiele brandstoffen via de accijnsheffing. Elektrisch rijden raakt steeds verder ingeburgerd. Mede daarom is op termijn een andere vormgeving van de autobelastingen noodzakelijk.

About the project

4i-TRACTION – innovation, investment, infrastructure and sector integration:
TRAnsformative policies for a ClimaTe-neutral European UnION

To achieve climate neutrality by 2050, EU policy will have to be reoriented – from incremental towards structural change. As expressed in the European Green Deal, the challenge is to initiate the necessary transformation to climate neutrality in the coming years, while enhancing competitiveness, productivity, employment.

To mobilise the creative, financial and political resources, the EU also needs a governance framework that facilitates cross-sectoral policy integration and that allows citizens, public and private stakeholders to participate in the process and to own the results. The 4i-TRACTION project analyses how this can be done.

Project partners

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