An international perspective on electric transportation

Survey on electric road transport 2012

Marcel Weeda **(ECN)**
Pieter Kroon **(ECN)**
Dick Appels **(Agentschap NL)**

September 2012
ECN-E--12-043

Acknowledgement

This study has been carried out by order of the Dutch Ministry of Economic Affairs, Agriculture and Innovation (EL&I). NL Agency collected the data used for this research from representatives in EU countries and members of the IEA IA-HEV network. At ECN this project has been registered under project number 5.1664.

A word of thanks goes to EL&I in the person of Foppe de Haan for his critical guidance. A word of thanks also goes to Maarten Van Leeuwen (NL Agency) for his assistance in collecting the quantitative information.

This summary has been condensed into the following points for use by interested foreign parties:

- The analysis of the Dutch situation compared to other countries has been omitted from the text: each reader will then be able to make an analysis relevant to his/her situation.
- The parts of the texts on the Dutch potential for revenue have been left out
- The conclusions, which primarily concern the Dutch market position compared to other countries, have been left out.
- The list of references, which was almost entirely in the Dutch language, has been left out.

Despite these changes we believe that the report also contains information of interest to the foreign reader. The researchers owe many thanks to the numerous professional contacts in their networks who worked without reward on the collection of the data.

Abstract

To compare the Dutch governmental efforts and developments in the field of electric road transport, the Ministry of Economic Affairs, Agriculture and Innovation has asked ECN Policy Studies and NL Agency to conduct an international assessment on electric mobility. The countries that have been considered are: Austria, Belgium, Denmark, France, Germany, the Netherlands, Norway, Portugal, Spain, UK, China, USA and South Korea.

The Netherlands has a high ambition level with regard to the number of electric vehicles and is one of the leaders as for the envisaged number of charging points. In the field of R&D, Germany, South Korea and China take the lead, followed by France, the UK, the USA and Austria. However, the assessment has only looked at specific funds for electric mobility, and has not looked at general R&D and innovation funds. The Netherlands has several electro-mobility field tests, but is not leading in number. Norway and Austria are leading countries when it comes to implementation of public charging infrastructure.

Contents

Summary

At the start of 2012 the Ministry of Economic Affairs, Agriculture and Innovation asked ECN Policy Studies and NL Agency to carry out an international assessment of electric mobility. This was a follow-up to the international comparison published in 2010 as part of the plan of action for electric transport 2011-2015, 'Elektrisch Rijden in de Versnelling' ('Electric road transport is Moving into the Fast Lane'). Based on literature this plan makes a first international comparison between the Netherlands and some ten other countries setting the trend in the field of electric road transport. Ambitions regarding the number of vehicles and the charging infrastructure are examined; international cooperation/interesting projects and the government's set of instruments. This second assessment again covers the same points but two years later. What has now been realised in the various countries as regards both vehicles and charging infrastructure is also examined.

This report is mainly based on data collected by NL Agency. It was opted to gather data from experts in the various countries to be as up to date as possible. This did not, however, always result in easily comparable overviews. The quantitative part is mainly based on on-going monitoring research by NL Agency into electric road transport in the EU. The qualitative part is primarily derived from the Hybrid Electric Vehicle Implementing Agreement network of the International Energy Agency (IEA IA-HEV).

The countries examined in this second assessment are: Belgium, Denmark, Germany, France, the Netherlands, Norway, Austria, Portugal, Spain, United Kingdom, China, United States and South Korea.

From the assessment it appears that as regards ambitions for the number of vehicles, the Netherlands is mid-table but has more ambition than France and Germany, both countries with their own large car industry. As for the charging infrastructure, the Netherlands is among the leaders. To realise these ambitions there is a full package of measures to stimulate the penetration of electric vehicles. There are, however, countries such as Norway and Denmark where the total financial incentive is larger than in the Netherlands.

For innovation the pace is being set by countries such as Germany, China and South Korea, although in the last two countries the actual penetration appears to lag behind. France, the United Kingdom, the United States and Austria follow. As regards the stimulation of innovation (R&D, pilot projects, support for industry) together with Belgium, Denmark, Norway, Portugal and Spain, the Netherlands is in a modest position. It must be noted here that general R&D budgets and regular policy for stimulating R&D and innovation in trade and industry could not be included. However, some of this R&D budget is also used for electric transportation.

As for the realisation of the number of electric cars as of 1 January 2012, the Netherlands is among the leaders, leaving out Norway for the time-being. Relatively speaking, this country is the absolute front runner. The Netherlands is also among the leaders with regard to goods vehicles, including small delivery vans. Apart from the trolley buses in Arnhem, the Netherlands has five electric buses in use. To the extent that data are available, and with the exception of a project in China, other countries also have limited numbers of electric buses.

When it comes to charging points for electric cars, Norway and Austria have the largest numbers, relatively speaking, Austria having strikingly large numbers of rapid chargers and semi-rapid chargers. The Netherlands is doing well in the field of implementation of the charging infrastructure. Of the other countries in the study, the Netherlands is the best of the rest.

It appeared from the assessment that international statistics on the numbers of electric vehicles and charging points and traffic performance of EVs currently fall short. International data on innovation efforts (including policy, budgets) in the field of electric road transport and (estimates of) the economic significance of the sector are also still insufficiently available (including job opportunities). It is desirable to make arrangements on an international level to realise improvements here.

1

Introduction

The Ministry of Economic Affairs, Agriculture and Innovation has asked NL Agency and ECN Policy Studies to conduct an international assessment of electric road transport. This report contains the results of that assessment. This report not only looks at ambition and sets of instruments; realisations in various countries are also compared with each other.

This assessment consists of six components in which thirteen countries are compared with each other. After an explanation of the method and the collection of data in Chapter 2, Chapter 3 addresses the ambitions divided up into vehicles and charging infrastructure. Chapter 4 then covers the policy instruments in various countries. This is also divided into government instruments aimed at expanding electric vehicles and the charging infrastructure, and instruments aimed at stimulating innovation in electric road transport. Chapter 5 contains a survey of the realisation of electric driving in practice, examining both the number of vehicles and the realisation of the infrastructure. Chapter 6 looks at the opportunities that electric road transport offers in view of future economic development and job opportunities in the Netherlands. Recent accents with regard to the deployment of government instruments and special attention for young branches of industry and the SME can contribute to a more pronounced position for innovation in the field of electric road transport (for obvious reasons this chapter is not included in the English version). The last chapter, Chapter 7, contains the conclusions.

Electric road transport is being developed, and this also applies for statistics and comparability. The conclusions accordingly close with some recommendations for improving statistics and monitoring.

The electric road transport assessment concerns road traffic. Electric transportation is a wider concept and also includes electric sailing, for example

2

Method and accountability

This report contains the second assessment of electric road transport. The first is in the report "Electric road transport is Moving into the Fast Lane; Plan of Action for electric transport 2011-2015"

The first plan of action for electric road transport 2009-2011 has an annex on "an international perspective on electric transportation" in which the plan of action of Germany, France, Great Britain and the US is explained with a brief look at the situation in Denmark and China (Ministry of Transport, Public Works and Water Management/Ministry of Economic Affairs, 2009). The ambition to support market initiatives to accelerate the market introduction of the electric car is continued in the Plan of Action for electric road transport 2011-2015 'Elektrisch Rijden in de Versnelling' (Electric road transport is Moving into the Fast Lane'; EL&I, 2011a). Annex 2 of this plan includes a first international comparison between the Netherlands and ten other countries which are leaders in electric road transport. The basis is primarily to be found in a report from Squarewise (2010) and partly in a German publication (Neue Mobilität, 2011).

The comparison briefly describes the following ambitions and situations:

- Ambition for the number of vehicles
- Ambition for the charging infrastructure
- International cooperation/interesting projects
- Government instruments.

In view of the great dynamism in electric road transport and the fact that a large part of the data for the last comparison is already two years old, it was desirable to update the data and make another assessment. Realisation figures on the number of vehicles and the charging infrastructure are now included for the first time. In view of the speed of developments, for example the strong increase in sales of plug-in hybrid[1] cars in the first half of 2012, it is desirable to repeat this assessment over two years.

[1] A hybrid car has an electric motor, a battery pack and a combustion engine. Braking energy can be stored in the battery pack. The use of both motors can also be optimised so fuel consumption falls. With a plug-in hybrid the battery pack can also be charged using the electricity grid so the first tens of kilometres can be driven fully electrically. This is sufficient for most journeys. If a longer range is required, one can continue using the combustion engine.

Method

In this report the annexes include the same overviews as in the first international comparison. The four subjects mentioned are also included again. The method developed for this can also be used in the next studies, so changes and the time dimension are also clearer to see.

A useable comparison basis was sought for the comparison of the countries. With absolute numbers of cars or research budgets it matters for the relative effort whether it is a large or small country. The comparison basis must also have good availability and be unambiguous. In most cases it was therefore decided to divide the ambition or realisation by the number of passenger cars in the country concerned in a recent historical year (2010). It was decided to leave out growth expectations concerning the size the passenger car fleet, because this makes the method more complicated and introduces extra uncertain factors. For the government effort as regards development and research and pilot projects, it was particularly the government budget per year versus the GDP (gross domestic product) in 2010 that was an important factor in this comparison. Because aspects such as effectiveness of innovation to be realised, market focus and the contribution of trade and industry are not (yet) weighed here, this mainly results in an indicative scale. As regards the government instruments, the comparison can focus on vehicle level (financial incentive per passenger car).

Benchmark method: making situations of countries comparable by relating them to each other for aspects such as the number of passenger cars and the GDP in 2010

Data collection

This report is mainly based on data collected by NL Agency. The quantitative part is mainly based on on-going monitoring research by NL Agency into electric road transport in the EU. In this research, set out in the first quarter of 2012, all EU countries were asked for quantitative information on ambitions and realised numbers of electric vehicles and charging posts. The qualitative part was mainly collected through the IEA IA-HEV network[2] of NL Agency Contrary to the previous assessment, where only publications were used, it was now decided to collect the most recent information from country representatives.

It must be noted here that not all countries systematically collect figures on electric vehicles and charging points. And even if this is the case, the results will not always be comparable with other countries. In many countries the first market figures only become available after a delay of one or two quarters. And there is also a difference between 'sold' and 'supplied' figures.

As regards financial incentives for electric vehicles, versus the tax regime for petrol and diesel vehicles, there are complicated rules changing in time that are also rarely comparable. An example is additional tax liability in the Netherlands. This is well-known among vehicle suppliers, but difficult to communicate in survey forms to foreign parties. Furthermore, even for domestic experts in the field it is difficult to get a good picture of the current government budgets and the actual allocation and status of (all) pilot projects. Despite the approached contact persons in the various countries having done an excellent job to ensure good and fast data collection, some information will still be missing or incomplete due to a greatly simplified presentation of measures. The people

Data supplied through contact persons in the field in the various countries. Shortcomings are not excluded, however

[2] The Implementing Agreement for cooperation on Hybridand Electric Vehicle Technologies and Programmes; one of the networks of cooperation of the International Energy Agency.

who carried out this research have, as much as possible, checked the information collected on the basis of other sources. More extensive research would possibly result in small changes in the picture between countries, but it still remains just a snapshot. The extra effort to obtain more accuracy can be wasted after just a few months because of the dynamism in the field.

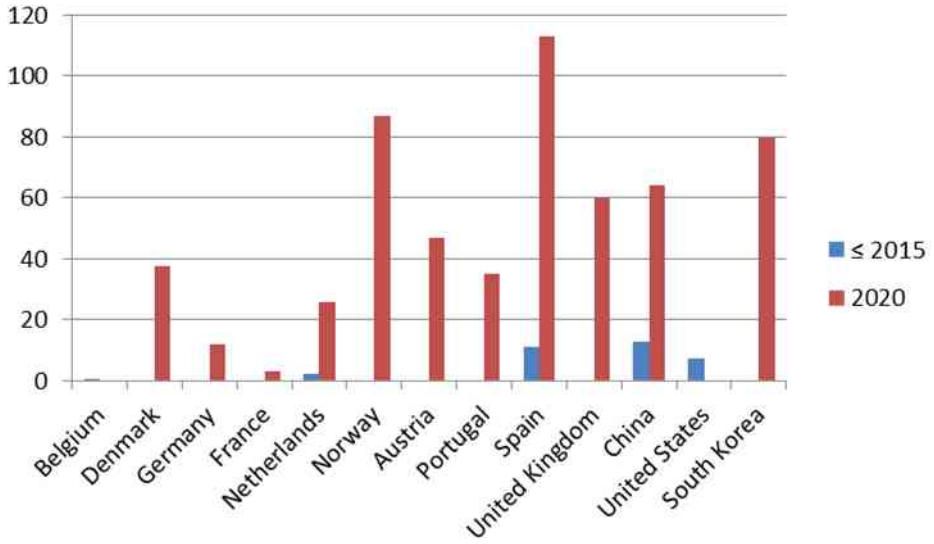
3

Ambitions compared

Figure 1 includes figures for ambitions with respect to electric road transport in the countries examined in this report. The figures involve ambitions for the number of vehicles on the road in a certain projection year. For the sake of mutual comparability, ambitions are benchmarked for the number of passenger cars in 2010.

The figures warrant a number of remarks. Figures for Belgium are absent. At the time of the survey, this country was still working on a master plan for electric vehicles. Neither are there any figures for Norway. This country has not formulated any objectives. This does not mean that Norway has no ambition, as will become evident in the chapters on policy measures (chapter 4) and realised vehicles and infrastructure (chapter 5). Contrary to all other countries, the ambition of Austria does not involve a number of cars, but a market share of electric cars in car sales. The ambition is a market share of 2.5% by 2020. The Austrian translation of this market share into vehicles on the road is used as the basis for the figure in the graph Germany, finally, is aiming for 1 million vehicles in 2020. Half of them, however, are fuel cell vehicles that form an integral part of electromobility in Germany, similar to the Netherlands. Fuel cell vehicles are left out in this report. The underlying figures for **Figure 1** are included in Annex A.

Figure 1: Ambition in numbers of vehicles in various countries per 1,000 passenger cars in 2010



Note: The objective for Belgium is still being prepared, Norway has not drawn up an objective

The ambition for charging infrastructure is usually the current situation with the plans for the following years

In the information from the various countries there is little on the long-term ambitions for charging infrastructure. This is generally the current number increased by the concrete plans that exist. The data are summarised in **Table 1**. There is barely mention of the year 2020 or later. Where this is the case, it often appears to be a direct derivative of the number of electric vehicles, and charging poles and charging points are mixed up[3].

Table 1: Ambition for the number of charging poles (or points) in the year mentioned

	≤ 2015	2020
Belgium		
Denmark	1,000	
Germany	2,000	
France		400,000
The Netherlands	10,400	
Norway	5,000	
Austria		
Portugal		25,000
Spain	10,500	
United Kingdom	9,700	
China	150,000	500,000
United States	22,000	
South Korea		2,200,000

Note: The ambition of China is 200,000 in 2016, and for comparability is counted down to 150,000 in 2015.

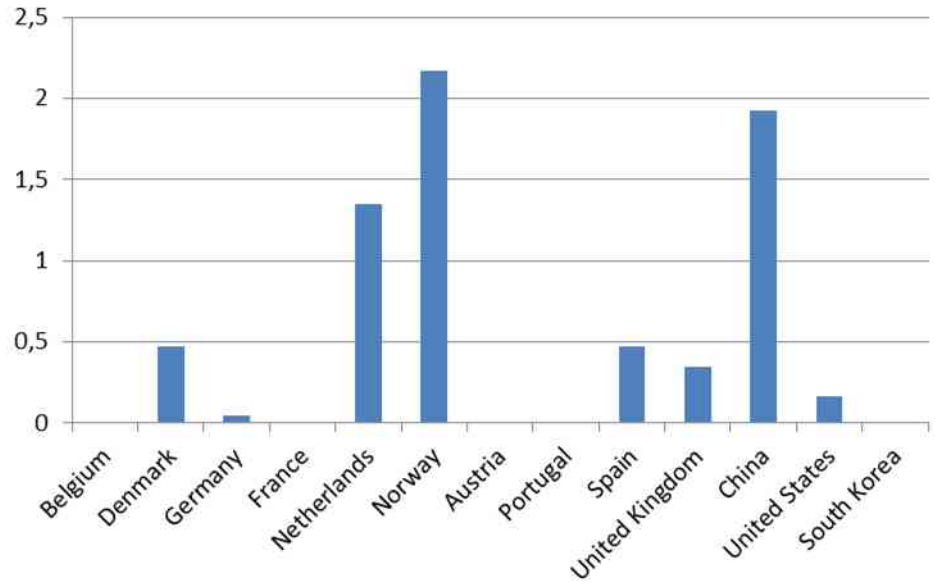
[3] With a charging infrastructure a distinction is generally made between locations (or places), poles (or posts or stations) and points (or connections). Multiple poles can exist at one location, for example a car park or underground car park. Each pole can have multiple charging points.

These also seem mixed up in the ambitions indicated. It is also not always clear if this concerns public and (semi-)public charging poles, or if private installations are also counted[4].

In **Figure 2** the figures are also graphically represented, and for comparability divided by the number of passenger cars in 2010. The figure does, however, provide little additional information relating to the ambition for the number of vehicles in **Figure 1**.

The long term ambition for charging posts offers little extra information in comparison with vehicle ambition

Figure 2: Ambition number of charging points in≤ 2015 per 1,000 passenger cars in2010



Note: Austria has no national objective, the objective for Belgium is not yet known, the Germany value is an estimate, some of the countries have a 2020 objective.

The data available for the year 2020 offers a reasonable basis for the comparison of ambitions for numbers of vehicles. Data for 2015 offer a better comparison basis for the charging infrastructure.

[4] Public and semi-public charging poles are accessible to all; free (alongside the road) or subject to payment (underground car park). Private installations are usually understood as home charging installations. Privately owned installations are poles "behind the gate" or in company car parks.

4

Policy instruments in various countries

This chapter compares the government policy of the various countries. The information used for this comparison was supplied by representatives in the various countries with extra details included in Annex B. The government policy can focus on the penetration of vehicles; more electric vehicles on the road. An infrastructure is accordingly required to realise this. The policy can also focus on research, development, pilot projects and support for the country's own car industry. This chapter makes a distinction between both groups.

The policy of the countries is partly aimed at vehicles, and partly at research, development and pilot projects

Instruments aimed at penetration

Table 2 shows a summary of relative values attached to policy measures as regards electric road transport in the various countries. Below the table it is explained how the scores were reached. It must be noted here that the scores are based on general information supplied about policy measures, such as exemption from purchase tax and a quick-scan for the translation of the measures into an amount in euros. For countries closely approaching a certain score it cannot be ruled out that the choice of other sources or the availability of more detailed information could have resulted in a higher or lower score. The score must therefore be seen as a general indication.

In **Table 2** the instruments aimed at penetration are looked at first of all. A distinction is made here between policy aimed at the purchase of an electric vehicle, policy aimed at recurring costs such as road tax or additional tax liability, and policy aimed at the charging infrastructure. Finally, there is a category of other measures.

It can generally be concluded that as regards stimulating the introduction and implementation of electric road transport, the Netherlands has a full policy package that stands comparison with other countries well. Norway, Denmark and the United Kingdom are in the lead.

Table 2: Government policy instruments/incentives aimed at penetration

Country	Purchase vehicle	Recurring costs	Realisation charging infrastructure	Other measures
Belgium	++	0	+	+
Denmark	+++	++	+	0
Germany	0	+	+	+
France	++	0	+	++
The Netherlands	++	+++	+	+
Norway	+++	++	+	+
Austria	++	++	+	+
Portugal	++	++	+	++
Spain	++	0	+	+
United Kingdom	++	++	+	+
China	+	0	+	0
United States	++	+	+	+
South Korea	+	0	+	+

Electric road transport is stimulated by the governments in all countries examined. This is usually done by making the purchase less expensive

Explanation of the table

In all cases "0" means that no or insufficient data has been supplied to assign a score.

The following ratings are used for the subjects "Vehicle purchase" and "Recurring costs". Here an estimation is made of the extent of benefits regarding recurring costs based on 4 years:

	Vehicle purchase	Recurring costs
+:	Incentive amount to €2,500	Benefit between < €500 and approx. €1,500
++:	Incentive amount in the order of €2,500 - €7,500	Benefit between < €500 and approx. €3,500
+++:	Incentive amount > €7,500	Benefit of approx. €1,000 to > €3,500

Realisation of charging infrastructure: Here there is no distinction between one or more "+"s. The quality of supplied data is insufficient to make a distinction. A score means that there are initiatives and/or measures to realise the charging infrastructure.

Other measures:

+: A score when a national initiative, programme or platform is created around electric road transport to stimulate the development of the option, or when there are further measures such as privileges with the use of lanes, free use of parking spaces and regulations to require the construction of a charging infrastructure at new buildings or public parking spaces

++: When both above-mentioned aspects are present.

Instruments for research, development and test equipment

Table 3 shows the assessment for research and development and for demonstrations, pilot projects and field tests. For some countries there is mention of direct support for companies, for example to finance a factory. A separate column has been added for this instrument. Below the table it is explained how the scores were reached.

Having a domestic car industry is a clear incentive for R&D support in a number of countries

Table 3: Government's set of instruments/incentives aimed at innovation/R&D

Country	Research and development (R&D)	Demonstrations Pilot projects Field tests	Development of industry
Belgium	+	+	0
Denmark	+	+	0
Germany	+++	++	0
France	++	++	+
The Netherlands	+	+	0
Norway	+	+	0
Austria	++	++	0
Portugal	+	+	0
Spain	+	+	0
United Kingdom	++	+	+
China	+++	++	+
United States	++	++	+
South Korea	+++	0	0

Explanation of the table

- The score for research and development is given based on data/estimates for the budget per year weighted by the GDP of a country.
- For demonstrations less clear information about annual budgets is available, but weighting is done based on the GDP. The score is simplified to the presence of field tests (+) and the presence of many and large field tests (++). For both, this is to the extent present in the information supplied by the country representatives.
- The "Development of industry" indicator is scored if data on support for the development of construction of production facilities for batteries and components for electric vehicles are available.

When it comes to innovation, Germany, China and South Korea take the lead. France, the United Kingdom, the United States and Austria follow. As for stimulating innovation (R&D, pilot projects, industry), the Netherlands, together with Belgium, Denmark, Norway, Portugal and Spain, scores more modestly.

New developments

Electric transportation is drawing great public interest and is a subject with great dynamism. Figures soon become obsolete, certainly now that the plug-in hybrid has made its entry on the market. There are also continuous changes in policy. An example of this is a recent decision in Germany to increase the budget for R&D from 0.5 billion to 1.5 billion. In addition, the "Model Regionen" testing phase has proceeded to a next "Schaufenster Regionen" phase. The number of regions is being reduced from eleven to four, but with intensification and scaling up taking place in each district. In France an order has been placed for more than 15,000 delivery vans. In the United Kingdom the budget for a purchase subsidy has been increased. BUS II has been launched in Spain, and in China the subsidy has been extended to cover private cars in five cities. Finally, in the Netherlands an extra effort is being made together with trade and industry to secure a good position in this growing market. A number of aspects of electric transportation enjoyed explicit attention in the Top Sector Policy introduced in 2011.

Conspicuous measures in other countries

The policy packages in the various countries for stimulating electric road transport are basically comparable. Similar to the Netherlands, most countries offer a tax exemption with the purchase of a car as well as a motorised vehicle tax exemption. Measures taken by one or a number of countries, but not included in the Dutch package are:

- The requirement to install a charging infrastructure in public parking spaces (imposed by local authorities) and in parking spaces for new buildings such as offices and blocks of flats.

The objective of local and national authorities to have electric vehicles form a distinct part of the annual renewal of the vehicle fleet.

5

Vehicles and realisation of infrastructure

Before the realisation figures are looked at, a comparison is first made with previously published figures. The realisation of a number of countries is shown in 2010 (EL&I, 2011b), see **Table 4**. For the sake of comparison, this table also mentions the figures that were recently collected for the situation on 1 January 2012. Both vehicles and charging points have almost doubled. Some of these countries are looked at in more detail in this chapter.

Table 4: Realisation figures for 2010 and figures as of 1 January 2012

Country	Number of e-vehicles 2010	Passenger cars 1 January 2012	Number of charging points 2010	Number of charging points 1 January 2012
Denmark	400	749	45	310
Finland	17	70	50	108
France	1,400	Approx. 4,000	178	4,568
Italy	2,700	3,100	670	228
The Netherlands	395	1,141	400	1,841
Norway	3,400	5,326	2,666	3,123
Austria	223	1,047	532	1,791
Total	8,353	Approx. 15,474	4,541	11,969

Note: The figures from France for 2010 appear to be on the low side because many older electric vehicles on the road there. In 2011 some 2,600 electric passenger cars were sold in France. For Austria, Finland, Italy and France information on the number of charging points is unavailable, and the calculation is based on an average of 1.8 charging points per charging location.

5.1 Realisation of electric vehicles

Table 5 includes the figures on the number of vehicles supplied by the various country representatives. For a number of countries the figures turned out too low or none were given, and as shown in the table below, figures collected by ECN were used. The problems with the collection of data included manufacturers of a vehicle type producing both an electric and a normal version (or a hybrid and a plug-in hybrid). The customary way in which sales figures are published (per vehicle type) then no longer gives insight in the number of electric vehicles. A dash in the table means there are no recent data for the country concerned. These figures have been translated into graphs, where in the graphs the number is related to the number of conventional vehicles.

Statistics not yet usable for monitoring electric vehicles

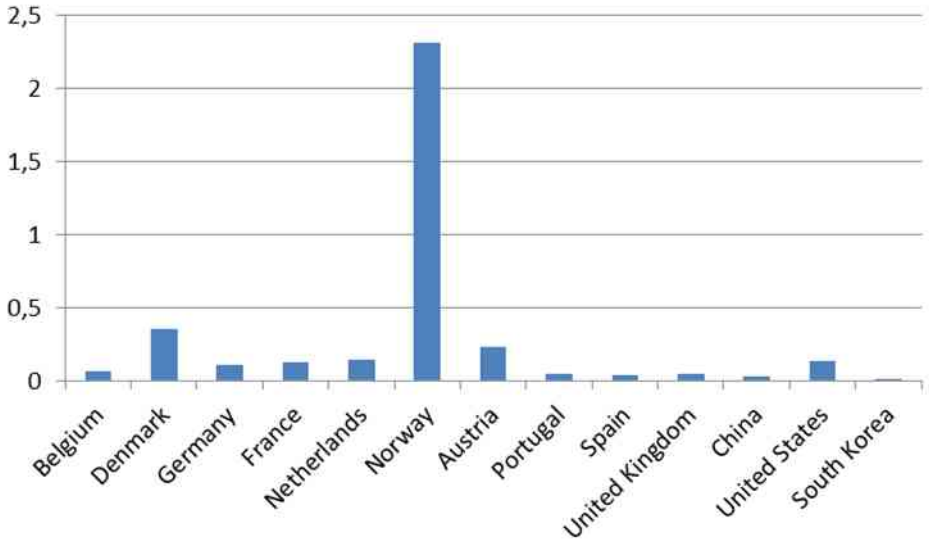
Table 5: Number of electric vehicles per country on 1 January 2012

	Passenger cars	Buses	Goods vehicles
Belgium	346	3	70
Denmark	749	11	106
Germany	4,541	-	338
France	> 4,000	-	1,566
The Netherlands	1,182	5	217
Norway	5,326	10	103
Austria	1,047	-	38
Portugal	250	22	13
Spain	753	6	459
United Kingdom	1,219	-	-
China	2,631	300	-
United States	18,076	5	3
South Korea	50	2	-

Note: The figures from Germany, France and United Kingdom have been adapted upwards by ECN. Figures for South Korea are for the year 2010; For China the figure for passenger cars includes delivery vans (NPE, 2012); Figures for buses in the US and Belgium are possibly incomplete. For goods vehicles in Germany, France and Austria sales figures from Eurostat for 2008-2010 are included because of the absence of figures supplied. A dash (-) means that there was no specific statement of figures and no supplementary figures were found either.

Figure 3 shows a summary of the relative number of passenger cars per country. Norway realises high scores here. Although good data for China and South Korea are lacking, there are no indications that strong growth has taken place there. Many older electric cars are probably missing for France.

Figure 3: Number of electric cars per 1000 passenger cars on 1 January 2012

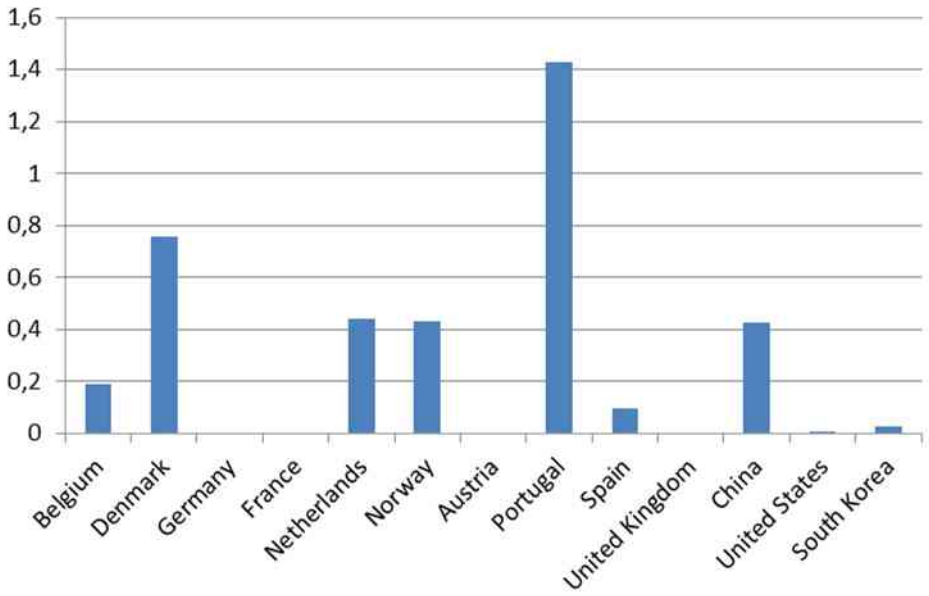


Note: Good data for France and South Korea are lacking.

Trolley buses are used in many countries. These are not included here

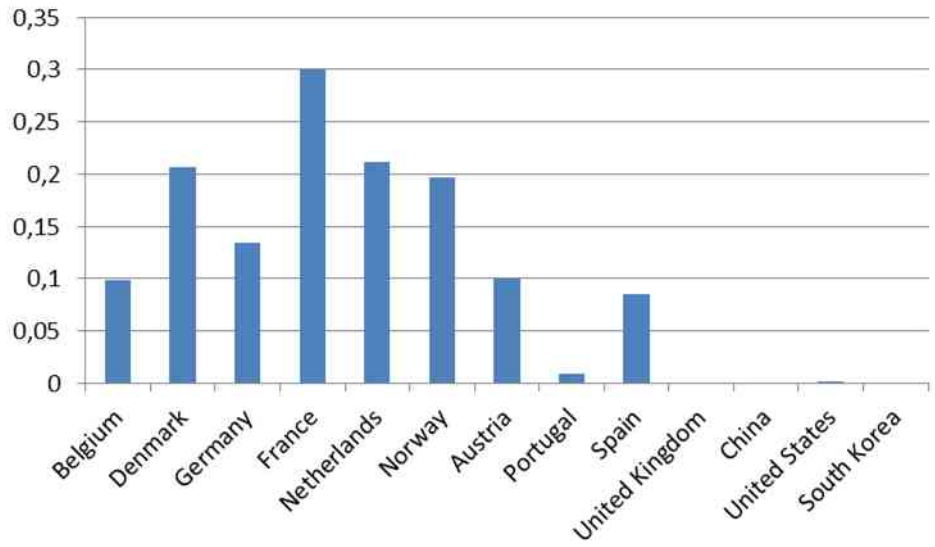
An indication of the number of electric buses per country is shown in **Figure 4**. A large number of trolley buses are used in Arnhem in the Netherlands. These are not included, just as in the many other countries where these are used. Eurostat makes no distinction between buses with batteries for their electric drive and trolley buses. It must be noted that Portugal's good score is based on 22 buses. The score in China is due to a project with 300 plug-in hybrid buses in Shenzhen (Verwijs, 2010).

Figure 4: Number of electric buses per 1,000 buses on 1 January 2012



In **Figure 5** the number of goods vehicles is included. This mainly concerns delivery vans. Many older electric vehicles are still driving around in Germany, France and the United Kingdom. These are not included here.

Figure 5: Number of electric goods vehicles per 1,000 goods vehicles



5.2 Realisation of infrastructure

Figures are still lacking for many countries

Table 6 includes the figures on the number of charging options. This concerns semi-publicly accessible charging points. Charging points on private land near a home or in a company car park for the company's own employees are therefore not included. In reality, however, many vehicles will use these charging points that are not accessible to third parties. Monitoring in the EV project in the United States demonstrates that approx. 75% (69-83%) of the charging is done at home. Approx. 23% (16-30%) of the charging takes place elsewhere. A small part of the charging happens outside the monitoring network (ECOtality, 2011). Because by no means everyone has the option to have a private charging point, semi-public charging points are essential for further development of electric road transport.

Table 6: Public and semi-public charging infrastructure in various countries on 1 January 2012

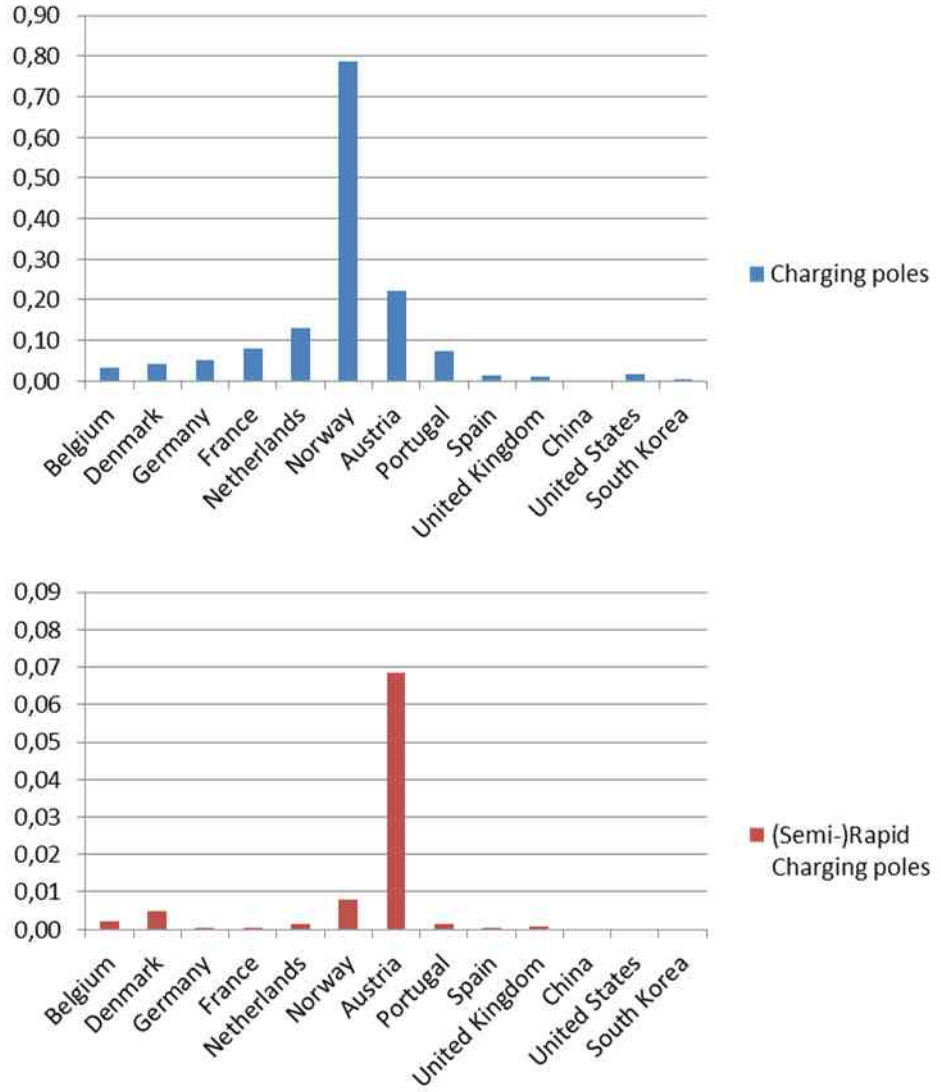
	Charging poles	Of which (semi-) rapid-charging poles	Total Charging points	Weighted Charging points
Belgium	172	12	250	310
Denmark	90	10	310	360
Germany	2,200	12	approx. 3,960	4,020
France	2,538	15	approx. 4,568	4,643
The Netherlands	1,015	11	1,841	1,916
Norway	1,818	18	3,123	3,213
Austria	995	306	approx. 1,791	3,321
Portugal	415	8	1,064	1,104
Spain	297	11	702	757
United Kingdom	275	25	approx. 495	620
China	No data	No data	No data	No data
United States	approx. 2,458	No data	8,042	8,387
South Korea	13	-	approx. 23	23

Note: The figure for South Korea is from 2010; the US figure for the number of charging locations has been adopted from an interactive map. The number of charging points in the US does come from the survey results. For a number of countries no data was received for the number of charging points. For these countries the calculation are based on an average of 1.8 charging points per charging pole, based on data for other countries. In the table the results are marked “approx.”.

First of all the table contains the total number of charging posts. This entails all poles at publicly accessible locations where a vehicle can be charged. Here specific questions were asked about the number of charging stations with (semi-)rapid-charging. Some poles (or stations) allow for simultaneously connecting multiple vehicles to the electricity grid. The number of charging points is therefore higher than the number of charging poles.

Figure 6 shows the number of charging locations per 1,000 passenger cars. Standardisation for the total number of vehicles yields a comparable picture. The number of rapid charging locations is also included. Although barely visible in the figure, the Netherlands is in fifth position here.

Figure 6: Number of charging poles and rapid-charging poles, per 1,000 passenger cars in 2010, on 1 January 2012



A certain degree of caution is advised when interpreting the figures supplied. Public and semi-public charging poles and points were requested. It is not clear here if the same definition is used for the semi-public charging infrastructure in all cases. There may be different perceptions of how to report charging poles installed in the street for home charging and those in parking facilities at companies. Depending on the definition used, figures could change.

Based on the available figures it is concluded that as regards charging points, Norway and Austria are out in front. Striking here is the relatively large number of rapid chargers and semi-rapid chargers installed in Austria.

6

Innovation opportunities and potential for revenue for the Netherlands

This chapter discusses the possibilities for the Netherlands to take part in the production, recycling and disposal chain associated with electric road transport through investments in innovation or the intensification of these investments. It is assumed that this is not so much a subject of interest to the foreign reader, hence the text is presented in abridged form here.

Monitoring of economic effects of electric road transport started

What is interesting is that the Netherlands has also started economic monitoring. The economic sustainable energy radar of Statistics Netherlands (July 2012) monitors the economic developments for businesses in the exploitation and innovation stages of various components of new sustainable energy in the long term in a similar way. Electric transportation is one of the 16 product profiles examined here. Monitoring will ultimately need to result in an understanding of the increase in the number of jobs due to the investments in and the trade balance for electric road transport in the Netherlands. Monitoring for 2009 accounted for 500 full-time jobs (FTE) with an added value of 40 million Euros.

7 Conclusions

The Ministry of Economic Affairs, Agriculture and Innovation asked NL Agency and ECN Policy Studies to conduct an international assessment of electric road transport. This report discusses the results, looking not only at policy ambitions and instruments, and level of policy support, but also comparing realisations in various countries.

As regards budgets for innovation, countries such as Germany, China, and South Korea are out in front. France, the United Kingdom, the United States and Austria follow. When it comes to stimulating innovation (R&D, pilot projects, industry) the Netherlands, together with Belgium, Denmark, Norway, Portugal and Spain, scores modestly.

International statistics are also insufficiently available for the monitoring of the numbers of electric vehicles and traffic performance. It is desirable to make further arrangements on an international level to make improvements here.

Appendix A. Ambitions per country

Table 7: Ambitions of the various countries

	Objective for electric vehicles	Objective for charging infrastructure
Belgium	Testing ground projects with 600 cars;in preparation: "National Master Plan for stimulating electric mobility in Belgium"	Local initiatives
Denmark	In 2020: 80,000	With two initiatives and the current total 2012 represents 2,000 charging places (4,000 charging points), 60 rapid-charging points and 20 battery changing stations in 2012. Increase of one party taking an initiative for 2015, 450 charging places and 90 rapid-charging points
Germany	In 2020: 500,000 electric battery vehicles (including plug-in hybrid) and 500,000 fuel cell vehicles; together 1 million vehides. In 2030 together 6 million	-
France	In 2015: 100,000, in 2020 2 million	In 2020 400,000
The Netherlands	In 2012: 15,000 to 20,000, in 2020 200,000, in 2025 1 million	Initiatives of 10,000 in 2012 and 400 in 2014
Norway	Ambition (no objective) 200,000 in 2020. Muchlow carbon and inexpensive electricity.	In realisation phase 5,000[5]
Austria	In 2020 a share of 5% BEV and 5% PHEV in sales of new vehicles. This provides an estimate of 200,000 for the fleet	Local initiatives
Portugal	In 2020 200,000	In 2020 25,000[5]
Spain	In 2012 70,000, in 2014 250,000 (EV and PHEV), in 2020 2 million PHEV and 500,000 EV	In 2012 2,250 and 20 rapid-charging stations growing to 10,500 and 90 rapid-charging stations in 2014
United Kingdom	In 2020 1.7 million	Initiatives running up to > 10,000 in 2013. In 2015 25,000
China	In 2015 1 million EV, in 2020 5 million EV	In 2016 220,000, in 2020 500,000
USA	President Obama has mentioned 1 million EV and PHEV as the objective for 2015. This objective has in the meantime been reformulated in line with production capacity	Initiatives around American Recovery and Reinvestment run up to 22,000 without precise date
South Korea	In 2015 10% of passenger cars electric and in 2020 20%	In 2020 2.2 million

[5] KVAB, 2012.

Table 8: Ambition for numbers of vehicles per year mentioned

	≤ 2015	2020	2025
Belgium	600		
Denmark		80,000	
Germany		1,000,000	
France		100,000	2,000,000
The Netherlands	15,000 – 20,000	200,000	1,000,000
Norway		200,000	
Austria		200,000	
Portugal		200,000	
Spain	250,000	2,500,000	
United Kingdom		1,700,000	
China	1,000,000	5,000,000	
USA	1,000,000		
South Korea		1,000,000	

Note: Austria concerns an estimate based on the expected share of electric vehicles in sales of new cars in 2020. The figure for Germany includes electric battery vehicles, including plug-in hybrid, and fuel cell electric cars. For both categories the objective is 500,000.

Appendix B. Policy incentives per country

Table 9: Incentives for the penetration of electric vehicles and charging infrastructure in various countries

Incentives government	Belgium	Denmark	Germany
Investment in vehicles	• For companies: 120% of purchase costs deductible for corporation tax with BEV; 100% deductible with PHEV with < 60 g CO_2/km • For private vehicles: 30% of the purchase price for a BEV, with max. €9,190 • For EV the lowest rate for vehicle registration tax applies; in Flanders a zero rate applies • In the Walloon Region an extra incentive of up to €3,500 for an EV through a bonus/malus system	• For BEV exemption from purchase tax (vehicle registration tax) on new cars to 2015 (strong incentive because tax is 105% of taxable value to 10,000 and 180% of taxable value over €10,000) • At present no exemption for PHEV!	
Operational vehicle costs		• Exemption from road tax for BEV • Lower road tax for PHEV based on a bonus/malus system	• Exemption from vehicle tax for 5 years
Investment in charging stations	• For companies: extra deduction of 13.5% of investment in charging infrastructure for corporate tax	• Programme for charging infrastructure roll-out mainly at homes; budget >€9M for 2013-2015	• Programme for investment in aspects including charging infrastructure in 11 model regions (focal areas): budget total €115 M incl. EVs to the end of 2011
Supplementary policy	• Public procurement programme for local authorities in the Walloon Region; 75% subsidy for EVs; maximally €15,000 for a car, €25,000 for a commercial vehicle		• Combination of policy of 4 ministries as regards electric road transport in a National Electromobility Development Plan; €500 M with focus on research (M€300 ; battery technology, integration in network, etc.) and pilot projects (total M€135); market preparation and introduction of EVs

Table 10: Incentives for the penetration of electric vehicles and charging infrastructure in various countries

Incentives government	France	The Netherlands	Norway	Austria
Investment in vehicles	• A bonus of €5,000 for cars with emissions < 60 g CO_2/km • Joint order in 2011 for >18,700 EVs for public bodies and companies at Renault and PSA Peugeot Citroen by the French government (first part of a joint order to support the emerging French EV industry)	• Exemption of purchase tax to 2015 • For companies deduction investment of amount for taxation • For companies small-scale investment deduction	• For BEV and FCEV exemption from considerable purchase/registration tax and VAT (EV price as a result comparable with an ordinary car!) • For PHEV the weight of the electric powertrain is not included in the purchase tax; the PHEV also benefits from low CO_2 emissions for a progressive CO_2 component in the purchase tax	• Exemption from fuel tax on consumption (NoVA) with purchase of a BEV • Bonus for PHEV and economical cars with NoVA depending on the CO_2 emissions; €300 - €800
Operational vehicle costs		• Exemption from road tax (MRB) to 2015 for cars with emissions < 50 g CO_2/km • Exemption from additional tax liability for private EV use "company vehicle" until 2014	• For BEV and FCEV: Use of lanes for public transport, free parking in public parking spaces, free use of public charging points, exemption from tolls on toll roads, lower annual tax, exemption from payment of ferry fares on national routes and 50% lower tax for commercial vehicles • For PHEV only free use of public charging points	• For BEVs exemption of monthly vehicle tax

Incentives government	France	The Netherlands	Norway	Austria
Investment in charging stations	• Financing of 50% of the costs for local authorities who install charging stations (possibly to €900 M co-financing for € 1.5 billion that appears necessary for public charging infrastructure development)	• For companies investment deduction of amount for taxation (MIA/VAMIL) • For companies small-scale investment deduction (KIA)		• Financial support for companies and individuals for the charging infrastructure from various government funds
Supplementary policy	• Rural 'Plan Voiture Electrique' action plan with total anticipated investment of €4 billion to 2020 for: knowledge development, initiatives/projects, fiscal arrangements and laws and regulations • Setting of quota of parking spaces for EV and charging stations at offices, shopping centres • Requirements of developers of blocks of flats for charging facility installation on the request of residents • Requirements of local authorities to fit public parking spaces with chargers	• National electric road transport platform in which government, the business community, organisations and knowledge institutes cooperate in stimulating electric road transport; Formula E-team for electric road transport plan of action with a package of M€65 for 2009-2011 for: Knowledge and innovation, pilot projects, launching customers, charging infrastructure and fiscal stimulation • Arrangements between the government and business community ("Green Deals") for: smart-grids tests in combination with EV, use of EV in transport and rural network of rapid charging stations	• Gronn bil (Green Car) project with the ambition of having 200,000 BEVs and PHEVs on the road in 2020; informing and asking owners of large public fleets and local authorities to purchase EVs	• Austrian Mobile Power Platform, cooperation between mainly industry and knowledge establishments to give shape to the future of electromobility in Austria.

Table 11: Incentives for the penetration of electric vehicles and charging infrastructure in various countries

Incentives government	Portugal	Spain	United Kingdom
Investment in vehicles	• Exemption for EVs from registration tax for new cars • Lowering of corporate tax for companies with EVs in the vehicle fleet • For first 5,000 EVs there is a subsidy of €5,000 per EV:	• Subsidy for 15% of the market price with a maximum of €7,000 (regional differences)	• Subsidy for a discount of 25% on the price of an EV to a maximum of £5,000 (€6,000) to 2015 (available budget £300 M (M€359), was M£250) • Announcement of a subsidy for a discount of 20% off electric vans to a maximum of £8,000 • Companies can fully deduct costs of electric car or vans from the taxable result in the year of purchase.
Operational vehicle costs	• Exemption for EVs from road tax		• Exemption from road tax • Exemption for employees and employers from fiscal added amount and national insurance contribution, both for cars and vans
Investment in charging stations	• Financing of new charging infrastructure network; rural network with 1,350 charging points in the 25 biggest towns and cities and along main roads	• Support for the implementation of the charging infrastructure (public and private) by the 'Instituto para la Diversificación y Ahorro de la energia' (IDAE) and regional authorities in 2011 and 2012	• "Plugged-In Places" regulation (M£30) for co-financing local consortia of companies and authorities for the installation of an EV charging infrastructure at strategic locations in the UK; at present the government supports 8 PIPs

Incentives government	Portugal	Spain	United Kingdom
Supplementary policy	• Requirement to install charging facilities at parking spaces for new buildings from 2010 • Access to specific lanes and areas in towns and cities for EVs • Priority parking for EVs in city centres • 20% EVs for annual renewal of the vehicle fleet of local and national authorities from 2011		• M£400 available for Green Cars in the 20082012 period with: £120 M for RD&D, £30 M charging infrastructure and £250 M EV stimulation • Announcement in 2011 ofM£68 for 3rd round Green Bus Fund with up to the start of 2012 526 HEV buses and 16 all-electric buses • London: exemption from congestion charge for inner city; *congestion charge* • Exemption/reduced rate for parking by some local authorities

Table 12: Incentives for the penetration of electric vehicles and charging infrastructure in various countries

Incentives government	China	United States	South Korea
Investment in vehicles	• Purchase subsidy/exemption from or decrease of taxes (particularly intended for vehicles with public function): for EV: €6,500 for cars; €54,000 for buses, for HEV: depending on consumption and emissions • From 2010 in 5 towns and cities also a subsidy with private purchases of $7,900 for BEV and $9,500 for PHEV	• At federal level tax discounts of $2,500 to $7,500 for purchasing an EV (depending on battery capacity); proposal in March 2012 to raise the upper limit to $10,000 without the restriction of the number of cars to which the scheme is applicable. • In various States supplementary subsidies and taxation measures are available for purchasing EVs (www.afdc.energy.gov/afdc/laws/matrix/tech)	• From 2009 tax reduction to €2,000 for a hybrid; still no support for fully electric car
Operational vehicle costs	• Exemption from or lowering of taxes (not specified in more detail)	• In various States there are discounts and exemptions from various annual taxes; in Washington State, for example, BEVs are exempt from sales and car taxes until 1 July 2015	• Separate pricing system for charging EVs
Investment in charging stations	• The Chinese electricity company has received an order for the construction of charging points in 3 towns and cities	• The objective under the American Recovery and Reinvestment Act from 2009 is to install approx. 22,000 public charging points by the end of 2013; installation is carried out in 8 projects with M$360 support from the Recovery Act • Announcement in March 2012 in California of a fund of M$100 for the construction of a covering network in the State with at least 200 rapid-charging stations and 10,000 ordinary charging stations at 1,000 locations	• The Korean government plans to invest M€111 up to 2020 for the installation of an EV charging infrastructure

Incentives government	China	United States	South Korea
Supplementary policy	• In the 12th 5-year plan "New Energy Vehicles" (including BEV, PHEV and FCEV) are classified as an emerging industry of strategic importance	• Establishment of a working group under the American National Standards Institute (ANSI) to coordinate standards forEV and charging infrastructure • In various States there is preferential treatment for EVs for the use of special roads and zones; exemption from parking fees; extra period of exemption from vehicle inspection for emissions (PHEV, BEV), etc. • In various States guidelines and obligations for purchasing EVs and promotional campaigns	• Government plan for the promotion of EVs incl. delivery of 1 million EVs in 2020 • EVs fall in the category of environmentally friendly cars; obligation for public organisations to purchase this category of cars with share increasing from 20% in 2011 to 50% in 2013 • Obligation for car makers to sell environment friendly cars; share in 2011 at 7.5% compared to 6.6 in 2010 • EVs may make use of designated roads/lanes • Seoul plans for M€7.3 investment in green vehicles such as electric buses

Table 13: Incentive research, development, demonstration projects and industry development in various countries

Incentives government	Belgium	Denmark	Germany
Research & Development (R&D)	• Car industry Expertise Centre. Fields of activity: energy storage, induction charging and electr. drive train. Support from regional funds	• Budgets for sustainable transport knowledge development (total M €75) including EV. • Contribution to various international projects with the focus on: business models and user experience and system integration EV	• M€300 for research into national plan for aspects including battery technology network integration • German government announcement for R&D support with another €1 billion in 2012/13 in PPP with industry; of this M€400 from the Ministry of Education and Research, including. M€38 for battery R&D • Programma Elektro mobilität Süd-West - road to global market: budget €40 M over 5 years from Federal Ministry of Research
Demonstrations (pilot projects)	• "Proeftuin Elektrische Voertuigen Vlaanderen"; budget > M€16.3 for the 2011-2014 period; objective 600 vehicles and 600 charging stations	• Programme at the Danish Energy Agency for the support of EV purchase and lease and projects for monitoring EVs and charging infrastructure; budget approx. M€6.7 for 2008-2015 period (was M€4.7 for 2008-2012) • Test an EV: project now with 175 EVs (objective 300) where households can test an EV for 3 months; 2010-2013	• Cross-border German/French field test with EVs in the Alsace and Baden-Württemberg (CROME project: CROss- border Mobility for EV) • Programme for investment in charging infrastructure and EVs in 220 projects in 11 model regions (focus areas): budget > M€115 for 2009-2011 • 4 large demo projects are selected for a continuation (electromobility showcases) with for each district a maximum of M€50
"Industry Development"			

Table 14: Incentive research, development,demonstration projects and industry development in various countries

Incentives government	France	The Netherlands	Norway
Research & Development (R&D)	• M€200 budget for research andM€250 for development and industrialisation (part of€4 billion' Plan Voiture Electrique' • Projects under 'Investment in the Future'programme, aimed at R&D into vehicles for the future on the road, rail and water have a worth of approx.€1 billion	• Expertise and innovation centre AutomotiveNL (previously HTAS) for automobile-related industry in the Netherlands with focus on: intelligent mobility, future powertrains and innovation, education and knowledge transfer (M€20 government support to HTAS tenders)	• Funds for research into efficient and sustainable solutions for transportand transport systems through the Research Council of Norway
Demonstrations (pilot projects)	• Cross-border German/French field test with EVs in the Alsace and Baden-Württemberg (CROME project: CROss-border Mobility for EV) • Testing ground with 100 ToyotaPrius PHEV and 135 charging stations in Strasbourg (completed?) • SAVE fleet test in the department Yvelines (west of Paris) started in April 2011 with 200 charging stations; pilot with a value of M€23 • In 2011 a car-sharing project in and around Paris was started up (Autolib) with plans for 3,000 EVs and 1,200 charging stations (700 in Paris) at approx. 1,000 points: support €50,000 per charging station; total support Paris approx. M€110 • STEP project in Paris: plan for 200 etaxis in 2012 with approx. 100 charging stations at 40 locations with reserved spaces, including at railway stations • Thirteen pilot towns and cities have already been designated French Electric road transport Green Paper where electric road transport is developing at pace	• Testing ground programme (M€10 for the period 2009 - 2014) hybrid and electric road transport; 9 projects with 115 vehicles and 196 charging points on 1-1-2012 (objective 204 vehicles)	• Transnova programme for support for environmentally friendly transport; including support for charging stations and pilot projects for batteries and how to introduce EVs in fleets • Pilot project with 6 electric taxis and rapid charging in Trondheim • RekkEVidde project that tests the performance of EVs in northern weather conditions
"Industry Development"	• M€125 investment in Renault battery plant		

Table 15: Incentive research, development, demonstration projects and industry development in various countries

Incentives government	Austria	Portugal	Spain	United Kingdom
Research & Development (R&D)	• R&D cooperation projects alternative powertrains and fuels; budget 2012: €M4 • Contribution of M €2.5 in 2011 to ERA-BARELY Transport Electrico-mobility+ programme	• A "flagship" project with the purpose of designing and developing a light EV that embodies the "green car revolution" • Research projects for the development of information and management systems concerning charging infrastructure aimed at interoperability, support services and optimisation of the use of the electricity network	• From 2009 seven projects related to EV under the programme "Inno Plans" of the Ministry of Science and Innovation, with a total amount of M€13.8 • Cenit Verde; technological co-operative venture/ programme (15 companies and 14 universities) with the purpose of developing technology and components for hybrid and electric cars; approx. €40 M budgeted	• "Integrated Delivery Programme" with M£120 of co-financing from the government (supplemented by industry up to M£200); financing of the development of low carbon vehicle technology in a public/private partnership, 2008 - 2012 (5 years)
Demonstrations (pilot projects)	• Model regions electric mobility; budget 2011 ~M€6 • "Lighthouse" projects electric mobility; 3 years, budget 2012 ~M€5	• Construction of a rural network with 1,350 charging points in the 25 biggest towns and cities and along main roads	• Demonstrations project MOVELE; M€10 support for the purchase of 1,116 EVs between 2009 and the start of 2011, and the installation of 546 charging stations by March 2012 • A budget of M€120 for strategic projects; > M€1, for 3-4 years with at least 3 Spanish regions. EV projects mainly by companies leasing and renting out vehicles	• Testing ground for testing ultra-low carbon vehicles with more than 300 cars with emissions < 50 g CO_2/km and approx. 200 electric and low carbon vans in 21 fleets (budget of M£10 for pilot projects with 100 EVs in 2009/2010)
"Industry Development"				

Table 16: Incentive research, development,demonstration projects and industry development in various countries

Incentives government	China	United States	South Korea
Research & Development (R&D)	• $18 billion from 2011-2020 for R&D (vehicle technology for alternative fuel and low emissions) and possible investment in industry	• Programmes for fundamental and applied research for: energy storage; battery materials, cells and systems (2012 budget M$93), power electronics and electric motors (2012 budget M$28.8) and simulating and testing vehicles and systems (2012 budget $44.3 M)	• The Korean government intends to invest heavily in smart grids. Charging stations (rapid and normal) are also developed in this context • Investment of M€270 in R&D for better batteries and systems
Demonstrations (pilotprojects)	• Expansion of 2009 demo project with 1,000 "new energy vehicles" in 10 towns and cities (was 13) for 25 towns and cities (ambition for 2012 was 60,000 vehicles); this programme is mainly intended for vehicles with a public function	• M$360 under the US "Recovery and Reinvestment Act (excl. company contributions), for large demos in more than 20 towns and cities, incl. nearly 13,000 EVs and more than 22,000 charging points: including EV project, (M$230; fitting and monitoring 10,000 charging stations)	
Industry Development"			

Appendix C. Key figures for the countries

The ambitions and developments for electric road transport can be related to the situation in the country concerned. To this end, a number of key figures have been collected per country. **Table 17** shows the key figures of the 13 countries compared. Most figures concern 2010 and originate from the UNECE (http://w3.unece.org./pxweb/). The number of buses and goods vehicles covers 2008. A number of figures are in italics because these come from other statistical sources or relate to other years.

Table 17: Key figures for the countries

	Passenger cars (x 1,000)	Buses (x 1,000)	Goods vehicles (x 1,000)	Residents (x 1,000)	GDP [billion $]	Car production (x 1,000)	Car possession per 1,000 residents
Belgium	5,276	16	712	10,883	409	314	485
Denmark	2,120	15	513	5,546	220	0	382
Germany	42,302	75	2,524	81,757	3,044	5,552	517
France	*31,394*	93	5,212	64,848	2,194	1,922	484
The Netherlands	7,736	11	1,026	16,612	702	48	466
Norway	2,308	23	523	4,889	280	0	472
Austria	4,462	9	381	8,388	335	86	532
Portugal	*5,691*	15	1,350	10,637	272	115	535
Spain	22,148	62	5,406	46,073	1,462	1,914	481
UK	28,421	114	3,874	62,262	2,247	1,270	456
China	*78,020*	*700*	*12,840*	1,311,000	*5,815*	13,897	60
US	*135,933*	842	*25,190*	309,774	14,527	2,731	439
South Korea	*12,560*	*80*	*4,310*	48,873	*1,014*	3,866	257

Note: The vehicle numbers for South Korea and China were collected from various sources. In China three-wheeled trucks are also counted under goods vehicles. GDP figures for China and Korea come from the IMF.

ECN
Westerduinweg 3
1755 LE Petten
The Netherlands

P.O. Box 1
1755 LG Petten
The Netherlands

T +31 88 515 4949
F +31 88 515 8338
info@ ecn.nl
www.ecn.nl