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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Proposal for a Directive

on the deployment of alternative fuels infrastructure

{COM(2013) 18 final}
{SWD(2013) 6 final}

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This report commits only the Commission's services involved in its preparation and does not prejudge the final form of any decision to be taken by the Commission.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

Identification

Lead DG: Directorate General for Mobility and Transport

Agenda Planning: 2012/MOVE/014

1.1. Background in the development of the legislative proposal

1. The White Paper "Roadmap to a Single European Transport Area – Towards a Competitive and Resource Efficient Transport System"[1] found that without the significant uptake of alternative fuels, we cannot achieve the targets of the Europe 2020 strategy and our climate goals for 2050. It therefore announces that the Commission will develop "*a sustainable alternative fuels strategy including also the appropriate infrastructure*" (Initiative 24) and ensure "*guidelines and standards for refuelling infrastructures*" (Initiative 26).

2. The Commission Communication[2] adopted on 24.01.2013 describes such comprehensive alternative fuels strategy, covering all modes of transport. The Impact Assessment accompanying the White Paper[3] had assessed the overall effect of the set of actions that are needed to achieve the uptake of alternative fuels. More specific impact assessments accompany the individual actions – listed in Appendix 3 – that have been or will be adopted as a follow-up.

3. This Impact Assessment report focuses on one particular element of this strategy: the deployment of appropriate infrastructure for alternative fuels, assessing whether supporting action is needed and what the merits of different options are.

1.2. Organisation and timing

4. This Impact Assessment was elaborated by DG MOVE, assisted by a Commission Inter-Service Group (ISG) created in spring 2010The ISG met on 26 April 2012 and on 10 July 2012[4]. The last IASG meeting took place on 26 July 2012. A final version incorporating the comments made during this meeting was circulated on 3 August 2012.

1.3. Consultation and expertise

5. With a view to preparing the ground for later policy developments, the Commission established the European Expert Group on Future Transport Fuels in March 2010 with the participation of all relevant stakeholders in the fields of transport and energy, and civil society. The Joint Expert Group Transport & Environment,

[1] COM(2011) 144 final

[2] COM(2013) 17 final

[3] SEC(2011) 358 final

[4] The services involved in this group included the Secretariat-General, DG Agriculture and Rural Development, DG Budget, DG Climate Action, DG Competition, DG Communications Networks, Content and Technology, DG Economic and Financial Affairs, DG Education and Culture, DG Employment, Social Affairs and Equal Opportunities, DG Energy, DG Enlargement, DG Enterprise and Industry, DG Environment, European External Action Service, DG Health and Consumers, DG Internal Market and Services, the Joint Research Centre, the Legal Service, DG Research, DG Regional Policy, DG Trade, and DG Taxation and Customs Union.

composed of experts from the Member States for consultation purposes, was also convened by the Commission to obtain its recommendations. Finally, the CARS 21 High Level Group on the Competitiveness and Sustainable Growth of the Automotive Industry in the European Union, consisting of representatives from European institutions, Member States, industry, and civil society, also delivered recommendations on "*Developing alternative fuel infrastructure*". The reports prepared by the two Expert Groups and the High Level Group are available on the Commission's website[5].

6. A Public Conference on "Future Transport Fuels" took place in the framework of the "European Union Sustainable Energy Week" on 13 April 2011. This was followed by an on-line public consultation which run between 11 August 2011 and 20 October 2011, and attracted more than 120 respondents. Finally, a targeted consultation of 124 stakeholders was carried out in November-December 2011. The summaries of the public conference and of the contributions received during the preceding public and targeted stakeholder consultations are available on the Commission website[6], and an overview is provided in Appendix 2.

7. Input from stakeholders has been taken into account both in developing the overall alternative fuels strategy set out in the Commission Communication[7] and in assessing the various options to deploy alternative fuels infrastructure.

8. As shown by the detailed assessment presented in Appendix 1 of this report, it can be concluded that the minimum standards for the consultation have been respected.

9. External expertise was used to assess the various options available, including aspects raised during the public consultation[8]. The studies have revealed large gaps in data availability, and confirmed uncertainties on future projections.

1.4. Results of the consultation of the Impact Assessment Board

10. Following the submission of a draft report to the Impact Assessment Board (IAB) on 17 August 2012, and a hearing with the IAB (which took place on 19 September 2012), the IAB sent its opinion on 21 September 2012, asking DG MOVE to resubmit the draft report. A revised version of the IA report has been sent to IAB on 12 October 2012.

11. In its opinion, the IAB made five recommendations that were addressed in the final version of the IA report in the following manner:

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[5] http://ec.europa.eu/transport/urban/cts/doc/2011-01-25-future-transport-fuels-report.pdf; http://ec.europa.eu/transport/urban/cts/doc/2011-12-2nd-future-transport-fuels-report.pdf; http://ec.europa.eu/transport/urban/cts/doc/jeg_cts_report_201105.pdf; http://ec.europa.eu/enterprise/sectors/automotive/files/cars-21-final-report-2012_en.pdf

[6] http://ec.europa.eu/transport/urban/events/2011_04_13_future_transport_fuels_en.htm; http://ec.europa.eu/transport/urban/consultations/doc/cts/report-on-results.pdf; http://ec.europa.eu/transport/urban/studies/doc/2012-08-cts-implementation-study.pdf

[7] Idem footnote 2.

[8] Two studies have been carried out by COWI sprl Belgium under two Specific Contracts. The first, "Study on Clean Transport Systems", was launched in September 2010 and explored possible contributions of various fuel-technology combinations in the transport sector to achieve the 60% GHG emissions reduction target set by the White Paper on Transport of March 2011. The second, "CTS Implementation Study on Alternative Fuels Infrastructure", was launched in October 2011. This study gathered further information on alternative fuels infrastructure, and assessed different options to develop an EU-wide alternative fuels infrastructure. The relevant reports are available at: http://ec.europa.eu/transport/urban/studies/urban_en.htm

(1) Strengthen the problem definition and the baseline scenario

12. In the revised IA report, the policy context (Section 2.1) has been extended and an appendix had been added on existing or planned initiatives at European level affecting the uptake of alternative fuels (Appendix 3). In addition, Section 2.2, 2.3 and 2.5, as well as the policy objectives in Section 3 have been revised clarifying the extent of problem, and better defining the basis of assessing the baseline developments. Finally, in Section 5, the impacts under the business-as-usual scenario have been clearly identified.

(2) Better define the policy options

13. The specific and operational policy objectives (Section 3.2 and 3.3) have been revised. Further clarification is provided on the policy options in the revised Section 4, as well as two new appendices have been added to explain the detailed pre-screening process (Appendix 7) and possible legislative formulations under each Policy Option (Appendix 8). The practical implications for implementation have been introduced in Section 5.1.1.3. Further assessment on the impact of standardization has been provided in Section 5.1.1.1.

(3) Improve the assessment of impacts and comparison of options

14. The revised version of the IA report contains a substantially extended Section 5 together with clear assessment of costs and benefits and improved presentation of the impact of the different policy options. The macroeconomic impacts, impacts on competitiveness, SMESs, functioning of the internal market have been extended, and the assessment of social and environmental impacts has been deepened.

(4) Better present stakeholders' views

15. A new appendix (Appendix 2) has been created to summarise the several rounds of stakeholder and expert consultation, and the relevant views of the stakeholders have been introduced throughout the report.

(5) Improve presentation

16. Some of the descriptive elements have been included in separate Appendices in order to shorten the report. The technical language has been simplified throughout the text, and a glossary has been included.

17. On 6 Nov 2012, the IAB issued a second opinion on the revised IA report with several recommendations which have been taken into account in the following manner:

(1) Further strengthen the problem definition and baseline scenario.

18. This recommendation has been addressed by revising Section 2.2 in order to provide additional evidence on the market and technological potential of the various alternative fuels. The uncertainties related to the projected market developments have also been explicitly stated in Section 2.2.2.

(2) Better define the policy options.

19. This recommendation has been addressed by:

- revising the description of policy options presented in Section 4.2,
- providing additional information on the estimated investment costs Member State by Member State in Section 5.1.1.2,

- revisiting the section presenting the potential sources of funding (Section 5.1.1.3).

(3) Improve the assessment of impacts and comparison of options.

20. This recommendation has been addressed by reinforcing the assessment of social impacts as well as of impacts on SMEs. An overview table of the estimated impacts has been added in Section 5.4.

2. PROBLEM DEFINITION

2.1. General context

21. Transport depends heavily on oil and oil products: for more than 95% of its needs worldwide and 96% in the European Union (EU)[9]. At the same time, more than 60% of the petroleum products used in OECD countries and about half of those used in non-OECD countries are used as transport fuels[10].

22. Oil dependency has a number of critical implications. The EU imports 84% of the oil it needs[11] at a cost of 2.1% of GDP in 2011[12]. The International Energy Agency estimated that the EU oil import bill increased in 2010 alone by $70 billion. The transport sector is very vulnerable to oil price increases with fuel typically accounting for a quarter of European hauliers direct operating costs[13]. Fuel also represents close to 7% of households' expenditure[14]. Recent projections on the price of oil are being revised upwards since, in the short term, the productive capacity fails to grow in line with demand and, in the long term, new reserves become more and more costly to extract[15]. Security of supply is an issue, since large amounts of oil are sourced from politically unstable regions of the world. Finally, fossil fuel engines used in transport are responsible for one quarter of all greenhouse gas in the EU and for high levels of local pollutants and noise in urban contexts.

23. Other regions of the world face the same challenges in relation to oil dependency of transport and seek alternative mobility solutions. This is particularly the case for the emerging economies of Asia, which have fast-growing motorisation rates. The development of alternative fuel technologies is thus a way not only to limit the drawbacks of oil use, but also to serve the demand of the fastest growing world markets.

24. Mandatory targets on the use of energy from renewable sources in transport have been in place since 2009 "to provide certainty for investors and to encourage continuous development of technologies which generate energy from all types of

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9 European Commission, Directorate-General for Mobility and Transport, EU Energy and Transport in Figures, 2012, available at: http://ec.europa.eu/transport/publications/statistics/statistics_en.htm

10 Source: International Energy Agency, 2009, Transport, Energy and CO_2: Moving Towards Sustainability.

11 Source: Eurostat.

12 SEC(2011) 288 Impact Assessment accompanying document to the Communication "A Roadmap for moving to a competitive low carbon economy in 2050".

13 European Commission, Directorate-General for Energy and Transport, Road Freight Transport Vademecum 2009, available at: http://ec.europa.eu/transport/road/doc/2009_road_freight_vademecum.pdf .

14 European Environmental Agency, Expenditure on personal mobility (TERM 024) - Assessment published Jan 2011, available at: http://www.eea.europa.eu/data-and-maps/indicators/expenditure-on-personal-mobility-2/assessment

15 See for example IEA, 2011, World Energy Outlook 2010.

renewable sources"[16]. Their setting was a direct consequence of the limited progress achieved when implementing the indicative targets of Directive 2003/30/EC, and of the recognition that "a clear indication of the future level of these targets is needed now, because manufacturers will soon be building vehicles that will be on the road in 2020 and will need to run on these fuels"[17].

25. In 2010, the Europe 2020 strategy[18] called for maintaining "the lead in the market for green technologies as a means of ensuring resource efficiency throughout the economy, while removing bottlenecks in key network infrastructures, thereby boosting our industrial competitiveness"[19]. More specifically, the Flagship Initiative "Resource efficient Europe" proposed to modernise and decarbonise the transport sector thereby contributing to increased competitiveness.

26. In line with this strategy, the White Paper on Transport[20] aims at halving oil dependence of transport and sets a target of 60% greenhouse gas (GHG) emissions reduction from transport by 2050. This is to be achieved through initiatives touching upon many aspects of transport policy, but economic modelling shows that alternative fuel technologies have a central role to play. As indicated in the White Paper, halving the use of conventionally fuelled cars in urban transport by 2030 and phasing them out in cities by 2050 is an almost obliged path to achieve environmental goals without curbing mobility.

27. In its Communication "A European strategy on clean and energy efficient vehicles"[21], the Commission recognised that "At present, there is a lack of a European framework for electric mobility. Therefore, to ensure technological neutrality in practice, […] on actions needed to ensure an equivalent regulatory framework for enabling this technology." and presented a set of specific actions to be taken in the areas of vehicle type-approval, and of standardisation and infrastructure for electric charging.

28. Based on the consultation of stakeholders and expertise gathered, the Commission has identified the alternative fuels which have already shown a potential for long-term oil substitution. The Commission approach is to preserve technological neutrality by creating the conditions for an efficient market selection of these, more mature, technologies.

29. In summary, full scale deployment and commercialisation of alternative fuels is mainly hampered by (1) the high price of vehicles related to technological and production capabilities, (2) poor consumer acceptance, and (3) lack of recharging /refuelling infrastructure[22]. The root causes can be found in the existence of multiple market failures that several initiatives at national and EU level are trying to correct[23].

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16 Directive 2009/28/EC.

17 COM(2006) 848 final.

18 COM(2010) 2020 final.

19 Under Flagship Initiative "An industrial policy for the globalisation era", the Commission announced "*to improve the way in which European standard setting works to leverage European and international standards for the long-term competitiveness of European industry. This will include promoting the commercialisation and take-up of key enabling technologies*".

20 Idem footnote 1.

21 COM(2010) 186 final

22 A recent report from the OECD found that: "*The following factors may explain the slow development* [of green vehicle markets]:

30. Previous initiatives and support actions have mainly addressed fuel production, vehicle technology development, and marketing of alternative fuel vehicles. The build-up of the necessary infrastructures has been neglected.

31. Ex-post analyses of projects and policy actions have pointed out the lack of recharging/refuelling infrastructure, and the inability of market forces to fill this gap, as a fundamental barrier[24]. Technological maturity of alternative fuel vehicles and vessels has been convincingly proven in large-size European projects, but those transport means remain dis-functional without at least a basic network of re-fuelling/recharging points. Without removing the 'chicken and egg' problem between vehicles and infrastructure, all other efforts to allow efficient market choices among technologies risk to remain ineffective.

32. A market failure in the provision of recharging/refuelling infrastructure affects particularly the deployment of three alternative transport fuels: electricity, hydrogen, and natural gas (LNG and CNG). The other main alternatives to oil – biofuels and liquefied petroleum gas (LPG) – are less concerned:

- Biofuels do not require specific distribution infrastructure, as long as they are brought into market through blending into conventional fuels at a level compatible with present vehicles (< 7% for biodiesel and < 10 % for bioethanol). Problems exist, however, with uneven labelling and offer of the different fuel types across the EU. For higher levels of biofuels, the availability of sustainable resources needs to be clarified before considering specific infrastructure requirements.

- LPG is currently the most widely used alternative fuel in Europe. Its market share stands at 3% of motor fuels, and about 6 million cars in the EU are running on LPG. LPG refuelling infrastructure is well established, with some 28,000 dispensing sites in the EU, but very unevenly distributed across the EU. More homogeneous supply infrastructure could be provided by industry initiatives, without need for EU intervention.

33. The analysis of the economic features of infrastructure investments (unit costs, initial investment required, possibility of stepwise build-up) shows that LPG can expand the established infrastructure network on a sound economic basis without additional

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• *High price of AFVs (especially BEVs, due to the cost of the battery) relative to conventional ICE vehicles.*
• *Lack of refuelling/charging infrastructure, which will take many years to be built fully.*
• *Restricted driving range compared to conventional ICE vehicles, and the perceived distance needs of consumers, which often do not correspond to their regular driving habits. But, even if BEVs have enough range for daily commutes, consumers may be reluctant to pay for a vehicle that is not suitable for a trip longer than 150 km before charging.*
• *Refuelling times that are longer than what consumers are accustomed to.*"
Source: OECD, 2012, Market Development for Green Cars.

23 Concerning issues (1) and (2), at EU level, Horizon 2020 (COM (2011)809 final) is targeting suboptimal research efforts; CO_2 standards for new road vehicles try to remedy consumer myopia and 'wait and see' attitudes of carmakers in a particularly risky business environment; proposals and legislation for energy taxation and for road pricing address the presence of negative externalities; initiatives on labelling help consumers making more informed choices. An overview of related initiatives is provided in Appendix 2.

24 This was stated again prominently again at the opening of the 2012 Mondial de l'automobile, Paris: "Le démarrage [de l'électrique] est freiné par le manque d'infrastructure de recharge" (Carlos Ghosn, CEO of Renault, in Le Figaro, 27 September 2012).

public intervention; while for biofuels the infrastructure requirements are not a significant barrier to vehicle deployment.

2.2. Description and scope of the problem – Insufficient infrastructure network for electricity, hydrogen and natural gas (LNG and CNG).

34. The availability of recharging/refuelling stations is not only a technical prerequisite for the functioning of alternative fuel vehicles, but also one of the most critical components for consumer acceptance[25]. The importance of infrastructure for alternative fuels has been recognised by a large number of Member States, regional and local authorities[26]. Several initiatives have been launched to address this problem. Their detailed overview is provided in Appendix 4.

35. In this context, the network for the provision of electricity, hydrogen and natural gas (LNG for trucks and waterborne transport and CNG for road transport vehicles) is currently insufficient compared to a network that would be necessary to enable market take up of these fuels and is not likely to become available in the near future. This is further explained in Sections 2.2.1 and 2.2.2.

2.2.1. Current and near-term development of the infrastructure network for electricity, hydrogen and natural gas (LNG and CNG).

36. This section describes the current state of play of the infrastructure networks for electricity, hydrogen and natural gas (LNG and CNG), and the likely market developments in the near future as a result of on-going and announced initiatives[27].

Electricity

37. Currently, while a large part of the infrastructure needed for the deployment of electric vehicles (i.e. the electricity grid) exists, the charging points for vehicles remain to be developed. As shown on Table 1, the number of dedicated e-mobility installations, including those commissioned in 2012, can be estimated to be around 26,080 (5,830 existing and 20,250 commissioned in 2012) private and 29,800 (10,400 existing and 19,390 commissioned in 2012) public[28] Alternative Current (AC) connectors.

Table 1: Indicative number of installations per country for the AC connector[29]

Country	AC connector	Installed	Commissioned in 2012

[25] "*Examining choice data from a survey of potential car buyers in Germany, we have shown in this paper that demand for alternative-fuel vehicles strongly depends on the availability of fuelling infrastructure. Consequently, a failure to significantly expand the network of stations for alternative fuels would significantly hamper the adoption of alternative-fuel vehicles in coming years.*" Source: Acthnicht et al., 2012, The impact of fuel availability on demand for alternative-fuel vehicles. Transportation Research Part D 17 (2012) pp. 262-269. Examples of other studies supporting this statement: Egbue et al, 2012, Barriers to widespread adoption of electric vehicles: Analysis of consumer attitudes and perceptions; Deloitte Development LLC, 2010, Gaining traction - A customer view of electric vehicle mass adoption in the U.S. automotive market.

[26] The fact that market penetration of alternative fuels requires the build-up of the appropriate infrastructure was also recognised by the CARS 21 High Level Group on the Competitiveness and Sustainable Growth of the Automotive Industry in the European Union in its recent report, available at http://ec.europa.eu/enterprise/sectors/automotive/files/cars-21-final-report-2012_en.pdf.

[27] In order to ease comparison, more details on business-as-usual developments (Policy Option 1) are provided in Section 5 "Impact analysis of policy options".

[28] 'Public charging point' is defined as publicly accessible charging point through this Impact Assessment.

[29] Source: Reproduced and updated based on data provided by EURELECTRIC, and in EURELECTRIC, March 2012, Facilitating e-mobility: EURELECTRIC views on charging infrastructure, Table 1.

		Private	Public	Private	Public
Austria[30]	Type 2	50	100	-	-
Czech Republic[31]	Type 2	5	20	-	61
Denmark[32]	Type 2	0[33]	280	-	-
Germany[34]	Type 2	385	1,750	-	97
Spain	Type 2	0	30	0	60
France[35]	Type 3	3,500	4,000	10,500	10,000
Ireland[36]	Type 2	358	202	750	1,000
Italy[37]	Type 2	233	120	8,000	2,000
Netherlands[38]	Type 2	>1,300	3,130	>1,000	>1,500
Portugal[39]	Type 2	0	525	-	675
United Kingdom[40]	Type 2	0	250	-	4,000

38. Table 1 also highlights that the majority of Member States do not have a significant number of charging points. This imbalance is even more apparent on Figure 1, Appendix 5, where publicly accessible charging points in the main European cities are displayed.

39. Moreover the infrastructure development across various Member States is highly uneven not only in terms of quantity, but also of 'quality', i.e. of technical solutions chosen. As highlighted by EURELECTRIC in its recent position paper: "*in the absence of any European agreement concerning the AC connector, European countries are either installing e-mobility infrastructure that is incompatible with other solutions (interoperability problems between Type 2 and Type 3) or are delaying investments until a European agreement is reached*". If these trends continue, the electricity charging infrastructure will continue developing in a fragmented way.

40. Based on announcements of public authorities, the current network of private and public charging points is expected to increase significantly only in France[41] with 4,400,000 points by 2020. In the rest of EU, only 600,000 points are expected to be deployed by 2020, further aggravating the already existing imbalance among Member States.

Hydrogen

41. The total number of hydrogen refuelling stations in operation in the EU is around 90 (Figure 3, Appendix 5). The stations are mainly located in Denmark, Germany, the

30 The figures reflect efforts of Verbund.
31 The figures represent efforts of CEZ, PRE and Eon in Czech Republic.
32 The figures reflect national situation in Denmark.
33 Private locations are equipped with standardised domestic sockets ("schuko") charging in Mode 2.
34 For public, figures reflect German electricity industry efforts, private installations reflect RWE installations.
35 The figures reflect the national French roll-out plan.
36 The figures reflect the national Irish roll-out plan.
37 The figures represent Enel's installations.
38 The figures reflect the national situation in the Netherlands.
39 The figures reflect the national Portuguese situation.
40 Private installations are equipped either with a standard connector for Mode 2, or a Mode 3 charger with a tethered cable. The figures reflect the national UK situation.
41 Source: Universität Duisburg Essen, 2012, Competitiveness of EU Automotive Industry in Electric Vehicles, Draft Final Report, study contracted by DG Enterprise and Industry.

Benelux states and the United Kingdom. By 2015, the number of filling station is expected to exceed 160 with a recent announcement in Germany to complete a 50-station network[42].

LNG

42. There are currently 20 LNG terminals in the EU[43]. However for transport use, the infrastructure development is more limited: only the LNG terminal in Nynäshamn, Sweden, has small-scale LNG bunkering facilities for ships[44], while there are only around 23 LNG/L-CNG fuelling stations for road vehicles in place, mainly in Spain and in Italy[45].

43. For the near future, further 13 LNG/L-CNG stations are planned to be built in the framework of the LNG Blue Corridors project, accompanied by the deployment of a fleet of approximately 100 LNG Heavy Duty Vehicles[46].

44. Concerning waterborne transport, small-scale export/bunkering facilities at Swinoujscie (Poland), Padilski (Estonia), Klaipėda (Lithuania), Rostock (Germany), Gotherburg (Sweden), Turku and Porvoo (Finland) are planned or proposed[47]. Stakeholders indicate that a number of ports (e.g. Antwerp, Rotterdam) in the vicinity of Sulphur Emission Control Areas (SECAs) intend to provide LNG by 2015, while ports in the Mediterranean (e.g. Marseille, Barcelona) are starting to study the provision of LNG by 2017-2020[48].

CNG

1. CNG (Compressed Natural Gas) as vehicle technology is mature for the broad market, with close to 1 million vehicles on the road in Europe and around 2,800 filling stations in the EU. However, the stations are unevenly distributed across MS. In fact, more than half are located in just two MS: Germany and Italy.

2.2.2. Assessment of the current and near-term development of the infrastructure network for electricity, hydrogen and natural gas (LNG and CNG).

46. In order to establish the extent of the problem, the current and expected development of the alternative fuels infrastructure needs to be compared to a network that would

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42 The German Federal Ministry of Transport, Building and Urban Development (BMVBS) and the industry (industrial partner Daimler, Linde, Air Products, Air Liquide and Total) decided in a joint declaration to expand the hydrogen filling station network in Germany. By 2015 there should be at least 50 public filling stations for fuel cell vehicles. For the time being, 15 exist. Source: http://www.bmvbs.de/SharedDocs/DE/Pressemitteilungen/2012/125-ramsauer-wasserstofftankstellen.html

43 Source: Gas LNG Europe.

44 14 LNG terminals in Norway are organised to supply fuel to vessels, and five of those are used as bunkering stations. Source: Idem footnote 47.

45 Source: Natural & bio Gas Vehicle Association Europe (NGVA Europe).

46 LNG Blue Corridors project under the 7th Framework Programme, Sustainable Surface Transport Priority, Green Cars Initiative. The project is pending on final Commission approval.

47 Danish Maritime Authority, 2011, North European LNG Infrastructure Project.

48 As part of Priority Project 21 of the Trans-European Transport Network, the COSTA Action aims at developing framework conditions for the use of LNG for ships in the Mediterranean, Atlantic Ocean and Black Sea areas. It will result in preparing an LNG Masterplan for short sea shipping between the Mediterranean Sea and North Atlantic Ocean as well as the Deep Sea cruising in the North Atlantic Ocean towards the Azores and the Madeira Island. The implementing bodies are as follows: RINA, Grimaldi Group, Grandi Navi Veloci, Portos dos Açores, Portos da Madeira. Further information is available at: http://tentea.ec.europa.eu/en/ten-t_projects/ten-t_projects_by_country/multi_country/2011-eu-21007-s.htm

be necessary to enable market take up of these fuels. The next sections describe such minimum necessary network for vehicles powered by electricity, hydrogen and natural gas (LNG and CNG).

47. It must be noted that the uncertainties related to projections on the development of alternative fuels infrastructure and of the number of vehicles are very large. There are many factors influencing the projections, such as technology developments (learning rates, possible technology breakthroughs), the price and availability of oil, abrupt changes in national policies, in the strategies of vehicle manufacturers etc. Therefore the following section draws on a large variety of sources to establish what can be regarded as conservative projections with relatively lower uncertainty.

Electricity

48. The minimum necessary network for electric vehicles is here defined as an infrastructure network that is not only capable of servicing the existing fleet of vehicles, but ensures that alternative fuel infrastructure is available in line with:

(1) the **critical mass of production** needed for vehicle manufacturers to achieve reasonable economies of scale in the initial phases of deployment of a new technology. The International Energy Agency (IEA)[49] considers this critical mass to be in the range of 50,000 to 100,000 vehicles per year and per model, in terms of global production. The European Automobile Manufacturers' Association (ACEA) estimates a 3 to 10% market share by the mid-2020s[50], which corresponds to "*new electrically chargeable vehicle registrations of between 450,000 and 1,500,000 units by 2020 to 2025*"[51].

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49 Source: IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

50 Source: Speech by Dieter Zetsche, President ACEA, CEO Daimler on the future of electric cars at the Informal Competitiveness Council of San Sebastian, 9 February 2010 available at: http://www.acea.be/images/uploads/files/20100211_Speech_Dieter_Zetsche.pdf

51 Source: ACEA position paper on electrically chargeable vehicles, 6 Sep 2011, available at: http://www.acea.be/images/uploads/files/ACEA_on_ECVs.pdf

Table 2: Overview of global industry targets for electric vehicles and plug-in hybrid electric vehicles[52]

Car manufacturer	Announced/reported production/sales targets	Battery manufactures[53]
Daimler	10,000 in 2013[54]	Johnson Controls – Saft (JCS), Sanyo, SK Innovation, Li-Tec Battery
Fisker	50,000 in 2013[55] 85,000 in 2014-2015	A 123 Systems
Ford	10,800 in 2012 21,000 in 2013-2015	LG Chem, JCS, MAGNA E-Car Systems, Toshiba, Sanyo
General Motors	120,000 in 2012-2015[42]	LG Chem, JCS
Mitsubishi	40,000 in 2012[56] 5% in 2015 20% in 2020	GS Yuasa Corporation, Lithium Energy Japan, Toshiba
Nissan	50,000 in 2010 in Japan 150,000 in 2012 in United States 50,000 in 2013 in United Kingdom	AESC
PSA	40,000 in 2014[57]	Lithium Energy Japan, GS Yuasa, JCS
Renault	250,000 in 2013	AESC, LG Chem, SB Limotive (SBL)
Tesla	10,000 in 2013[42] 20,000 in 2014-2015	Panasonic Energy Company
Th!nk	10,000 in 2013[42] 20,000 in 2014-2015	A123 Systems, Enerdel, FZ Sonick
Volkswagen	3% in 2018[58]	Sanyo, Toshiba, SBL, Varta Microbattery

(2) the **research findings,** which centre around the projected deployment of electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs)[59] of

52 Source: Reproduced and updated based on Table 5A in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

53 This may contain development partners and former partnership.

54 Source: www.bloomberg.com/apps/news?pid=20601100&sid=aT_u.QS7Y4tg

55 Source: http://energy.gov/sites/prod/files/edg/news/documents/1_Million_Electric_Vehicle_Report_Final.pdf

56 "*In June 2009, the company formulated and published the "Mitsubishi Motors Group Environmental Vision 2020" as its overarching guidelines for environmental initiatives. Among the goals to be achieved by 2020 are electric-powered vehicles (EV and PHEV) accounting for 20% or more of total production volume, (new) models' CO2 emissions to be reduced by 50% in comparison from FY2005 levels as a global average.* […] [The] *"Environment Initiative Program 2015" sets interim targets for 2015 as a step along the way to achieving the 2020 targets. It calls for electric-powered vehicles to account for at least 5% of total production volume* […]." Source: www.mitsubishi-motors.com/publish/pressrelease_en/corporate/2011/news/detail0771.html

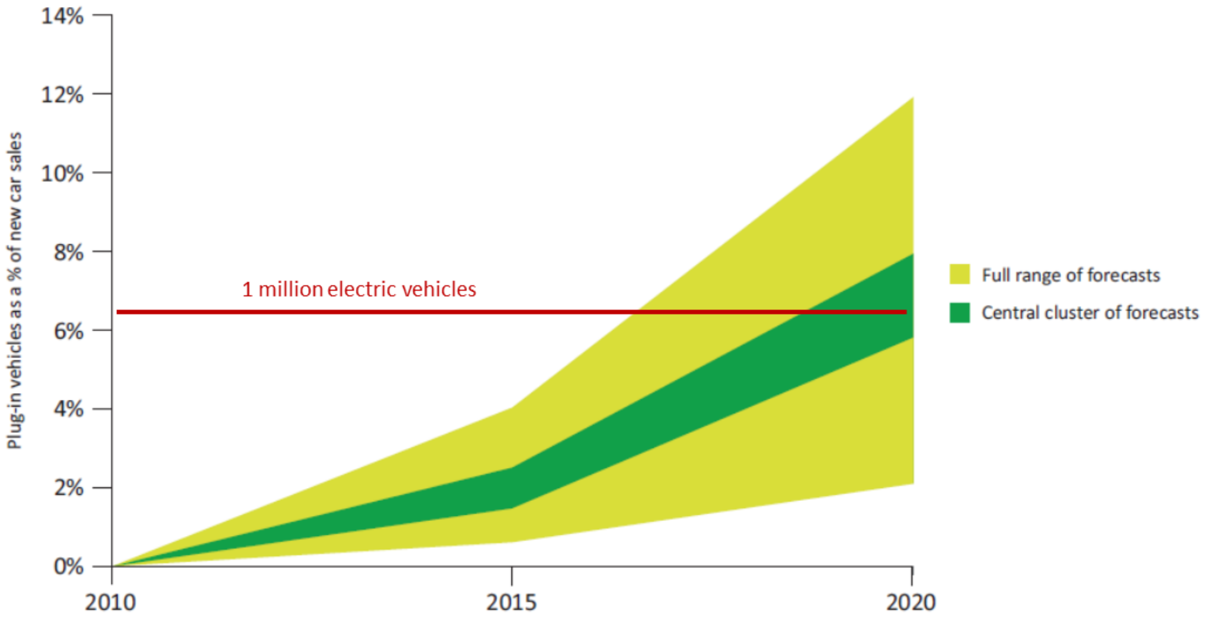
57 www.ft.com/cms/s/0/3a4324f4-4353-11e0-aef2-00144feabdc0.html#axzz1FLb87CdI

58 Estimated to be 300,000 cars. Source: http://content.usatoday.com/communities/driveon/post/2010/07/vw-sales-to-be-3-gybrid-and-electric-vehicles-by-2018/1; http://www.treehugger.com/cars/volkswagen-plans-to-sell-300000-electric-cars-a-year-by-2018.html

59 Extended-Range Electric Vehicles (E-REVs) are considered PHEVs in this report. PHEVs are considered by many as bridging technology towards full (battery-only) EVs. According to the findings of the PHEV demonstration project undertaken by Toyota in Europe, the average trip distance of PHEV users was 13.2 km, two-thirds of the trips were under 20 km, and one-third of total driving time was done in pure electric mode.

approximately 6-8% of new vehicle sales in 2020[60] (900,000 to 1,200,000 units).

Figure 1: EV and PHEV uptake forecasts for 2015 and 2020[61]



49. The above references suggest taking the benchmark number of around 4 million vehicles on the road by 2020[62] as the fleet that needs to be serviced by an adequate network. This corresponds to 1 million vehicle sales in 2020, i.e. 7% of new vehicle sales, which is the mid-point of scientific projections. This amount can be translated into the mass production of up to 20 different vehicle models.

50. Four million vehicles on the road by 2020 is less than half of what Member States announced as objective for deployment of vehicles. It can therefore be considered to be a conservative benchmark in comparison to the Member States' aim of 8-9 million EVs and PHEVs on the road by 2020 (

60 7% is the conclusion of Universität Duisburg Essen, 2012, "Competitiveness of EU Automotive Industry in Electric Vehicles", Draft Final Report, study contracted by DG Enterprise and Industry.

61 Figure is based on selected PHEV and EV uptake forecasts by Arup-Cenex, BCG, Berger, Cheuvreux, Deutsche Bank, Frost & Sullivan and McKinsey, as shown in Department for Transport, 2011, Making the Connection, The Plug-In Vehicle Infrastructure Strategy, United Kingdom, available at: http://www.dft.gov.uk/publications/plug-in-vehicle-infrastructure-strategy/

62 The sales figure for 2020 of 1 million vehicles can be translated into an estimated stock of EVs and PHEVs in 2020 using a simple interpolation between the sales figure in 2011 of around 8,700 and the sales figure of 2020. The result of a similar exercise done by the International Energy Agency is shown on Figure 2.

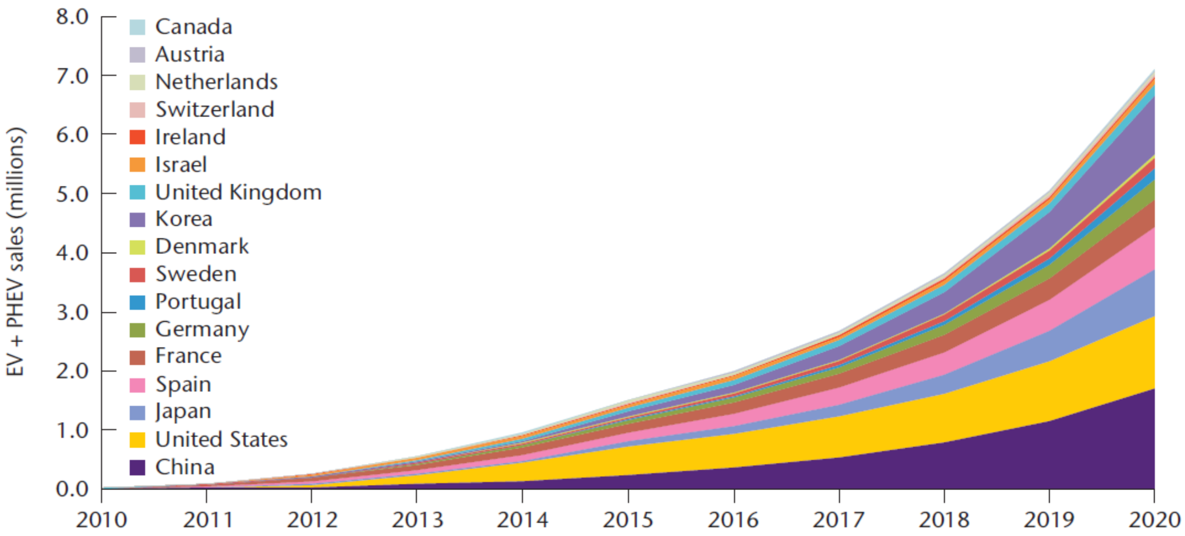
Table **3**).

Table 3: Overview of national targets and principal projections for EV and PHEVs[63]

Country	Target	Announcement/ Report date	Source
Australia	2012: first car on road 2018: mass adoption 2050: up to 65% stock	04 Jun 2009	Project Better Place Energy White Paper (referencing Garnault Report)
Australia	2020: 20% production	10 Jun 2009	Mitsubishi Australia
Canada	2018: 500,000 2020: 18,000 (EV sales in Ontario)	Jun 2008 15 Jul 2009	Government of Canada's Canadian Electric Vehicles Technology Roadmap
China	5,000,000 stock	March 2011	Electric Vehicle Initiative (EVI)
China	540,000 by 2015	8 Jul 2009	Pike Research
China	2008: 21,000,000 electric bike stock	27 Apr 2009	*The Economist*
China	2030: 20% to 30% market share	Oct 2008	McKinsey & Co.
Denmark	**2020: 200,000** **2020: 50,000**	**-**	**ENS Denmark** **EVI**
France	**2020: 2,000,000**	**March 2011**	**EVI**
Germany	**2020: 1,000,000**	**March 2011**	**EVI**
Ireland	**2020: 350,000**	**28 Apr 2009**	**Houses of the Oireachtas**
Ireland	**2020: 230,000** **2030: 40% market share**	**1 Oct 2009**	**Electricity Supply Board (ESB)**
Israel	2011: 40,000 EVs 2012: 40,000 to 100,000 EVs annually	9 Sept 2008	Project Better Place
Japan	2020: 20% market share (800,000 based on IEA estimate of 4,000,000)	March 2011	EVI
Netherlands	**2015: 20,000 stock** **2020: 200,000 stock**	**May 2011**	**Dutch Energy Agency**
New Zealand	2020: 5% market share 2040: 60% market share	11 Oct 2007	Prime Minister Helen Clark
Spain	**2020: 2,500,000**	**March 2011**	**EVI**
Sweden	**2020: 600,000**	**March 2011**	**EVI**
Switzerland	2020: 145,000	Jul 2009	Alpiq Consulting
United Kingdom	**2020: 1,200,000 stock EVs + 350,000 stock PHEVs** **2030: 3,300,000 stock EVs + 7,900,000 stock PHEVs**	**Oct 2008**	**Department for Transport "High Range" scenario**
United States	2015: 1,000,000 PHEV stock	Jan 2009	President Barak Obama
Worldwide	2015: 1,700,000	8 Jul 2009	Pike Research
Worldwide	2030: 5% to 10% market share	Oct 2008	McKinsey & Co.
Worldwide	2020: 10% market share	26 Jun 2009	Carlos Ghosn, President Renault
Europe	**2015: 250,000 EVs**	**4 Jul 2008**	**Frost & Sullivan**
Europe	**2015: 480,000 EVs**	**8 May 2009**	**Frost & Sullivan**
Nordic countries	**2020: 1,300,000**	**May 2009**	**Nordic Energy Perspectives**

[63] Non-EU countries have also set targets for the deployment of EVs and PHEVs. These targets need to be taken into account to assess the likely global demand for the vehicles, and compare this to the critical mass of production globally. Source: "Individual Country Roadmaps and Announced Targets, as listed in the references." Reproduced based on Table 4 in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

Figure 2: National EV/PHEV sales targets, if national target year growth rates extend to 2020[64]



Source: IEA data.

51. Based on the 2nd Report of the Expert Group on Future Transport fuels[65], the number of charging points needed for servicing the benchmark 4 million vehicles can be estimated to be around 8 million points, with overwhelming majority being located at home and at the workplace, and around 1 charging point per 5 vehicles at a publicly accessible car park or on-street. These estimates take into account that the recharging network has to develop beyond the bare minimum needed for servicing the vehicles, in order to address the so-called 'range anxiety' of users[66].

52. In order to determine the minimum number of charging points required in each Member State, motorisation and urbanisation rates can be used as described in Table 4. The level of car ownership also serves as a proxy for income per capita, while the share of population residing in densely populated areas shows the potential for deployment of EVs, which will have limited operating range (< 200km) in the near-future. By comparing these numbers to Figure 2, Appendix 5 and Table 3, Appendix 4, it can be concluded that France is the only Member State that has made a firm commitment[67] to deploy a sufficient network of both private and public EV charging points.

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64 Source: Figure 6 in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

65 The report is available at: http://ec.europa.eu/transport/urban/cts/doc/2011-12-2nd-future-transport-fuels-report.pdf

66 Source: Wiederer et al., 2010, Policy option for electric vehicle charging infrastructure in C40 cities.

67 France has announced the deployment of 4,000,000 private and 400,000 public charging points by 2020. Source: http://www.cleanvehicle.eu/info-per-country-and-eu-policy/member-states/france/national-level/

Table 4: Minimum number of charging points in each Member State, in thousands[68]

Step 1 Step 2 Step 3

$$\frac{\text{Car stock }(MS_1)}{\text{Car stock (EU)}} * \frac{\text{Share of urban population }(MS_1)}{\text{Share of urban population (EU)}} * \text{EV stock (EU)} * 2 = \text{Number of charging points needed in } MS_1$$

			Step 1			Step 2		Step 3	
Member State	Existing stock of passenger cars	Existing car stock in each MS compared EU total	Distribution of EVs based on existing stock	Share of urban population in each MS	Share of urban population compared to EU	Distribution of EVs based on share of urban population	Scalling with the estimated number of vehicles	Number of charging points needed	Number of publicly accessible charging points needed
BE	5,276	2.20%	88	91%	1.20	105	**103**	207	21
BG	2,602	1.08%	43	62%	0.81	35	**34**	69	7
CZ	4,496	1.87%	75	67%	0.88	66	**65**	129	13
DK	2,164	0.90%	36	58%	0.76	27	**27**	54	5
DE	42,302	17.61%	704	83%	1.08	764	**752**	1,503	150
EE	553	0.23%	9	52%	0.68	6	**6**	12	1
IE	1,899	0.79%	32	27%	0.35	11	**11**	22	2
EL	5,217	2.17%	87	57%	0.75	65	**64**	128	13
ES	22,147	9.22%	369	87%	1.14	419	**412**	824	82
FR	31,709	13.20%	528	71%	0.93	493	**485**	969	97
IT	36,751	15.30%	612	80%	1.04	637	**627**	1,255	125
CY	463	0.19%	8	100%	1.31	10	**10**	20	2
LV	637	0.26%	11	62%	0.81	9	**8**	17	2
LT	1,692	0.70%	28	57%	0.75	21	**21**	41	4
LU	337	0.14%	6	100%	1.31	7	**7**	14	1
HU	2,984	1.24%	50	53%	0.70	35	**34**	68	7
MT	239	0.10%	4	100%	1.31	5	**5**	10	1
NL	7,536	3.14%	125	99%	1.30	163	**161**	321	32
AT	4,441	1.85%	74	61%	0.80	59	**58**	116	12
PL	17,240	7.17%	287	62%	0.81	234	**230**	460	46
PT	4,480	1.86%	75	64%	0.84	62	**61**	123	12
RO	4,320	1.80%	72	54%	0.71	51	**50**	101	10
SI	1,062	0.44%	18	57%	0.75	13	**13**	26	3
SK	1,669	0.69%	28	50%	0.65	18	**18**	36	4
FI	2,877	1.20%	48	57%	0.75	36	**35**	71	7
SE	4,335	1.80%	72	78%	1.02	74	**72**	145	14
UK	29,334	12.21%	488	97%	1.27	620	**611**	1,221	122
HR	1,515	0.63%	25	58%	0.76	19	**19**	38	4
EU	240,277	100%	4,000	76%	1.00	4,065	4,000	8,000	800
EU15	200,805	84%	3,343	81%		3,543	**3,486**	6,973	697
EU13	39,472	16%	657	58%		522	**514**	1,027	103

Hydrogen

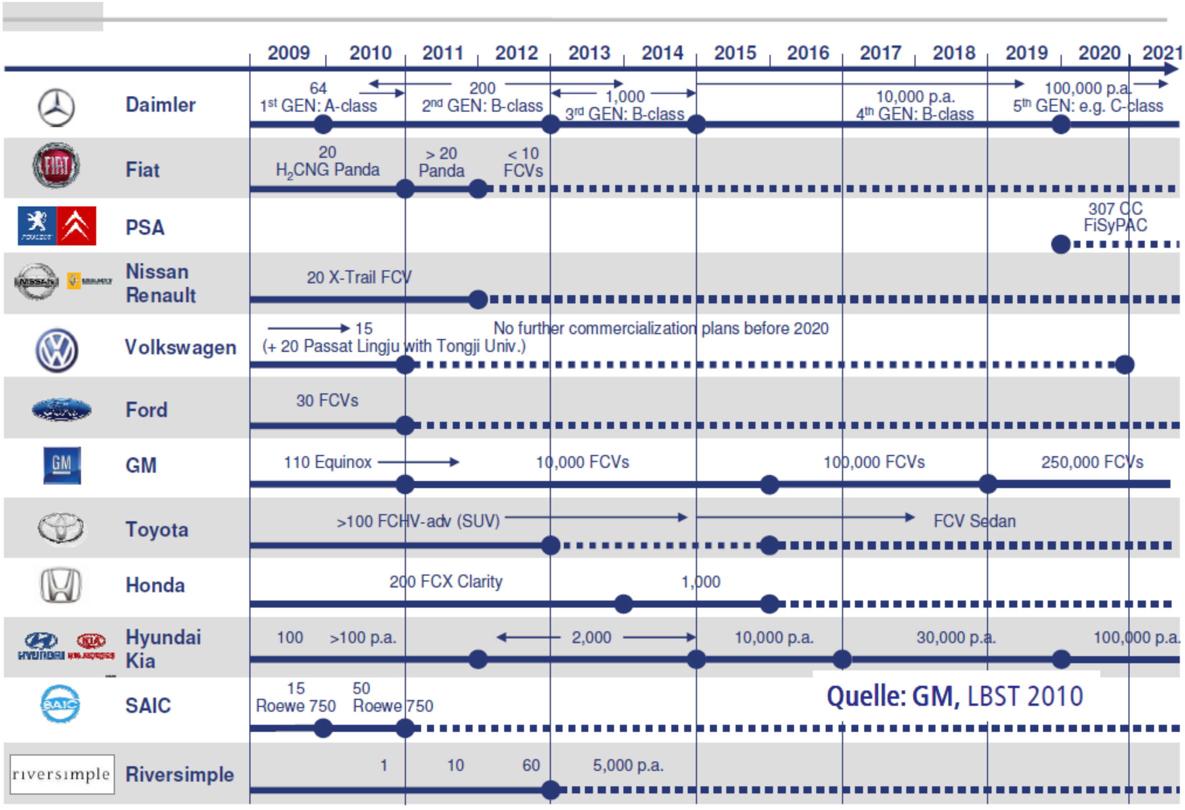
53. Higher uncertainty and lower predicted sales volumes characterise the deployment of Fuel Cell Electric Vehicles (FCEVs), particularly up to 2015, both from the side of the industry (

[68] Data on the existing stock of passenger cars and share of urban population in each Member State is sourced from Eurostat.

Figure 3) and the research community[69].

[69] For example, according to Pike Research commercial sales of FCEVs will reach 1.2 million vehicles cumulatively by 2020. Source: http://www.pikeresearch.com/newsroom/fuel-cell-vehicle-sales-to-cross-the-1-million-mark-in-2020

Figure 3: Overview of industry targets for FCEVs[70]



54. Despite these uncertainties, the United States have carried out pioneering work in the establishment of what can be considered a minimum infrastructure network for enabling the deployment of FCEVs. The U.S. National Renewable Energy Laboratory has financed a number of projects in order to identify a minimum infrastructure that could support the introduction of FCEVs. First, the location and number of hydrogen stations were determined that would make hydrogen available along the most commonly travelled interstate roads, thus making interstate and cross-country travel possible. A network of 284 hydrogen refuelling stations was proposed that would facilitate travel along 65% of the U.S. interstate highway system[71]. Second, a phased urban roll-out was established whereby the fuelling network is created on the basis of major urban centres, followed by the establishment of early corridors linking these[72].

55. In the EU, several Member States have been working on detailed plans for hydrogen infrastructure deployment. Most recently, in June 2012, Germany has announced the expansion of its refuelling network focusing on the country's metropolitan regions

[70] Source: Ludwig-Bölkow-Systemtechnik GmbH, 2011, German efforts on hydrogen for transport, available at: http://www.hydrogennet.dk/fileadmin/user_upload/PDF-filer/Aktiviteter/Afholdte_aktiviteter/Transportworkshop%20d.%201.%20dec%202011/6_Buenger.pdf

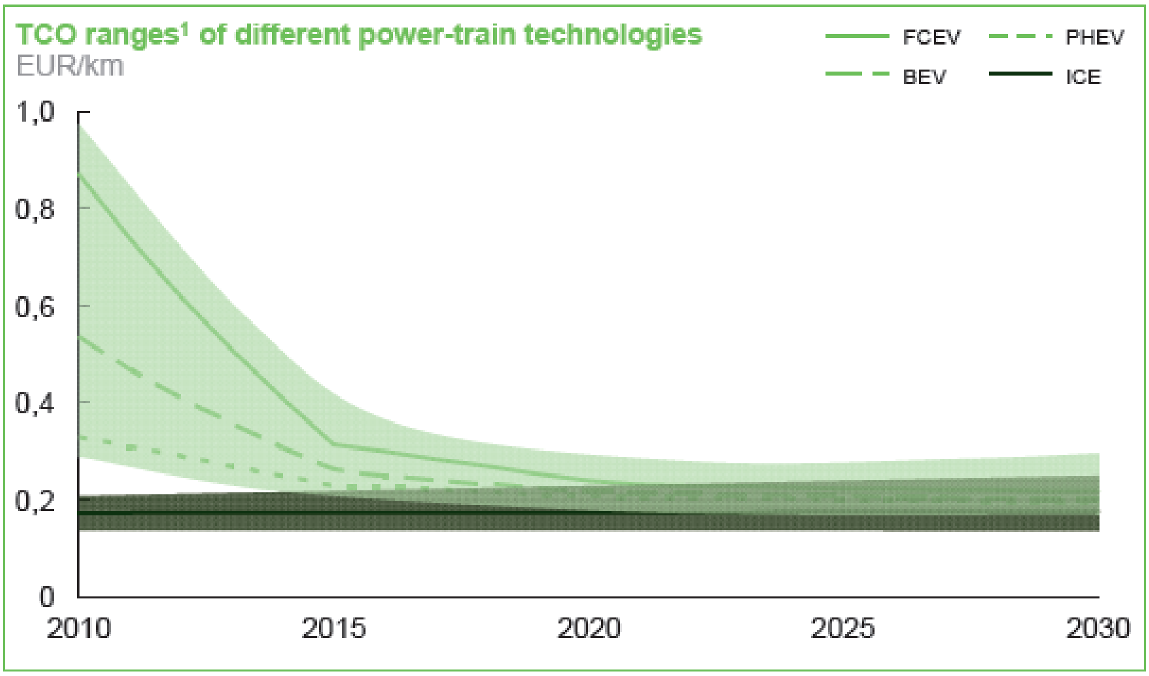
[71] Source: Melendez et al, 2005, Analysis of the Hydrogen Infrastructure Needed to Enable Commercial Introduction of Hydrogen-Fueled Vehicles.

[72] Source: Melendez et al, 2007, Geographically Based Hydrogen Consumer Demand and Infrastructure Analysis: Final Report.

and the creation of corridors connecting these metropolitan regions[73]. Denmark has also announced an infrastructure programme earlier this year, with the objective is to establish national coverage by 2015[74].

56. These strategies are partly motivated by industry projections that show that hydrogen fuel cell vehicles can become cost-competitive with conventional vehicles in the medium-term (Figure 4). Depending on the applicable tax regimes, the cost-competitiveness can be achieved even sooner: according to the estimates of H2 Logic[75], a FCEV vehicle in Denmark will cost around € 49,770 in 2015, while a comparable gasoline car would have a price tag of €49,583, including VAT and tax.

Figure 4: Projected development of the total cost of ownership[76]



1 Ranges based on data variance and sensitivities (fossil fuel prices varied by +/- 50%; learning rates varied by +/- 50%)

57. In line with these strategies, building on existing fuelling stations and those planned in the Member States, to link these urban clusters along main road transport corridors would create a network capable of supporting the commercialisation of hydrogen vehicles on the 2020 horizon. Subject to the uncertainties regarding technology

73 Source: BMVBS, 2012, 50 hydrogen filling stations for Germany: Federal Ministry of Transportation and industrial partners build nationwide network of filling stations, available at: http://www.netinform.net/H2/files/pdf/50-hydrogen-filling-stations-Germany.pdf

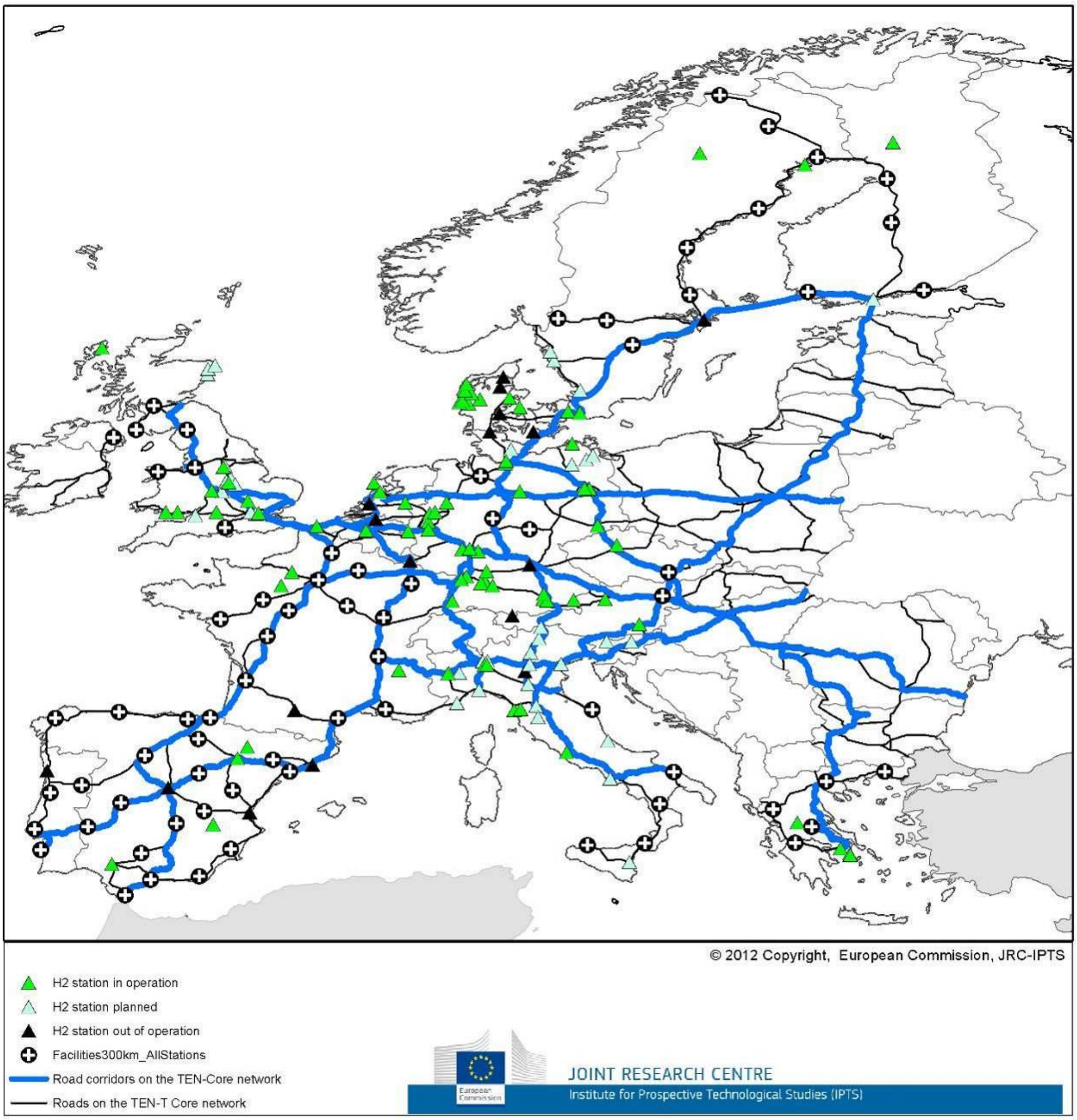
74 Source: http://hydrogenlink.net/eng/PR-Danish-Government-launch-hydrogen-initiatives-23-03-2012.asp The Danish industry coalition analysis & roadmap on “Hydrogen for transport in Denmark onwards 2050” proposes to establish national coverage with 15 fuelling stations, achieving the maximum distance of 150 km to the nearest station. Source:http://www.hydrogennet.dk/fileadmin/user_upload/PDF-filer/Aktiviteter/Afholdte_aktiviteter/Transportworkshop%20d.%201.%20dec%202011/4_Sloth.pdf

75 Idem footnote 74.

76 Source: McKinsey & Company, 2010, A portfolio of power-trains for Europe: a fact-based analysis. The role of Battery Electric Vehicle, Plug-in Hybrids and Fuel Cell Electric Vehicles. Exhibit 28 "*After 2025, the TCOs of all the power-trains converge*", available at: http://ec.europa.eu/research/fch/pdf/a_portfolio_of_power_trains_for_europe_a_fact_based__analysis.pdf

development, Figure 5 shows how hydrogen fuelling stations already built or planned can provide national coverage and be connected via the proposed Trans-European Transport Network (TEN-T) Core Network[77] with the maximum distance of 300 km between stations[78]. The number of additional fuelling stations to achieve this network is 72.

Figure 5: Minimum infrastructure network for hydrogen



Natural gas (LNG and CNG)

58. The technological uncertainty related to use of LNG in waterborne and road transport is low. This being said, the take-up of LNG technology in Europe is still mainly in its

77 COM(2011) 650 final, Proposal for a Regulation of The European Parliament and of the Council on Union guidelines for the development of the trans-European transport network.

78 A route-based methodology rather than a strictly distance-based (Euclidean-based) approach was applied. This choice avoids the underestimation of the number of required stations as shown in Gutiérrez et al., 2008, Distance-measure impacts on the calculation of transport service areas using GIS.

planning stage[79], with the availability of LNG fuelling possibilities being very limited.

59. Despite the fact that it has been identified by industry as a main fuel option relatively recently, it is already likely to achieve significant market penetration within a decade. This is partly supported by regulatory developments, such as international requirements on the use of low-sulphur fuels in shipping by 2015 in SECAs, and globally by 2020[80]. Around 10,000 ships are currently mainly used for short sea shipping in Europe, of which around 5,000 are spending more than 50% of their time in SECAs, thus having to use mainly low sulphur marine gas oil. Stakeholder expectations are to have 500 LNG fuelled ships on order by 2015, and more than 1,000 by 2020.

60. In the inland waterways sector, more than half of the engines will need to be replaced or adapted within a decade, given their typical life cycle. The industry anticipates tightening requirements on pollutant emissions; in particular as currently only about 14% of the existing 8,500 vessels are subject to emission requirements[81].

61. For road transportation, the LNG technology in many regards is similar to CNG, and according to the estimates of one of the main producer of LNG trucks, the market penetration of LNG heavy-duty vehicles could reach more than 50,000 units per year by 2020[82]. According to industry estimates[83], the additional investment costs required for an LNG truck (€ 21,000) can be amortised within less than a year due to fuel cost savings, while for a diesel-LNG dual fuel truck (€30,000), the amortization would take less than two years.

62. CNG vehicles can play an important role in urban and medium distance transport in the mid-term 2020. According to the estimations of the main association of natural gas vehicles, a market share of 5% could be possible by 2020, with some 15 million vehicles. Sweden is leading the use of biomethane which is now accounting for 65% of all the natural gas use in some 28,000 vehicles (as of June 2010).

63. Often located in the direct vicinity of existing and planned LNG import terminals, which could be used to further distribute and provide shipping with bunker fuel, the 83 maritime ports of the TEN-T Core Network are the primary locations on a network that could enable the use of LNG in shipping. Linking these maritime ports

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79 Idem footnote 47 and 46. A number of further studies, co-financed with EU funding available for the development of the TEN-T network, analyse and refine LNG bunkering networks on a regional basis, such as LNG in Baltic ports (until December 2014), LNG infrastructure and pilot project in the North Sea (until March 2013), COSTA study on use of LNG in the Mediterranean, Atlantic Ocean and Black Sea (until April 2014).

80 "*Under the revised MARPOL Annex VI, the global sulphur cap is reduced initially to 3.50% (from the current 4.50%), effective from 1 January 2012; then progressively to 0.50 %, effective from 1 January 2020, subject to a feasibility review to be completed no later than 2018. The limits applicable in ECAs for SO_x and particulate matter were reduced to 1.00%, beginning on 1 July 2010 (from the original 1.50%); being further reduced to 0.10 %, effective from 1 January 2015*." Source: IMO, available at: http://www.imo.org/ourwork/environment/pollutionprevention/airpollution/pages/air-pollution.aspx

81 Source: NEA et al, 2011, Medium and Long Term Perspectives of IWT in the European Union.

82 Source: Westport, 2011, LNG: An Immediate Fuel Alternative for Truck Transportation in Europe, available at: http://www.ngvaeurope.eu/members/presentations/Westport-Innovation-Nicholas-Sonntag.pdf

83 Source: HAM, 2012, Presentation "LNG fuel trucks experience" available at: http://www.empresaeficiente.com/uploads/workshops/docs/f83279340ba1651353cbbe1e283e7cad1e1f478d.pdf

by equipping the inland waterway and road transport corridors[84] would provide sufficient coverage for the deployment of this alternative fuel in these transport modes as well. This would require additional bunkering facilities at the 41 inland ports of the Core Network, and additionally locating 21 LNG/L-CNG fuelling stations at the maximum distance of 400 km on road (as illustrated on Figure 6)[85].

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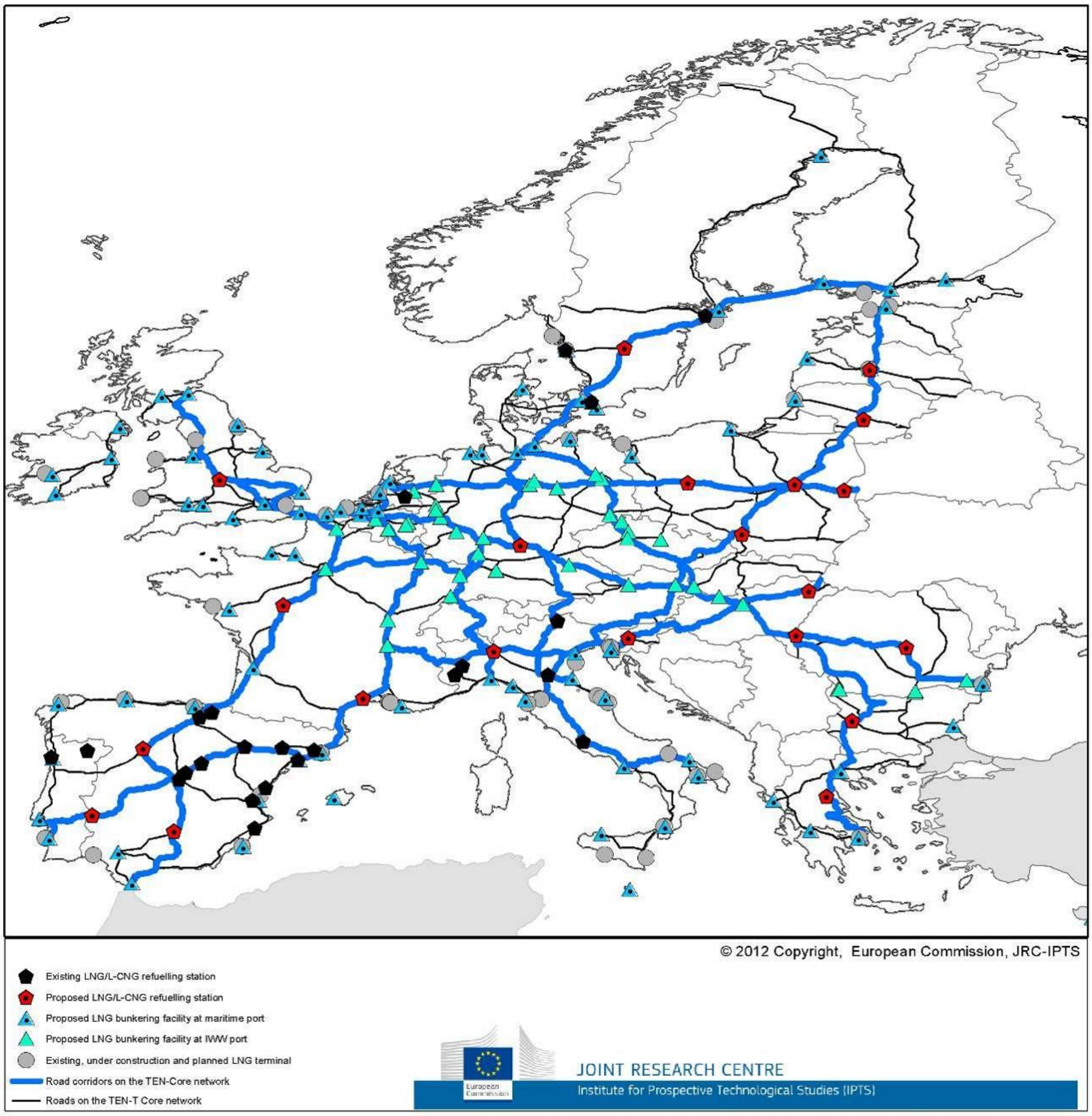
[84] As identified in COM(2011) 665 final, Proposal for a Regulation of the European Parliament and of the Council establishing the Connecting Europe Facility.

[85] Idem footnote 78.

Figure 6: Minimum refuelling network for LNG



Conclusion of Section 2.2

On the basis of projected market developments and in comparison with what would be necessary to allow widespread commercialisation of the corresponding vehicles, the infrastructure for electric, hydrogen, LNG for trucks and vessels and CNG for road transport vehicles is likely to remain insufficient in quantity and (in particular for electricity) in quality.

2.3. The root causes of the insufficiency of the infrastructure for alternative fuels

64. Following the above conclusion, this section analyses the underlying problem drivers that lead to an insufficient recharging/refuelling infrastructure for alternative fuels.

2.3.1. *Existing recharging/recharging equipment cannot be connected and is not interoperable in all related alternative fuel vehicles/vessels*

65. The technology necessary for the construction of a network for the distribution of alternative fuels is substantially mature for all types of recharging/refuelling systems, as highlighted in the Report of the Expert Group on Future Transport Fuels[86]. However, currently the standards for alternative fuels infrastructure are not common EU-wide. This is partly because voluntary standardisation has failed to deliver (e.g. plugs for electric vehicles), the application of (draft) standards is not compulsory (hydrogen) or because the standardisation work has not been completed for natural gas (LNG and CNG). The situation of the selected alternative fuels is summarised in Appendix 6.

Overall assessment

66. Stakeholders consider the issue of the lack of common standards for recharging/refuelling as the main *technical* barrier that prevents the creation of a single market as well as the reduction of costs of alternative fuels infrastructure. This problem discourages potential infrastructure investors, manufacturers of alternative fuel vehicles and vessels and consumers. Without EU-wide harmonised standards, consumers are obliged to use adaptors while investors and manufacturers face retrofit costs for adopting new recharging/refuelling systems.

67. The lack of harmonised development of alternative fuels infrastructure across the EU prevents two beneficial effects: economies of scale on the supply side and network effects on the demand side. Economies of scale can derive from reducing the unit cost of production of refuelling/recharging points by introducing alternative fuels infrastructure at a mass scale[87]. In addition, interoperability across the network due to harmonisation would allow vehicle and recharging/refuelling equipment manufacturers (e.g. for smart meters and charging devices) to sell off-the-shelf products which need not be differentiated across national markets. At the same time, network effects of harmonised alternative fuels infrastructure can be described as 'demand-side economies of scale'. This means that consumers would obtain higher value out of the infrastructure than the price they would need to pay to access it.

68. On the other hand, network effects may cause lock-in into certain technologies and standards[88]. In such circumstances, the risk is that, at later stages of the infrastructure development, the costs of revising those standards and implementing new ones, including the cost of disutility for the public, may be excessive.

Conclusion of Section 2.3.1

The lack of common standards on alternative fuels infrastructure leads to the fragmentation of internal market against the development of a European market. Even where international

[86] Idem footnote 5.

[87] Source: Corts, K., 2009, Building out alternative fuel Retail Infrastructure: Government Fleet Spillovers in E85, Center for the Study of Energy Markets, University of California Energy Institute.

[88] "*Network externalities can cause inertia in the development and diffusion of green cars. Barriers to entry can arise from increasing returns to scale in networks and contribute to creating a bias in the market towards existing technologies. Consumers may be reluctant to purchase an AFV* [alternative fuel vehicle] *if they are uncertain that a network of refuelling/charging infrastructure will be extended far enough to cover their needs. Instead, they will tend to favour the incumbent ICE technologies for which gasoline and diesel refuelling stations abound." Source:* Idem footnote 22.

standards exist, their implementation is voluntary, which allows EU-wide fragmentation, thereby discouraging potential infrastructure investors, car manufacturers and consumers.

2.3.2. Investment uncertainty hinders the deployment of recharging/refuelling infrastructure for electricity, hydrogen and natural gas (LNG and CNG)

69. Currently, fuelling stations for gasoline and diesel represent a mature and attractive market for investors. The lifetime of a conventional petrol station is estimated to be approximately 15 years[89], depending on the country and the location. The existing vehicle fleet running on petrol or diesel provides high utilisation rates, and this allows for a fast recovery of the initial investment with an estimated payback period of approximately 5 years.

70. On the contrary, the business case for providers of alternative fuels infrastructure for electricity, hydrogen and natural gas (LNG and CNG) is not yet established. The situation of each of these alternative fuels is summarised in Appendix 6.

Overall assessment

71. In addition to the higher costs for products at an early stage of technological development and market deployment, there are market failures that are responsible for the missing business case.

72. There is notably insufficient co-ordination among the relevant actors in a market that has strong complementarity between alternative fuels distribution and alternative fuel vehicles. This translates into a vicious circle whereby investors do not invest in alternative fuel infrastructure as there is an insufficient number of vehicles and vessels, the manufacturing industry does not offer alternative fuel vehicles and vessels at competitive prices as there is insufficient consumer demand, and consumers do not purchase the vehicles and vessels for lacking of dedicated infrastructure. This coordination failure among the complementary market actors, often referred to as the 'chicken and egg' issue, generates uncertainty about the utilisation rates of infrastructure and the length of payback periods for potential investors, and thereby hinders the deployment of recharging/refuelling infrastructure for electricty, hydrogen and natural gas (LNG and CNG).

73. Three different market participants would need to coordinate in order to exit this vicious circle: (1) the fuel supply industry (or in the case of electricity, the DSOs), which needs to invest in alternative fuels infrastructure and provide a service at a sufficient scale prior and parallel to the development of fuel demand; (2) the manufacturers of alternative fuel vehicles and vessels who need to achieve economies of scale so as to be able to supply those alternative fuel vehicles and vessels at competitive prices; (3) the final consumers, who need to be convinced about the attractiveness of alternative fuel vehicles and vessels and are likely to purchase them only if they are assured about the availability of sufficient recharging/ refuelling infrastructure[90]. Unless these actors proceed in a coordinated manner, uncertainty for investors will remain exceedingly high, and the markets will overall deliver a suboptimal solution (Figure 7).

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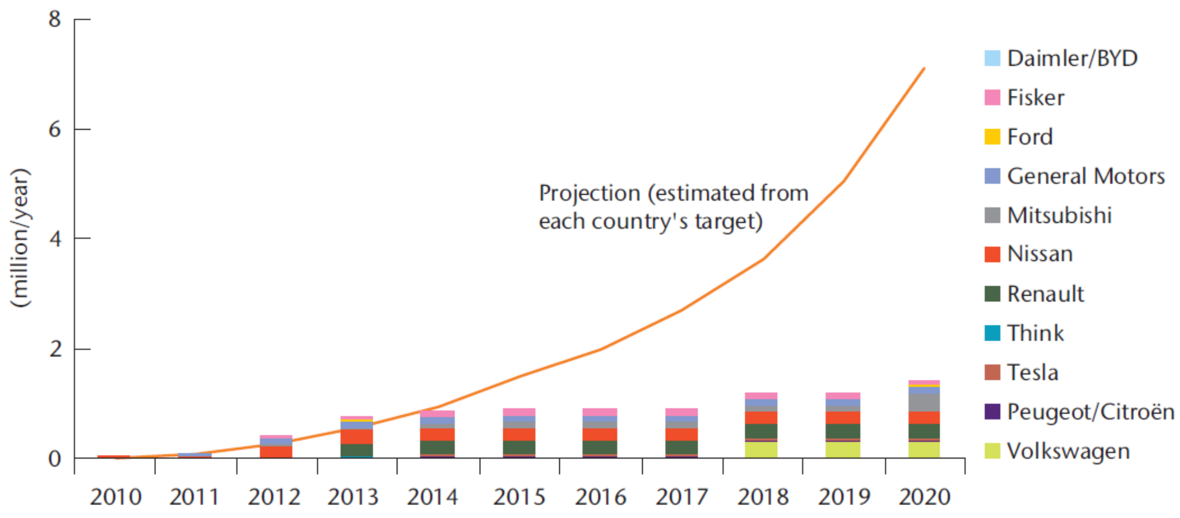
89 Source: Royal Dutch Shell plc, 2005, Annual Report.

90 Idem footnote 25.

74. A good example of cooperation between different market players can be found in the many demonstration projects in which car-makers and electricity utilities have teamed-up to provide consumers with a full package of vehicle plus home charging point plus a few public charging stations. Interestingly, the number of applicants to such schemes often largely exceeds the available places, which gives evidence on the potential demand from consumers. However, the transformation of these demonstration projects into concrete business models would require greater certainty of operators on the actual deployment of a minimum sized network. Indeed, the value of a network – and therefore of the whole mobility system based on the alternative fuel – increases with the dimension of the network itself. In the stages of initial deployment, the 'system' has therefore little appeal for users and low profitability for investors. This problem can only be overcome if there is a clear commitment for sufficient investment in many geographical areas and within the same time horizon.

Figure 7: Gap between deployment targets of governments and vehicle manufacturers[91]



** Production/sale capacity levels shown here are assumed to remain constant after year of construction. In practice, capacities may rise after plants enter service.*

75. The lack of business case also results from the fact that investors may be less willing to finance open-access recharging/refuelling infrastructure for risk of 'free riding' by competitor investors[92]. 'First mover investors, and – to a smaller extent – follower investors, are confronted with high upfront costs and uncertain payback times for investments due to the low diffusion of alternative fuel vehicles and vessels and, consequently, the initially slack demand for alternative fuels. First mover' investors run the risk of losing some of their future profits to market players who will enter the market at a later stage when the demand for the marketed product consolidates, and financial viability is improved. Such a risk discourages first movers' investments.

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91 Idem footnote 49.

92 This risk has been highlighted by stakeholders promoting hydrogen: "*The main challenge to overcome for market introduction is to break through the first-mover disadvantage and to raise sufficient financial resources. Due to the high risk and amount of initial investments to enter a mature and established market, there is little economic incentive for any individual market-player to move first.*" Source: New-IG, 2011, Fuel Cell and Hydrogen technologies in Europe, Financial and technology outlook on the European sector ambition 2014-2020, available at: http://www.new-ig.eu/uploads/Modules/Publications/111026fchtechnologiesineurope-financialandtechnologyoutlook2014-2020_000.pdf

76. There can also be a 'principal-agent'-type market failure, which is manifested in the scarce interest of landlords in providing charging points for tenants/users in private dwellings and in office buildings[93].

77. Some Member States and national authorities have tried to address these problems through different measures, including on the demand side – for example by stimulating demand of vehicles through consumer incentives and public procurement. However, the different timing and scope of these initiatives has resulted in different perceptions of consumers in national markets and has not been sufficient to build up a 'critical mass' of demand and signal long-term commitment to the support of alternative fuels. Initiatives that are aimed exclusively at promoting the demand for vehicles do not appear sufficient to trigger investment in infrastructure, as underlined by representatives of automotive industry[94].

Conclusion of Section 2.3.2 In order to establish a business case for alternative fuels infrastructure, the underlying co-ordination failure among vehicle manufactures, infrastructure providers, national authorities and final users must be addressed. Initiatives that are specifically addressed at promoting infrastructure provision appear necessary to break the deadlock and elicit consumer confidence in alternative fuel technologies.

2.4. Who is affected, in what ways, and to what extent?

78. European citizens are hardly hit by high oil process, but do not feel sufficiently confident yet in switching to other technologies. Widespread availability of infrastructure, not only in some areas in a few cities, but throughout the EU, can convince consumers that these technologies are mature for deployment and it is time to invest in clean vehicles.

79. If the recharging/refuelling stations are established by market operators, the investment cost will be recovered from the users of that infrastructure. However, this will not impact substantially the operational cost of clean vehicles, for which the fuel cost will remain significantly lower than for oil products (cf. §131 and §133).

80. Public authorities, fuel suppliers and distributors, vehicle and waterborne vessel manufacturers and road and waterborne transport operators are also affected, for different reasons and to different extents, by the lack of alternative fuels infrastructure.

81. As a consequence of this insufficient infrastructure for the selected alternative fuels:

(1) The automotive and shipbuilding industry is discouraged from producing alternative fuel vehicles and vessels.

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93 This market failure has been addressed in France, where a requirement was put in place in 2010 for new buildings (large complexes), defining an obligation for installing recharging points for EVs. Source: http://www.cleanvehicle.eu/info-per-country-and-eu-policy/member-states/france/national-level/

94 "Automaker Renault frustrated by the speed at which electric car chargers are being installed across France":
Source:
http://uk.reuters.com/article/2012/06/12/uk-renault-electriccars-chargers-idUKBRE85B0CJ20120612

(2) Mobility with alternative fuel vehicles and vessels running on electricity, hydrogen and natural gas (LNG and CNG) is currently constrained to few geographical areas that provide recharging/refuelling facilities.

(3) The development of a single EU market for alternative fuels in which the industry can benefit from economies of scale is jeopardised.

(4) The competitiveness of the EU industry related to alternative fuels and alternative fuel vehicles and vessels industry at the global level is limited.

2.5. Does the Union have the right to act?

82. The right for the EU to act in the field of transport is set out in Articles 90-91 of the TFEU, in Title VI, which makes provisions for the Common Transport Policy and in Articles 170-171 of the TFEU, Title XVI on the trans-European networks.

83. An EU initiative in this field would be necessary since Member States do not have the instruments to achieve pan-European coordination in terms of technical specifications of infrastructure and timing of investments. This would prevent a sufficiently even and widespread deployment of infrastructure, despite the existing and planned policy measures by Member States.

84. The value added of European action in this field derives from the trans-national nature of the identified problem. Vehicle and equipment manufacturers need to produce on a large scale for a single EU market, and they need to be able to rely on consistent developments across Member States. Similarly, consumers and transport users[95] are interested in pan-European mobility. European action can provide the requested coordination at the level of the entire EU market.

85. In addition, to comply with the principle of proportionality, the proposed action only addresses two transport modes (road and waterborne) for which the development of a minimum necessary network cannot be achieved without EU support. These sectors represent more than 80% of the modal split in freight and passenger transport[96]. In these sectors, the use of alternative fuels is functional to the reduction of oil dependence, and GHG and pollutant emissions.

Conclusion of Section 2.5

EU action is necessary to address technical, regulatory and financial barriers across the EU in order to facilitate the development of a single market for alternative fuels infrastructure and consequently for alternative fuel vehicles and vessels, so as to create the proper conditions for the various market actors to fulfil their respective functions. The EU intervention should focus on ensuring the EU-wide implementation of common standards and breaking the vicious circle of coordination failure among market actors.

3. OBJECTIVES

86. Section 2 has shown that:

(1) the existing refuelling/recharging equipment cannot be connected and is not interoperable in all related alternative fuel vehicles/vessels; and that

95 Further details on the importance of cross-border journeys within the EU are provided in paragraph 0.
96 Idem footnote 9.

(2) the investment uncertainty hinders the deployment of recharging/refuelling infrastructure for electricity, hydrogen and natural gas (LNG and CNG).

3.1. General policy objective

87. As part of the Climate and Renewable Energy Package of 2009, the EU has agreed on a binding targets on the share of renewable energy in the final energy use of transport (10% by 2020), and on a reduction of the greenhouse gas intensity of the energy that they supply for the road sector (-6% by 2020). The White Paper on Transport announced a reduction of 60% of CO_2 emissions by 2050 based amongst others on a significant uptake of alternative fuels.

88. The general objective of this initiative is to ensure, within the current economic climate, the provision of a sufficient infrastructure network for alternative fuels[97], contributing thereby to achieve the take-up of the alternative fuel vehicles' and vessels' market announced in the White Paper.

3.2. Specific policy objectives

89. The general objective can be translated into more specific goals:

(1) To make sure that recharging/refuelling equipment can be connected and are interoperable in all vehicles/vessels;

(2) To ensure that investment uncertainty is sufficiently reduced to break up the existing 'wait and see' attitude amongst market participants.

Table 5: Problem tree: mapping problems and objectives

General context **Last year's White Paper on Transport found that without the significant uptake of alternative fuels, we cannot achieve the targets of the Europe 2020 strategy and our climate goals for 2050. The Impact Assessment accompanying the White Paper has already described and assessed the set of Commission actions that are needed to achieve the uptake of alternative fuels. Most of these actions have been or will be accompanied by an individual Impact Assessment.**	**Context of the general objective** **As part of the Climate and Renewable Energy Package of 2009, the EU has agreed on a binding targets on the share of renewable energy in the final energy use of transport (10% by 2020), and on a reduction of the greenhouse gas intensity of the energy that they supply for the road sector (-6% by 2020). The White Paper on Transport announced a reduction of 60% of CO_2 emissions by 2050 based amongst others on a significant uptake of alternative fuels.**
Problem **Based on planned investments of Member States and, the alternative fuel infrastructure for electricity, hydrogen and natural gas (LNG and CNG) is likely to remain insufficient to enable the uptake of alternative fuels.**	**General objective** The general objective of this initiative is to ensure, within the current economic climate, the provision of a sufficient infrastructure network for alternative fuels, contributing thereby to achieve the take-up of the alternative fuel vehicles' and vessels' market announced in the White Paper.
Problem driver 1 **Existing recharging/refuelling equipment cannot be connected and is not interoperable in all related alternative fuel vehicles/vessels**	**Specific objective 1** To make sure that recharging/refuelling equipment can be connected and are interoperable in all vehicles/vessels

97 As defined in Section 0, paragraphs 0, 0, 0.

Problem driver 2	**Specific objective 2**
Investment uncertainty hinders the deployment of recharging/refuelling infrastructure for electricity, hydrogen and natural gas (LNG and CNG)	To ensure that investment uncertainty is reduced to a level breaking up the existing 'wait and see' attitude amongst market participants

3.3. Operational policy objectives

90. The following operational objectives have been defined in order to achieve the specific policy objectives set above:

(1) All recharging stations for electric vehicles, hydrogen and CNG and LNG refuelling stations for road transport vehicles, and LNG refuelling facilities for waterborne vessels can be connected, and are interoperable in all related alternative fuel vehicles/vessels.

(2) The number of recharging points for electric vehicles reaches the threshold set out in Table 1 in each MS, with at least 10% of this minimum number of recharging points being publicly accessible.

Table 6: Minimum number of electric vehicle charging points in each Member State (in thousands)

MS	Number of charging points	Number of publicly accessible charging points
BE	207	21
BG	69	7
CZ	129	13
DK	54	5
DE	1503	150
EE	12	1
IE	22	2
EL	128	13
ES	824	82
FR	969	97
IT	1255	125
CY	20	2
LV	17	2
LT	41	4
LU	14	1
HU	68	7
MT	10	1
NL	321	32
AT	116	12
PL	460	46
PT	123	12
RO	101	10
SI	26	3

SK	36	4
FI	71	7
SE	145	14
UK	1221	122
HR	38	4

(3) Existing hydrogen refuelling stations are connected via the Trans-European Transport Core Network (TEN-T) with a maximum distance of 300 km between stations by 2020.

(4) LNG refuelling facilities for waterborne vessels are available in all maritime ports of the TEN-T Core Network no later than by 2020.

(5) LNG refuelling facilities for waterborne vessels are available in all inland ports of the TEN-T Core Network, which are located on one of the corridors identified in the Regulation of the European Parliament and of the Council establishing the Connecting Europe, no later than by 2020.

(6) LNG refuelling stations for road transport vehicles are available in along the principal motorways of the TEN-T Core Network with a maximum distance of 400 km between stations by 2020. These motorways are identified as being parallel to one of the corridors identified in the Regulation of the European Parliament and of the Council establishing the Connecting Europe Facility no later than by 2020.

(7) CNG publicly accessible refuelling points are available, with maximum distances of 150 km, to allow the circulation of CNG vehicles Union-wide by 2020.

3.4. Consistency with horizontal objectives of the European Union

91. The Europe 2020 strategy, the Single Market Act and the Sustainable Development Strategy have set the scene for the transport sector. In addition, due to strong complementarities, the objectives of the European energy policy need to be taken into account.

3.4.1. Europe 2020 Strategy and Single Market Act

92. The Europe 2020 Strategy, under the flagship initiative “Resource efficient Europe”, aims at supporting the shift towards a resource efficient and low carbon economy through the reduction of CO_2 emissions as well as through increased competitiveness and energy security. The specific objectives set out in section 3.2 above work towards the aim of the above-mentioned flagship. These objectives are also consistent with other objective defined in priority areas of the Europe 2020 strategy such as innovation, high employment, social and territorial cohesion.

93. The objectives listed in section 3.1 and 3.2 are also fully in line with the ambition to create a stronger, deeper and extended Single Market as set out in the Single Market Act[98].

[98] COM(2011) 206 final, Communication from the Commission “Single Market Act, Twelve levers to boost growth and strengthen confidence, “Working together to create new growth”“.

3.4.2. Sustainable Development Strategy

94. The overall objective of the Sustainable Development Strategy, regarding sustainable transport is "to ensure that our transport systems meet society's economic, social and environmental needs whilst minimising their undesirable impacts on the economy, society and the environment". The related operational objectives are:

(1) Achieving sustainable levels of transport energy use and reducing transport greenhouse gas emissions;

(2) Reducing pollutant emissions from transport to levels that minimise effects on human health and/or the environment;

(3) Reducing transport noise both at source and through mitigation measures to ensure overall exposure levels minimise impacts on health.

3.4.3. European Energy Policy

95. The European energy policy aims at providing sustainable, secure and competitive supply of energy to all consumers. The European Council of 4 February 2011 concluded that "*major efforts are needed to modernise and expand Europe's energy infrastructure and to interconnect networks across borders, in line with the priorities identified by the Commission communication on energy infrastructure*".

96. The changes to the energy system, driven by the targets to use 20% renewable energy (which translates to +/- 35% electricity from renewable energy, of which +/- 17% will be intermittent, in particular wind and solar energy), to reduce CO_2 emissions by 20%, and to reduce energy consumption by 20% by 2020, mean that generation of electricity will become more variable and less controllable, and the electricity system needs to manage this variability to ensure uninterrupted supply to consumers. Grids need to become smarter and allow consumers to participate in the energy market. EVs can contribute to this policy by providing a source of flexibility. This policy has been elaborated in the following ways:

(1) The Electricity Market Directive[99] obliges Member States to roll-out smart meters for consumers[100], and requires DSOs to take into account demand-side management when operating their system[101].

(2) The Energy Efficiency Directive[102] puts emphasis on participation of energy consumers in the energy market through demand response and participation of consumers in the balancing markets;

(3) In November 2011, the Commission has proposed a Regulation on "Guidelines for trans-European energy infrastructure"103, to enhance the investments in networks in the EU, as well as the Connecting Europe Facility as part of the EU budget for 2014-2020104, to provide EU funding for the development of networks, including smart grids and investments in ICT at distribution level.

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99 OJ L 211 14.8.2009, p.94

100 Annex I.2.

101 Article 25.7.

102 On the basis of COM(2011) 370, agreement has been reached in principle, but the final legislation still needs to be formally adopted.

103 COM(2011) 658 final.

104 COM(2011) 665 final.

4. POLICY OPTIONS

97. This section will explore alternative policy options aimed at achieving the objectives set out in Section 3.

4.1. Pre-screening of possible policy options

98. The Commission undertook an extensive consultation of stakeholders preceding this Impact Assessment. where various policy options were put forward for the alternative fuels, namely:

(1) Regarding technical specifications: no harmonisation at EU level; voluntary standardisation; and mandatory application of common standards concerning the issue of connectivity and interoperability

(2) Regarding infrastructure deployment: no EU intervention; industry self-regulation on the basis of commonly agreed methodology and indicative targets per Member State; and binding targets on Member States to solve the coordination failure.

99. To arrive to the policy options that are assessed in depth, a pre-screening of possible options was carried out on the basis of the following criteria:

(1) Consistency with general, specific and operational objectives

(2) Technology neutrality

(3) Feasibility

100. The complete description of the pre-screening process is provided in Appendix 7.

4.2. Description of policy options

101. On the basis of the pre-screening, the Commission has hence identified three policy options besides the 'no policy change' baseline scenario. These are described below, with an overview provided in Table 7.

4.2.1. Policy Option 1

(pre-screened FC4)

102. Policy Option 1 represents the future without any additional policy intervention to change current trends. Policy Option 1 refers to the 'no policy change' scenario. This policy option takes into account all current legislative and policy initiatives in the field of alternative fuels infrastructure, as well as the current and announced industry developments[105]. It also considers national announcements for the deployment of EV charging points as shown on Figure 2, Appendix 5 and Table 3, Appendix 4, and it includes the continuation of previous action programmes and incentives, such as:

(1) EU and Member States funding for RTD&D projects to promote the deployment of alternative fuels infrastructure;

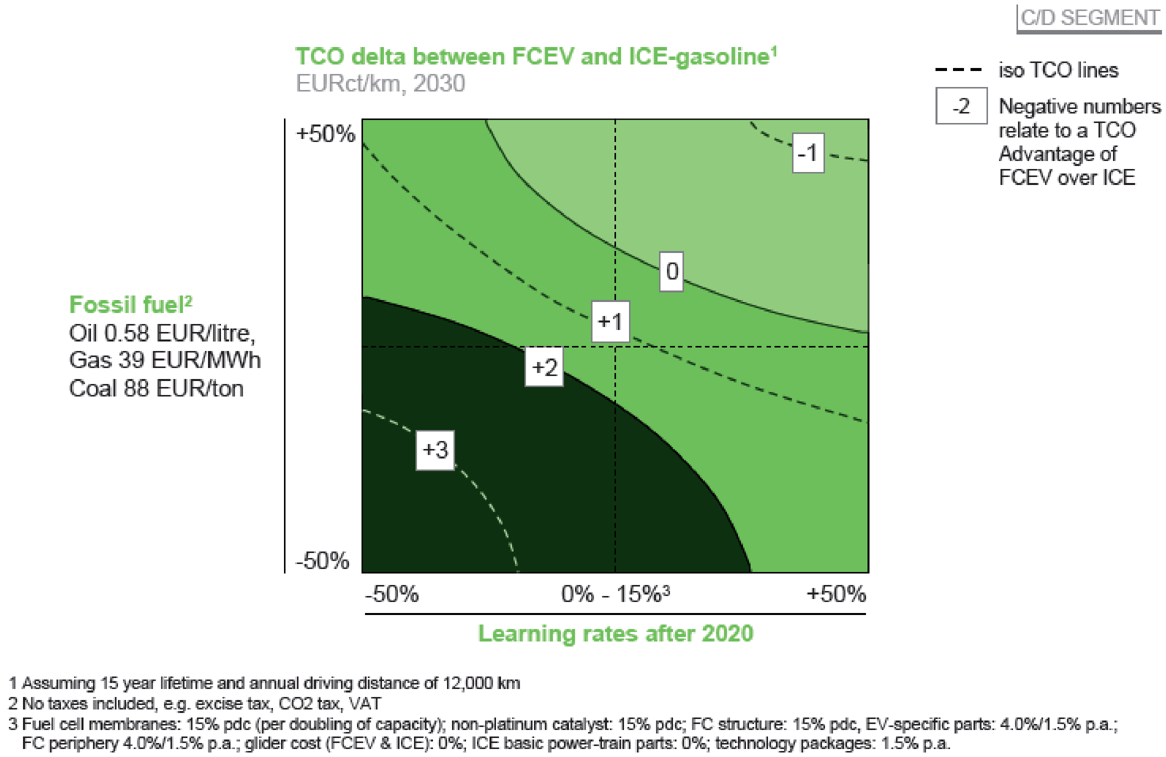
(2) Allocation of state aid on individual basis for the construction of alternative fuels infrastructure;

(3) Use of existing European funding schemes (Cohesion and TEN-T funding) and of EIB loans.

[105] Planned and proposed infrastructure to be achieved by 2015 is not considered as additional investment for the description of Policy Option 1.

103. According to economic modelling presented in Appendix 10, the oil price is foreseen to substantially increase in the coming decades. This will heavily influence future consumption trends, by incentivising a shift away from the use of oil in transportation. As demonstrated on Figure 8, with the increase of the oil price, alternative fuel technologies will become more attractive and cost-competitive with conventional technologies.

Figure 8: The influence of oil price on the cost competitiveness of FCEVs[106]



104. However, despite existing initiatives (and the resulting developments in technology) and projected increase in oil prices, the share of alternative fuels in the energy consumption of passenger cars and vans is expected to remain less than 10% by 2050 without further action on infrastructure. LNG and CNG would also not make significant inroads in road transport and the same would also happen with LNG for waterborne transport due to the lack of refuelling infrastructure.

4.2.2. Policy Option 2

(pre-screened FC16)

105. The EU will issue recommendations to ensure the application of standards developed by international and European organisations concerning alternative fuels infrastructure. At the same it will issue recommendations setting out basic criteria

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106 Source: Idem footnote 76. Exhibit 12 "*All conclusions are robust to significant variations in learning rates and the cost of fossil fuels*", available at: http://ec.europa.eu/research/fch/pdf/a_portfolio_of_power_trains_for_europe_a_fact_based__analysis.pdf

and indicative targets[107] for the deployment of infrastructure for electricity, hydrogen and natural gas (LNG and CNG), addressed to Member States.

4.2.3. Policy Option 3

(pre-screened Fuel Package III)

106. The EU will set out essential or specific requirements for alternative fuels infrastructure for Member States. At the same time it will set out basic criteria for minimum infrastructure coverage, together with binding targets[108] for the technologically most mature fuel technologies (electricity, and LNG for waterborne transport), addressed to Member States. For the remaining fuels (hydrogen and natural gas (LNG and CNG) for road transport), the targets would remain indicative[109].

4.2.4. Policy Option 4

(pre-screened FC40)

107. The EU will set out essential or specific requirements for alternative fuels infrastructure for Member States. At the same time it will set out basic criteria for minimum infrastructure coverage, together with binding targets[110] for the electricity, hydrogen and natural gas (LNG and CNG) in road and LNG in waterborne transport, addressed to Member States.

4.2.5. Summary overview of policy options

108. The possible legislative formulations under the various policy options are provided in Appendix 8.

109. It should be noted that EU legislation would not specify further requirements beyond the number and the minimum technical standards for the recharging/refuelling points. Member States authorities would thus have responsibility for deciding on the regulatory framework, territorial localisation, and other implementation measures, in line with the principle of subsidiarity.

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[107] The formulation of these targets could be similar to Article 3 (1) of Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport: “(a) Member States should ensure that a minimum proportion of biofuels and other renewable fuels is placed on their markets, and, to that effect, shall set national indicative targets. […]” Source: OJ L 123 17.5.2003, p.42

[108] The formulation of these targets could be similar to Article 3(4) of Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC: “Each Member State shall ensure that the share of energy from renewable sources in all forms of transport in 2020 is at least 10 % of the final consumption of energy in transport in that Member State. […]” Source: OJ L 140 5.6.2009, p.16

[109] Idem footnote 107.

[110] Idem footnote 108.

Table 7: Detailed content of Policy Options 2, 3 and 4

Problem and drivers	**General and specific objectives**	**Policy Option 2**				**Policy Option 3**				**Policy Option 4**			
Fuels		Electricity	Hydrogen	Natural Gas		Electricity	Hydrogen	Natural Gas		Electricity	Hydrogen	Natural Gas	
Vehicle segments				LNG Vessels	LNG and CNG vehicles			LNG Vessels	LNG and CNG vehicles			LNG Vessels	LNG and CNG vehicles
Insufficient infrastructure network for selected alternative fuels	**Provide sufficient infrastructure network for alternative fuels supply enabling market take-up**												
Lack of EU-wide implementation of common standards for alternative fuel recharging and refuelling	Ensure EU-wide implementation of common standards to avoid risk of deployment of different standards and non-interoperable equipment	Recommend technical requirements for charging points	Recommend technical requirements for fuelling stations	Recommend technical requirements for fuelling stations	Recommend technical requirements for fuelling stations (LNG and CNG)	Mandate technical requirements for charging points	Mandate technical requirements for fuelling stations	Mandate technical requirements for fuelling stations	Mandate technical requirements for fuelling stations (LNG and CNG)	Mandate technical requirements for charging points	Mandate technical requirements for fuelling stations	Mandate technical requirements for fuelling stations	Mandate technical requirements for fuelling stations (LNG and CNG)
Missing business case for infrastructure providers: coordination failure among the complementary market actors ('chicken and egg' issue)	Trigger coordinated commitment at national, regional and local levels, and thereby enhance investment certainty	Recommend quantity requirements for charging points	Recommend quantity requirements for fuelling stations	Recommend quantity requirements for fuelling stations	Recommend quantity requirements for fuelling stations (LNG and CNG)	Mandate quantity requirements for charging points	Recommend quantity requirements for fuelling stations	Mandate quantity requirements for fuelling stations	Recommend quantity requirements for fuelling stations (LNG and CNG)	Mandate quantity requirements for charging points	Mandate quantity requirements for fuelling stations	Mandate quantity requirements for fuelling stations	Mandate quantity requirements for fuelling stations (LNG and CNG)

5. IMPACT ANALYSIS OF POLICY OPTIONS

110. This section provides an assessment of the economic, social and environmental impacts supported by modelling results[111], previous studies and/or by academic research where possible.

111. As highlighted in Section 3, promoting the deployment of recharging/refuelling infrastructure addresses only one of the various market failures that prevent efficient technological choices and the market up-take of alternative fuel vehicles and vessels. In other words, the Policy Options under consideration aim to provide the fulfilment of one fundamental condition for such market up-take, but cannot ensure it without the concourse of the other initiatives that are part of the overall strategy.

112. This circumstance complicates the analysis. For this reason, the assessment is based, on the one hand, on modelling results that try to quantify the 'direct' or 'stand-alone' benefits of the policy proposal, and, on the other hand, on evidence from other studies on the wider impact of the proposal, when it is seen in combination with other existing and forthcoming initiatives to promote alternative fuel vehicles.

113. The 'stand-alone' impact is assessed through modelling the effects of providing harmonised technical standards for infrastructure and of deploying a recharging/refuelling network that is denser then in a baseline projection. More specifically, the benefit of the initiative is quantified by looking at the extra utility that it brings to vehicle users[112] with respect to baseline developments.

114. In fact – since it can be argued that an equivalent monetary incentive would have to be provided to potential vehicle buyers to compensate for has more limited recharging possibilities – the model simulations implicitly compare the option of investing in infrastructure with that of providing a subsidy to vehicle buyers given a certain sales objective.

115. This approach has the advantage of providing an estimate of the benefits of additional infrastructure with respect to other possible incentive measures that have the same objective. However, it does not gauge the merits of a successful market up-take of vehicles and vessels, since it would be difficult to disentangle the effects of the numerous existing and forthcoming initiatives that pursue this same objective (CO_2 standards, energy taxation, fuel quality, road pricing, etc.).

116. Moreover, modelling is not capable quantifying the greater benefits that are associated with reaching critical mass in demand/production and the subsequent improvement in the competitive position of the European industry on global markets. However, as already demonstrated, baseline developments are unlikely to promote a deployment of alternative fuel vehicles that is in line with critical mass production and sustainable mobility scenarios.

117. That is why, in addition to modelling the direct impacts, reference is also made to the more general benefits of being able to kick-start a process of wide deployment of

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[111] Modelling results build primarily on the PRIMES-TREMOVE transport model.

[112] A refuelling/recharging network has a certain utility to vehicles users. This utility is very high when the availability of infrastructure is low: without infrastructure, alternative fuel vehicles would be useless. On the other hand, the utility of infrastructure is marginally decreasing and eventually an extra charging point will not make any significant difference to the user. The relevant evidence can be found in the studies mentioned in footnote 25.

alternative fuel vehicles. These benefits are multiple, and affect the economy (lower operating cost of vehicles, lower cost of oil import, higher competitiveness of car and ship manufacturing industry), and the society (improved public health, more high value-added, high-skill jobs) and the environment (lower emissions of greenhouse gases, noise and local pollutants).

118. For the purposes of this Impact Assessment, and in order to assess the range of impacts for each Policy Option, it is assumed that:

(1) under Policy Option 2, despite the recommendation of the Commission on the application of certain standards concerning alternative fuels infrastructure, some Member States will decide to follow their own, dissimilar national rules[113];

(2) under Policy Options 3 and 4, the Commission would set out mandatory essential or specific requirements in its proposal for a Directive.

119. In order to better identify the range of likely costs and benefits of indicative and binding targets on deploying the minimum infrastructure network for electricity, hydrogen and natural gas (LNG and CNG), for the purposes of this Impact Assessment, it is assumed that:

(1) under Policy Option 2, only partial deployment of sufficient EV charging infrastructure and LNG infrastructure for vessels will take place; and there will be no deployment of hydrogen infrastructure, LNG infrastructure for trucks and CNG infrastructure for vehicles.

(2) under Policy Option 3, full deployment of sufficient EV charging infrastructure and LNG infrastructure for vessels will take place; and there will be no deployment of hydrogen infrastructure, and LNG infrastructure for trucks and CNG infrastructure for vehicles.

(3) under Policy Option 4, full deployment of sufficient infrastructure for electricity, hydrogen, LNG for trucks and vessels and CNG for road transport vehicles will be achieved.

120. The assumption on the insufficient deployment of infrastructure under Policy Option 2 needs further qualification. As already indicated, many Member States have ambitious plans for alternative fuel, in particular electric, vehicles which would go beyond the objectives of the present initiative. These plans, however, will inevitably be influenced by market developments, as an insufficient response from consumers and investors would oblige Member States to step up incentives and rely more on

113 *"Internationally uniform standards can only be effective if there is correspondingly harmonized government regulation. Coordination processes in standardization will reach their limits if countries adopt regulations that counteract harmonization because of diverging industry policy interests. There is currently a need for action with regard to reaching agreement on a uniform charging infrastructure, which will have a significant impact on the customer uptake of electric vehicles. There is a pressing need for the harmonization of national regulations in favour of pan-European and international solutions."* Source: Second Report of the National Platform for Electromobility, published on 20 Jun 2012, is available at: http://www.bmvbs.de/cae/servlet/contentblob/86656/publicationFile/59036/electric-mobility-second-report-national-platform.pdf

public resources for the necessary infrastructure investments. There is therefore a risk that these plans are significantly revised[114].

121. As argued in Section 2.3.2 "Overall assessment", the deadlock between the various market players needs to be removed to trigger widespread adoption of clean vehicles and vessels. This can only be done if there is a credible commitment, which Member States' plans, voluntary industry agreements and EU recommendations might not be sufficient in providing. Indeed, market participants are aware of past non-binding initiatives in this field that failed to produce the intended result. The example of the Biofuels Directive[115] and of the 1995 strategy for reducing CO_2 emissions from light duty vehicles[116] can be quoted in this respect.

5.1. Economic impacts

122. This part assesses the economic impacts of the various policy options looking first (Section 5.1.1) at the 'stand-alone' costs and benefits of the deployment of infrastructure according to the methodology described in §112-119. It then assesses the macroeconomic impacts (Section 5.1.2), as well as those on competitiveness (Section 5.1.3), SMEs (Section 5.1.4), internal market (Section 5.1.5), and on consumers (Section 5.1.6), also by reference to the wider effect of this initiative as part of a strategy for alternative fuels' developments.

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114 Highlighting the importance of public policy action, Gas Infrastructure Europe stated that "Gas infrastructure investment entails long-lead times and thus requires long-term visibility. A sound investment climate together with a stable and predictable regulatory framework is fundamental for the development of infrastructure".

115 The Biofuels Directive 2003/30/EC established a reference value of a 2% share for biofuels in petrol and diesel consumptions in 2005 and 5.75% in 2010. Member States were required to set indicative targets for 2005, taking this reference value into account. While these targets "constitute a moral commitment on behalf of Member States, there is no legal obligation for them to achieve the levels of biofuel use they have chosen to target." Regular assessments and reports have been prepared on the EU's progress towards its 2010 targets and on its efforts in general to develop renewable energy. The reports issued in 2007 as well as the Renewable Energy Roadmap (COM(2006) 845 final) highlighted "*the slow progress Member States were making and the likelihood that the EU as a whole would fail to reach its 2010 target. The Roadmap explained possible reasons for this, which included the merely indicative nature of the national targets and the uncertain investment environment provided by the existing legal framework*." The Commission therefore proposed a new, more rigorous framework to drive forward the development of renewable energy and more solid, legally binding targets for 2020, as part of the Climate and Renewable Energy Package.

116 The Community strategy for reducing CO_2 emissions from light duty vehicles was based on three pillars, as proposed by the Commission in 1995, and subsequently supported by the Council and European Parliament. This structure allowed for the comprehensive integration of measures addressing both supply (voluntary commitments from the three principal automotive industry associations) and demand (labelling and taxation). In its Communication (COM(2007) 19 final) in 2007 the Commission recognised that the progress achieved so far goes some way towards the 140 g CO_2/km target by 2008/2009, but in the absence of additional measures, the EU objective of 120 g CO_2/km will not be met at a 2012 horizon. "As the voluntary agreement did not succeed, the Commission considers necessary to resort to a legislative approach and underlines that in addition to the proposed legislation urgent action should also be taken by the public authorities". Mandatory binding CO_2 standards have been since adopted for both passenger cars (in 2009) and vans (in 2011).

5.1.1. Direct costs and benefits of technical standards and infrastructure deployment

5.1.1.1. Impacts associated with standardisation[117]

123. Academic research on different EU Member States agrees on the beneficial overall effects of standards both for companies and sectors as well as the economy. While the specific effects of standardisation for specific sectors of the economy vary according to their characteristics, studies also point out that sectors such as transport and communications services benefit more from standards. The recent Impact Assessment on European Standardisation found that "*In particular, compatibility and interface standards add economic value to goods with network externalities and facilitate the development of networks. Compatibility standards can increase direct network externalities by allowing products to work as part of a system or network. They allow each individual participant in the network to derive benefits from interacting with other participants in the network*".

124. The assessment also highlighted some of the benefits that companies and industries in the European Union derive from standardisation, such as:

125. Cost reduction or cost savings derived mainly from economies of scale, the possibility to anticipate technical requirements, the reduction of transaction costs and the possibility to access standardised components.

126. Improved market access as a result of increased competitiveness due to increased efficiency, reduced trading costs, simplified contractual agreements (because the characteristics and functionalities of the product are clear as a result of the standards) and increased quality.

127. Better relations with suppliers and clients derived from increased safety for consumers, increased trust, reduced liability risk and wider choice of suppliers for the same reasons mentioned above.

128. Optimized returns on investment resulting from the possibility to confront competing possible options for the development of a certain product or technology early in the process and to avoid investments in those that will not be widespread.

129. Concerning possible negative effects of standardisation, first of all, the impact on competition needs to be considered. Standards can have anticompetitive effects unless they are available to all potential innovators and competitors. Second, there are costs associated with retrofitting existing infrastructure. These costs are particularly relevant for electricity, where a higher number of charging points have already been deployed. For hydrogen and natural gas (LNG and CNG) infrastructure, the issue of 'stranded investments', which are not interoperable, and the need to retrofit existing fuelling stations is much less relevant due to the very early stage of their deployment.

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117 Further details of the impacts related to EVs will be provided in the specific impact assessment, led by Directorate-General Enterprise and Industry, into the legislative options and technical modalities, ensuring that practical and satisfactory solutions for the infrastructure side of the interface are implemented throughout the EU. This is in line with the conclusions of the final report of CARS 21 High-Level Group on the Competitiveness and Sustainable Growth of the Automotive Industry in the European Union. The assessment provided here draws upon the findings of the Impact Assessment accompanying the proposal for Regulation on European Standardisation (SEC(2011) 671).

130. As explained in Section 2.3.1, one of the principal issues hindering the deployment of EV charging infrastructure relates to the lack of decision on the type of socket-outlet (Type 2 or Type 3) to be deployed.

131. Under **Policy Option 1**, the amount of 'sunk' capital investment in various Member States can be calculated using the cost assumption of 520 € per private and 5,280 € per public charging point and the estimates on existing e-mobility points shown in Table 1. By the end of 2012, around 90 million € and 80 million € will have been invested in installing Type 2 sockets and Type 3 sockets, respectively. Considering announced plans of Member States for the deployment of charging infrastructure as shown on Figure 2 (and in Appendix 4), and assuming no change in the preference of Member States regarding the type of socket deployed, an additional 508 million € and 4.1 billion € would be spent by 2020 on installing Type 2 and Type 3 charging points, respectively.

132. On the other hand, the cost of ensuring interoperability of existing infrastructure could be estimated based on information concerning retrofitting costs provided by stakeholders[118]. Assuming adaptation cost of 250 € per private e-mobility point, and of 3,000 € per public charging station, requiring the use of a single type of socket from 2013 onwards could imply 45 – 50 million € total retrofitting costs for the charging infrastructure foreseen by the end of 2012.

133. **Policy Option 2** would almost certainly be sufficient to affect the choices of Member States that have not yet started significantly deploying one or other type of socket. However, it would likely prove ineffective to alter the choice of socket-outlet in many of the countries mentioned in Table 1, who are rather advanced in deployment and would face the difficult trade-off between substantial retrofitting costs (amounting to around half of their total investment costs so far) on the one hand, and lack of interoperability of their charging infrastructure on the other.

134. Under **Policy Options 3 and 4**, Member States would be required to adopt a single type of socket EU-wide, and it would correspondingly necessitate the retrofitting of existing charging points. The cost of these options would be as stated in paragraph 132, while the benefits would be that investments become 'future-proof' against issues of interoperability.

5.1.1.2. Estimated costs of infrastructure deployment

135. This section assesses the costs of deploying a minimum infrastructure network for electricity, hydrogen and natural gas (LNG and CNG) based on the unit cost of a recharging point, refuelling station and bunkering facility as provided by stakeholders, and shown in Appendix 6. The unit cost per smart private charging point can be estimated to be around 520 €; while for a publicly accessible charging point it is approximately 5,280 €. The cost of hydrogen refuelling station is 1.6 million €. The unit cost of a small-scale bunkering facility is 15 million €, the cost estimate used for LNG fuelling station is 400,000 € and the cost estimate for CNG fuelling station is 250,000 €. These costs are high-end estimates, not fully taking into account likely decreases due to learning effects (Table 8).

[118] The unit cost per smart private charging point can be estimated to be around 520 €; while for a publicly accessible charging point it is approximately 5,280 €. The cost of hydrogen refuelling station is 1.6 million €. The unit cost of a small-scale bunkering facility is 15 million €, while the cost estimate used for LNG fuelling station is 400,000 €. The estimate retrofitting costs are derived in paragraph 0.

Table 8: Estimated investments costs under each Policy Option[119]

	Number of additional charging points/fuelling stations	Policy Option 2	Policy Option 3	Policy Option 4
	thousands	*Million €*		
Electricity (Total)	**8,000**	**3,984**	**7,968**	**7,968**
of 90% private	7,200	1,872	3,744	3,744
of 10% publicly accessible	800	2,112	4,224	4,224
Hydrogen	**0.077**	**-**	**-**	**123**
LNG for vessels	**0.139**	**1,140**	**2,085**	**2,085**
LNG for trucks	**0.144**	**-**	**-**	**58**
CNG for vehicles	**0.654**	**-**	**-**	**164**
Estimated investment costs of infrastructure deployment		5,124	10,053	10,398
Estimated retrofitting costs		-	45 – 50	90 –100
Estimated total investments costs		**5,124**	**10,103**	**10,498**

136. The breakdown per Member State of the estimated investment costs under Policy Option 4 is provided in

119 Source: Idem footnote 118.

Table 9 and

Table 10. As further elaborated in Section 5.1.1.3, the choice of who will finally bear these investments costs will depend on the Member State's policy decisions among a large variety of possible measures. These policy decisions will also determine what the precise incentive mechanisms are that will ensure effective delivery of the targets.

Table 9: **Estimated investment costs of recharging points per Member State under Policy Option 4**

MS	Total charging points (thousands)	Publicly accessible charging points (thousands)	Investment cost for publicly accessible charging points (Million €)	Private charging points (thousands)	Investment cost for private charging points (Million €)	Total investment costs (Million €)
BE	207	21	109	186	97	206
BG	69	7	36	62	32	69
CZ	129	13	68	116	60	128
DK	54	5	29	49	25	54
DE	1503	150	794	1353	703	1497
EE	12	1	6	11	6	12
IE	22	2	12	20	10	22
EL	128	13	68	115	60	127
ES	824	82	435	742	386	821
FR	969	97	512	872	453	965
IT	1255	126	663	1130	587	1250
CY	20	2	11	18	9	20
LV	17	2	9	15	8	17
LT	41	4	22	37	19	41
LU	14	1	7	13	7	14
HU	68	7	36	61	32	68
MT	10	1	5	9	5	10
NL	321	32	169	289	150	320
AT	116	12	61	104	54	116
PL	460	46	243	414	215	458
PT	123	12	65	111	58	123
RO	101	10	53	91	47	101
SI	26	3	14	23	12	26
SK	36	4	19	32	17	36
FI	71	7	37	64	33	71
SE	145	15	77	131	68	144
UK	1221	122	645	1099	571	1216
Total	**8000**	**800**	**4224**	**7200**	**3744**	**7968**

Table 10: **Estimated investment costs of LNG, CNG and hydrogen refuelling stations per Member State under Policy Option 4**

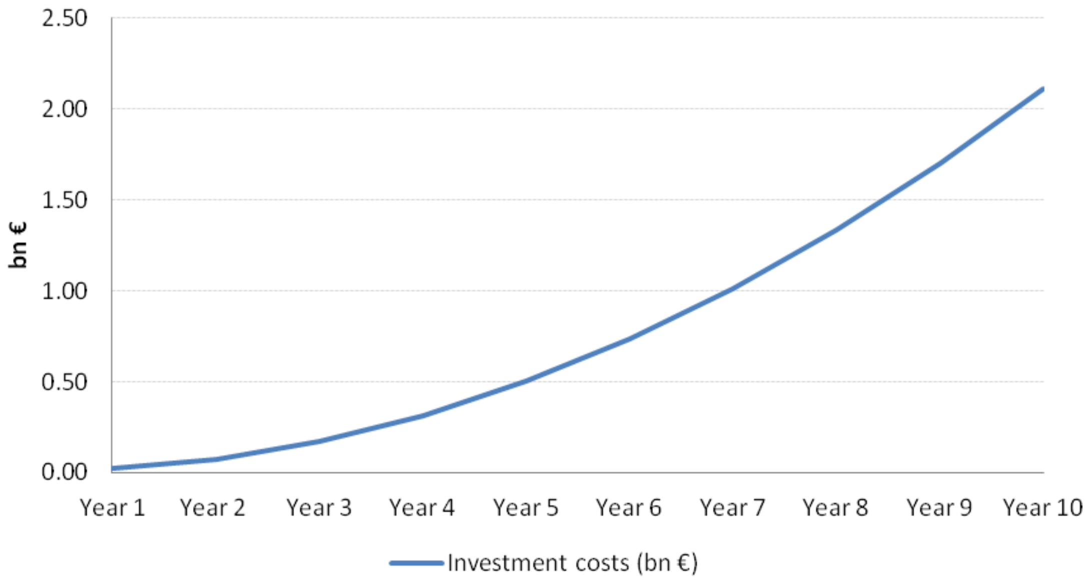
MS	Estimated number of additional LNG bunkering facility in	Estimated number of additional LNG bunkering facility in	Estimated number of additional LNG refuelling points on motorways	Estilared number of additional CNG refuelling points	Estimated number of additional hydrogen refuelling stations	Total estimated investment costs (Million €)
BE	3	6	2	10	3	143
BG	1	2	5	0	0	47
CZ	0	4	4	0	4	68
DK	2		2	20	existing>target	36
DE	5	17	25	0	existing>target	340
EE	1		0	15	0	19
IE	3		3	22	0	52
EL	4		6	40	6	82
ES	10	1	5	90	18	218
FR	7	7	18	105	19	274
IT	12	2	12	0	existing>target	215
CY	1		0	4	0	16
LV	2		4	20	0	37
LT	1		3	21	0	21
LU		1	0	0	0	15
HU		2	4	21	0	37
MT	1		0	1	0	15
NL	3	5	1	0	existing>target	120
AT		2	4	0	4	38
PL	2		15	51	0	49
PT	3		3	23	0	52
RO	2	3	6	44	0	88
SI	1		1	5	existing>target	17
SK		2	3	6	0	33
FI	3		6	60	6	72
SE	5		12	0	17	107
UK	13		0	96	existing>target	219
Total	**85**	**54**	**144**	**654**	**77**	**2,430**

137. Further analysing these costs, it is clear that investment is made most optimally if its profile is gradual and if it is more or less parallel with the vehicle uptake. In fact, using the example of electric vehicle uptake, modelling results show that initial investment costs would amount to around 20 million € in the first year, then 70 million €, and so on, gradually reaching 2.1 bn € by the final year. The net present value of the total investment in charging infrastructure would be 6.1 bn € under **Policy Option 4** (Table 11 and Figure 9).

Table 11: Illustrative investment profile parallel to vehicle uptake under Policy Option 4

	Additional cost of private charging points per year (bn €)	Additional cost of public charging points per year (bn €)	Total investment costs per year (bn €)	Discounted investment costs per year (bn €)
Unit cost	*520*	*5280*		
Discount rate		*4%*		
Year 1	0.01	0.01	0.02	0.02
Year 2	0.03	0.04	0.07	0.07
Year 3	0.08	0.09	0.17	0.16
Year 4	0.15	0.17	0.31	0.28
Year 5	0.24	0.27	0.50	0.43
Year 6	0.34	0.39	0.73	0.60
Year 7	0.47	0.54	1.01	0.80
Year 8	0.63	0.71	1.33	1.01
Year 9	0.80	0.90	1.70	1.24
Year 10	0.99	1.12	2.11	1.48
Total	**3.7**	**4.2**	**8.0**	**6.1**

Figure 9: Illustrative investment profile under Policy Option 4



138. In addition to these costs, there could be possible impacts on the electricity grid. To illustrate these impacts, it can be shown that the simultaneous charging of 100 EVs will generate a peak load of 300 kW, 2000 kW or 17500 kW depending on the recharging form, which would require the installation of 1, 4 or 35 additional transformers and, in the last case, massive distribution network reinforcement[120]. In the case of France, 2 million EVs could, if recharged simultaneously at around 19:00, generate an electricity demand equivalent to 10% of the current peak load, although their annual consumption would only represent 1-2% of total annual electricity

120 GEODE position paper on Electric Vehicles, April 2010.

consumption[121]. On average, the additional distribution grid investment needs could amount, according to estimations by Électricité Réseau Distribution France, to 1 billion € per a million EVs, assuming only less than 10% of fast charging stations.

139. At the same time, Israel Electric Company calculated in 2008 that grid reinforcement costs could go down to less than 200 million € per a million EVs, if managed recharging solutions were chosen. Hence, if infrastructure for EVs allows managed charging, the need to develop the electricity system further to meet this increasing demand will be limited and these vehicles can contribute to the flexibility of the electricity system. Furthermore, controlled charging will mean less need to build additional peak (and expensive) electricity production capacity[122].

140. For these reasons, an additional sensitivity analysis, shown on Table 12, has been carried out on how requirements on private charging points to be smart meters would affect these investment costs. By assuming varying rates (25% to 50%) of deployment of charging points capable of Mode 3 charging[123] instead of 100% as done in Table 8, and taking into account that all public charging points should be smart, the investment costs would decrease by only around 15%.

121 Assuming no other investments in electricity storage facilities such as stationary electricity storage.

122 A more detailed assessment of the grid-related requirements for the recharging infrastructure has been carried out as part of the Grid-for-Vehicles (G4V) project (http://www.g4v.eu/index.html).

123 Mode 3 charging enables vehicle-to-grid communication.

Table 12: Sensitivity analysis on investments costs regarding smart charging under each Policy Option[124]

	Number of additional charging points/fuelling stations	Cost (high penetration of smart charging)	Cost (medium penetration of smart charging)	Cost (low estimate of smart charging)
	thousands	*million €*		
Electricity				
Total (full deployment)	**8,000**	**7,968**	**7,032**	**6,564**
of 90% private	7,200	3,744	2,808	2,340
of 10% publicly accessible	800	4,224	4,224	4,224
Total (partial deployment)	4,000	3,984	3,516	3,282
Hydrogen	**0.077**	**123**	**123**	**123**
LNG for vessels	**0.139**	**2,085**	**2,085**	**2,085**
Partial deployment	**0.076**	**1,140**	**1,140**	**1,140**
LNG for trucks	**0.144**	**58**	**58**	**58**
CNG for vehicles	**0.654**	**164**	**164**	**164**
Estimated investment costs in PO2		**5,124**	**4,656**	**4,422**
Estimated investment costs in PO3 [125]		**10,053**	**9,117**	**8,649**
Estimated investment costs in PO4 [126]		**10,505**	**9,462**	**8,994**
Cost (high estimate): All EV charging points that count towards the mandated number are capable of Mode 3 charging ("smart charging").				
Cost (medium estimate): Half of private charging points that count towards the mandated number are capable of Mode 3 charging ("smart charging").				
Cost (low estimate): 25% private charging points that count towards the mandated number are capable of Mode 3 charging ("smart charging").				

141. With respect to the interaction of LNG bunkering facilities and the existing gas infrastructure, it is assumed that there is little interaction. Only at LNG regasification terminals, which are built to feed natural gas into the transmission network and could in the future also provide refuelling services to ships, may there be an impact on the gas network. However, as quantities of LNG for shipping will be relatively small compared to the overall gas market in the EU to have an impact on the price. At the same time, they may make investments in LNG regasification terminals more profitable for project developers that do not only gasify LNG for inland consumption, but also sell LNG as a transport fuel. Therefore, it is assumed that, as

124 The unit cost per smart private charging point can be estimated to be around 520 €; while for a publicly accessible charging point it is approximately 5,280 €. The unit cost assumed per non-smart private charging point is € 260.

125 Estimated retrofitting costs to be added € 45-50 million.

126 Estimated retrofitting costs to be added € 90-100 million.

demand for LNG as fuel increases, LNG regasification terminals can satisfy the increased demand for LNG without impacting the operation of the gas network.

5.1.1.3. Source of funding for infrastructure deployment

142. The recommendation/mandate addressing problem driver 2 ("Investment uncertainty hinders the deployment of recharging/refuelling infrastructure for electricity, hydrogen and natural gas (LNG and CNG)") and calling for a minimum number of recharging/refuelling points could be implemented in various ways by Member States. While there will be no implication for the EU budget, national budgets may be affected depending on the specific measures chosen by the Member States.

143. Member States could ensure implementation and thereby compliance through a variety of measures, without necessarily involving public spending. In addition to the measures described in Appendix 9, the following examples reflect some of the initiatives already taken by national or local authorities:

144. Minimum requirements in building codes: national law could require a minimum percentage of individual parking places to be equipped with independent electric lines. The obligation could concern all new buildings and gradually extend to existing buildings, notably office and business premises[127].

145. Obligations on DSOs to build-up the recharging points required by authorities

146. Conditions for parking lots permits: the authorisation to open/operate parking lots in public venues (shopping malls, governmental facilities, airports, restaurants, cinemas, hotels, major retail outlets) could be made conditional on the installation of a minimum percentage of charging stations.

147. Schemes that certify the environmental performance of businesses could acknowledge and promote the installation of charging points open to employees/customer.

148. Joint investments between port authorities and port terminal operators for the provision of LNG terminals.

149. Building companies, concession holders, and other operators facing obligations to provide recharging/refuelling points would likely pass (part of) the costs onto consumers; however these users would still face lower operating costs for their vehicles, than those relying on conventionally fuelled cars[128] and ships.

150. Electric utilities, carmakers and mobility service providers would also have an interest in investing in charging stations. For electric utilities, in particular, electromobility does not only have the advantage of additional demand, but also the benefits of peak-load control highlighted in §139[129].

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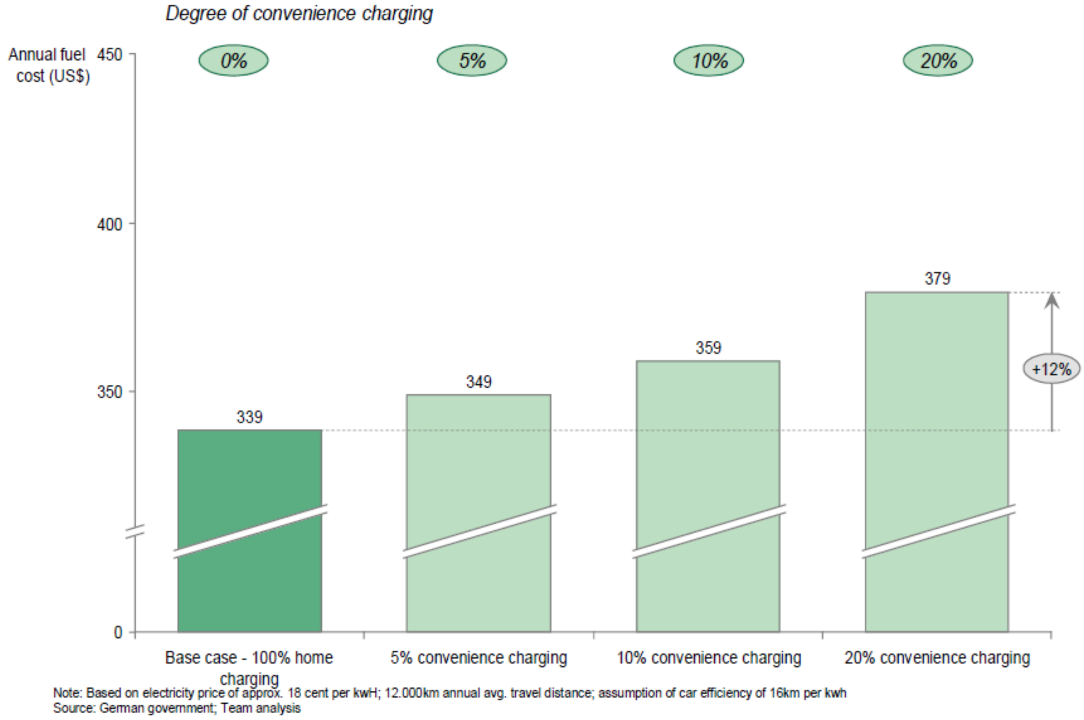
127 In France, the national target of 4.4 million charging points supported by a national law adopted in 2011. The national law (JORF n°0172 du 27 juillet 2011 Texte n°11: Décret 2011- 873 du 25 juillet 2011) requires 10% of existing individual parking to be equipped with independent electric lines to low charging points in new buildings from January 2012 and in existing buildings from January 2015.

128 See for example the calculation of energy costs on a fuel-tax parity basis provided in Figure 4.2A.7 in EUROPIA White Paper on Fuelling EU Transport, available at: http://www.europia20years.eu/uploads/Europia_White_paper/

129 Electric vehicles have the advantage of an on-board storage system and therefore the possibility to adapt their charging schedule to demand and supply conditions.

151. Partnerships for demonstration projects between utilities and vehicle manufacturers are already present in many Member States. Typically, the customer has to pay a fee for using the charging service that often exceeds the electricity cost by a mark-up, and these enable the investor to recover the cost of the installation[130]. As shown on Figure 10, the impact of these additional costs on total fuel costs is limited. Other business models foresee access to charging stations as part of a package that includes the purchase or lease of an electric vehicle, or is granted choice of an electricity provider[131].

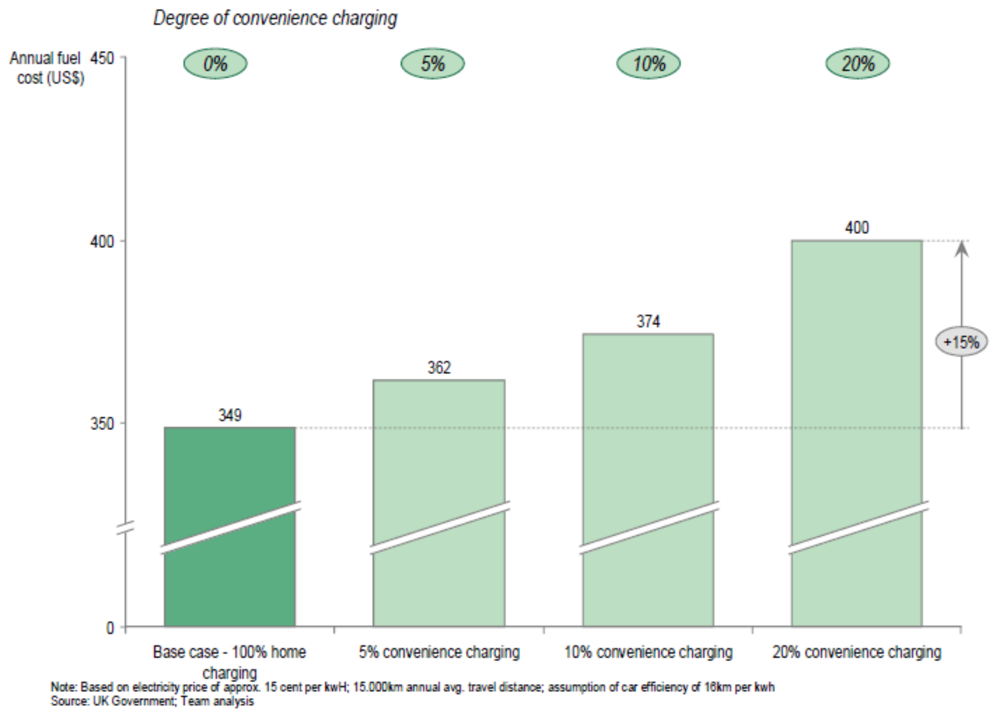
Figure 10: Impact of using public charging points applying a mark-up on electricity price on total fuel cost of end-users – example of Berlin and London[132]



130 Assuming a utilization of 205, which means that each charging station is used at least approx.. 5 hours per day, approx.. a 50% mark-up over private household electricity prices is required to achieve positive returns. Source: Idem footnote 66.

131 See for example Ecotricity UK, http://www.ecotricity.co.uk/for-the-road/frequently-asked-questions

132 Figure 3.2.2.2 in source shown in footnote 66.

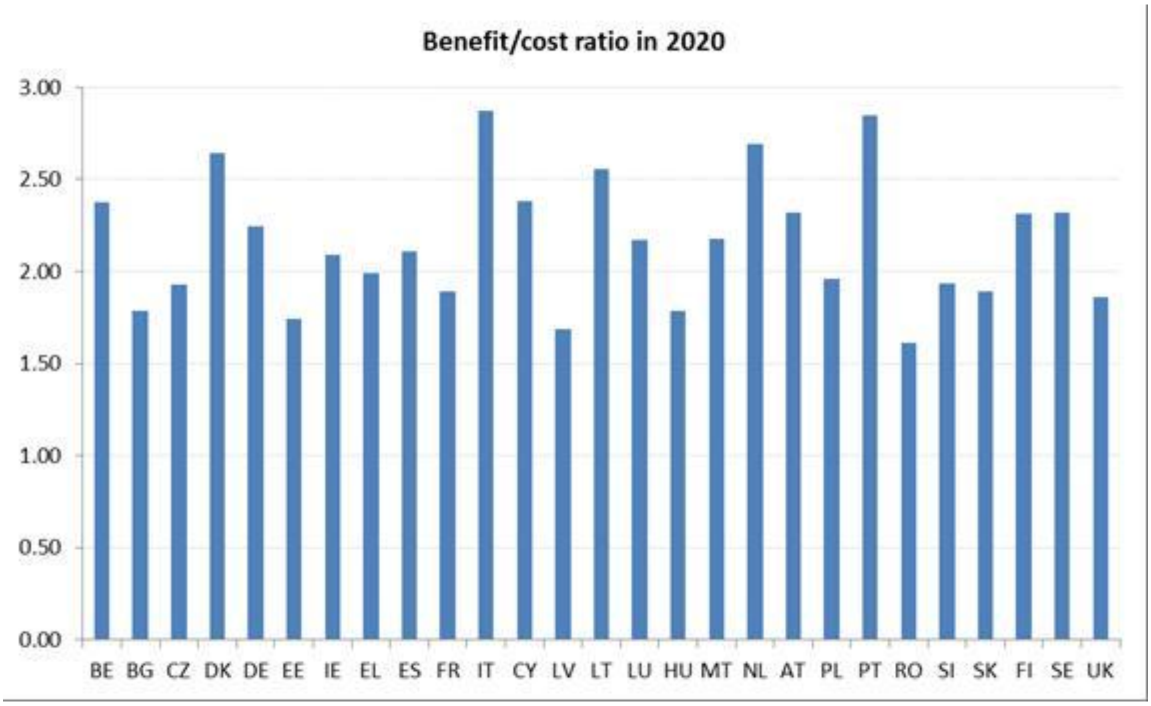


5.1.1.4. Cost/benefit analysis of infrastructure deployment

152. The costs shown on Table 8 and on Table 12 need to be compared to the benefits of deploying this minimum network of alternative fuels infrastructure. For this purpose, the approach described in §120-130 and in Appendix 10 has been used.

153. The results of this cost-benefit analysis are shown on Figure 11. This limited approach does not take into account the benefits of reduced oil dependency, increased competitiveness and better functioning of the internal market. Nonetheless, even under the policy option that implies the most extensive deployment of alternatives fuels infrastructure (**Policy Option 4**), comparing the benefits of choosing deployment of infrastructure to the costs of other possible policies that can address the existing disutility of alternative fuel vehicles and vessels results in higher than 1.5 ratios in all Member States.

Figure 11: Indicative benefit-to-cost ratios across Member States[133]



5.1.2. Macroeconomic impacts

154. Under **Policy Option 1**, the pace of electrification in the transport sector is projected to remain slow: electric propulsion in road transport does not make significant inroads by 2050. As a consequence, the EU transport system would remain extremely dependent on the use of fossil fuels. Oil products would still represent 90% of the EU transport sector needs in 2030 and 89% in 2050.

155. **Policy Option 2, 3 and 4**, open up the possibility for an alternative path for the transport system with much faster deployment of alternative fuels. The main macroeconomic effect would be on reduced oil consumption and avoided fuel expenditure. The impact of this reduced fuel expenditure depends on the alternative use of these resources. Part of the savings would have to finance investment in fuel infrastructure and in the extra cost alternative fuel vehicles, which remain more expensive than the conventional models. Expenditure in infrastructure would benefit activity through the multiplier effect, whereas the expenditure for vehicles will benefit EU economy in proportion to the EU manufacturers' market share in those vehicles. Some macroeconomic effects can also be expected as a result of lower operating costs of vehicles for businesses and consumers.

156. The modelling analysis carried out for the White Paper showed that as a result of the implementation of policy measures presented, final consumption of oil by transport is expected to decrease by about 70% by 2050, relative to business-as-usual. Based on the results of economic modelling undertaken for the purposes of this Impact Assessment, described in detail in Appendix 10, avoided fuel use increases progressively over the decades 2010-2030 from about 610 million € per year in 2020 to about 2.3 bn € per year in 2030 under **Policy Option 2**, 1.7 bn € per year in 2020 to 4.6 bn € per year in 2030 under **Policy Option 3**, and 4.2 bn € per year in 2020 to 9.3 bn € per year in 2030 under **Policy Option 4**.

133 Results of PRIMES-TREMOVE model.

157. In addition, it is possible to estimate the economic benefits of improved energy security by calculating the cost of achieving a similar improvement in energy security through the establishment of a (additional) strategic stock of oil. The Joint Research Centre estimated this cost to be about 130 € per tonne of oil equivalent (upper bound value). Based on this, the estimated aggregate energy security benefit increases gradually over the decades 2010-2030 from 150 million € per year in 2020 to 460 million € per year in 2030 under **Policy Option 2**, 410 million € per year in 2020 to 915 million € per year in 2030 under **Policy Option 3**, and 1.04 bn € per year in 2020 to 1.9 bn € per year in 2030 under **Policy Option 4**.

158. The main difference between **Policy Option 2 and 3** consists in the different probability of achieving the same results through recommendations or mandates: Policy Option 2 is considered much less effective on the basis of the arguments presented in §120-121. Similarly, the difference between **Policy Option 3 and 4** is the smaller likelihood of deployment of a hydrogen refuelling network in Policy Option 3 as well as for LNG for trucks and CNG for road ranspor vehicles: the macroeconomic impact could be significant if these technologies gains market acceptance, although this is subject to greater uncertainty than the case of electricity and LNG for vessels. The high potential gains should however be assessed against the relatively small investment costs (123 million €).

5.1.3. Impact on competitiveness

159. This section identifies the potential impacts of Policy Options 1-4 on the competitiveness of European manufacturers of alternative fuels infrastructure equipment, and of manufacturers of alternative fuel vehicles and vessels (hereinafter “manufacturers”), in terms of unit costs and pace of technological development in comparison to their global competitors.

160. The European automotive industry is a key industrial sector with a turnover of over €780 billion[134] and representing about 8% of European manufacturing value added. According to data from 2007, EU car makers hold around 27% of global market share, but there are concerns on the ability to maintain this position in new vehicle technologies[135].

161. Today the world market share of electric, LNG for vessels and trucks and hydrogen vehicles is very limited, with less than a 0.1% of vehicles sold in 2011. Regarding natural gas vehicles; in 2011 there were 15.2 million in the world, representing 1.2% of the total stock. The main markets for electric vehicles are Japan and the United States (Figure 13). However, according to projections by IEA, the sales of electric vehicles alone could reach close to 7 million per year in 2020, 17.7 million in 2025 and 33.3 million in 2030. This represents a sizeable market opportunity for car makers and manufacturers of transport equipment, in particular in the fast growing emerging markets (Figure 12).

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134 SEC(2009) 1111 final, Comission Staff Working Document, European Industry in a Changing World Updated Sectoral Overview 2009.

135 This is supported by the conclusions of a recent study "Competitiveness of EU Automotive Industry in Electric Vehicles” (idem footnote 60): "*European companies have performed well in terms of patent applications in the last few years, which is reflected in the increased public reporting and perception. However, even if this is a noticeable upward trend in Europe, it is doubtful that the European companies will catch up with the Asian companies within a few years*."

Figure 12: EV/PHEV total sales by region through 2020[136]

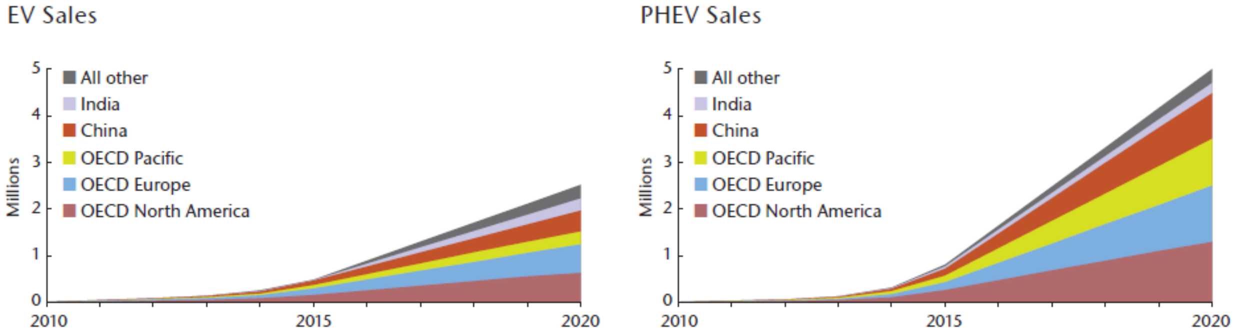
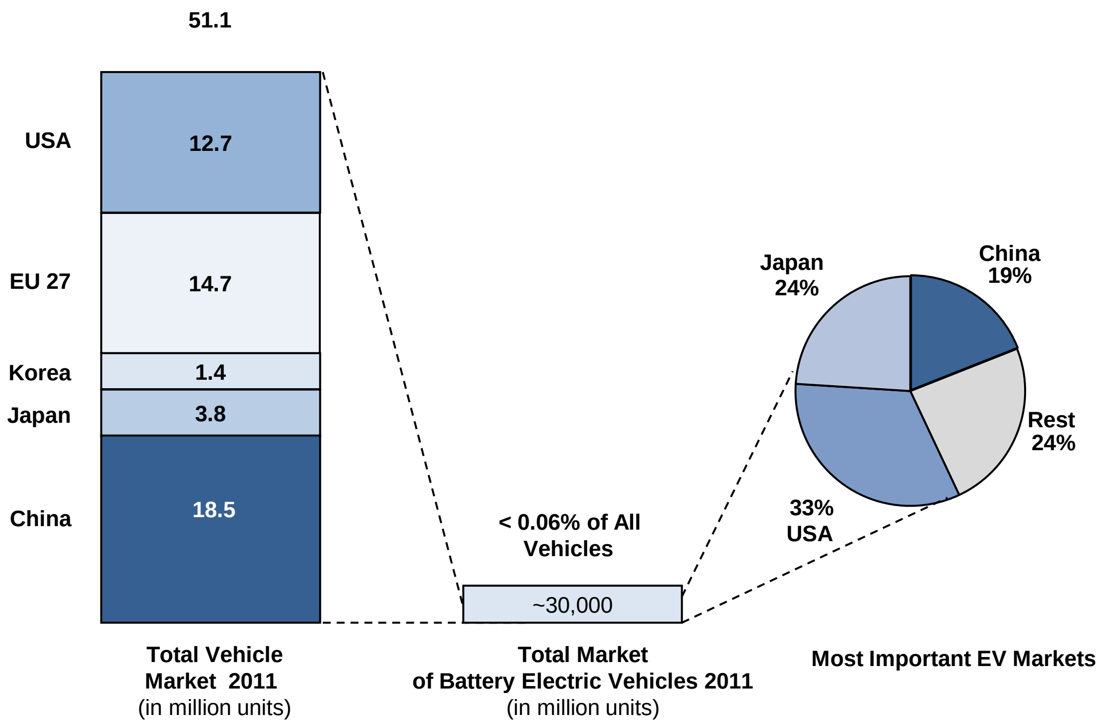


Figure 13: Current Sales of Electric Vehicles[137]



162. Under **Policy Option 1**, manufacturers will be directly affected by the lack of EU-wide application of standards and by the un-coordinated demand for their products, as they will not able to reap the benefits of mass-producing for a single European market, but would need to cater for national requirements. In particular, the learning effects and technology development associated with mass production could be negatively affected. As illustrated on Figure 14, manufacturing rates are an essential

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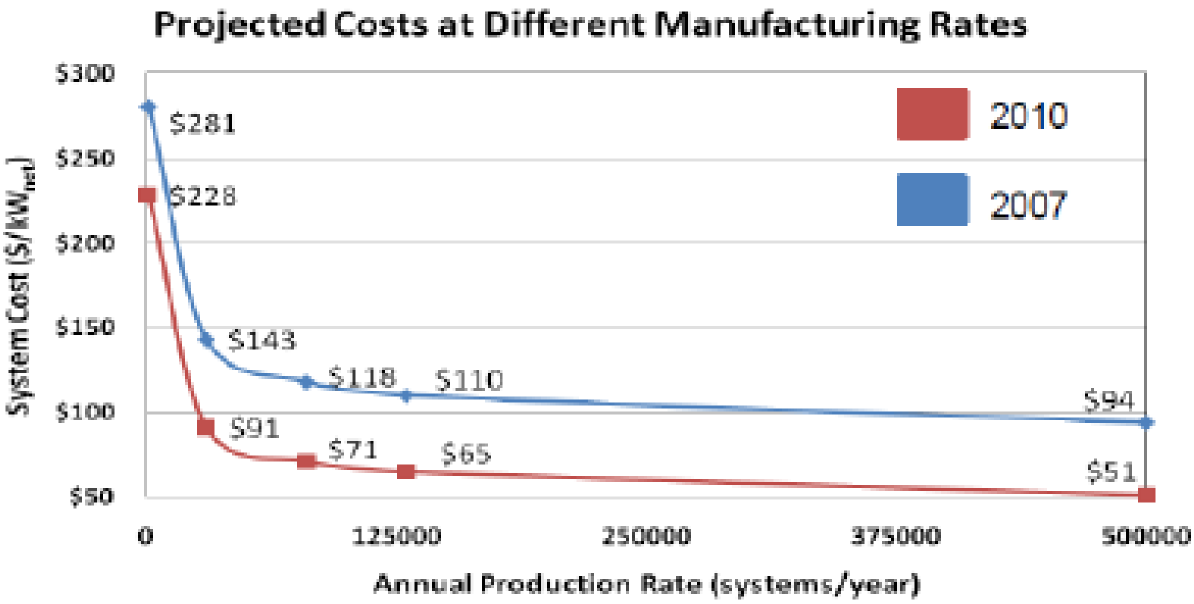
136 Source: Figure 5 in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

137 Idem footnote 60.

factor in achieving competitive prices of recharging/refuelling equipment, vehicles and vessels.

Figure 14: Impact of mass production on unit costs in the case of FCEVs[138]



163. These impacts would disadvantage European firms vis-à-vis those producers that can optimise their production processes due to their presence in large and uniform markets such as United States and Japan. The competitiveness of EU manufacturers would then likely be lower when aiming to enter these or other emerging markets. Currently, an assessment of patent applications shows a very recent catching up of European manufacturers on electric and hybrid vehicles in the EU (Figure 15).

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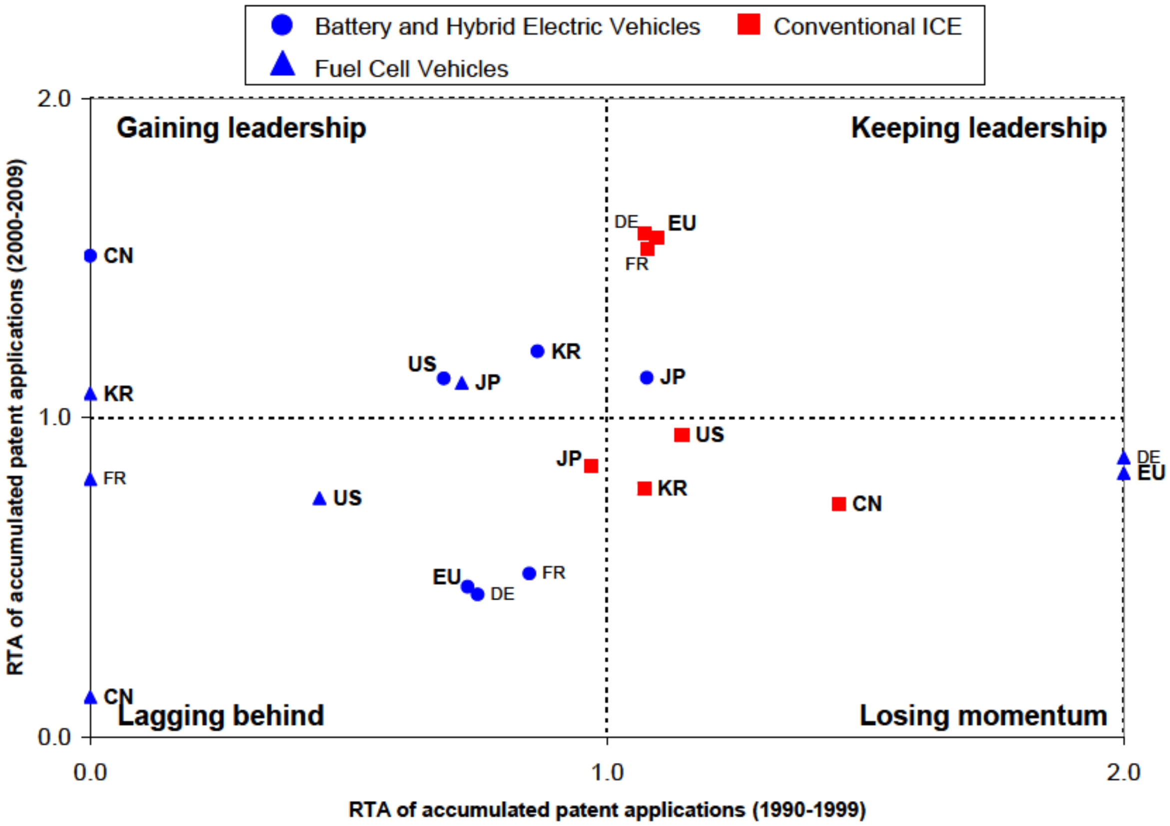
138 Projected costs based on analysis by the United States Department of Energy. Source: United States Department of Energy, 2011, 2010 Fuel Cell Technologies – Market Report, Figure 3, available at http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/2010_market_report.pdf

Figure 15: The dynamics of the Revealed Technological Advantage Index for different technologies for selected car manufacturers[139]



164. Under **Policy Option 2**, the economies of scale that could be achieved by manufacturers would likely be higher, although not corresponding to the whole EU market for reasons explained in paragraph 133. Further benefits could be achieved under **Policy Options 3** for EVs and ships and barges capable of running on LNG and further still under **Policy Option 4**, for the manufacturers supplying FCEVs, LNG trucks and CNG road transport vehicles.

5.1.4. Impact on SMEs and micro-enterprises

165. There is generally limited quantitative evidence on the impact of deploying alternative fuels on SMEs and micro-enterprises. However, these companies dominate the road haulage and the taxi market, which suffer greatly from high oil prices. More generally, SMEs and micro-enterprises are largely present in traditional sectors of activity (retail, personal services, construction and maintenance) for which transport costs typically represent a significant share of overall costs. SMEs and micro-enterprises often have no alternative to the use of personal vehicles and LDV and contrary to large enterprises have more difficulty in optimising logistic costs and finding alternative arrangements for transport. Although the use of alternative fuel vehicles requires a larger initial investment in the vehicle, many studies show that for the high mileage typically associated with professional use, the lower operating costs allow to amortise the extra expenditure on the vehicle in a shorter time period.

139 Source: JRC-IPTS based on the EPO-esp@cenet database for 21 world car manufacturers using a keyword-based search strategy developed by Oltra and Saint Jean (2009), as shown on Figure 7 in Wiesenthal. et al, 2011, Mapping innovation in the European transport sector, available at: http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/26129/1/lfna24771enn.pdf

166. A recent paper on the French EV market by the OECD/ITF[140] has found that currently:

(1) The additional consumer cost of a compact or sedan EV is around € 4000-5000 over the vehicles lifetime;

(2) The consumer saving of a compact EV van is around € 4000 compared to a conventional vehicle,

(3) and concluded that "Under these conditions, one might expect that a market already exists for BEV vans if potential buyers have confidence in the advertised driving ranges and dealer support for these vehicles."

167. From this point of view, SMEs and micro enterprises would benefit from the policy proposals since many of them could profit from the reduced operating costs of alternative fuel vehicles. **Policy Option 4** would be the most favourable, although the LNG infrastructure for ships would mainly concern large enterprises and thus provide only a small advantage to SMEs compared to **Policy Option 3**.

168. The proposals, however, do not concern SMEs and micro-enterprises only from a cost reduction perspective. Although the large car and vessels manufacturers are more directly affected, a lot of the components and assisting technologies – such as fuel cells, batteries, power electronics, gas liquefaction technologies, electrolysers for hydrogen production – come from SMEs.

169. Moreover, alternative fuel vehicles have many advantages, but do not exactly reproduce the characteristics of the conventionally powered vehicles. For this reason, their deployment will be associated with new business models and modified behaviour of users. In fact, an alternative *system* of mobility will gradually develop, characterised to a larger extent by multimodality, mobility service providers and IT technologies.

170. SMEs will have many opportunities in a transport system with such characteristics as service providers, software developers and manufacturers of equipment and components; indeed SMEs play an important role in green markets and the related areas of eco-innovation and resource efficiency[141]. Green jobs are mostly created in small and medium enterprises.

171. Whilst eco-innovation is found one of the strongest drivers for growth and value generation of SMEs, uncertain demand from the market is considered by far the largest barrier to an accelerated market uptake, as shown in a recent Eurobarometer poll carried out for DG Environment[142]. The value of the proposals, namely of **Policy Option 3 and 4**, in reducing uncertainty and helping the build-up of new markets with alternative fuel infrastructure would therefore first and foremost benefit to SMEs and create new jobs there.

5.1.5. Impact on functioning of the internal market and market development

172. Imposing technical specifications at an early stage of market development could thwart innovation and act as a barrier to entry for providers having developed

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[140] International Transport Forum, 2012, Electric Vehicles Revisited – Costs, Subsidies and Prospects, Discussion Paper 2012-03, available at: http://www.internationaltransportforum.org/jtrc/DiscussionPapers/DP201203.pdf

[141] http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/index_en.htm

[142] http://ec.europa.eu/public_opinion/flash/fl_315_en.pdf

alterative solutions. In a later phase, however, the lack of technical standards could become a serious obstacle to wide acceptance of a product and the reaping of economies of scale; dissimilar national requirements could be used to limit competition[143] on the market for equipment and vehicles, by becoming a barrier to the free movement of goods.

173. In the field of recharging/refuelling infrastructure, the phase of development can be considered completed and the type of technology involved is not particularly sophisticated. Eventually, a standard is likely to be adopted, since the persistence of different technical solutions would represent a serious obstacle to pan-European mobility and would not be tolerable. This however might imply considerable stranded costs and additional expenditure for adaptation if a decision is delayed. This is the likely scenario under **Policy Option 1** (cf. §66-68).

174. Under **Policy Option 2**, the Commission would express its preference for one specific technical standard without imposing it. This is an inferior solution with respect to either **Policy Option 3-4 or Policy Option 1**: if the recommendation is followed, there would be no difference in impact with respect to a mandate, but if the recommendation is not (or only partially) followed the objective would not be reached. Moreover, by recommending a specific solution it would not facilitate any alternative agreement in the industry as theoretically possible under Policy Option 1. In any event, many voices have already been raised in favour of the establishment of standards without any decision being taken: under Policy Option 1 the deadlock is not likely to be broken within the desirable timeframe.

5.1.6. Impact on users of alternative fuel vehicles and vessels

175. The impact on households and non-business users of the various policy options is analogous to the impact on SMEs and micro-enterprises as described in §165-167. Under **Policy Option 1**, users would have more limited possibilities to switch to alternatives fuels in response to soaring gasoline and diesel prices. These alternatives are increasingly expanded under **Policy Option 2, 3 and 4**.

176. **Policy Option 3 and 4** would not only provide a more extended network, but ensure that this network covers all Member States and has the same technical specifications. This would allow wider commercialisation of vehicles with lower production costs to the benefit of users.

177. Ultimately, investors will have to recover the cost of infrastructure and will most likely do it by charging users. Accordingly, Policy Option 3 and 4 imply a 'premium' over Policy Option 1 and 2, for the availability of a wider network. The modelling exercise, however, suggests that this premium is inferior to the additional utility for the users.

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143 This issue has been *inter alia* recognised in Directive 2008/57/EC of the European Parliament and of the Council of 17 June 2008 on the interoperability of the rail system within the Community (Recast) in its recitals: "*(7) There are major differences between the national regulations and between internal rules and technical specifications which the railways apply, since they incorporate techniques that are specific to the national industries and prescribe specific dimensions and devices and special characteristics. This situation prevents trains from being able to run without hindrance throughout the Community network. (8) Over the years, this situation has created very close links between the national railway industries and the national railways, to the detriment of the genuine opening-up of markets. In order to enhance their competitiveness at world level, these industries require an open, competitive European market*."

178. An additional advantage to users is related to cross-border mobility. A significant number of cross-border journeys, in particular with holiday purpose, take place every year in the EU. The large majority of them are undertaken using passenger cars[144]. As for road freight, the volume of intra-EU cross-border transport increased from around 1,000 billion tonne km in 1995 to over 1,500 billion tonne km in 2005[145]. Around 10,000 ships are currently used for European Short Sea Shipping. Under Policy Option 1, the possibility of using alternative fuel vehicles and vessels to undertake these trips would be severely limited due to first, the lack of harmonised standards on recharging and refuelling infrastructure; second, the lack of sufficient infrastructure.

179. The various Policy Options would impact the users involved in these cross-border trips differently: Policy Option 2 would enable seamless mobility only across Member States that follow the Commission's recommendations, while under Policy Option 3 the possibility of pan-European mobility would be ensured for all EVs and for all ships and barges using LNG. Policy Option 4 would in addition cater for the users of the main road transport corridors with LNG trucks, it would ensure enough coverage for CNG vehicles, and would also enable cross-border mobility in-between more than 15 Member States that already have hydrogen refuelling stations on their territory.

5.2. Social impacts

180. The assessment of social impacts tries to identify the possible effect of the proposal on four dimensions: employment; workers skills; social cohesion and health.

181. The direct impacts on employment would have to be estimated in the sectors related specifically to alternative fuels infrastructure. However, the main manufacturers of equipment for alternative fuels infrastructure are very large global companies (Siemens AG providing work for 360,000 employees; General Electric, employing more than 280,000 people; ABB with number of employees over 130,000; Schneider Electric, employing some 124,000 people etc), with a complex and wide portfolio of products and services. Due to these characteristics, it is very difficult to determine the number of people employed strictly in relation to the manufacturing of alternative fuels infrastructure. An overview of current employment figures is nonetheless provided in Appendix 11.

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144 Studies, such as Peeters et al, 2004, European tourism, transport and environment, estimate that the car is the most important mode of transport used for tourism within the EU; and that the total number of passenger km related to tourism can represent up to 20% of total passenger transport due to the larger distances covered by these trips. Statistics are only available however for a small number of Member States. For instance in the case of the Netherlands: "*In 2008 the Dutch made 35.9 million holidays, of which 18.4 million, or 51,3%, abroad. In 54% of the holidays abroad, the private car was used, air travel made up 34% of the total, rail 4%, and coach 5% (CBS Statline, website).*" Non-holiday cross-border trips can be estimated to be less than 1% of the trips, less than 160,000 trips a day, 77% of which made on road. Source: Pieters et al, 2012, Cross-border Car Traffic in Dutch Mobility Models, available at:
http://www.ejtir.tudelft.nl/issues/2012_02/pdf/2012_02_02.pdf

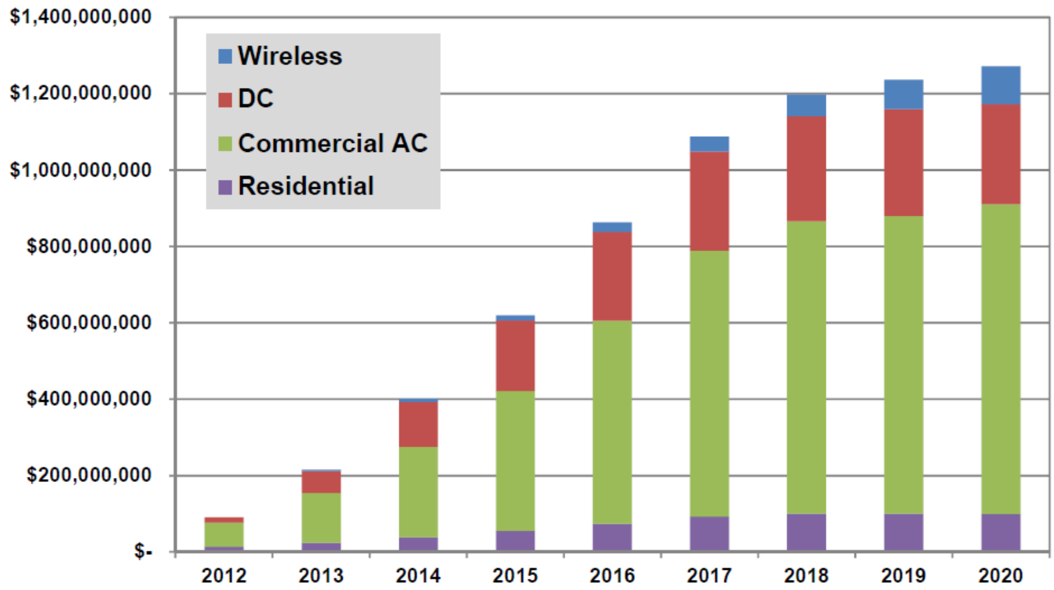
145 GHK and Technopolis, 2007, Evaluation of the Functioning of Regulation (EC) No 2679/98 of 7 December 1998 on the functioning of the Internal Market in relation to the free movement of goods among the Member States, study contarcted by DG Enterprise and Industry, available at:
http://ec.europa.eu/enterprise/dg/files/evaluation/regulation_report_en.pdf

5.2.1. Impact on employment levels

182. The procurement of investment goods and services for the build-up of infrastructure for the main alternative fuels would be mostly placed in Europe, given that the EU would be a first mover in alternative fuel infrastructure investments. Most part of the direct economic impact is associated with the creation of income for the sectors directly involved in the infrastructure build-up process, as well as additional employment.

183. Additional employment, with a wide range of job qualifications, will be created for a long period of co-existence of alternative and conventional fuels, through investment into alternative fuel infrastructure sectors, in particular in the areas of construction, manufacturing, electricity, information and communication technology, advanced materials, computer applications. In electricity, e.g. additional employment would mostly come from smart meters maintenance; additional employment in the LNG and CNG supply chain with high technical skills employees. According to recent market research[146], revenues related to EV charging infrastructure alone will grow from 72 million € in 2012 to more than 1 billion € by 2020, assuming the deployment of 4.1 million charging points (Figure 16).

Figure 16: EV charging equipment revenue by segment in Europe[147]



(Source: Pike Research)

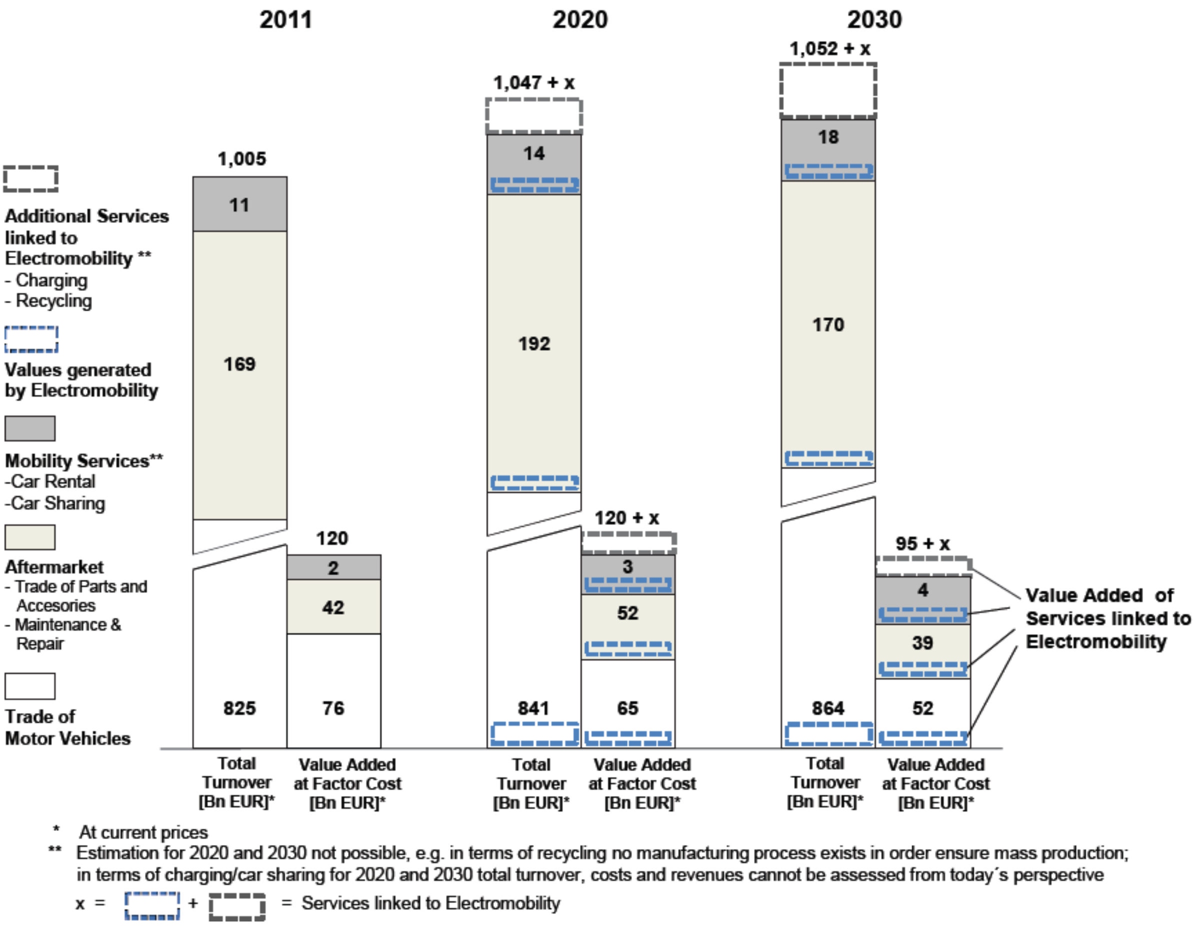
184. The wider impact on employment mirrors that of the economic impacts described in Sections 5.1.3 and 5.1.4. In sectors, such as automotive manufacturing and refining, employment will shift, on the long term, to new qualifications required by the alternative fuel technologies. This will follow the transformation of value added in the different sectors: for instance in the automotive sector, the importance of aftermarket services is foreseen to decrease while that of mobility services to

146 Pike Research, 2012, Electric Vehicle Charging Equipment in Europe.

147 Source: Chart 1.1 as provided in the Executive Summary of Pike Research, 2012, Electric Vehicle Charging Equipment in Europe.

increase (Figure 17). Several reports[148] indicate that a relatively stable core employment in the automotive industry in Europe can be expected with the deployment of EVs. The proximity of markets will be crucial in the selection of the manufacturing location for these vehicles, due to long and costly transport of batteries and finished EVs. Therefore it can be safely assumed, that the majority of vehicle assembly will concentrate in those areas which offer the greatest market demand.

Figure 17: Future shift in value added in automotive services[149]



185. The current decline of refining industry in Europe is related to improving energy efficiency in transport, and consequently less fuel consumption. A gradual market build-up for alternative fuels will, in the short term, not accelerate that development, but rather provide additional investments and employment. It will also prepare smoothly for a shift to alternative fuels, in the long term.

186. Early start of the adaptation of the job market to the new requirements with the support to the market build-up of alternative fuels will give a competitive advantage to Europe.

5.2.2. Impact on skills

187. Particularly the skills of the young professionals, which are needed in the field of R&D of the automotive companies, will need to change significantly. In the future,

[148] Fraunhofer IAO, 2012, Results of ELAB (Elektromobilität und Beschäftigung) Project.
[149] Idem footnote 41.

chemists and materials scientists will have significantly higher proportions among the employees than today[150].

188. Almost all manufacturers and suppliers focus on recruiting young professionals from universities, competing for the best graduates. Regarding the access to specialists, the responses of the different experts for the purposes of a recent study[151] undertaken for the Directorate-General Enterprise and Industry, vary considerably. While the large European manufacturers do not anticipate any problems concerning the acquisition and advanced education of employees, the majority of European associations, suppliers, and public policy makers expect a shortage of skilled labour, even in the long run.

5.2.3. Impact on social cohesion

189. Affordable mobility is an important component of social cohesion; currently this is largely dependent on the use of private vehicles. Under **Policy Option 1**, personal mobility by car will encounter increasing difficulties linked to high oil price and to limits to local pollutants and greenhouse gas emissions that will inevitably become more stringent. Whereas greater use of public transport, walking and cycling is advisable, not all situations allow these alternatives.

190. Some of the less affluent parts of society will be particularly penalised by these developments: people leaving in poorly connected areas or not having the means to purchase more modern and performing vehicles. Middle income groups also spend a higher proportion of their income on transport fuel[152].

191. Alternative fuels vehicles will be initially targeted to 'early adopters'[153] which typically belong to high income groups. They will also be a relatively small number up to 2020. Accordingly, **Policy Option 2, 3** and **4**, will not have a significant direct effect on social cohesion. However, in the longer-term, a significant proportion of alternative fuels vehicles can have a dumping effect on the demand, and therefore, on

150 "*A large spectrum of the surveyed companies plan to expand or maintain their competitive advantages while focusing on R&D and education of their employees. A German automotive premium manufacturer stated that particularly in the area of new distribution channels future competitive advantages can be expected. In this context it will be important to build up new skills and competencies, since electromobility can be associated with a change in consumer behaviour as well as mobility needs. The majority of European suppliers and manufacturers consider the development of electrical, electronic, or carbon technology skills (e.g. lightweight construction) to be most important in securing competitive advantages. Additionally, a German volume manufacturer underlined the importance of skills in relation to new business models (e.g. Connected Cars).*" Source: "Competitiveness of the EU Automotive Industry in Electric Vehicles" Final Report. December 19th of 2012. Framework Contract ENTR/2009/030 (Lot 3). Universität Duisburg Essen

151 Idem footnote 150. **Error! Bookmark not defined.**.

152 The middle income quintiles spend a larger share of their incomes on heating and transport fuels combined, while the lower-income households do not tend to own cars (and the high-income households spend relatively less on fuel. *"Focusing on energy products consumed by households, the study shows that expenditure (and taxes) on personal transport fuels constitutes the largest category. Personal transport fuels account for the largest share of total expenditure of middle-income groups or, looking from another perspective, the expenditure of manual workers and the unemployed, followed by the non-manual workers. Conversely, the retired and inactive do not spend that much on mobility*". Source: EEA, 2011 Environmental tax reform in Europe: implications for income distribution

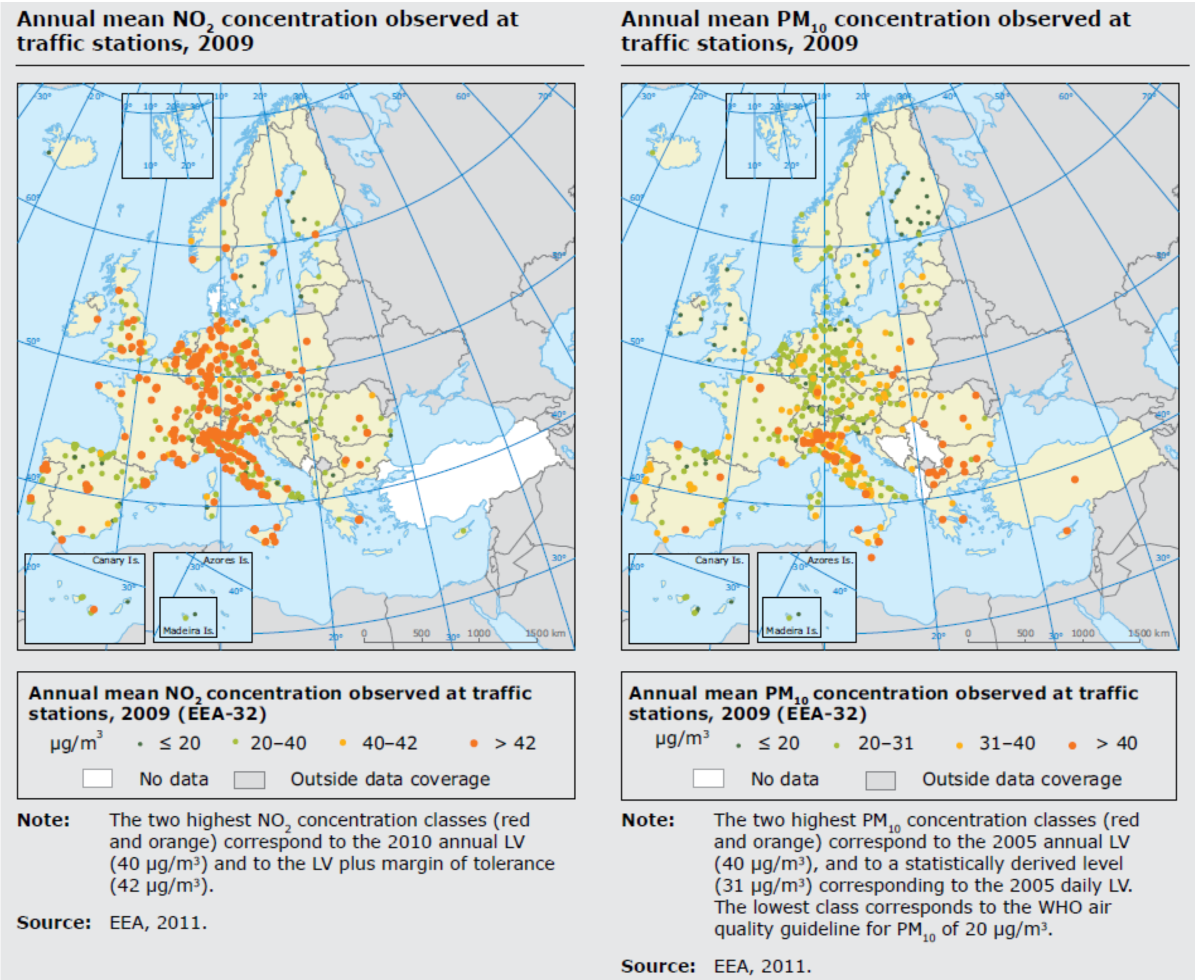
153 As shown for the United States, 'early adopter' consumers have a very distinct profile: they have a much higher-than-average household income, they tend to reside in urban or suburban areas, and nearly 90 % have garages with electricity. Their weekly mileage is low (about 160 km), and they are environmentally sensitive. Source: Deloitte, 2010, Gaining traction A customer view of electric vehicle mass adoption in the U.S. automotive market

the price of oil. Perhaps more importantly, alternative fuel vehicles will be a component of a mobility system which will demand greater complementarity between private vehicles and public transport, and any improvement in the public transport system will contribute to greater social cohesion.

5.2.4. *Impact on health*

192. Air and noise pollution is a persistent issue affecting the life of millions of European citizens, in particular in urban areas. Despite European legislation setting limit values for pollutants, PM_{10} and NO_2 concentrations regularly exceed those in large areas of Europe (Figure 18). The European Environmental Agency concluded that in 2011, that "*In urban areas, the exceedances of the LVs for PM_{10} and NO_2 imply exposure to concentrations levels which are expected to have adverse effects on human health*".

Figure 18: Exceedances of air quality objectives due to traffic[154]



193. Moreover, in March 2011, a joint assessment carried out by the World Health Organization (WHO) and the Commission's Joint Research Centre found that noise generated by road traffic accounts for at least 1 million healthy life years lost in the Western Europe[155]. Most recently, in June 2012, the International Agency for

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[154] Source: Box.2.5 in EEA, 2011, Laying the foundations for greener transport — TERM 2011: transport indicators tracking progress towards environmental targets in Europe, available at: http://www.eea.europa.eu/publications/foundations-for-greener-transport?b_start:int=0

[155] WHO/JRC, 2011, Burden of disease from environmental noise. Quantification of healthy life years lost in Europe, available at:

Research on Cancer (IARC), which is part of the WHO, classified "*diesel engine exhaust as carcinogenic to humans (Group 1), based on sufficient evidence that exposure is associated with an increased risk for lung cancer*"[156].

194. Under **Policy Option 1**, economic modelling shows that NO_x emissions and particulate matter would drop by about 20%, and by 37% by 2020, respectively. The increase in traffic would lead to a roughly 8 billion € increase of noise-related external costs by 2020. As demonstrated in detail in the following section on environmental impacts, the deployment of alternative fuel vehicles reduces further these external costs and therefore the impact on health. While **Policy Options 3 and 4** perform better in the reduction of external costs for noise than **Policy Option 2** on the 2020 horizon, the results do not vary greatly among the scenarios. On the other hand, significant differences can be seen among the scenarios for the emissions of pollutants such as NO_x and particulate matter. While under **Policy Option 4**, NOx emissions decrease by 2.8% due to the higher deployment of clean fuels such as CNG in road ransport and LNG in road transport and shipping, this reduction by 2020 is only 2.0% for **Policy Option 3** and 1.4% in **Policy Option 2**. By 2020, the reduction in particulate matter emissions follow a similar pattern to NOx emissions, declining by 2.1% in **Policy Option 4** relative to **Policy Option 1**, by 1.6% in **Policy Option 3** and 0.8% in **Policy Option 2**.

5.3. Environmental impacts

195. There are potentially large environmental benefits of deploying alternative fuels. As these benefits can only be realised if market penetration is achieved, building up sufficient infrastructure as foreseen in the Policy Options is a pre-condition. The potential impacts of deploying vehicles and vessels (on energy use, pollutant and GHG emissions and noise) are assessed below on the basis of modelling results. The full description of the modelling exercise can be found in Appendix 10.

196. Results of three scenarios, corresponding each to the respective Policy Option, are provided in comparison to **Policy Option 1**, in order to illustrate the environmental benefits of action on alternative fuel infrastructure in conjunction with policy intervention on other issues hampering the deployment of alternative fuel vehicles and vessels.

197. The modelling exercise shows that there would be significant environmental impacts in terms of reduced noise, pollutant and CO_2 emissions relative to developments under business-as-usual. Results are shown for these main environmental impacts and for oil consumption. While the focus of the exercise was 2020, modelling results are displayed for three chosen years, 2020, 2030 and 2050, on Figure 19, Figure 20 and Figure 21, respectively.

198. As a result of increased deployment of electric and fuel cell vehicles, including plug-in hybrids, already by 2020, CO_2 emissions decrease by up to 0.3% in **Policy Option 2** and 0.3% in **Policy Option 3** both compared to Policy Option 1. The reduction is marginally higher in Policy Option 3 relative to 4, due to increased emissions from LNG trucks in Policy Option 4 in the medium-run.

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http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&obj_id=13090&dt_code=NWS&lang=en

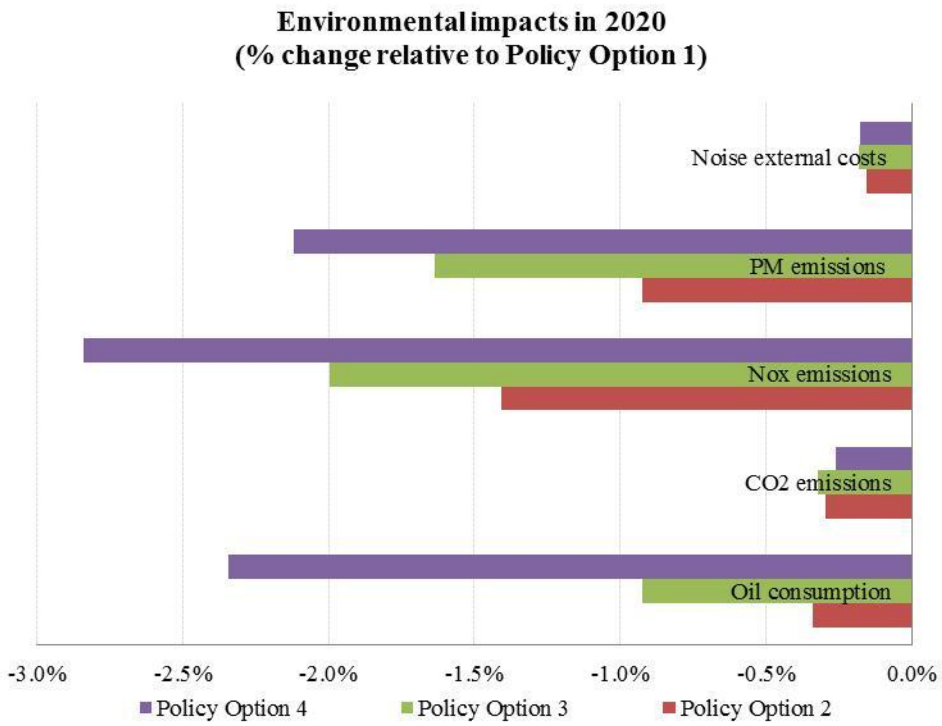
156 WHO, 2012, Press Release N° 213, available at: http://www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213_E.pdf

199. Under **Policy Option 2**, NO_x emissions decrease by 1.4% by 2020, by 2.0% in Policy Option 3, and in **Policy Option 4** by 2.8%. Particulate matter emissions follow a similar pattern to NO_x emissions. External costs for noise are reduced by about 0.2% in **Policy Options 3 and 4**, and by slightly less than 0.2% under **Policy Option 2** on the 2020 horizon.

200. Oil consumption goes down by about 2.3% by 2020 in **Policy Option 4** relative to **Policy Option 1**, reflecting the highest uptake of alternative fuels, electricity, hydrogen, natural gas (LNG and CNG) among the scenarios. Oil consumption decreases by only 0.3% by 2020 in **Policy Option 2** and about 0.9% in **Policy Option 3**.

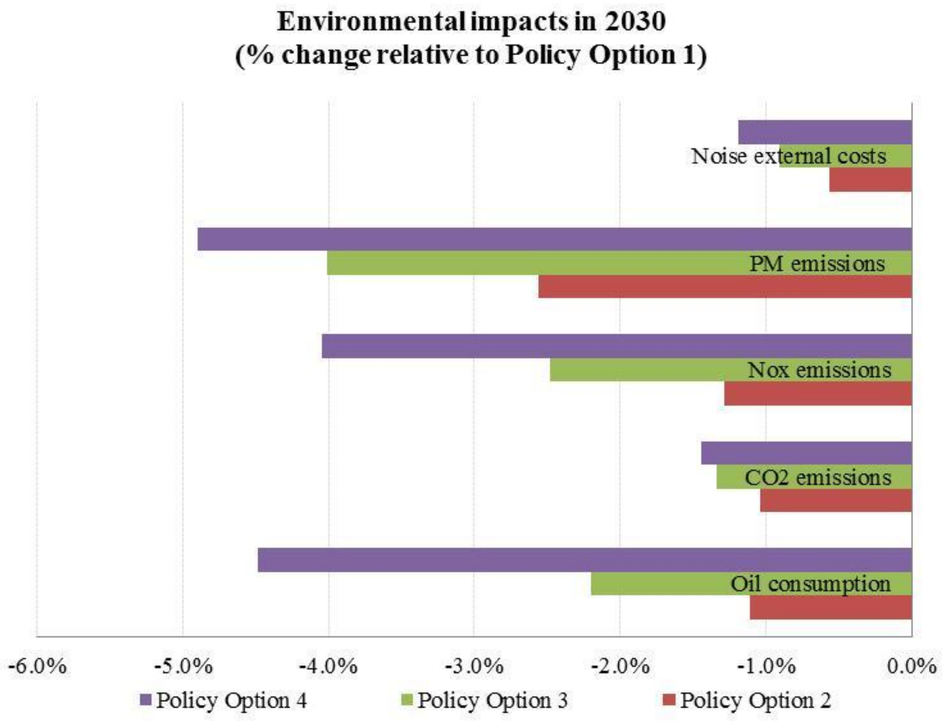
201. Similar reduction patterns among scenarios are shown for 2030 and 2050. However, **Policy Option 4** provides the highest reduction in CO_2 emission (-4.6%) by 2050 relative to **Policy Option 1**, followed by **Policy Option 3** (-3.4%) and **Policy Option 2** (-1.3%). Particulate matter emissions drop by more than 8% by 2050 in **Policy Option 4**, while NO_x emissions by about 6% under the same scenario. The reduction in oil consumption is also highest in **Policy Option 4** by 2050, at more than 8% relative to **Policy Option 1**.

Figure 19: Summary of scenario results for 2020



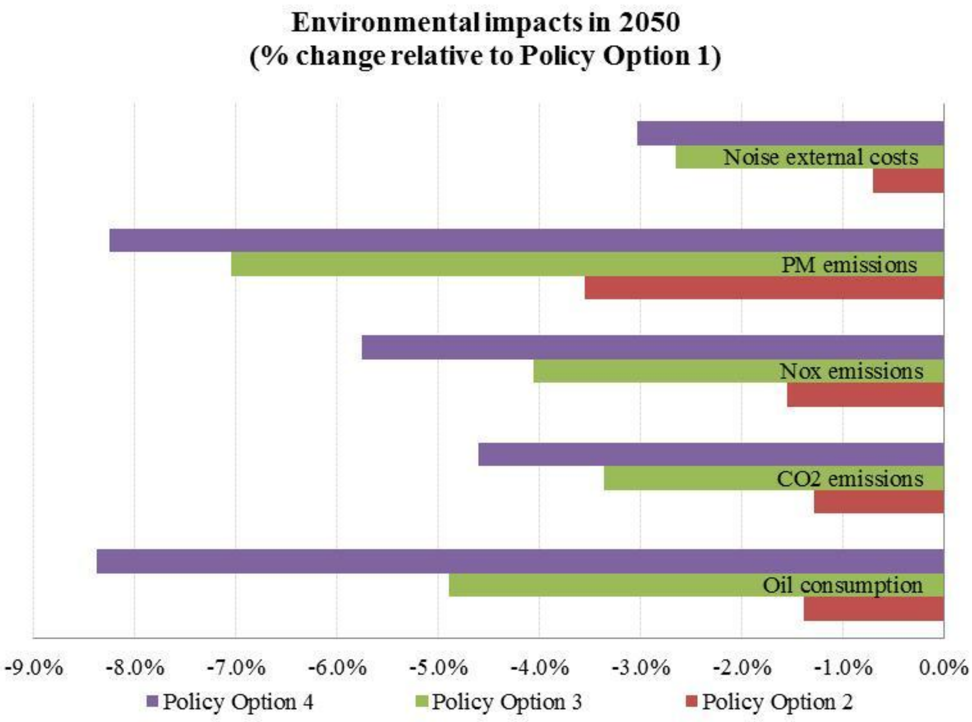
Source: PRIMES-TREMOVE transport model

Figure 20: Summary of scenario results for 2030



Source: PRIMES-TREMOVE transport model

Figure 21: Summary of scenario results for 2050



Source: PRIMES-TREMOVE transport model

5.4. Conclusions

202. This section is based on the comparison of each individual policy option, acting on both problem drivers, to Policy Option 1. The analysis of impacts shows that investing in a minimum recharging/refuelling network is the most efficient way to promote alternative fuel vehicles (Figure 10, Appendix 10). While infrastructure alone has no major direct impact, an intervention on the refuelling/recharging network can have very large and positive effect in combination with other initiatives targeted at the introduction of cleaner vehicles.

203. Under **Policy Option 4**, the benefits in terms of lower oil consumption over the lifetime of the alternative fuel cars, HDVs and vessels whose uptake would be enabled by this minimum network amount to about 84.9 bn € (with corresponding additional energy security benefit of 18.9 bn €), while lower impact on the environment can be monetised to be around 15.4 bn €. Hence, the benefits clearly outweigh the approx. 10 bn € which are needed to put in place the minimum network. Under **Policy Option 3** the corresponding numbers for avoided fuel consumption, the energy security benefits and the reduction in external costs are: 37.7 bn €, 8.3 bn € and 12.5 bn €, respectively. Under **Policy Option 2** the benefits in terms of lower oil consumption amount to 17.5 bn € (with corresponding additional energy security benefit of 3.8 bn €), while lower impact on the environment can be monetised to be around 8.9 bn €.

Table 13: Summary table of impacts

	Policy Option 2	Policy Option 3	Policy Option 4
Economic impacts			
Investment costs	-	--	---
Macroeconomic impacts	+	++	+++
Competitiveness	+	++	+++
SMEs	+	++	++
Internal market	+	++	++
Users	+	++	++
Social impacts			
Employment level	=	=/+	+/++
Skills	+	++	+++
Social cohesion	=	=	=
Health	+	++	+++
Environmental impacts	+	++	+++

Legend:
= baseline or equivalent to Policy Option 1
+ to +++ low to high improvement compared to Policy Option 1
- to - - - low to high worsening compared to Policy Option 1

6. Comparison of the options

204. This section provides for an assessment of how the policy options will contribute to the realization of the policy objectives, as set in Section 3, in light of the following evaluation criteria:

- effectiveness – the extent to which options achieve the objectives of the proposal;
- efficiency – the extent to which objectives can be achieved at least cost;
- coherence – the extent to which policy options are likely to limit trade-offs across the economic, social, and environmental domain.

Effectiveness

205. The objectives set out in Section 3 are fully achieved under **Policy Option 4** for all alternative fuels considered in the IA. **Policy Option 3** differs only in the coverage of fuels, and the objective of enhancing investment certainty would be limited to technologically more mature fuel solutions. **Policy Option 2** has the greatest risk of not satisfactorily delivering on the specific and horizontal objectives, due to the very large margin of discretion left to Member States for implementation of the Commission's recommendations.

Efficiency

206. The least cost can be associated to **Policy Option 2**, which is however a result of lower effectiveness in the achievement of objectives. While the costs of **Policy Option 4** are higher than of **Policy Option 3**, the potential benefits can overweigh this difference, subject to the technological developments.

Coherence

207. **Policy Option 2** would likely result in lower investments at lower overall costs. This outcome would particularly penalise the environmental dimension since the development of clean vehicles would be slower. **Policy Option 3** achieves the most comprehensive limitation of trade-offs across the economic, social and environmental fields, taking into account in particular that large-scale investment is only mandated for technologies that are mature enough to deliver their economic, social and environmental benefits with high certainty. **Policy Option 4** would represent a more risky option, which can be considered to place more emphasis on the environmental dimension with respect to the economic one.

Conclusion

208. The table below summarizes the results of the comparison of policy options in terms of effectiveness, efficiency and coherence based on the assessment provided above.

Table 14: Comparison of Policy Options

	Effectiveness	Efficiency	Coherence
Policy Option 1	no	no	no
Policy Option 2	low	medium	low
Policy Option 3	medium	high	high
Policy Option 4	high	medium	medium

209. In light of the above, Policy Option 2 is discarded, since it compares unfavourably with both Policy Option 3 and Policy Option 4.

210. On the other hand, the assessment of impacts do not point to huge differences between Policy Option 3 and Policy Option 4, and indeed the two options have many elements in common, such as the measures envisaged in relation to the EU-wide implementation of common standards and the deployment of alternative fuel infrastructure for EVs. The preference is given to Policy Option 3 since it appears to better take into account the economic constraints, particularly at a time of crisis.

211. However, Policy Option 4 is not formally discarded as its suitability is mostly influenced by existing technological uncertainties and prospects that can change in the near future with technology progressing rapidly. This would increase the efficiency, which presently is rated medium.

212. The overriding necessity of giving clear signals to the markets, both industry and consumers, would rather give larger political merits to the comprehensive Policy Option 4. If chosen, such a decisive step on EU level could accelerate the market development of alternative fuels in general and ensure that investments have a larger impact on economic growth in Europe.

213. Rapid implementation of the necessary actions, with market comforting targets set for 2020, can also strongly enhance the momentum for the EU 2020 strategy.

7. MONITORING AND EVALUATION

214. The Commission would need to explore the inclusion of some monitoring and reporting requirements on the availability of alternative fuels infrastructure in the legislative proposal, building on existing reporting channels between the Statistical Offices of Member States and Eurostat and carrying out additional information collection through existing Joint Undertakings, Technology Platforms, and expert groups.

215. Internet portals launched by the Commission, such as the Clean Vehicle Portal would be used for data collection and market surveys.

216. The new European Electromobility Observatory, launched by the Commission in 2012 will aggregate data and information on the development of electricity and hydrogen as fuels across the EU and support new policy and market actions on regional and local level.

217. Member States would most likely need to provide the Commission with national plans on the build-up of alternative fuels infrastructure every two years. These reports could *inter alia* include the following information:

- Detailed sales information on alternative fuel vehicles and vessels
- Consumption of alternative fuels, including electricity, hydrogen and natural gas (LNG and CNG) for transport
- Annual progress of the number of each of the concerned alternative fuels infrastructure
- Location and density of these infrastructures

218. The Commission would submit reports on the implementation and impacts of this Directive to the European Parliament and the Council every two years. The report would assess the actions taken by individual Member States and the effects of the Directive, in particular on the market development of the alternative fuels covered by the Directive, and the need for further action.

219. The reports would also review the requirements and the dates in view of the technical, economic and market developments of the respective fuels, and propose adjustments as appropriate.

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9. GLOSSARY

- **Alternative fuels:** fuels such as electricity, hydrogen, biofuels (liquids), synthetic fuels, methane (natural gas (CNG and LNG) and biomethane) and Liquefied Petroleum Gas (LPG) which substitute, at least partly**,** fossil oil sources in the energy supply to transport, contribute to its decarbonisation and enhance the environmental performance of the transport sector.
- **AC:** Alternative current connector
- **ACEA:** European Automobile Manufacturers' Association
- **CARS21:** Competitive Automotive Regulatory System for the 21st century
- **CEN:** European Committee for Standardization
- **CENELEC:** European Committee for Electro-technical Standardization
- **CHIC:** Clean Hydrogen in European Cities Project
- **CNG:** Compressed Natural Gas
- **DECC**: Department of Energy and Climate Change
- **DSO:** Distribution System Operator
- **E-REV:** Extended-Range Electric Vehicles
- **ETSI:** European Telecommunications Standards Institute
- **EV:** Electric Vehicle
- **FCEV:** Fuel Cell Electric Vehicle
- **GHG:** Greenhouse Gas
- **HDV:** Heavy Duty Vehicle
- **HEV:** Hybrid electric vehicle
- **HICE:** Hydrogen Internal Combustion engine
- **HRS:** Hydrogen Refuelling Station
- **HyTEC:** Hydrogen Transport in European Cities project
- **HDV:** Heavy Duty Vehicle
- **IEA:** International Energy Agency
- **IEC:** International Electro-technical Commission
- **ISO:** international Organization for Standardization
- **IMO**: International Maritime Organization
- **LCV:** Light Commercial Vehicle
- **LDV:** Light Duty Vehicle
- **LNG:** Liquefied Natural Gas
- **LPG:** Liquefied Petroleum Gas
- **MS:** European Union's Member State

- **OCIMF:** Oil Companies International Marine Forum
- **PHEV:** Plug-in Hybrid Electric Vehicle
- **SAE:** Society of Automobile Engineers
- **SECA:** Sulphur Emission Control Area
- **SIGGTO**: Society of International Gas Tanker and Terminal Operators
- **SME:** Small and medium enterprise
- **TEN-T:** Trans-European Network for Transport
- **Type of plug 1:** Single phase vehicle coupler
- **Type of plug 2:** Type 3: Single & three phase vehicle coupler with shutters
- **Type of plug 3:** Single & three phase vehicle coupler with shutters

10. APPENDICES

Appendices 1 to 11 are provided in a separate document.

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Part II

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Proposal for a Directive

on the deployment of alternative fuels infrastructure

{COM(2013) 18 final}
{SWD(2013) 6 final}

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

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Proposal for a Directive

on the deployment of alternative fuels infrastructure

APPENDICES

Appendix 1: Assessment of the application of the minimum consultation standards

Aim and content of the consultation process

1. The White Paper "Roadmap to a Single European Transport Area – Towards a Competitive and Resource Efficient Transport System"[157] announces that the Commission will develop "*a sustainable alternative fuels strategy including also the appropriate infrastructure*" (Initiative 24) and ensure "*guidelines and standards for refuelling infrastructures*" (Initiative 26).

2. The aim of the consultation was to gather the views of the EU citizens and stakeholders on this initiative.

3. The consultation process has been structured as follows:

   (4) Consultation of stakeholders (industry and NGOs) through several meetings of the European Expert Group on Future Transport Fuels;

   (5) Consultation of representatives of the Member States;

   (6) Public Consultation;

   (7) Targeted stakeholders' consultation on the policy options regarding the deployment of refuelling and charging infrastructure under the study Exergia S.A. et al., 2012, Assessment of the Implementation of a European Alternative Fuel Strategy and Possible Supportive Proposals.

4. The General Principles and Minimum Standards for Consultation of Interested Parties by the Commission were respected in the elaboration and presentation of the consultation questionnaire.

Publication

5. All reports have been published on the Commission website at the following addresses:

   http://ec.europa.eu/transport/urban/cts/doc/2011-01-25-future-transport-fuels-report.pdf;

   http://ec.europa.eu/transport/urban/cts/doc/2011-12-2nd-future-transport-fuels-report.pdf;

   http://ec.europa.eu/transport/urban/cts/doc/jeg_cts_report_201105.pdf;

   http://ec.europa.eu/transport/urban/consultations/doc/cts/report-on-results.pdf;

   http://ec.europa.eu/transport/urban/studies/doc/2012-08-cts-implementation-study.pdf

Time limits for participation

6. The consultation of the European Expert Group on Future Transport Fuels started on 26 April 2010, and ended with the publication of the second report of the Group in December 2011.

7. The consultation of the Joint Expert Group Transport & Environment started on 17 March 2011, and ended with the publication of its report in May 2011.

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157 COM(2011) 144 final

8. A public on-line consultation was published on 11 August 2011. The questionnaire was available on-line until 20 October 2011, respecting the minimum consultation standard period of at least eight weeks.

9. The consultation under the Exergia S.A. et al., 2012, Assessment of the Implementation of a European Alternative Fuel Strategy and Possible Supportive Proposals took place between November and December 2011.

Acknowledgement and feedback

10. The Commission requested and obtained the approval of all members of the European Expert Group on Future Transport Fuels and the Joint Expert Group Transport & Environment before publishing the relevant reports.

11. As to the Public Consultation, stakeholders were informed on-line that their contributions would be handled by a consultant and used by the Commission services, and a summary of the consultation's results would be published on the Commission's website.

Appendix 2: Results of consultation with interested parties

The studies and the consultations with industry experts, national experts and the public, carried out between 2010 and 2012, have arrived at the conclusion that a fuel mix of several main alternative fuels is considered the only realistic solution, not just as transition, but for the foreseeable future. All main alternative fuel options should therefore be developed in parallel. However, the efforts will need to be adjusted to the technological, and economic maturity of the different fuels and related propulsion systems. Infrastructure networks with refuelling/recharging facilities have been highlighted by all parties consulted as an essential and necessary condition for the market penetration of alternative fuels.

The stakeholders that participated in the process belong to the sectors of energy supply to transport; manufacturers of vehicles, vessels, planes and trains; transport operators; users; public authorities; and civil society.

The relevant findings can be summarised as follows.

- The vast majority of respondents consider that EU policy action should be taken to steer an EU wide market introduction of alternative fuels.

Furthermore, the majority of respondents:

- supports the build-up of alternative fuel infrastructure
- believes that a mix of alternative fuels (electricity, hydrogen, biofuels, methane, LPG and synthetic fuels) should be included in the EU long-term strategy.
- believes that EU action should not be limited to the adoption of common standards
- considers that voluntary action of industry alone could not achieve the development of refuelling/recharging infrastructure
- considers that EU legislation requiring minimum refuelling/recharging infrastructures is required
- believes that that the public sector should intervene in the development of the refuelling/recharging infrastructures
- considers that support mechanisms (such as incentives, RTD funds, loans, concession rights for first investors…) should be set-up to promote alternative fuels vehicles and infrastructures.

Stakeholders' Expert Group on Future Transport Fuels

A European Expert Group on Future Transport Fuels (EEGFTF) was created in March 2010 to obtain advice on the development of policy strategies and specific actions aimed to gradually substituting oil as transport fuel in the long term and to decarbonise transport while ensuring economic growth. The Group was composed of all relevant industrial stakeholders, including transport organisations and civil society. The Commission chaired the Group and coordinated its activities.

The EEGFTF prepared two reports, namely:

– The first report (January 2011) sets out a long-term strategy, a roadmap, and recommendations on short-, mid- and long-term actions to support the market build-up for alternative fuels for all modes and segments of transport. The Group identified electricity, hydrogen, and liquid biofuels as long-term options for gradually substituting oil as an energy source for propulsion in transport. Synthetic fuels, methane and LPG can be considered as short/mid-term options. The report is available at http://ec.europa.eu/transport/urban/cts/doc/2011-01-25-future-transport-fuels-report.pdf.

– The second report (December 2011) focuses on the "Infrastructure for Alternative Fuels". This report provides additional recommendations on short-, mid- and long-term actions to support the market build-up of alternative fuels for all modes and segments of transport and the relevant infrastructure. The report is available at http://ec.europa.eu/transport/urban/cts/doc/2011-12-2nd-future-transport-fuels-report.pdf

The EEGFTF pointed out that an appropriate regulatory framework and financial instruments will be required to introduce sustainable low carbon alternatives to the market.

Some members rejected binding targets in fuel infrastructure as they believe that development in infrastructure, not in line with market development, would not be cost effective; legislation should only aim at creating a level playing field.

Most members however share the opinion that binding targets could become a real driver for the alternative fuel market, attracting clients and steering market demand for these fuels. An appropriate refuelling infrastructure would need to exist before producing and promoting more alternative fuelled vehicles on the manufacturer side.

Furthermore the EEGFTF highlighted the need for supporting the private sector to undertake effective actions to accelerate the development of new refuelling infrastructure with the following objectives:

– To establish EU-wide a minimum coverage of refuelling infrastructure for the main alternative fuels that have technological viability and market potential, to facilitate economies of scale for market introduction;
– To ensure a harmonised implementation of standards for the main alternative fuels;
– To align policy and public/private funding and taxation in the field of alternative fuel infrastructure.

While mandates on infrastructure are objected by some members, the other members of the EEGFTF consider public intervention necessary to break deadlocks between potential market growth for alternative fuel technologies and missing fuel supply.

In conclusion, most members consider not realistic to expect the market to cater for the transition to more expensive low-carbon alternatives alone, and that, therefore, important interfaces should be defined by legislation to allow and encourage this market demand.

Report of the Joint Expert Group on Transport and Environment

The Joint Expert Group Transport & Environment -JEGTE (composed of experts from 24 Member States and Norway for consultation purposes) was convened by the Commission to obtain recommendations on the development of a consistent long-term alternative fuels strategy of the EU, as preparation for the CPT initiative. The JEGTE met on 17 March 2011 and discussed possible scenarios for future transport fuels. In a report to the Commission[158] the Group agreed with the fuel mix recommended by the (EEGFTF). High potential in

[158] Report of the Joint Expert Group Transport & Environment, 22 May 2011

feedstock, energy efficiency, and CO_2 reduction would be important selection criteria. The main alternative fuels should be available EU-wide with harmonised standards. The Group also noted that the different transport modes require different alternative fuels. The report is available at http://ec.europa.eu/transport/urban/cts/doc/jeg_cts_report_201105.pdf.

<u>Stakeholders' Consultation</u>

A consultation of stakeholders in the alternative fuels sector was launched on 14/11/2011 as part of the study "Assessment of the implementation of a European alternative fuel strategy and possible supportive proposals" MOVE C1/497-1-2011. The consultation was mainly intended to data collection for modelling.

In total, 124 questionnaires were distributed to members of the Expert Group on Future Transport Fuels and other relevant stakeholders. The organisations that responded are: IATA, ePure, EBB, SCANIA, Eurelectric, AVERE, SIEMENS, ERTRAC, NEW ENERGY WORLD IG, AirLNG, NGVA Europe, IVECO, AEGPL Europe, UPEI, SHELL, ASFE, Ministry of Economic Affairs, Agriculture and Innovation of the Netherlands, CEDEC, HyER. The report is available at http://ec.europa.eu/transport/urban/studies/doc/2012-08-cts-implementation-study.pdf.

Electromobility

The majority of respondents:

- consider the infrastructure for dedicated/captive fleets not to be enough for the development of an electric vehicles market, and that a network for private electric vehicles has to be developed, since about half the electric vehicles sales are for private users.
- consider the number of charging points on the basis of the annual vehicles registrations as the most effective indicator to define the minimum, appropriate and optimum coverage.
- support the participation of both the government and the industry in the investment cost. Government should help the industry (e.g. electricity companies) participate with research and implementation of the first steps to demonstrate accessibility (e.g. through incentives for the promotion of the electric vehicles infrastructure, subsidization on the national or regional level) possibly up to 2017. Afterwards the private sector can bear the investment cost and expect normal profit (positive business case).

Respondents consider that the proposed electric charging infrastructure would have a positive impact to the competitiveness of the EU automotive industry and creation of additional jobs for equipment manufacturers and along the supply chain.

Hydrogen

- It is generally acknowledged that the European hydrogen network would be effectively established if the regulatory barriers at EU and national level were removed. The existing ISO and SAE standards should be adopted EU-wide.
- According to the majority of respondents, during the initial phase, public support is needed to realize the technological shift. When moving closer to the commercial phase, risks should be borne by industry.

Biofuels

- The majority suggest that European Standards (EN norms)/specifications of the higher grades of biofuels have to be established and harmonised across the EU, and the OEMs to adjust the engine manufacturing accordingly to meet the standards, so as to incentivize growth of a vehicle fleet that is compatible with higher grades of biofuels.
- The majority of respondents expressed the opinion that higher biofuel blends should be introduced in dedicated fleets, as a first (but not a sufficient) step for the development of a market.

CNG

- The majority of respondents consider that the minimum infrastructure coverage for private passenger cars and commercial fleets using cars and vans should correspond to 10% of the urban filling stations and to 25% of the stations along the motorways. This percentage should be linked to the availability of methane stations at least every 150 km along motorways.

LNG

- For heavy duty vehicles, there is a further distinction in infrastructure coverage according to the type of transport (whether it is urban for the transport of goods, or heavy trucks for long distance). In the case of transport of goods, refuelling with LNG should be made possible every 400 km.
- NGVA expects that the development of adequate infrastructure for natural gas and biomethane will lead to an increased number of natural gas vehicles, which will increase the competitiveness of this sector in the EU, currently lying behind compared to the global natural gas vehicle development.
- According to most respondents, the future of LNG as fuel in vessels at European level depends on the policy measures that will be taken. If the policy measures are appropriate, 20-30 new LNG fuelled vessels could be expected per year.

LPG

- AEGPL suggests that binding targets for harmonization in the LPG fuel quality can help the market develop, in order to stimulate car makers. A regulatory process for establishing a unique LPG connector in the EU is an example of how the market can grow.
- The majority of respondents see a positive impact on automotive industry/equipment manufacturers from the development of refilling stations, as it would lead the automotive industry to invest in more LPG technology, manufacturing facilities, marketing and R&D.

Public consultation

A public on-line consultation took place between 11 August 2011 and 20 October 2011.
123 responses were received, with almost equitable distribution among individuals (31.7%), private sector companies (33.3%) and industry associations or NGO (29.3%). A small portion represented local or regional public authorities (4.1%) and national public authorities (1.6%).
The report is available at:
http://ec.europa.eu/transport/themes/urban/consultations/doc/cts/report-on-results.pdf
The main indications from the different sectors are the following.

A vast majority (89%) shares the view that there is the need that EU steers an EU-wide market introduction of alternative fuels through policy actions.

In particular:

- ACEA underlines that "The roll-out of the necessary infrastructure to deliver and supply such fuels *[electricity, hydrogen, biofuels, biomethane, LPG, and others]* should be matched to technical development and to enable the market penetration of new vehicles technologies".
- Daimler indicates "Harmonisation, fuel infrastructure legislation, specification of blends" as issues justifying EU policy action. Furthermore, Daimler indicates the need for legislative measures on fuel infrastructures.
- The Centro Richerche FIAT underlines the need for "Regulations and procedures to enhance realization of infrastructures for fuel distribution".
- The Oil Companies International Marine Forum (OCIMF) states that "The European Union should progress the use of alternative fuels for short sea maritime transport".
- The natural Gas Vehicle Association NGVA indicated that EU action is necessary for "infrastructure, research and Development, funding and fiscal treatment".

As to what fuels should be included in the EU long-term strategy:

- A vast majority of respondents pronounced in favour of electricity
- A considerable majority pronounced in favour of biofuels and hydrogen
- Synthetic fuels, and CNG/LNG, and LPG were indicated by significant shares of respondents
- Electricity, biofuels and methane-related fuels are mostly suggested for the urban (short) transport mode
- Biofuels were suggested mostly for long distance road-passenger vehicles followed by methane derivatives and synthetic gas
- Biofuels and LNG was mostly indicated for waterborne transport
- Biofuels and synthetic fuels, followed by methane LNG were mostly indicated for airborne transport.

In particular,

- The Association of German Transport Companies VDV indicated "Long-term: rather electricity, hydrogen, biofuels. Medium-term: also synthetic fuels and methane".
- Polis declared "Emphasis should be placed on these first three fuels (electricity, hydrogen, and biofuels). It must be ensured that biomethane is included under biofuels. Synthetic fuels should include those from biomass."
- Shell commented that "A combination or mosaic technologies will be needed to supplement fossil fuels across the various transport sectors".

Three quarters (77%) of the respondents considered that public sector should intervene in the development of the refuelling/recharging infrastructure.

In particular:

- Renault stated that "In the case of the electric vehicles and the fuel cells the development of charging/refuelling infrastructure is critical for the mass deployment. Therefore, the role of the public sector is essential to guarantee an adequate regulatory framework and the support needed to move quickly into a mass market solution."

- Gas Infrastructure Europe stated that: “Gas Infrastructures are needed to ensure the availability of CNG and LNG as alternative fuels. Gas infrastructure investments entail long-lead times and thus require long-term visibility. A sound investment climate together with a stable and predictable regulatory framework is fundamental for the development of infrastructure.”
- Polis declared that “[The public sector] should intervene at least with regulation.”
- The Port of Rotterdam stated that “Policy instruments could be used to cover financial/operational risks taken by the private sector investing in alternative fuel technology.”
- Shell points out that “There is clearly work needed on harmonization of standards”.
- The European Hydrogen Association (EHA) underlined the need to support the activities of local alternative fuel technology and business clusters, facilitating industrial investment incentives and ensuring a sustainable level of SME participation in large EU transport infrastructure programmes.

The majority of respondents consider that:

- **EU actions should not be limited to ensuring the relevant infrastructure standards in order to achieve a consistent and significant deployment of alternative fuels.**
- **Voluntary action of industry alone cannot achieve the development of the refuelling/recharging infrastructures required for travelling across the whole EU on alternative fuels.**
- **EU legislation requiring minimum refuelling/recharging infrastructures is needed.**

In particular:

- ACEA declared that “The parallel development of vehicle technology and infrastructure needs coordination and common policies. In some areas this has already failed, e.g. HFCV and hydrogen filling infrastructure.”
- Renault stated that “In addition to the relevant infrastructure standards and deployment, it is important to ensure the visibility of the full support of the European public authorities to the zero emissions technologies. Only with a transparent and clear support at European level it will be possible to have a quick market introduction at the level of the Member States.”
- Shell underlines that “the EU should promote public funding in PPP projects”
- Better Place, Fédération Internationale de l’Automobile and UITP stated that privileged access to access restriction zones and lower charging tariffs for infrastructure use could be supportive measures.
- UITP considers that here should be no obligations to introduce a specific alternative fuel for public transport. If legislation is chosen, there should be no actions that put un-proportionate burden on public transport undertakings and public transport authorities only.
- HyER (Hydrogen and Electromobility European Regions) considers that “next to the necessary policy action at EU level, as support for general standardisation of vehicles and refuelling and recharging infrastructure, tax incentives as well as risk-sharing financial schemes, national and regional policy support needs to be leveraged to facilitate a rapid up-take of alternative fuels and customer acceptance”.

Appendix 3: Existing or planned initiatives at European level affecting the uptake of alternative fuels

(1) Decision No 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020

(2) Directive 2009/28/EC on the promotion of the use of energy from renewable sources

COM (2012) 271 Renewable Energy: a major player in the European energy market

(3) Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity

COM (2011) 169 Proposal for a Council Directive amending Directive 2003/96/EC

(4) Directive 2009/30/EC amending Directive 98/70/EC relating to the quality of petrol and diesel fuels

(5) Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles

(6) Regulation 443/2009/EC establishing CO_2 emissions performance requirements for new passenger cars

(7) Regulation 510/2011/EC establishes CO_2 emissions performance requirements for new light commercial vehicles

(8) COM (2010) 186 European strategy on clean and energy efficient vehicles

(9) Strategy for heavy-duty vehicle emissions

(10) Directive 2008/50/EC on ambient air quality and cleaner air for Europe

(11) Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants

(12) COM (2005) 261 Proposal for a Council Directive of 5 July 2005 on passenger car related taxes

(13) Green Cars Initiative

(14) Fuel Cell and Hydrogen Joint Undertaking

(15) Directive 1999/94/EC relating to the availability of consumer information on fuel economy and CO_2 emissions in respect of the marketing of new passenger cars

Appendix 4: Existing initiatives for the deployment of alternative fuels infrastructure

1. This appendix provides an overview of some of the national initiatives and policies implemented for the deployment of alternative fuels infrastructure.

Electricity

2. The following tables (Table 15, Table 16, Table 17) summarise some of the national initiatives and policies implemented for the deployment of EV charging infrastructure, together with national targets on infrastructure and vehicle deployment.

Table 15: Targets for electric vehicles, and existing policies for the deployment of infrastructure

Member States	Targets regarding electric vehicles (PHEVs and EVs)	Targets regarding infrastructure	Existing measures for the deployment of infrastructure
Austria	2020[159]: 250,000 stock	By 2020: 4,500 semi-public charging stations	The National Implementation Plan for Electric Mobility covers the following topics: EVs, charging infrastructure, users (demands and requirements), preferential areas to start implementation, industrialization and the national economic policy, instruments for research, innovation and technology, energy systems and resources, integration of electric mobility in the transport system, environmental impacts, and laws and regulations to support innovation. *Financial support :* Support of € 1,000 was available in 2010 and 2011 for a charging Station (Klima: aktiv programme, Ministry of Environment). Also 30% of support for charging stations and incentives for E-Cars in 3 model regions.
Belgium	-	2020 (tentative)[160]: - Slow: 35,000 – 130,000 charging stations - Fast 1,000 – 4,000 charging stations	Masterplan for electric mobility is being prepared covering the following topics: challenges for the infrastructure of charging stations, training for the service station mechanics towards the setup of new business models to make this new project successful. *Financial support :* For investment in infrastructure (i.e. public charging points), there is a 40% tax credit for individuals (max € 180, € 250 for 2010).
Bulgaria	-	-	Several large cities, including Sofia, have decided or are planning to provide street space for free parking of EVs next to charging stations. In Sofia several

159 http://www.ieahev.org/by-country/austria-on-the-road-and-deployments/

160 Contribution from AVERE The European Association for Battery, Hybrid & Fuel Cell Electric Vehicles - Public support for infrastructure for Electromobility

			charging stations are in the process of being installed by the company FullCharger in cooperation with the street lighting company and the electric utility company CEZ.[161]
Czech Republic	-	-	Planned investments in public infrastructure (charging points), direct subsidies, fiscal incentives for the supply and operation of recharging system and for the purchase of EVs are already in place. The e-mobility project "futuremotion" (€ 20,000,000 budget until 2012), which initiated in Prague in 2009, includes the development of a public charging network.
Germany	2020: 1,000,000 stock 2030: 5,000,000 stock[162]	2012-2013: 2,000[163]	The Federal Government, together with industry, is making available € 2 billion to promote research on how people can maintain their mobility in the future despite fossil fuels growing scarce. For this reason they jointly created the "National Platform for Electric Mobility" in May 2010[164].
Denmark	2015: 10-15,000 stock 2020: 50,000 stock[165] 2020: 200,000 stock[166]	2020: 20,000 charging points[167]	In 2009, the Climate and Energy Agreement allocated DKK 30,000,000 (aprox. € 4,000,000) to promote demonstration programmes for battery EVs. The program is being administered by the Danish Energy Agency. DDK 200,000,000 (aprox. € 28,000,000) has been allocated specifically for demonstration projects between 2010 and 2013 that promote environmentally aware and energy-efficient transport solutions, including test projects with alternative types of fuels, electric cars, electric buses, and electric trucks. DKK 70,000,000 (aprox. € 9,400,000) are allocated to support infrastructure for electrical, hydrogen and gas cars. This will be launched in 2013.
Estonia	-	-	The electromobility program (2010): • An incentive scheme was introduced for electric car buyers. 50% or up to € 18,000 is compensated, plus € 1,000 is provided for the installation of a charger at home or office.

161 Idem footnote 160.

162 EVI Electric Vehicles Initiative http://www.cleanenergyministerial.org/our_work/electric_vehicles/
The Electric Vehicles Initiative (EVI) is a multilateral policy forum for accelerating the introduction and adoption of electric vehicles (EVs) worldwide. EVI seeks to facilitate the global deployment of 20,000,000 EVs, including plug-in hybrid electric vehicles and fuel cell vehicles, by 2020. Data is available for participating governments: Denmark, Finland, France, Germany, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

163 http://www.ieahev.org/by-country/germany-charging-infrastructure/

164 http://www.ieahev.org/by-country/germany-research/

165 Idem footnote 162.

166 ENS Denmark, as reported in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

167 www.dtu.dk/upload/institutter/dtu%20transport/projekter/bev%20paper%202011_7_tcj_clean3.pdf

			• A country-wide fast charger network is being built so that the distance of fast chargers will not be more than 50 km. The network is expected to be in use starting from 2013.
Greece[168]	-	By 2020: 6,900 public double outlet charging points in the main urban areas	*Governmental support* A Special Commission, constituted by the decision of the Minister of Energy and Climate Changes (Ministerial Act 21612/20.9.2011) is charged with the responsibility of identification of the pillars needed for the development of a substantial market penetration of the electric and plug-in hybrid vehicles. The Hellenic Institute of Electric vehicles (HEL.I.E.V) is member of this Commission. Major section of the Commission's work is the planning of the necessary infrastructure in the form of private and public networks suitable to cover the demand expected until the end of the decade (2020). The result of this investigation has already been submitted to the Ministry and the next expected step is the announcement of a call for bids for the supply and installation of two demonstrative EV's charging networks, in collaboration with two selected municipalities located nearby of the two major urban centers of Athens and Thessaloniki. Additionally a link constituted by some fast chargers will be realized along the connecting main road axis of each one of these municipalities with the corresponding major urban center. The expected budget for these demonstrative and pilot networks is estimated to reach € 3,000,000. . *Regional support* - Next to the realization of the above demonstrative networks and the evaluation of its techno-economic parameters, a report will be forwarded to the 13 regions of the country with proposals/suggestions for the planning and creation of Regional EV charging station networks. It is estimated that a total number of 6.900 public double outlet charging points should be in operation in the main urban areas of the country in the year 2020. *Municipalities' support* - The interest of municipalities is attracted by the possibility to combine small photovoltaic installations of 10 kWh installed on top of EV charging parking lots, whose legislation permits the connection of these small energy production units with the grid without the same bureaucratic procedures needed for photovoltaic generators with bigger capacity. By selling the generated energy to the grid on a permanent basis during a reasonable time period, they can balance the initial cost of the whole equipment.

[168] Idem footnote 160.

Spain	2012: 72,000 stock[169] 2014: 1,000,000 stock[170] 2020: 2,500,000 stock[171]	2014[172]: Homes: 62,000 Public parking: 12,150 Public road-side: 6,200 charging points	The Spanish Strategy for Energy Savings and Efficiency 2004–2012 includes the promotion of alternative fuels and vehicle technologies (LPG, natural gas, HEV, PHEV, BEV, hydrogen and fuel cells) as a key action line. In April 2010, Spain's national government also presented the "Integral Plan for the Promotion of Electric Vehicles", which includes an *"Integrated Strategy for EVs 2010–2014"*. *Governmental support* - MOVELE's plan (El Plan de Accion del Vehiculo Electrico - Ministry of Industry) supports the installation of charging station in three cities (Barcelona, Madrid, Sevilla) subsidies 40% of the price of the station. *Regional support* - At a regional level each Autonomous Community can develop a plan to support EVs. Andalusia, Castilla y Leon & Navarra have a plan and are supporting the installation of charging points. In Andalusia, the economic support for the installation of charging station is around 25% of the costs.[173]
France	2015: 450,000 2020: 2,000,000 stock[174]	1,250 public stations to be installed by 2012 in 20 cities 2015: 900,000 private and 7,500 public charging points 2020: 4,000,000 private and 400,000 public charging by 2020[175]	The Grenelle II legislation adopted in July 2010 addresses a number of environmental topics, including EV charging. *Governmental support* - € 50,000,000 between 2011 and 2015 for funding 50% of for normal and fast charging stations in 20 demonstrative cities. *Regional and Municipalities' support* - The same cities should finance the other 50%. The situation is different in Paris, where 300 charging points had been build 15 years ago. The Autolib system of e-car renting counts today 250 stations, each of them has 4 to 6 plugs, 10% open to other cars. It has been financed by the operating company, group Bollore. The old ones are supposed to be replaced by the new ones.

169 http://www.movele.es/index.php/mod.pags/mem.detalle/relmenu.57/relcategoria.1031/idpag.33

170 Integrated Strategy for EVs 2010-2014, http://www.ieahev.org/by-country/spain-policy-and-legislation/

171 IEA, Implementing Agreement for co-operation on Hybrid and Electric Vehicle Technologies and Programmes (IA-HEV), 2011, Hybrid and Electric Vehicles, The Electric Drive Plugs In, available at: http://www.ieahev.org/assets/1/7/IA-HEV_2010_annual_report_6MB.pdf

172 Universität Duisburg Essen, 2012, Competitiveness of EU Automotive Industry in Electric Vehicles, Draft Final Report.

173 Idem footnote 160.

174 National French roll-out plan http://www.developpement-durable.gouv.fr/Point-d-avancement-du-plan-avril,26840.html

175 Idem footnote 172; http://www.cleanvehicle.eu/info-per-country-and-eu-policy/member-states/france/national-level/

Ireland	2020: 230,000 stock[176] 2020: 350,000 stock[177]	2015: 6,000 charging points 2020: 25,000 public charging points[178]	*E-car Ireland*[179] Electric vehicles are exempt from the registration tax until 30 April 2011. From 1 May, they will benefit from VRT relief of maximum € 5,000. Plug-in hybrids benefit from VRT relief of maximum € 2,500 until 31 December 2012. Conventional hybrid vehicles and other flexible fuel vehicles benefit from VRT relief of maximum € 1,500 until 31 December 2012.
Italy	By 2015: 100,000 EV passenger cars and 30,000 EV commercial vans - sales[180]	1,000 charging points 2013: 588 public charging stations 2014: 150 public[181]	*Governmental support:* - Draft bylaw in discussion at the Parliament in the framework of a public support to electrical road mobility. - 5 pilot projects partially supported until 2015 by the Italian Authority for Energy, for building in total more than 1,000 public charging points in different cities such Roma, Milano, Napoli, Bari, Catania, Genova, Bologna, Perugia, but also in other cities in Emilia-Romagna and Lombardy regions and in commercial sites. Among the above charging points, 200 have been supported also by the Ministry of Environment and 150 by Lombardy Region.
Luxemburg	2020: 40,000 stock[182]	-	€ 5,000 Grant for private purchase of electric vehicles.
Malta	-	-	Malta has various initiatives to promote EVs particularly in city centres such as Valletta. For instance, Transport Malta recently held a seminar in Malta to promote new regulations which provide incentives for transport operators to operate electric mini cabs for taxi services.
Netherlands	2015: 20,000 stock 2020: 200,000 stock[183]	2013: 10,000 public charging stations 50 fast charging	Formula E-team's[185] activities for vehicles and infrastructure deployment can be summarized as follows: test projects for hybrid and electric mobility (9 projects), establishment of a committee under the standards organization of the Netherlands for electric transport (an agreement on standardized plugs);

176 Sustainable Energy Authority of Ireland http://www.seai.ie/Renewables/EV_support_programme_launched/

177 House of the Oireachtas, as reported in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

178 http://www.mobieurope.eu/the-project/ongoing-initiatives/e-car-ireland/

179 http://www.esb.ie/electric-cars/index.jsp

180 Idem footnote 171.

181 http://www.ieahev.org/by-country/italy---charging-infrastrure/

182 Policy and Activities in electric mobility in Luxembourg www.janson.be/var/media/site/presentaties/ENOVOS 05012012 Presentation e-mobility.pptx

183 Dutch Energy Agency as reported in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

		stations[184]	global access to charging facilities in the implementation phase; government roadmap for development of a market model for charging services; exemption from private motor vehicle and motor cycle tax (BPM) and motor vehicle tax (MRB); e-mobility program (e-rijden), which focuses on operating electric vehicles and licensing charging points along motorways. Amsterdam will implement at least 200 charging points in the city in the next two years and expects to have 10,000 EVs by 2015.[186]
Poland		2013: 300 charging points[187]	The activities from the "public support for infrastructure electromobility" of Warsaw were launched in 2009. Within the EU project the first charging points in Warsaw were constructed, while the first e-cars were tested by the local police and municipal service. The Warsaw City Hall works on implementation and preparation of pilot projects aimed at popularization of electric cars by creating adequate charging infrastructure together with RWE Poland.[188]
Portugal	2020: 200,000 stock[189]	2020: 25,000[190]	National Program for Electric Mobility - The government project Mobi-E: Construction of a nationwide charging points network. € 5,000 purchasing grant for a vehicle (first 5,000 vehicles), exemption from road tax; € 1,500 subsidy for trading the old car for an EV. The 1,300 public normal charging stations will be installed in the following municipalities: Almada, Aveiro, Beja, Braga, Bragança, Cascais, Castelo Branco, Coimbra, Évora, Faro, Guarda, Guimarães, Leiria, Lisboa, Loures, Portalegre, Porto, Santarém, Setúbal, Sintra, Torres Vedras, Viana do Castelo, Vila Nova de Gaia, Vila Real e Viseu. Additional 50 public fast charging stations, will be installed in primary roads and highways connecting the mentioned municipalities, which will allow travelling between them, and in strategic areas to guarantee emergency charges.191
Romania	-	-	The Government set up a special working group for developing the e-mobility strategy in Romania,

185 "Formula E Team" is a working group collaborating with local governments, private companies and research institutes to create national and regional electric vehicle initiatives.

184 http://www.emobilitymagazine.nl/EmobilityeCarTec2011.pdf and http://www.ieahev.org/by-country/the-netherlands-charging-infrastructure/

186 http://www.d-incert.nl/electric-mobility-in-the-netherlands-powering-implementation-and-innovation/

187 http://www.retailpoland.com/104848/300-electric-car-charging-points-planned-in-Poland.shtml

188 Idem footnote 160.

189 Idem footnote 171.

190 Idem footnote 171.

191 http://www.ieahev.org/by-country/portugal-policy-and-legislation/

			subsidies for EV purchase recently introduced (up to € 3,700).[192]
Sweden	2020: 600,000 stock[193] 2020: 18,000 sales[194]	-	The City of Gothenburg aims to evaluate 500 charging stations. Initially, 250 vehicles will be involved in the activity. The Swedish Hybrid Centre2 is managing many of these efforts and acts as a hub for knowledge and development[195].
Slovenia	2030: 23% (14,062) stock[196],[197]	-	No current public support at national or regional level for charging infrastructures. Subsidies for purchase of EVs: In 2011 and 2012, a support for legal entities and natural persons (€ 500,000 each year): - for purchase of new EV or PHEV between € 5,000 (M1 category) and € 2,000 (L6e[198] category) - for remodeling of vehicles with IC motor to electric drive between € 4,000 (M1 category) and €1,000 (L6e category)[199]
United Kingdom	2020: 1,200,000 stock EVs 350,000 stock PHEVs 2030: 3,300,000 stock EVs 7,900,000 stock PHEVs[200]	By 2020 : 8,500 charging points[201]	Plugged-in-Places project GBP 400,000,000 for "green cars" in 2008-2012, of which: GBP 30,000,000 for charging network, GBP 10,000,000 for test projects in 2009 and 2010, GBP 120,000,000 for R&D (loans to market players).

Table 16: Overview table of Member States' targets for electric vehicles

Member state	2015	2020	2030

192 http://www.rolandberger.cz/media/pdf/Roland_Berger_CEE_emobility_study_20111020.pdf
193 EVI, as as reported in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf
194 Idem footnote 171.
195 http://www.ieahev.org/by-country/sweden-charging-infrastructure/
196 European Commission, Directorate-General Mobility and Transport, 2012, Statistical pocketbook 2012.
197 http://www.rolandberger.cz/media/pdf/Roland_Berger_CEE_emobility_study_20111020.pdf
198 Quadricycles whose unladen mass is not more than 350 kg - http://ec.europa.eu/transport/road_safety/vehicles/categories_en.htm#L
199 Idem footnote 160.
200 Department for Transport "High Range Scenario", as reported in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf
201 http://assets.dft.gov.uk/publications/making-the-connection-the-plug-in-vehicle-infrastructure-strategy/plug-in-vehicle-infrastructure-strategy.pdf

Austria[202]	-	250,000 (stock)	-
Belgium	-		-
Bulgaria	-	-	-
Cyprus	-	-	-
Czech Republic	-	-	-
Germany[203]	-	1,000,000 (stock)	5,000,000 (stock)
Denmark[204]	10,000 – 15,000 (stock)	50,000 (stock)[205] 200,000 (stock) [206]	-
Estonia	-	-	-
Greece	-	-	-
Spain[207]	1,000,000[208]	2,500,000 (stock)	-
Finland	-	-	-
France	450,000 (stock)	2,000,000 (stock)[209]	-
Hungary	-	-	-
Ireland	-	230,000 (stock)[210] 350,000 (stock) [211]	-
Italy	130,000 (stock) [212]	-	-

202 http://www.ieahev.org/by-country/austria-on-the-road-and-deployments/

203 EVI Electric Vehicles Initiative http://www.cleanenergyministerial.org/our_work/electric_vehicles/ . and The International Council on Clean Transport, 2011, Vehicle Electrification Policy Study
The Electric Vehicles Initiative (EVI) is a multilateral policy forum for accelerating the introduction and adoption of electric vehicles (EVs) worldwide. EVI seeks to facilitate the global deployment of 20,000,000 EVs, including plug-in hybrid electric vehicles and fuel cell vehicles, by 2020. Data available for participating governments: Denmark, Finland, France, Germany, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

204 Idem footnote 162.

205 Idem footnote 162.

206 ENS Denmark, as reported in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

207 http://www.ieahev.org/assets/1/7/IA-HEV_2010_annual_report_6MB.pdf Spain

208 http://www.ieahev.org/by-country/spain-policy-and-legislation/

209 National French roll-out plan, available at: http://www.developpement-durable.gouv.fr/Point-d-avancement-du-plan-avril,26840.html

210 Sustainable Energy Authority of Ireland http://www.seai.ie/Renewables/EV_support_programme_launched/

211 House of the Oireachtas, as reported in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

212 http://www.ieahev.org/assets/1/7/IA-HEV_2010_annual_report_6MB.pdf Italy

Lithuania	-	-	-
Luxembourg	-	40,000 (stock)[213]	-
Latvia	-	-	-
Malta	-	-	-
Netherlands	20,000 (stock)	200,000 (stock)[214]	-
Poland	-	-	-
Portugal	-	200,000 (stock)[215]	-
Romania	-	-	-
Sweden	-	600,000 (stock)[216] 18,000 sales[217]	-
Slovenia	-	23% (approx. 14,062 stock - based on existing new vehicles registration for 2011)[218],[219]	-
Slovak Republic	-	-	-
UK	-	1,200,000 stock EVs 350 000 stock PHEVs[220]	3,300,000 stock EVs 7,900,000 stock PHEVs[221]

213 Policy and Activities in electric mobility in Luxembourg www.janson.be/var/media/site/presentaties/ENOVOS 05012012 Presentation e-mobility.pptx

214 Dutch Energy Agency as reported in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

215 http://www.ieahev.org/assets/1/7/IA-HEV_2010_annual_report_6MB.pdf Portugal

216 EVI, as reported in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

217 http://www.ieahev.org/assets/1/7/IA-HEV_2010_annual_report_6MB.pdf Sweden page 290

218 Idem footnote 196.

219 http://www.rolandberger.cz/media/pdf/Roland_Berger_CEE_emobility_study_20111020.pdf

220 Idem footnote 43

221 Department for Transport "High Range Scenario", as reported in IEA, 2011, Technology Roadmap, Electric and plug-in hybrid electric vehicles, available at: http://www.iea.org/papers/2011/EV_PHEV_Roadmap.pdf

Table 17: Overview table of Member States' targets for deployment of EV charging points

Member state	Functional	2012-2013 Under construction	2014-2016 Planned	2020 Proposed
Austria	489[222]	-	-	**Semi-public 4,500**[223]
Belgium	188[224]	-	-	**Public: 35,000 – 130,000** **Public Fast 1,000 – 4,000**[225]
Bulgaria	1[226]	-	-	-
Cyprus	-	-	-	-
Czech Republic	Private 3 Public 20[227]	**Public 250**[228]	-	-
Germany	Private 613 Public 836 Semi-public 488[229]	**2,000**[230]	-	-
Denmark	Public 280[231]	30		**Public 20,000**[232]
Estonia	2[233]	-	250[234]	-
Greece	-	-	-	**Public 6,900**[235]
Spain	Public 731 LDVs: 625[236], [237]	-	**Private: 325,000**[238] **Public parking : 12,150** **Public road-side : 6,200**	-
Finland	1[239]	-	-	-

222 http://openchargemap.org/
223 http://www.verbund.com/cc/en/news-media/news/2012/04/10/e-mobility-provider-verbund-siemens
224 http://www.asbe.be/en/locations
225 Idem footnote 160.
226 http://openchargemap.org/
227 EURELECTRIC, 2012, EURELECTRIC views on charging infrastructure – Facilitating e-mobility.
228 http://www.ceskapozice.cz/en/business/companies/cez-plugs-electric-cars-charging-network
229 http://www.ieahev.org/by-country/germany-charging-infrastructure/
230 http://www.ieahev.org/by-country/germany-charging-infrastructure/
231 Idem footnote 227.
232 www.dtu.dk/upload/institutter/dtu%20transport/projekter/bev%20paper%202011_7_tcj_clean3.pdf
233 http://openchargemap.org/
234 http://www.successcharging.com/content/eastern-european-country-has-pledged-set-nationwide-network-250
235 Idem footnote 160.
236 Of which: normal load 616 and rapid charging 9, Motorcycles: 96, Disabled: 10.
237 http://www.movele.es/index.php/mod.puntos/mem.mapa/relmenu.20
238 Idem footnote 172.
239 http://openchargemap.org/

France[240]	236	STET 1,250	Private 900,000 Public 7,500	**Private: 4,000,000** **Public:** **400,000**
Hungary	7[241]	-	-	-
Ireland[242]	Public: 640 of which are 27 fast charge points		6,000	**Public: 25,000**
Italy[243]	1,000	Public: 588	150	
Lithuania	-	-	-	-
Luxembourg	7[244]	-		-
Latvia	1[245]	-	-	-
Malta	-	-	-	-
Netherlands	1,700	**Public: 10,000** **Fast: 50**[246]	-	-
Poland[247]	Public: 27[248]	**300**	-	-
Portugal[249]	Public 1,300 Fast 50 charging station			**Public 25,000**
Romania	-	-	-	-
Sweden	-	-	-	-
Slovenia	-	-	-	-
Slovak Republic	3[250]	-	-	-
UK	703[251]	-	-	**8,500**[252]

240 Idem footnote 172; and http://www.cleanvehicle.eu/info-per-country-and-eu-policy/member-states/france/national-level/
241 http://openchargemap.org/
242 http://www.mobieurope.eu/the-project/ongoing-initiatives/e-car-ireland
243 http://www.ieahev.org/by-country/italy---charging-infrastrure/
244 http://openchargemap.org/
245 http://openchargemap.org/
246 http://www.emobilitymagazine.nl/EmobilityeCarTec2011.pdf
247 http://www.retailpoland.com/104848/300-electric-car-charging-points-planned-in-Poland.shtml
248 14 normal open-access, 1 fast charging stations and 12 commercial points 1 demonstration in front of their headquarters in Warsaw Polenergia
249 Idem footnote 171.
250 http://openchargemap.org/
251 http://openchargemap.org/
252 http://assets.dft.gov.uk/publications/making-the-connection-the-plug-in-vehicle-infrastructure-strategy/plug-in-vehicle-infrastructure-strategy.pdf

Hydrogen

3. In the following, some of the national initiatives and policies implemented for the deployment of hydrogen infrastructure, together with industry-led action, are described.

4. Many of the first hydrogen refuelling stations have been co-financed by regional and local authorities operating or financing captive fleets (i.e. bus fleets or cars that are part of public fleets). The first industry initiatives to establish a national network of stations are the "H2 Mobility" initiative in Germany, with similar initiatives in the UK[253] and France[254] (e.g. Clean Hydrogen in European Cities Project), mostly focused on refuelling passenger cars.

Germany – H2 Mobility

5. The partners of the initiative "H2 Mobility" are Linde, Daimler, EnBW, OMV, Shell, Total, Vattenfall and the NOW GmbH National Organisation Hydrogen and Fuel Cell Technology. During the 1st phase of the project, kicked-off in 2008, an evaluation of options of where to place hydrogen fuelling stations in Germany took place, as well as the definition of a joint business plan agreement, setting out possible public support measures. During the 2nd phase, the installation of new hydrogen fuelling stations must take place in order to develop hydrogen fuelling stations network that will facilitate the introduction of hydrogen powered vehicles by 2015. This initiative falls under the framework of the German economic stimulus package (Konjunkturpaket II) and other national and state programs in order to look into standardization and cost reduction issues[255].

Italy, UK, Norway, Switzerland – The Clean Hydrogen in European Cities Project (CHIC)

6. The Clean Hydrogen in European Cities Project (CHIC) was launched in 2010. The project involves integrating 26 fuel cell buses in daily public transport operations and bus routes in five locations across Europe – Aargau (Switzerland), Bolzano/Bozen (Italy), London (UK), Milan (Italy), and Oslo (Norway). The CHIC project is supported by the European Union Joint Undertaking for Fuel Cells and Hydrogen (FCH JU) with funding of € 26,000,000, and has 25 partners from across Europe, which includes industrial partners for vehicle supply and refuelling infrastructure. The project is based on a staged introduction and build-up of FCH bus fleets, the supporting hydrogen refuelling stations and infrastructure in order to facilitate the smooth integration of the FCH buses in Europe's public transport system.256

United Kingdom – UKH2 Mobility

7. In January 2012, the Department for Business Innovation and Skills launched the project UKH2 Mobility in partnership with the industry. The Government is investing £ 400,000,000 to support the development, demonstration and deployment of hydrogen vehicles. The project will evaluate the potential for hydrogen as a fuel for Ultra Low Carbon Vehicles in the UK before developing an action plan for an anticipated roll-out to consumers in 2014/15.

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253 http://www.fch-ju.eu/news/launch-uk-h2-mobility-new-governement-and-cross-industry-programme-make-hydrogen-powered-travel

254 http://washingtonfuelcellsummit.com/proceedings/aftKeynote1_mcGowan.pdf

255 http://www.hydrogen.energy.gov/pdfs/4_williamson_0610.pdf

256 http://chic-project.eu/about/background/chic-in-brief

8. The objectives of UKH2 Mobility are as follows:

9. Analyse in detail the specific UK case for the introduction of hydrogen fuel cell electric vehicles as one of a number of solutions to decarbonise road transport and quantify the potential emissions benefits;

10. Review the investments required to commercialise the technology, including refuelling infrastructure; and

11. Identify what is required to make the UK a leading global player in hydrogen fuel cell electric vehicle manufacturing thereby paving the way for economic opportunities to the UK, through the creation of new jobs and boosting of local economies.[257]

United Kingdom – £ 19,000,000 investment in hydrogen fuel cell projects

12. In July 2012, the Technology Strategy Board and the Department of Energy and Climate Change (DECC) announced that they will invest £ 9,000,000 for six new projects. The objective of the projects is to demonstrate the potential of fuel cell systems and hydrogen technology which can be integrated into energy and transport industries.

13. The projects are co-financed by private industry and they will include the creation of the UK's first end-to-end, integrated, hydrogen production, distribution and retailing system, centred around a fully publicly accessible 700 bar renewable H_2 refuelling station network across London.[258]

United Kingdom – Isle of Wight[259]

14. The Isle of Wight, off the UK's south coast is test project for hydrogen fuel technology in a £ 4,660,000 project led by energy storage and clean fuel company ITM Power. £ 1,300,000 of the budget is financed by a grant from the government-backed Technology Strategy Board.

15. The project will design, build, install and operate two grid-connected hydrogen refuelling platforms on the Isle of Wight. A 15kg/day refueller will be used in a marine capacity located on the south coast of the Island, and a larger 100kg/day unit will be installed on a centrally located business park for the operation of a fleet of hydrogen vehicles including Hyundai, Microcab and River Simple. Vehicles showcased will include Fuel Cell Electric Vehicle (FCEV) cars, Hydrogen Internal Combustion Engine (HICE) vans and a HICE boat. ITM Power will design and build two refuellers and take a key role in the system integration.

16. The Technology Strategy Board is also sponsoring five other projects which include an end-to-end, green hydrogen production, distribution and retailing system in London, a wind-powered hydrogen generation system in Aberdeen to serve a fleet of fuel cell buses and two solar-generated hydrogen projects in Swindon and Surrey.

17. The Isle of Wight is part of the Ecoisland project – a community-based initiative aiming to make the Isle of Wight self-sustaining by the end of the decade. The island

257 http://news.bis.gov.uk/content/detail.aspx?NewsAreaId=2&ReleaseID=422877&SubjectId=2

258 http://www.thegreencarwebsite.co.uk/blog/index.php/2012/07/23/uk-invests-19-million-in-hydrogen-fuel-cell-projects/

259 http://www.eco-island.org/hub/page/press

will be home to a hydrogen energy production, storage and vehicle refuelling system, which will be integrated into the existing power network.

United Kingdom – London[260]"Hydrogen network"

18. In March 2010, the Mayor of London announced the creation of a "Hydrogen network" by 2012, in order to help accelerate the wider use of this zero-polluting, zero-carbon energy in the capital. The London Hydrogen Partnership (LHP) is working with London boroughs and private landowners on plans to deliver at least six refuelling sites to run hydrogen-powered vehicles in the capital over the next two years. One is already being built in east London for the refuelling of hydrogen-fuelled buses that will begin running on the RV1 route later this year.

19. One of the objectives of the action plan is to encourage a minimum of 150 hydrogen-powered vehicles on the road in London by 2012. This includes cars, vans, taxis, motorbikes, and lorries. Fifty of the vehicles are expected to be operated by the Greater London Authority's functional bodies – Transport for London (TfL); the London Development Agency (LDA); the London Fire and Emergency Planning Authority (LFEPA); and the Metropolitan Police Authority (MPA). The London Hydrogen Partnership and the Greater London Authority are also working with BAA on a hydrogen feasibility study to explore ways to use hydrogen and fuel cell technologies at Heathrow airport.

United Kingdom – London (part of the HyTEC project)

20. The HyTEC project (Hydrogen Transport in European Cities), which is co-funded by the European Union, will deploy up to 15 London black fuel cell taxis, five fuel cell scooters and a new H_2 refuelling station operational in London by 2013.

21. The first hydrogen-powered taxis are now ready to operate and they will be used to transport VIPs during the Olympic period, and will be fuelled at Air Products' new fuelling station at Heathrow airport. Copenhagen will be receiving ten fuel cell electric vehicles (FCEV).[261] Also a hydrogen fuelling station is finalized in time for the Olympic Games.

Denmark – Copenhagen (part of the HyTEC project)

22. The vision of the city of Copenhagen is to become carbon neutral by 2025. It has adopted a new climate plan including a target of 85% of the municipality vehicle fleet by 2015 to be powered by electric propulsion systems (battery and/or hydrogen). The deployment of the passenger vehicles of the HyTEC project fits in perfectly with this ambitious goal and plan.

23. A new publicly accessible Central-Copenhagen refuelling station network, able to accommodate a minimum of 200 kg/day (across the network) 700 bar hydrogen refuelling according to SAE specifications. The city network is to be linked with other major cities in Denmark, contributing to the efforts of securing a countrywide station network beyond 2015.[262]

The Scandinavian Hydrogen Highway Partnership (SHHP)[263]

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260 http://www.london.gov.uk/media/press_releases_mayoral/london%E2%80%99s-%E2%80%98hydrogen-network%E2%80%99-plans-unveiled

261 http://www.london.gov.uk/lhp/documents/HyTEC%20Fuel%20Cell%20Taxi%20Handover.pdf

262 http://hy-tec.eu/2012/h2-refueling/hytec-innovation/

263 http://www.scandinavianhydrogen.org/news?page=1

24. The SHHP is a partnership between local, regional and national authorities and private industries and research institutions. The national networking institutions are: HyNor (Norway), Hydrogen Sweden (Sweden) and Hydrogen Link (Denmark).

25. The objective of the SHHP is to make the Scandinavian region one of the first regions in Europe where hydrogen is commercially available and used in a network of refuelling stations.

26. The target by 2015 is to create a Hydrogen Refuelling Stations (HRS) network that includes:

27. 15 stations

28. 30 satellite stations

29. and a large fleet of vehicles: 100 buses, 500 cars and 500 speciality vehicles.

LNG

30. In the following, some of the national initiatives and policies implemented for the deployment of LNG infrastructure, together with industry-led action, are described.

The Netherlands – Green Deal LNG[264]

31. In June 2012, the representatives of the Dutch government (Minister of Economic Affairs, Agriculture and Innovation and the Secretary of State), the Rotterdam Port Authority and their partners (3TU, VSL, TNO, Energy Valley, Deltalinqs), have signed the agreement "Green Deal LNG". The main goal of the LNG Green Deal is to make the inland shipping, fisheries and marine more sustainable through the use of Liquid Natural Gas (LNG) as fuel.

32. The Green Deal focuses on two specific areas: the Wadden and North Sea area and the Rhine between Rotterdam and Basel, including Amsterdam and Vlissingen. In both areas, initiatives are being developed, such as the LNG ferry owned by shipping company Doeksen between Harlingen and Terschelling, petrol station "Green Planet" in Pesse where an LNG tank infrastructure will be installed for heavy trucks and two Anthony Veder ethylene vessels, which will run between England and the European continent.

The Netherlands – The National LNG Platform[265]

33. The government also established the National LNG Platform. The Platform has a "50-50-500 objective": at least 50 barges, 50 sea-going vessels and 500 trucks running on LNG by 2015. Initiators of the Platform are the two areas: the Wadden Sea-North Sea and the Rhine region from Rotterdam to Basel, Switzerland, which will include the cities of Amsterdam and Vlissingen, unified in Energy Valley (the energy cluster in the north of the Netherlands) and Deltalinqs (the business organization representing companies in the port of Rotterdam, part of the Rotterdam

[264] http://www.tno.nl/content.cfm?context=overtno&content=nieuwsbericht&laag1=37&laag2=69&item_id=2012-06-15%2013:45:52.0&Taal=2

[265] http://www.ngvglobal.com/netherlands-sets-2015-goals-for-lng-fuelled-transportation-0702

Climate Initiative). In addition, LNG TR&D (collaboration between 3TU, VSL and TNO).

Danube Region Masterplan[266]

34. The Danube region is preparing a Masterplan for the introduction of LNG as fuel and as cargo for Danube navigation. One of the targets of the EU Danube Strategy is the modernisation of the Danube fleet in order to improve environmental and economic performance. Switching from gasoil to LNG as fuel will have a contribution to this goal.

35. The Masterplan will investigate the benefits of implementing LNG as fuel and as cargo for the Danube fleet and identify obstacles and costs. It will develop a comprehensive strategy together with a detailed master plan for the necessary implementation steps.

36. The budget for the Masterplan is € 1,250,000 and around € 10-15,000,000 will be allocated for Pilot Implementations (2013 onwards). The project is financed by the Structural Funds, IPA, ENPI, TEN-T and by financial contributions from related private industry.

37. The project partners are: a consortium made up by barging companies, port and terminal operators, shipyards, government authorities, vessel classification societies, gas industry, key stakeholders for LNG use, LNG technology providers (storage, carriage, transhipment), and engine providers.

Belgium – LNG study[267]

38. The Flemish government and the port authorities signed a contract with Det Norske Veritas AS (DNV) to undertake a feasibility study for the provision of liquefied natural gas (LNG) bunkering facilities at the ports of Antwerp, Zeebrugge and Ghent in Belgium. The work will consist of a market survey, a risk and safety analysis, and modeling of the logistics, legal and regulatory requirements needed to establish LNG bunkering infrastructure at the ports.

Belgium – Port of Antwerp[268]

39. Port of Antwerp is part of the International Association of Ports and Harbours (IAPH), within the World Ports Climate Initiative. The association organize workshops for port members on LNG and for the new workshop the Port of Antwerp was asked to be the lead port. In the last workshop on LNG several ports participated: ports of Amsterdam, Bremen, Brunsbüttel, Frederikstad, Gothenburg, Hamburg, Los Angeles, Oslo, Rotterdam and Stockholm, as well as the classification bureaus Det Norske Veritas (DNV) and Germanischer Lloyd (GL-group) and the gas company Gasnor.

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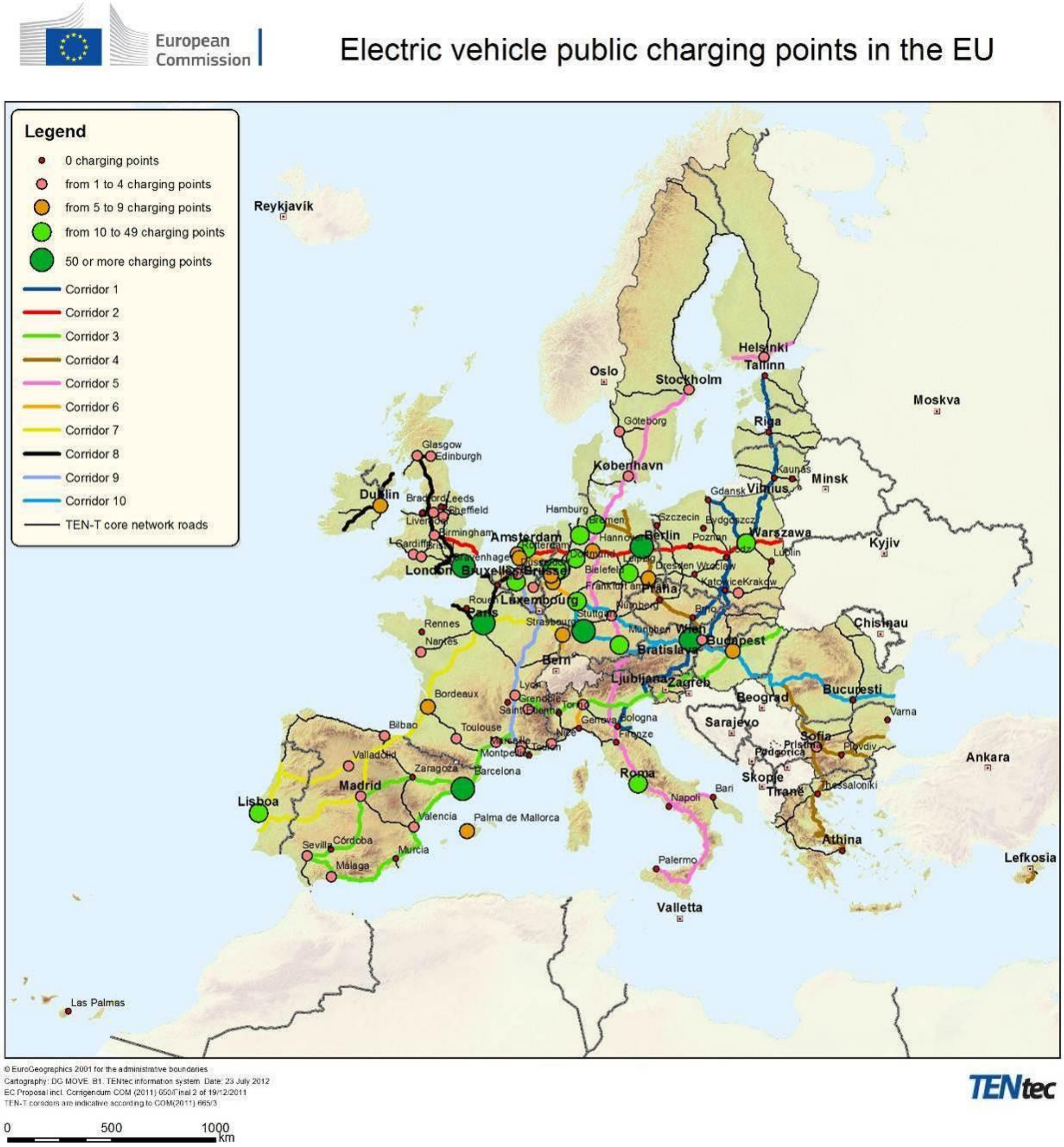
266 http://www.prodanube.eu/index.php?option=com_content&view=article&id=49&Itemid=3

267 http://www.dnv.com/press_area/press_releases/2012/dnvtomapthefutureoflngbunkeringinbelgium.asp

268 http://wpci.iaphworldports.org/project-in-progress/lng-fueled-vessels.html

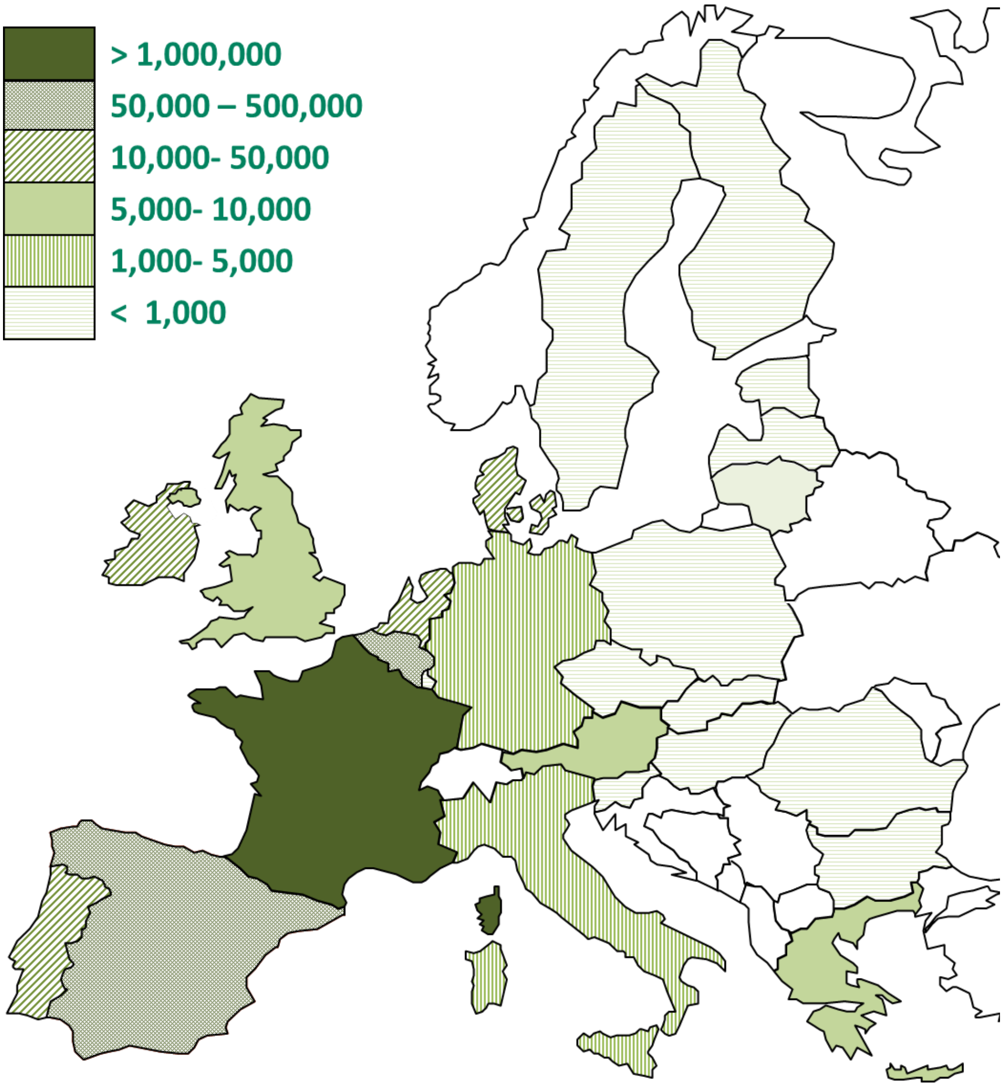
Appendix 5: Existing and expected alternative fuels infrastructure in the EU

Figure 1: Public charging points in the main urban areas of the EU[269]



269 Information shown on this graph is illustrative, reflecting the state of deployment at the time of data gathering (1st half of 2012). It has been compiled based on publicly available data sources such as: www.lemnet.org/LEMnet_Land.asp; http://openchargemap.org/; http://www.electromaps.com/; http://www.asbe.be/en/locations.

Figure 2: Illustrative overview of announced plans of Member States for the deployment of charging points by 2020[270]



270 Cyprus and Malta have not announced any plans for the deployment of charging points. Further details on the data sources are provided in Table 17 in Appendix 2.

Figure 3: Existing and planned hydrogen fuelling stations in the EU[271]

[271] Information shown on this graph is illustrative, reflecting the state of deployment at the time of data gathering (1st half of 2012). It has been compiled based on publicly available data sources such as www.h2stations.org by LBST; and input received from the European Hydrogen Association.

Figure 4: Existing LNG terminals and L-CNG fuelling stations in the EU[272]

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272 Information shown on this graph is illustrative, reflecting the state of deployment at the time of data gathering (1st half of 2012). It has been compiled based on publicly available data sources such as http://www.gie.eu.com/index.php/maps-data/lng-map; and input received from NGVA Europe.

Appendix 6: The root causes of the insufficiency of the infrastructure for alternative fuels – Fuel-by-fuel analysis

<u>Existing recharging/recharging equipment cannot be connected and is not interoperable in all related alternative fuel vehicles/vessels</u>

Electricity

1. In June 2010, the Commission mandated[273] three standardisation organisations, the European Committee for Standardisation (CEN), the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI) to develop European standards or to review existing ones in order to ensure interoperability and connectivity between the electricity supply and the EVs, including appropriate smart-charging issues[274], so that the charger can be connected and be interoperable in all vehicles. This work has not been concluded yet as no consensus was found to select either Type 2 or Type 3 EV charging socket (Figure), which are both standardised under the same catalogue number 62196-2 of the International Electrotechnical Commission (IEC). This current failure of voluntary standardisation can be principally traced back to vested industrial interests.

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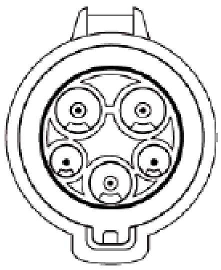
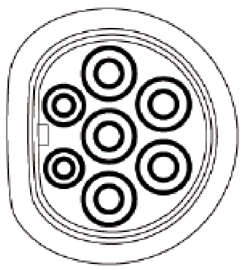
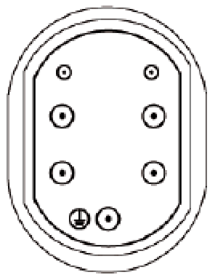
[273] The objectives of the mandate are as follows:
"*a) Ensure interoperability and connectivity between the electricity supply point and the charger of electric vehicles, including the charger of their removable batteries, so that this charger can be connected and be interoperable in all EU States […]*
b) Ensure interoperability and connectivity between the charger of electric vehicle- if the charger is not on board- and the electric vehicle and its removable battery, so that a charger can be connected, can be interoperable and re-charge all types of electric vehicles and their batteries.
c) Appropriately consider any smart-charging issue with respect to the charging of electric vehicles.
d) Appropriately consider safety risks and electromagnetic compatibility of the charger of electric vehicles in the field of Directive 2006/95/EC (LVD) and Directive 2004/108/EC (EMC)"
Source: European Commission, Directorate-General Enterprise and Industry, June 2010, Standardisation Mandate to CEN, CENELEC and ETSI concerning the charging of electric vehicles (Mandate M/468), available at: http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/2010_06_04_mandate_m468_en.pdf

[274] Regarding smart charging issues, Mandate M/468 is coordinated with Commission Mandate M/490 to European standardisation organisations (ESOs) to support smart grids standards, which will deliver a first set of standards by the end of this year. Source: http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/2011_03_01_mandate_m490_en.pdf

Figure 5: Three types of EV charging sockets[275]

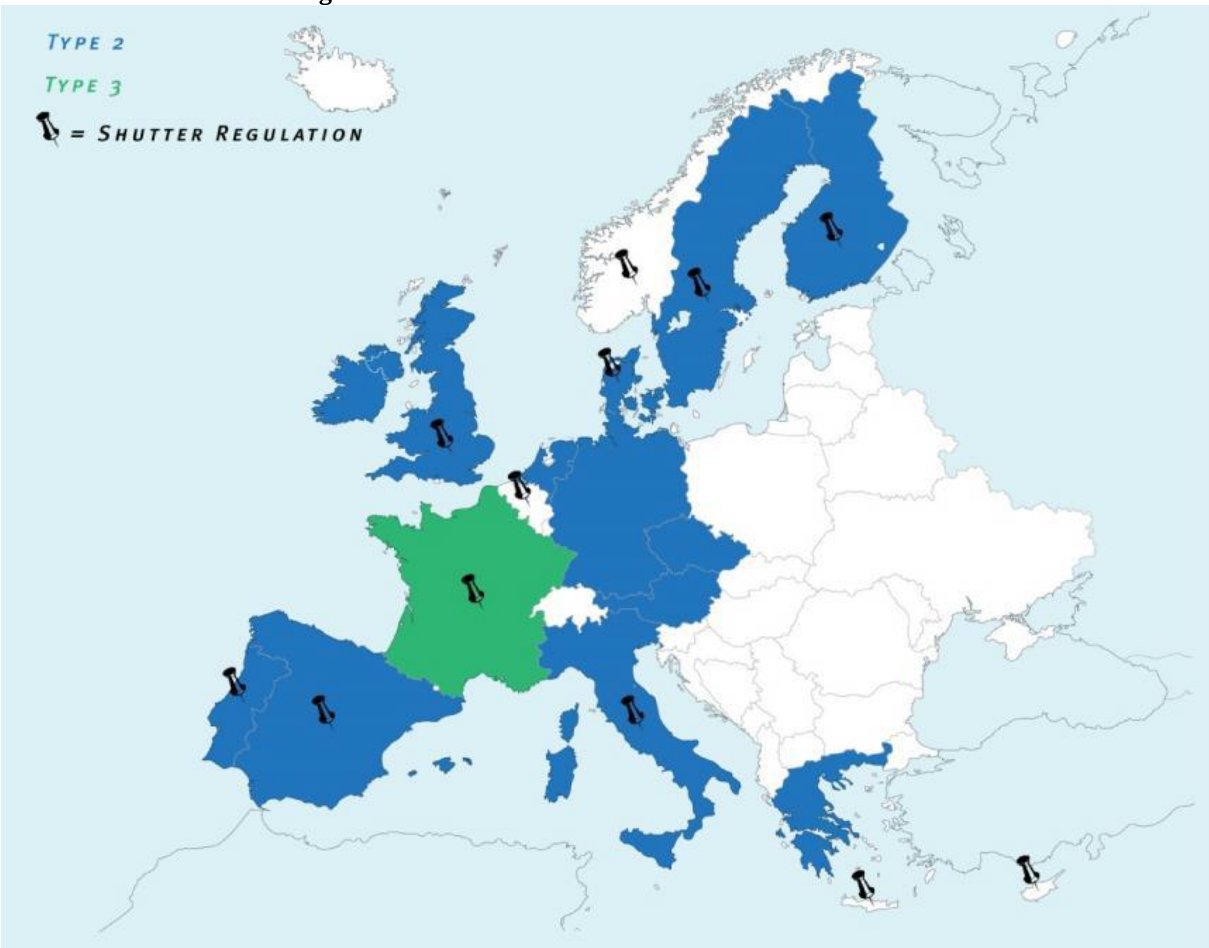
Characteristics	Type 1	Type 2	Type 3
Phase	Single-phase	Single-phase / 3-phase	Single-phase / 3-phase
Current	32 A	70 A (single-phase) 63 A	32 A
Voltage	250 V	500 V	500 V
No. of prongs	5	7	5 or 7
Blanking device	No	No	Yes
Diagram			

2. This situation led to, on the one hand, the deployment of both charging sockets at the same time with France deploying Type 3 and other Member States deploying Type 2 sockets (Figure), on the other hand, the delay by certain countries to deploy charging infrastructure at all. Stakeholders have repeatedly called for ending this deadlock, fearing that "*this situation is not beneficial to e-mobility development*"[276].

[275] Source: Schneider Electric, 2010, Connection system on the recharging spot – a key element for electric vehicles, available at: http://www.evplugalliance.org/wp-content/uploads/pdf/White%20paper%20connection%20system-english.pdf

[276] Source: EURELECTRIC, March 2012, Facilitating e-mobility: EURELECTRIC views on charging infrastructure. European car manufacturers (ACEA) recommend installing Type2/Type Combo inlet/connector, as of 2017, for charging electric vehicles.

Figure 6: Choice of socket in various Member States[277]



Hydrogen

1. The International Organization for Standardization (ISO)[278] and the Society of Automobile Engineers (SAE)[279] have developed standards on hydrogen refuelling interface, hydrogen fuel quality, and hydrogen refuelling station safety. Some of them are being revised, such as ISO standards on gaseous hydrogen fuelling stations and on gaseous hydrogen land vehicle refuelling connection devices. The existing standards are currently applied voluntarily, and stakeholders have confirmed that

277 Source: Reproduced and updated based on data provided by EURELECTRIC, and in EURELECTRIC, March 2012, Facilitating e-mobility: EURELECTRIC views on charging infrastructure, Table 1.

278 Work is carried out by Technical Committee 197 on standardization in the field of systems and devices for the production, storage, transport, measurement and use of hydrogen. France, Germany, Italy, the Netherlands, Spain, Sweden, and the United Kingdom participate in the Committee; Austria, Czech Republic, Finland, Hungary, Poland and Romania are observing countries. Published standards include ISO/TS 20100:2008 which specifies the characteristics of outdoor public and non-public fuelling stations that dispense gaseous hydrogen used as fuel on-board land vehicles of all types; ISO 17268:2006 that applies to design, safety and operation verification of Compressed Hydrogen Surface Vehicle (CHSV) refueling connection devices (nozzle and receptacle).

279 Work is undertaken in the Fuel Cell Standards Committee. Examples of issued standards: J2719 Hydrogen Fuel Quality for Fuel Cell Vehicles; J2601 Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles; J2600 Compressed Hydrogen Surface Vehicle Refuelling Connection Devices

although they are already instrumental in supporting deployment and gaining acceptance, their legislative establishment would be important.

Natural Gas (LNG and CNG)

LNG

Currently, for road vehicles, there are different LNG fuelling systems as LNG vehicle manufacturers use different engine inlet pressures. This has led the market to the existence of LNG storage tanks working at different pressures. This makes necessary for the refuelling infrastructure to be able to adapt to different existing systems.

1. Work is on-going within the ISO International Organization for Standardization for the development of LNG/L-CNG refuelling station standards and on LNG connectors and receptacles[280].

2. For international shipping, in addition to on-going work at Technical Committee 67 of the ISO, the International Maritime Organization (IMO) is developing an international code for the construction and equipment of ships carrying LNG (IGC Code). The IMO has also started work on a new international code on safety for gas-fuelled ships (IGF Code). In addition and complementing ISO and IMO, the Society of International Gas Tanker and Terminal Operators (SIGGTO) and the Oil Companies International Marine Forum (OCIMF) are also working on international standards, including for LNG bunkering and related port operations.

CNG

3. Currently, there is no EU applicable CEN standard for the build-up of CNG vehicles refuelling infrastructure. In the past, a process was created with the intention to fill this gap, and CEN worked over six years to prepare the prEN 13638 2007, project standard that had to be cancelled on its final approval step, as unanimity could not be achieved.

4. This fact has led to different countries creating national standards on this topic in order to answer the market demands. Some countries like Spain (UNE 60631), adopted this draft CEN standard as the national standard to follow in their territory.

5. ISO has recently created a new committee covering all the necessary aspects (design, construction, operation, maintenance and inspection) for CNG refuelling infrastructure. This committee is the TC/ 252 which is divided in two sub-groups separately dealing with the CNG and LNG/LCNG standards (ISO/WD 16923 and ISO/WD 16924 respectively). This committee is aiming at having the ISO standard ready by the second half of 2014.- Fuelling Stations: ISO/TC 252 is working on an international standard for fuelling stations for NGVs. The WG1 is dealing with the CNG standard, and the WG 2 with the LNG & L-CNG standard. Target date to deliver is mid-2015.

[280] Work is carried out by Technical Committee 22 on vehicles using gaseous fuels, and by Committee 252 on natural gas fuelling stations for vehicles. In latter Committee, Austria, Belgium, the Czech Republic, Germany, Italy, the Netherlands, Spain, Sweden, and the United Kingdom participate in the Committee; France, Finland, Poland and Portugal are observing countries. ISO/CD 12617 standard on LNG vehicles -- Connector for refuelling vehicles is foreseen to be published in Apr 2014, while, according to information provided by NGVA Europe, the target date to deliver the ISO/CD 12614 standards on LNG fuel system components is mid-2015.

Investment uncertainty hinders the deployment of recharging/refuelling infrastructure for electricity, hydrogen and LNG

Electricity

1. Electricity recharging infrastructure is characterised by a high degree of uncertainty and risk. As regards electricity, the investment consists of building recharging points. The costs per smart[281] private charging point can be estimated to be around € 520; while for a publicly accessible charging point it is approximately € 5,280[282].

Figure 7: Estimates for investment and installation cost for single charging outlets[283]

in US $	Level II: Private home/garage	Level II: Commercial garage/ public street	Level III	Battery swap
PlanNYC/ McKinsey	1,500-2,500	2,000-7,500 dependent on location	more than 40,000	-
BCG, Element Energy and other studies	500-2,000	3,000 -8,000 dependent on location	more than 50,000	-
Interviews and author's estimates	500-1,000	3,000 –7,000	40,000 – 75,000	+1,500,000

2. Public charging points need to be smart, in the sense that there is controlled charging and vehicle-to-grid communication, in order to ensure that the impact on the grid is manageable, to ensure adequate billing and to ensure that the charging of EVs can contribute to grid flexibility. In particular, the price for electricity at a charging point needs to be able to reflect the electricity price in the wholesale market at the time of charging, i.e. the price for electricity in that particular period (e.g. a price per every 15 minutes)[284].

3. In addition, the existing grid will simultaneously require investment in sub-stations, in local stationary storage, in smart metering and in advanced control systems, in order to improve the balancing of demand and supply, to address grid congestion and peak shaving and to stabilise the voltage and the development of the electricity grid

281 At home, when investing in separate charging points for EVs, the EU smart meter policy (Annex I.2 of Directive 2009/72/EC) needs to be taken into account: Member States shall equip at least 80% of all consumers for which an assessment of the long-term costs and benefit has shown that the balance is positive, with smart meters by 2020. The assessment had to be done by every Member State by 3 September 2012, and the European Commission is currently analysing these assessments. The national policy on separate charging points for private locations needs to be consistent with smart meter roll-out plans of the Member State: when smart meters are planned to be installed they need to ensure that EV charging benefits from it. Vice-versa, smart meters may become more cost-beneficial for owners of EVs.

282 Source: Kaneko et al., 2011, EV/PHEV charging infrastructure analysis.

283 Figure 3.2.2.2 in source shown in Wiederer et al., 2010, Policy option for electric vehicle charging infrastructure in C40 cities.

284 To stimulate the development of EVs, electricity market participants need to be able to use the flexibility of the electric car, and they need to be able to charge the costs of the electricity delivery.

at large[285]. This is necessary as the use of the grid for EVs will be an additional demand for transport of electricity through the grid. Obviously, the additional demand for electricity from EVs will depend on the quantity of vehicles, their use, and the type of charging (slow or fast), and on local circumstances and current status of the electricity grid.

4. From an institutional perspective, the entities investing in recharging infrastructure will need to cooperate with the electricity distribution system operators (DSOs) and the grid owners. Fast charging points seem to be the most risky investments as they require high initial capital and their utilisation rates are difficult to foresee. Although the slow charging stations have lower unit costs, the relative short ranges of EVs imply that the charging infrastructure needs to initially develop with a sufficient density to incite consumers using such vehicles, and thus ensure utilisation rates that lead to a reasonable payback period.

5. These requirements imply that the initial amount of investment is substantial and has to take place before having certainty about the size of the EV fleet. Investors might need to impose a mark-up on the electricity price in order to recuperate their investment[286].

Hydrogen

1. Hydrogen refuelling infrastructure is characterised by an even higher degree of uncertainty and risk. The case of hydrogen implies building a production, transportation, distribution and retailing infrastructure, which do not exist today to the extent necessary for penetration in the transport sector. Consequently, the amount of initial investment is high. According to the Expert Group on Future Transport Fuels, the average capital cost of a hydrogen refilling station ranges from € 0.6-1.6 million.

2. From an institutional and business perspective, the transportation and distribution infrastructure has features similar to natural gas (e.g. with respect to regulation), whereas the retailing infrastructure can be handled on a pure private basis as the conventional pump stations. Studies show that, while the transportation of hydrogen can be done using trucks at the early stages of infrastructure development, the high capital cost of the hydrogen retailing stations and the (un)certainty of the utilisation rates are key factors for the viability of the investment.

Natural Gas (LNG and CNG)

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285 This is in principle not any different from any other investment in the distribution grid due to the installation of an additional demand-point. It requires however that the Distribution System Operator (DSO) is at least involved in the installation of (public) electricity charging points or that the investment is done by the DSO itself. Operating the distribution grid is a regulated activity, and the terms and conditions for network connection including tariffs for access to the grid are approved by the national regulatory authority, according to Article 37(6) of Directive 2009/72/EC. Investments in reinforcement of the grid are therefore part of the regulated activity, and do not bear high financial risk for the DSO as long as the regulator approves the investments (apart from for example risks linked to efficiency requirements set by the regulator).

286 An open issue is who can control the charging: the owner of the charging station (i.e. when he/she has an electricity contract to provide flexible demand) or the owner of the car (i.e. when he/she has bought a car with the electricity included). At the moment, it seems that both models should be possible, and that prohibitive contracts that limit the freedom of electric vehicles to charge at any point available, needs to be prevented: this needs to be monitored in the coming years.

1. The recovery of investment cost of an LNG bunkering facility station highly depends on the use of LNG as a fuel by shipowners. Such choice for LNG as alternative fuel is induced by two factors: the need for ships to reduce in particular sulphur emissions and the cost savings due to using LNG instead of oil.

2. According to an analysis undertaken by a recent TEN-T co-financed study[287], the investment cost is around 15,000,000 € for small scale, purpose-built LNG bunkering facility. The payback period for a local LNG bunkering infrastructure is expected to range between 8-15 years (allowing for lower LNG prices when choosing longer payback periods). The economies of scale prevail in the economics of LNG bunkering infrastructure investment and the demand for LNG. This implies that the higher the capacity of the terminal (m^3), the lower the specific tank cost (€/m^3 LNG). Similarly higher demand for LNG at a particular refuelling station can reduce the unit costs. Both may reduce the payback period.

3. As for LNG/ CNG fuelling stations, the investors face higher upfront initial costs compared to a conventional petrol station, in the range of 200,000-400,000 €[288]. For new dedicated LNG fuelling stations, in particular those that will be developed on inland waterways, it is assumed that LNG will be supplied to the fuelling stations in liquid form, and therefore will not interact with the natural gas transmission network.

[287] Danish Maritime Authority, 2011, North European LNG Infrastructure Project..

[288] Source: NGVA Europe, as presented in the 2nd report of the Expert Group on Future Transport Fuels.

Appendix 7: Detailed pre-screening of possible policy options

Possible combinations of soft and strict regulatory approaches

1. All possible combinations of soft and strict regulatory approaches are shown in Table 18 below.

Table 18: Overview of the preliminary policy options

Operational objective 1 / Operational objective 2	No EU intervention	Voluntary standardisation	Mandatory application of common standards
No EU intervention	Preliminary Policy Option (PPO) 1	PPO2	PPO3
Indicative targets at Member States level and industry self-regulation	PPO4	PPO5	PPO6
Binding targets at Member States level	PPO7	PPO8	PPO9

2. As a result of the evaluation of stakeholder and expert input, four preliminary policy options were selected for further analysis that reflect the whole range of possible combination of soft and strict regulatory approaches: PPO1, PPO5, PPO6 and PPO9. The remaining preliminary policy options were discarded for not being capable of simultaneously achieving the specific objectives 1 and 2:

- Providing the investors with certainty on technical standards would not be sufficient to create a business case for infrastructure in the absence of sufficient demand for vehicles, nor would be enough to drive consumer demand before the recharging/refuelling network is actually in place (PPO2, PPO3). Conversely, quantitative targets on the deployment of infrastructure would not automatically harmonise the required technical standards (PPO4, PPO7);
- while it is theoretically possible to apply stricter policy measures to address the coordination failure causing investment uncertainty, it does not appear reasonable to do so without an appropriate level of harmonisation in the ‘quality’ of infrastructure to be deployed (PPO4, PPO7, PPO8).

Possible combinations of the various fuels

3. The combination of various policy approaches as described above can be taken forward to apply to the three fuels (and in case of LNG, either to vessels and/or to heavy-duty vehicles (HDVs)) in differing degrees. All possible combinations with the selected preliminary policy options are shown on Table 19, except for those that are strongly interlinked: the deployment of LNG for HDVs is not feasible without the prior or parallel deployment of LNG for vessels.

Table 19: Overview of the possible combinations of the various fuels

	Electricity	Electricity & Hydrogen	Electricity & Hydrogen & LNG for vessels	Electricity & Hydrogen & LNG for vessels & LNG for trucks & CNG for vehicles	Electricity & LNG for vessels	Electricity & LNG for vessels & LNG for trucks & CNG for vehicles	Hydrogen	Hydrogen & LNG for vessels	Hydrogen & LNG for vessels & LNG for trucks & CNG for vehicles	LNG for vessels	LNG for vessels & LNG for trucks & CNG for vehicles	LNG for trucks & CNG for vehicles
	1	2	3	4	5	6	7	8	9	10	11	12
PPO1	Fuel combination (FC) 1	FC2	FC3	FC4	FC5	FC6	FC7	FC8	FC9	FC10	FC11	FC12
PPO5	FC13	FC14	FC15	FC16	FC17	FC18	FC19	FC20	FC21	FC22	FC23	FC24
PPO6	FC25	FC26	FC27	FC28	FC29	FC30	FC31	FC32	FC33	FC34	FC35	FC36
PPO9	FC37	FC38	FC39	FC40	FC41	FC42	FC43	FC44	FC45	FC46	FC47	FC48

4. The number of possible combinations is very large, however most of them would violate technological neutrality and would strongly favour the deployment of one specific fuel over the other technologies. This possible course of action was rejected by stakeholders in the consultation process, is not consistent with previous Commission analysis and policy documents and is not warranted by any clear technical or economic superiority of any particular technology.

5. Technological neutrality is only ensured in combinations where all fuels, which face the problems identified in Section 2, of the IA are covered. Hence, the combinations in columns 1-3 and 5-12 are discarded, and only FC4, FC16, FC28 and FC40 are taken forward.

6. In spite of this, it is possible to address all fuels, but with a differing of policy intervention as envisaged under the preliminary policy options. The possible 'packages' of fuel combinations are highlighted in Table 19, and are as follows:

- Fuel Package I (FC7 + FC12 + FC17): together with voluntary standardisation, indicative targets would be set only for electricity and LNG for vessels, but there would be no EU action on hydrogen, LNG for trucks and CNG for vehicles.

- Fuel Package II (FC6 + FC19): together with voluntary standardisation, indicative targets would be set only for hydrogen, but there would be no EU action on electricity and natural gas (LNG and CNG).

- Fuel Package III (FC31 + FC36 + FC41): together with mandatory application of common standards for all fuels, mandatory targets would be set only for electricity and LNG for vessels. Indicative targets would apply for hydrogen and LNG for trucks and CNG for vehicles.

- Fuel Package IV (FC30 + FC43): together with mandatory application of common standards for all fuels, mandatory targets would be set only for hydrogen. Indicative targets would apply for electricity and natural gas (LNG and CNG).

7. Out of these 8 technologically-neutral combinations, four (FC4, FC16, FC40 and Fuel Package III) have been selected for further analysis. The remaining four combinations (FC28, Fuel Packages I, II and IV) were discarded for the following reasons:

- It is unjustified to apply a stricter regulatory approach to fuels and technological solutions that are in an earlier stage of technological maturity (Fuel Package II and IV).
- Mandatory application of standards coupled with industry self-regulation for all alternative fuel infrastructure (FC28) will not be effective due to the very large number of industries that would need to be involved and come to a consensus: fuel suppliers, electricity providers, vehicle manufacturers, equipment manufacturers and mobility service providers. The stakeholder consultation[289] confirmed that the likelihood of vested interests in certain technologies preventing cross-industry agreements would be very high.

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[289] See for example the following responses to the question “Do you think that voluntary action of industry alone could achieve the development of the refuelling/recharging infrastructures required for travelling across the whole EU on alternative fuels?”:
“No, as for any new technology introduced in the market the consensus between the different players about the future of the refuelling/recharging infrastructure is not possible. Pushing for a voluntary action will result in a slow-down of the market uptake rather than a quick introduction of existing technologies.” (Renault)
“No. The development of this market needs significant investments on infrastructure and on converting the trucks or vessels. Players will be understandably reluctant to take risks to invest too much before a certain critical mass is reached and before the legislative and fiscal framework is clearer.” (Gas Infrastructure Europe)
“Absolutely not: For certain fuels, public support is a pre-requisite for achieving the necessary development of infrastructure and creates favourable market conditions.” (AEGPL)

Appendix 8: Possible legislative formulations in the Policy Options

1. Addressing problem driver 1 ("Existing recharging/refuelling equipment cannot be connected and is not interoperable in all related alternative fuel vehicles/vessels"):

- All recharging stations for electric vehicles should [PO2] / shall [PO3, PO4] be compliant with the technical standards no later than from 2015,

2. All hydrogen refuelling facilities for road transport vehicles should [PO2] / shall [PO3, PO4] be compliant with the technical standards no later than from 2015.

3. All LNG refuelling facilities for waterborne vessels should [PO2] / shall [PO3, PO4] be compliant with the technical standards no later than from 2015.

4. All LNG refuelling facilities for trucks and CNG for vehicles should [PO2] / shall [PO3, PO4] be compliant with the technical standards no later than from 2015.

5. Addressing problem driver 2 ("Investment uncertainty hinders the deployment of recharging/refuelling infrastructure for electricity, hydrogen and natural gas (LNG and CNG)"):

6. Member States should [PO3] / shall [PO3, PO4] ensure that a minimum number of recharging points for electric vehicles are established according to the targets set for each Member State no later than by 2020. At least 10% of this minimum number of recharging points shall be publicly accessible recharging points.

Table 20: Minimum number of electric vehicle charging points in each Member State (in thousands)

MS	Number of charging points	Number of publicly accessible charging points
BE	207	21
BG	69	7
CZ	129	13
DK	54	5
DE	1503	150
EE	12	1
IE	22	2
EL	128	13
ES	824	82
FR	969	97
IT	1255	125
CY	20	2
LV	17	2
LT	41	4
LU	14	1
HU	68	7
MT	10	1
NL	321	32
AT	116	12
PL	460	46

PT	123	12
RO	101	10
SI	26	3
SK	36	4
FI	71	7
SE	145	14
UK	1221	122
HR	38	4

7. Member States should [PO2, PO3] / shall [PO4] ensure that existing hydrogen refuelling stations are connected via the Trans-European Transport Core Network (TEN-T) with a maximum distance of 300 km between stations, no later than by 2020.

8. Member States should [PO2] / shall [PO3, PO4] ensure that LNG refuelling facilities for waterborne vessels are established in all maritime ports of the TEN-T Core Network no later than by 2020.

9. Member States should [PO2] / shall [PO3, PO4] ensure that LNG refuelling facilities for waterborne vessels are established in all inland ports of the TEN-T Core Network, which are located on one of the corridors identified in the Regulation of the European Parliament and of the Council establishing the Connecting Europe, no later than by 2020.

2. Member States should [PO2, PO3] / shall [PO4] ensure that a minimum number of publicly accessible LNG refuelling stations for trucks are established along the principal motorways of the TEN-T Core Network, identified as being parallel to one of the corridors identified in the Regulation of the European Parliament and of the Council establishing the Connecting Europe Facility no later than by 2020. The maximum distance between the refuelling stations should be 400 km. In addtion, CNG publicly accessible refuelling points are available, with maximum distances of 150 km, to allow the circulation of CNG vehicles Union-wide by 2020.

Table 21: Overview of regulatory approaches in the policy options

Policy Option	2	3	4
Problem driver 1	Soft ("should")	Strict ("shall")	Strict ("shall")
Problem driver 2	Soft ("should")	Soft ("should") / Strict ("shall")	Strict ("shall")

Appendix 9: Illustration of possible implementation measures

<u>Protection of first mover investors on infrastructure</u>

1. First mover investors, and - to a smaller extent - follower investors, are confronted with high upfront costs and uncertain payback times for investments due to the low diffusion of alternative fuel vehicles and vessels and, consequently, the initially slack demand for alternative fuels.

2. Moreover, first mover investors run the risk of losing some of their future profits to market players who will enter the market at a later stage when the demand for the marketed product consolidates, and uncertainty on financial viability is reduced. Such a risk discourages first movers' investments. The policy instruments that have been identified as adapt to protect first investors are:

The granting of exclusivity rights to first mover investors

3. An example of how exclusivity rights protected first investors is that of telecommunications. Market entry for mobile communications has been initially facilitated by a policy granting licenses only to few potential investors. The aim was to tolerate oligopoly rents at a certain extent as a means of ensuring that service prices above marginal costs would be sufficient to recover upfront investment. This was justified by the market circumstances in the initial phases of mobile communications characterised by high uncertainty about future demand for mobile telecommunications.

Awarding concessions

4. Concessions in ports are granted by the port authority (usually public body or corporatized public entity) to private investors in order to operate the port terminal efficiently. The investor uses and improves (maintains, repairs) the infrastructure provided by the port authority and further invests in superstructure (equipment for handling the cargo). Port authorities can make joint investments with the private operators in port related infrastructure like barge and rail terminals.

Direct public financial support

5. Funding support is necessary to lower the risk premium, calculated based on the initial capital costs for alternative fuel infrastructure, which are generally higher than those for petroleum-based fuels due to the lack of economies of scale on the side of alternative fuelling equipment manufacturers, and the expected financial returns. Direct public financial support can take various forms such as grant loans or loan guarantees and public-private partnerships (PPPs). Incentives are not a standalone instrument and further instruments are necessary.

Public guarantees

6. These measures are dedicated to the implementation of infrastructure with high risks of non-profit. Public guarantees can lower the risk of financing the infrastructure by guaranteeing loans or guarantees in the form of state aid. Specifically, public guarantees can assist the investor in obtaining a loan in better financial terms.

The use of public procurement

7. Public procurement allows for risk sharing. Public procurement contracts for the introduction of alternative fuels through public fleets would mean that the technology

would first be trialled through publicly financed demonstration projects and in case it failed commercially the loss would be compensated to the investor.

Measures to promote alternative fuels

The example of Sweden: renewable fuel obligation on filling stations

8. Ethanol 85 was introduced in Sweden in 2006 on the grounds of the "pump law", where the government, the national car manufacturers and the oil companies cooperated in an efficient way. The law obliged all filling stations selling more than 3000 cubic meters of fuel per year to supply at least one kind of renewable fuel. Due to lower capital cost required for biofuels infrastructure, most petrol stations added additional outlets for E85 instead of biogas, which would have required higher investments, and arguably would have been more socially beneficial on the medium and long-term. In parallel, the government gave incentives to consumers to purchase flex-fuel cars, in order to facilitate the economic viability of such infrastructure investments. This resulted in increased use of E85 as a transportation fuel.

The example of France: introduction of national targets[290]

9. National targets of 4.4 million charging points supported by national laws adopted in July 2010 and July 2011.

10. "Grenelle II Law" from July 12th, 2010 sets requirements for every newly built residential complex (at least two residential units) with securised parking spaces or an individual parking garage to be equipped with cables, cable ducts and safety equipment needed to install charging electrical outlets for electric or plug-in hybrid vehicle as long as the request for building permit is submitted after January 1st 2012.

11. The law also sets a modification of co-ownership rules in condominiums already built obliging the co-owners assembly to put the topic of works to allow recharging of electric or plug-in hybrid vehicles on its agenda and the decision to install the recharging station shall be a majority vote of all co-owners. Also, the owner or the building management of a residential complex cannot object to a request of a lessee regarding the installation of charging infrastructure without "a serious and legitimate reason".

12. According to this law, already built office buildings used mainly as workplace and with parking lots for employees' cars must be equipped with charging infrastructure before January 1st 2015.

13. The national law from July 2011[291] requires at least 10% of existing individual parking spaces (with minimum of at last 1) to be equipped with independent electric lines to low charging points in condominiums for which the building permit was submitted after January 1st 2012 and in existing buildings from January 2015.

14. For newly built office buildings (i.e. those whose request for building permit was submitted after January 1st 2012) the law obliges the owner to electrify the car park

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[290] Darcet-Felgen, Anouk (BMH Advocates), Electromobility for Europe - Overcoming Technical, Economical and Legal Challenges, Round Table Discussion: Overview of European Member States Policy – FRANCE (January 16th, 2012)

[291] JORF n°0172 du 27 juillet 2011 Texte n°11: Décret 2011- 873 du 25 juillet 2011

and to design all or some of the spaces to allow charging stations on a minimum of 10% of all spaces.

15. For “existing buildings” (i.e. those for which a request for building permit was submitted before January 1st 2012), the law obliges the owner to install charging stations to cover at least 10 % of the parking spaces in urban areas with more than 50,000 inhabitants, 5 % in other cases, provided that the building and car park is owned and occupied by one and the same person.

The example of Estonia: the electromobility programme (2010)[292]

16. In March 2011, the Government of Estonia signed a contract with Mitsubishi Corporation for the sale of 10 million AAUs to start the Estonian electromobility programme. Besides achieving better city environment, energy efficiency and fuel independence, the government of Estonia also recognised the opportunity for positive branding to become the first demo-country in the world to be using innovative technologies and covering the whole territory with quick electric charging points.

17. Programme is fully financed by the Mitsubishi Corporation and consists of three pillars:

18. In May 2012, 507 Mitsubishi iMiev electric cars were given in use to different public sector organisations as an example and to promote electric cars (most of these are used by social workers all over Estonia, but also by the police and air force for example).

19. In July 2011, an incentive scheme was introduced for private and corporate pucharses buying an electric car. The purpose of the grant is to decrease the pollution load of transport. 50% or up to € 18,000 of the cost of the car is compensated, plus € 1,000 is provided for the installation of a charger at home or office. Eligibility date for the grant scheme is the end of 2012 and the goal of the scheme is to provide grant for approx. 500 cars.

20. The goal of selling 500 electric cars with the purchase grant already by the end of 2012 turned out to be too ambitious. As of October 2012, 94 purchase grant applications have been submitted (75 grants have been awarded). Also in July, government gave an authorisation to sign amendments to the contract with Mitsubishi Corporation to prolong support scheme until the end of 2014.

21. With the proposed amendment of July 2012, the selection the plug-in hybrid electric vehicles would be also added. The grant amount for plug-in hybrids shall be up to 30% of the purchase price, but not more than 12,000 euros per vehicle. The more detailed terms are being presently developed.

22. A quick charging infrastructure for electric cars will be created to cover the whole country by the end of 2012 to ensure sufficient freedom of movement for all users of electric cars. There will be 163 quick charging points with the distance not more than 40-60 km between them. The network will be covering all roads with intense traffic, settlements with population over 5000 inhabitants and ports serving local and international travel. The chargers will be built in locations where people would move anyway – petrol stations, shopping centres, parking lots, banks etc. It is expected that while finishing the quick charging infrastructure by the end of the 2012, the grant scheme will also be fully exhausted.

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[292] Estonian Electromobility Programme, http://elmo.ee/en

23. As part of the programme an extensive survey of user experience of electric cars is planned.

The example of Bulgaria

24. Bulgarian government started drafting the national action plan aimed at promoting the development of sustainable transport, including electric mobility in Bulgaria, for the period 2012–2014 in the beginning of 2012 and it was submitted to the Council of Ministers in August 2012[293]. The legislation intended to introduce a preference for electric car owners – free parking in all cities, as well as the opportunity for those vehicles to drive in the bus lanes. Additional stimulus for electric vehicle owners in Bulgaria has been proposed by ministers, like offering value-added-tax, local tax and registration fees exemptions and also from the obligation of buying a vignette.

25. In Sofia several charging stations are in the process of being installed by the company FullCharger in cooperation with the street lighting company and the electric utility company CEZ. As of October 2012, there a total of ten charging stations in Sofia and one station in Dobrich installed by FullCharger[294].

26. For the near future, plans for the construction of a grid of 150-200 charging points by end 2012 in Sofia and big Bulgarian cities are under way. The next two years will see installing charging stations along highways and intercity roads. City of Dobrich will be another municipality promoting electromobility[295]. There is a goal of building 20 charging stations in Dobrich. Even though the initiative in Dobrich came from FullCharger, the city government have also showed their fully supportive role.

The example of the Czech Republic

27. The environmental initiative "FutureMotion" (20,000,000 € budget until 2012), which initiated in Prague in 2009 by CEZ, the Czech energy production and service company, among other things focuses research on electric cars, and the development of smart grids[296]. The task of CEZ is to set up the charging infrastructure and provide the necessary energy to the customers. The motor company Peugeot has joined in providing 100 cars for testing and promotion of electric vehicles.

28. First charging stations were installed on 2010. CEZ plans to install 200 public stations by 2013. The stations will be not only in Prague but also in Central Moravia, South Moravia, West and East Bohemia.

29. Besides CEZ, there has been a significant promotion of electric cars also by other major regional power companies like E-ON and Prazska Energetika[297].

The example of Austria: support to natural gas vehicles and filling stations

30. Austria has supported the market introduction of natural gas vehicles and through the program "klima:aktiv", in the frame of the Austrian climate strategy. One of the targets of this program is to reduce CO2 emissions from the transport sector. The purchase of the natural gas vehicles is supported by up to 30% of the investment

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293 BG Ministry of Economy, Energy and Tourism homepage http://www.mi.government.bg/en/news/delian-dobrev-we-are-foreseeing-tax-relief-for-owners-of-electric-cars-812.html

294 https://fullcharger.chargepointportal.eu/index.php/device/devicelocation.html

295 *Europost*, June 8, 2012 "Additional 19 EV charging stations to be built"

296 CEZ Group, Press release of May 3rd, 2011, http://www.cez.cz/en/cez-group/media/press-releases/3321.html

297 U.S. Commercial Service: Electric Vehicles – Europe in Brief, Ed 2010-2011

costs. The program also includes a financial support for building CNG filling stations (10,000 euro per pump). The design, construction, installation and operation of a natural gas vehicles filling station is described in the regulation ÖVGW G97, Feb 2008 (Revised 2010), published by the Austrian Association for Gas and Water. The natural gas quality as well as the quality of biomethane is regulated in the quality standards ÖVGW G31 and G33.

National Innovation Programmes

The case of Germany

31. As part of the National Innovation Program for Hydrogen and Fuel Cell Technology (NIP), Germany's federal government and industrial sector are investing more than 40 million euros to expand the country's network of hydrogen filling stations from currently 15 to 50. The total funding for the National Innovation Programme will be 700 M€ for ten years.

32. The infrastructure expansion plan focuses on the country's metropolitan regions and the creation of corridors connecting these metropolitan regions. The network of hydrogen filling stations accompanies the commercialization of fuel cell vehicles that the automobile industry has announced for 2014/15.

33. The project "Clean Energy Partnership- CEP" continues the activities carried out under the EU project "Hyfleet-Cute". CEP is one of the largest hydrogen demonstration projects in the world, is the main lighthouse project, and comprises deployments of passenger vehicles, buses, infrastructure, and sustainable production and delivery in several cities throughout Germany. The project currently involves 15 partners including international automotive companies, energy companies, and public transportation providers, and is focused on validating the technologies under real-world conditions. Vehicles from seven different manufacturers (BMW, Daimler, Ford, GM/Opel, Honda, Toyota, Volkswagen, and soon Hyundai) are being used in everyday operation by real customers and fuelled at stations that are integrated with the existing refuelling stations and open to the public. The project also incorporates hydrogen buses serving actual customers within public transit networks.

The case of the United Kingdom

34. In January 2012, the Department for Business Innovation and Skills launched the project UKH2 Mobility in partnership with the industry. The Government is investing £ 400 million to support the development, demonstration and deployment of hydrogen vehicles. The project will evaluate the potential for hydrogen as a fuel for Ultra Low Carbon Vehicles in the UK before developing an action plan for an anticipated roll-out to consumers in 2014/15.

Set-up of alternative fuels' networks

The case of London

35. In March 2010, the Mayor of London announced the creation of a "Hydrogen network" by 2012, in order to help accelerate the wider use of this zero-polluting, zero-carbon energy in the capital. The London Hydrogen Partnership (LHP) is working with London boroughs and private landowners on plans to deliver at least six refuelling sites to run hydrogen-powered vehicles in the capital over the next two

years. One is already being built in east London for the refuelling of hydrogen-fuelled buses that will begin running on the RV1 route later this year.

Appendix 10: Results of illustrative economic modelling

Business-as-usual developments

Overall description

1. The Commission has carried out an analysis of possible future developments in a scenario at unchanged policies, the so-called baseline scenario or 'Reference scenario'. This 'Reference scenario' was used in the following Impact Assessments (IAs):

(8) the IA accompanying the White Paper - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system[298];

(9) the IA accompanying A Roadmap for moving to a competitive low carbon economy in 2050[299]; and

(10) the IA accompanying the Energy Roadmap 2050[300].

2. Accordingly, the 'Reference scenario' has been extensively described in:

(11) the IA accompanying the White Paper - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, Appendix 3 (pages 130-152). The list of policy measures included in the 'Reference scenario' is provided in Appendix 4: Inventory of policy measures relevant for the transport sector included in the 2050 Reference scenario (pages 153-155).

(12) the IA accompanying A Roadmap for moving to a competitive low carbon economy in 2050.

(13) the IA accompanying the Energy Roadmap 2050, Part A of Annex 1, which describes assumptions, results and sensitivities with respect to the Reference scenario (pages 49-97)[301].

3. The 'Reference scenario' is a projection of developments in the absence of new policies beyond those adopted by March 2010. In order to take into account the most recent developments, such as higher energy prices and additional policies on infrastructure and energy taxation adopted by November 2011, an additional scenario (Scenario 1) has been modelled to serve as a business-as-usual scenario for the present IA. Scenario 1 was used in the IA accompanying the proposal for a Regulation to define the modalities for reaching the 2020 target to reduce CO_2 emissions from new passenger cars and the proposal for a Regulation to define the

298 SEC(2011) 358 final, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2011:0358:FIN:EN:PDF

299 SEC(2011) 288 final, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2011:0288:FIN:EN:PDF

300 SEC(2011) 1565/2, available at: http://ec.europa.eu/energy/energy2020/roadmap/doc/sec_2011_1565_part1.pdf

301 Short-term projections for oil, gas and coal prices were slightly revised according to the latest developments in the Reference scenario as compared to the version used in the White Paper - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system and A Roadmap for moving to a competitive low carbon economy in 2050.

modalities for reaching the 2020 target to reduce CO_2 emissions from new light commercial vehicles[302].

4. The starting point for developing Scenario 1 is the 'Reference scenario'. Similarly to the 'Reference scenario', Scenario 1 builds on a modelling framework including the PRIMES energy model and its transport model (PRIMES-TREMOVE)[303], the PROMETHEUS and GEM-E3 models[304].

5. The differences between Scenario 1 and the 'Reference scenario' have been presented in the IA accompanying the proposal for a Regulation to define the modalities for reaching the 2020 target to reduce CO_2 emissions from new passenger cars and the proposal for a Regulation to define the modalities for reaching the 2020 target to reduce CO_2 emissions from new light commercial vehicles (pages 39-50 of the Annex).

Main assumptions

6. In light of the references listed above, we will focus on the main assumptions and the most relevant information with respect to the subject of this IA. For the purposes of this IA, Scenario 1 is considered as an illustration of developments under Policy Option 1.

7. The **population and macro-economic assumptions** used in Scenario 1 are common with those used in the 'Reference scenario', and are shown on Table 22.

Table 22: Population and macroeconomic assumptions

Annual growth rates (%)	*2010-2020*	*2020-2030*	*2030-2040*	*2040-2050*
Population	0.29	0.12	0.00	-0.09
GDP	2.21	1.74	1.50	1.45

8. The population projections draw on the EUROPOP2008 convergence scenario[305] from Eurostat, which is also the basis for the 2009 Ageing Report[306]. The key drivers for demographic change are higher life expectancy, low fertility and inward migration.

9. The recent economic crisis is assumed to have long-lasting effects, leading to a permanent loss in GDP. The macro-economic projections show that the recovery

302 SWD(2012) 213/2, available at: http://ec.europa.eu/clima/policies/transport/vehicles/cars/docs/impact_assesment_en.pdf

303 Model description available at.: http://www.e3mlab.ntua.gr/e3mlab/PRIMES%20Manual/The_PRIMES_MODEL_2010.pdf

304 Model description available at: http://147.102.23.135/e3mlab/index.php?option=com_content&view=section&id=8&Itemid=56&lang=en

305 EUROpean POPulation Projections, base year 2008

306 European Commission, DG Economic and Financial Affairs, 2009 Ageing Report: Economic and budgetary projections for the EU-27 Member States (2008-2060). EUROPEAN ECONOMY 2|2009, available at http://ec.europa.eu/economy_finance/publications/publication14992_en.pdf. The "baseline" scenario of this report has been established by the DG Economic and Financial Affairs, the Economic Policy Committee, with the support of Member States experts, and has been endorsed by the ECOFIN Council.

from the crisis is not expected to be sufficiently vigorous to compensate for the current GDP losses. In this scenario, growth prospects for 2012 are subdued. However, the economic recovery enables higher productivity gains, leading to somewhat faster growth from 2013 to 2015. After 2015, GDP growth rates mirror those of the 2009 Ageing Report. Hence the pattern of the 'Reference scenario' is consistent with the intermediate scenario 2 "sluggish recovery" presented in the Europe 2020 strategy[307]. The medium and long term growth projections follow the "baseline" scenario of the 2009 Ageing Report.

10. The **assumptions on energy import prices** for the EU-27 in Scenario 1 are common with those used in the 'Reference scenario', and are shown on Table 23.

Table 23: Energy import prices

$'10 per boe (*)	*2010*	*2020*	*2030*	*2040*	*2050*
Oil	85.2	89.0	106.6	116.9	127.6
Gas (NGV)	53.8	62.5	77.1	87.4	99.0
Coal	22.8	28.9	32.8	32.8	33.7

Note: (*) $'10 = U.S Dollar in 2010 prices; boe = barrel oil equivalent

11. These price assumptions are the result of world energy modelling using the PROMETHEUS stochastic world energy model[308], which derives price trajectories for oil, gas and coal under a conventional wisdom view of the development of the world energy system. This stochastic model is particularly well suited given the great uncertainty regarding future world economic developments and the extent of recoverable resources of fossil fuels. The price development to 2050 is expected to take place in a context of economic recovery and resuming GDP growth without decisive climate action in any world region.

12. The **price of the CO_2 emissions allowances** in the EU Emissions Trading Scheme, derived with the PRIMES energy system model, reaches 15 €'10/tCO_2 by 2020, and is projected to be around 50 €'10/tCO_2 by 2050 in Scenario 1, in line with the 'Reference scenario'.

13. Scenario 1 includes all policy measures included in the 'Reference scenario' and adopted by March 2010. The list of these policy measures is provided in the IA accompanying the White Paper on Transport[309], while the additional policy measures, included in Scenario 1 relative to the 'Reference scenario' are provided in Table 24. These are measures adopted by November 2011.

307 Communication from the Commission: Europe 2020. A strategy for smart, sustainable and inclusive growth. COM(2010)2020, Brussels, 3.3.2010.

308 Model description available at: http://www.e3mlab.ntua.gr/e3mlab/PROMETHEUS%20Manual/prometheus_documentation.pdf

309 Idem footnote 298. The list of measures is provided in Appendix 4: Inventory of policy measures relevant for the transport sector included in the 2050 Reference scenario (pages 153-155).

Table 24: Additional policy assumptions relative to the 'Reference scenario'

Area	*Measure*	*How it is reflected in the model*
Efficiency standards	Update of the CO_2 standards for vans according to the adopted regulation[310]	Implementation of CO_2 standards for vans (175 g of CO_2 per kilometre by 2017, phasing in the reduction from 2014, and to reach 147g CO_2/km by 2020).
Pricing and taxation		
Taxation	Energy Taxation Directive (revision 2011)	Changes to minimum tax rates to reflect the switch from volume-based to energy content-based taxation and the inclusion of a CO_2 tax component. Where Member States tax above the minimum level, the current rates are assumed to be kept unchanged. For motor fuels, the relationships between minimum rates are assumed to be mirrored at national level even if the existing rates are higher than the minimum rates. Tax rates are kept constant in real terms.
Internalisation of local externalities	Eurovignette Directive (Directive 2011/76/EU)	Reflected through the introduction of infrastructure charges in Poland (starting with 2011) and the announced introduction of distance based infrastructure charges in Denmark and Belgium (from 2014).
Infrastructure	TEN-T guidelines (revision 2011) and Connecting Europe Facility.	Reflected through the increase in the capacity and performance of the network resulting from the elimination of bottlenecks and addition of missing links, and increase in the train length (to 1.5 km) and maximum axle load (to 22.5 tonnes), reflected through decreases in operation costs and time costs and higher load factors for freight.
Internal market	Recast of the first railway package (2010)	Reflected through a reduction of average operating costs for railway undertakings.
Other assumptions		
Energy import prices		Short-term increase to reflect the evolution of prices up to 2010 as in the Energy Roadmap 2050.
Technology assumptions	Developments in national support measures and the intensification of previous action programmes and incentives, such as funding research and technology demonstration (RTD) projects to promote alternative fuels.	Slightly higher penetration of EVs. One private connector per electric vehicle and one public AC connector per 10 vehicles is assumed by 2020. Around 120 existing hydrogen refuelling stations mainly located in Denmark, Germany, the Benelux states and the United Kingdom. Existing and planned LNG/ CNG stations.

310 Regulation (EU) No 510/2011 of the European Parliament and of the Council of 11 May 2011, setting emission performance standards for new light commercial vehicles as part of the Union's integrated approach to reduce CO2 emissions from light-duty vehicles

Main results

14. **Total transport activity** is expected to continue growing in line with economic activity in the long-run, even though a decrease is visible for 2008-2009 as a result of the recent economic crisis. Total passenger transport would increase by 21% between 2005 and 2020, and an additional 25% by 2050. Freight transport is projected to grow by 22% by 2020 and by about 49% between 2020 and 2050. The annual growth in transport activity by mode is provided in Table 25.

Table 25: Annual growth in transport activity in Scenario 1

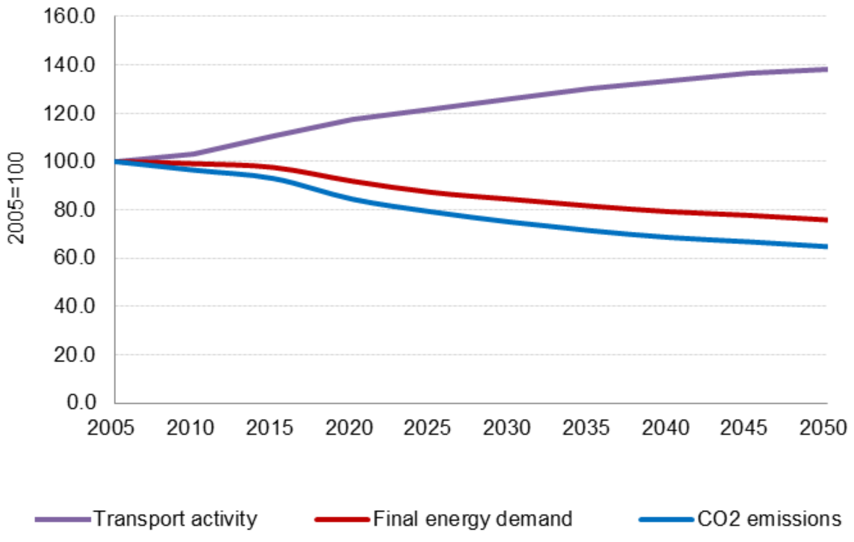
EU27 - Annual growth rates (in %)	*2005-2020*	*2020-2030*	*2030-2040*	*2040-2050*
Transport activity				
Passenger transport activity in Gpkm	1.3%	1.0%	0.7%	0.5%
Public road transport	0.8%	0.5%	0.4%	0.3%
Passenger cars & LCVs	1.1%	0.7%	0.6%	0.4%
Powered two wheelers	1.1%	1.1%	0.6%	0.4%
Rail	1.6%	1.9%	1.1%	0.7%
Aviation	3.0%	2.6%	1.5%	1.3%
Inland navigation	0.9%	0.8%	0.5%	0.3%
Freight transport activity in Gtkm	1.3%	1.5%	1.3%	1.3%
Trucks (HDVs) & LCVs	1.5%	0.6%	0.7%	0.5%
Rail	2.0%	1.3%	0.8%	0.6%
Inland navigation	1.0%	1.4%	0.6%	0.3%
Maritime	1.3%	1.7%	1.4%	1.4%

Source: PRIMES-TREMOVE transport model

15. The various modes are in general expected to maintain their relative importance at EU level. Passenger cars and light commercial vehicles (LCVs) would represent slightly more than 70% of total passenger activity in 2020 and about 67% in 2050, although this would correspond to a decrease of 6 percentage points in modal share by 2050 compared to 2005. Road transport would also maintain its dominant role in inland freight transport, contributing about 72% in 2030 and 70% in 2050.

16. Transport accounts today for over 30% of **final energy consumption**. In a context of growing demand for transport, final energy demand by transport is projected to increase by about 5% by 2020 and to slightly decrease afterwards (-7% between 2020 and 2050).

Figure 8: Evolution of transport activity, energy demand and CO_2 emissions of passenger cars and LCVs



Source: PRIMES-TREMOVE transport model

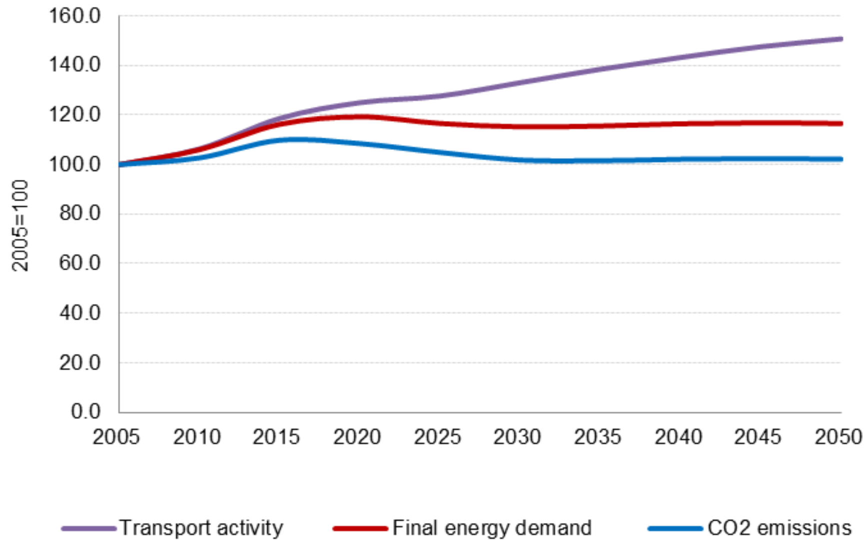
17. The energy use of passenger cars and LCVs would drop by about 8% between 2005 and 2020 due the implementation of the regulations setting emission performance standards for new passenger cars and vans[311], and by an additional 17% by 2050. The use of alternative fuels (LPG, CNG, electricity and hydrogen) is expected to remain limited in Scenario 1. Their share is projected to be around 4% in 2020, and 8% in 2050.

18. The uptake of electric vehicles (battery and plug-in hybrids) is projected to be limited: 0.5% in 2020, and 14% by 2050. Fuel cells do not make significant inroads. The availability of charging infrastructure acts as a limiting factor, in addition to the technology developments.

19. Energy consumption by heavy duty vehicles (HDVs) and freight LCVs is projected to increase by almost 20% between 2020 and 2050, and to stabilise afterwards. Energy consumption in waterborne transport would grow by about 10% between 2005 and 2020, and an additional 30% by 2050. LNG does not make significant inroads in either road freight or waterborne transport due to the lack of refuelling infrastructure.

[311] Regulation (EC) 433/2009 and Regulation (EU) 510/2011.

Figure 9: Evolution of transport activity, energy demand and CO_2 emissions of freight HDVs and LCVs



Source: PRIMES-TREMOVE transport model

20. In Scenario 1, the EU transport system would remain extremely dependent on the use of fossil fuels. Oil products would still represent 91% of the EU transport sector needs in 2020 and about 88% by 2050.

21. Compared to 2005, **CO_2 emissions** from passenger cars and LCVs are projected to be 16% lower in 2020, and about 35% lower in 2050. The decrease in CO_2 emissions is higher than the reduction in energy use due to the use of biofuels and the uptake electric vehicles[312]. CO_2 emissions from HDVs and freight LCVs roughly stabilise at their 2005 by 2050. Overall, CO_2 emissions from transport would still be 31% higher than their 1990 level by 2020, and 23% higher by 2050 in Scenario 1, owing to the fast rise in the transport emissions during the 1990s. This trend is not compatible with the objective of a low-carbon, competitive economy that would meet the long-term requirements for limiting climate change to 2 °C.

22. NO_x emissions and particulate matter would drop by about 20%, and by 37% by 2020, respectively. As a result, external costs related to air pollutants would decrease by almost 40%. The increase in traffic would lead to a roughly 8 billion € increase of noise-related external costs by 2020.

Modelling of illustrative scenarios

Overall description

23. Scenario 1, described above, provides business-as-usual developments that could be regarded as an illustration of the results of Policy Option 1. Three additional scenarios have been modelled, each corresponding to the respective Policy Option 2, 3 and 4. The focus was on year 2020, therefore no strengthening of policy

[312] The modelling results reflect the accounting method set out in Commission Decision (2007/589/EC) establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council for the use of biofuels. In this Decision, biomass is considered as CO_2 neutral.

intervention was assumed beyond 2020. The purpose of this modelling exercise was to illustrate the environmental impacts of an overall policy intervention aimed at deployment of alternative fuels for inland transport[313].

24. As highlighted in Section 3 of the IA, deploying recharging and refuelling infrastructure alone is not capable of ensuring the market up-take of alternative fuel vehicles and vessels. In other words, the Policy Options under consideration in the IA merely aim to provide the fulfilment of one necessary condition for such market up-take: the deployment of a sufficient level of standardised infrastructure.

25. As stated in Section 5 of the IA, environmental impacts of deploying alternative fuels infrastructure alone, without policy intervention on issues related to technology and consumer acceptance, would not be significant relative to business-as-usual developments.

Main assumptions

26. The assumptions underlying each scenario have been set as follows, in line with the general assumptions for the assessment of impacts shown in Section 5 of the IA.

27. Under Scenario 2, illustrating Policy Option 2, only partial deployment of sufficient EV charging infrastructure and LNG infrastructure for vessels will take place. This is modelled by assuming that only a fraction of the sufficient EV charging network will be in place by 2020. Only inland waterway ports located on more than one TEN-T Corridor will provide LNG bunkering facilities. It is also assumed that there will be no deployment of hydrogen infrastructure, and LNG refuelling infrastructure for trucks and CNG refuelling infrastructure for road transport vehicles in addition to developments under business-as-usual.

28. Under Scenario 3, illustrating Policy Option 3, full deployment of sufficient EV charging infrastructure and LNG infrastructure for vessels will take place. It is however assumed that there will be no deployment of hydrogen infrastructure, and LNG refuelling infrastructure for trucks and CNG refuelling infrastructure for road transport vehicles in addition to developments under business-as-usual.

29. Under Scenario 4, illustrating Policy Option 4, not only will there be a full deployment of sufficient EV charging infrastructure and LNG infrastructure for vessels, but also full deployment of sufficient refuelling infrastructure of hydrogen, of LNG for trucks and CNG refuelling infrastructure for road transport vehicles is assumed.

Cost-benefit analysis

30. In order to assess the investments costs identified in the IA, economic modelling has been carried out to the benefits of deploying this sufficient network of alternative fuels infrastructure. For this purpose, the following approach has been used:

(14) Identify the investment costs associated with the deployment of alternative fuels infrastructure.

(15) Assume that additional EU, national, regional and local policies are put in place in order to enable vehicle and vessel deployment. These policies would normally aim at decreasing the current disutility costs of vehicles, which are

[313] The illustrative modelling exercise did not cover the environmental impacts on maritime transport.

related *inter alia* to their higher purchase price, driven by technological limitations and lack of consumer acceptance.

This is a crucial step because the deployment of infrastructure is merely a necessary, but not sufficient condition to ensure the market up-take of alternative fuel vehicles and vessels.

(16) Determine the minimum number of vehicles and vessels that would come to market as a result of the assumed policies of Step 2, enabled by the infrastructure deployed.

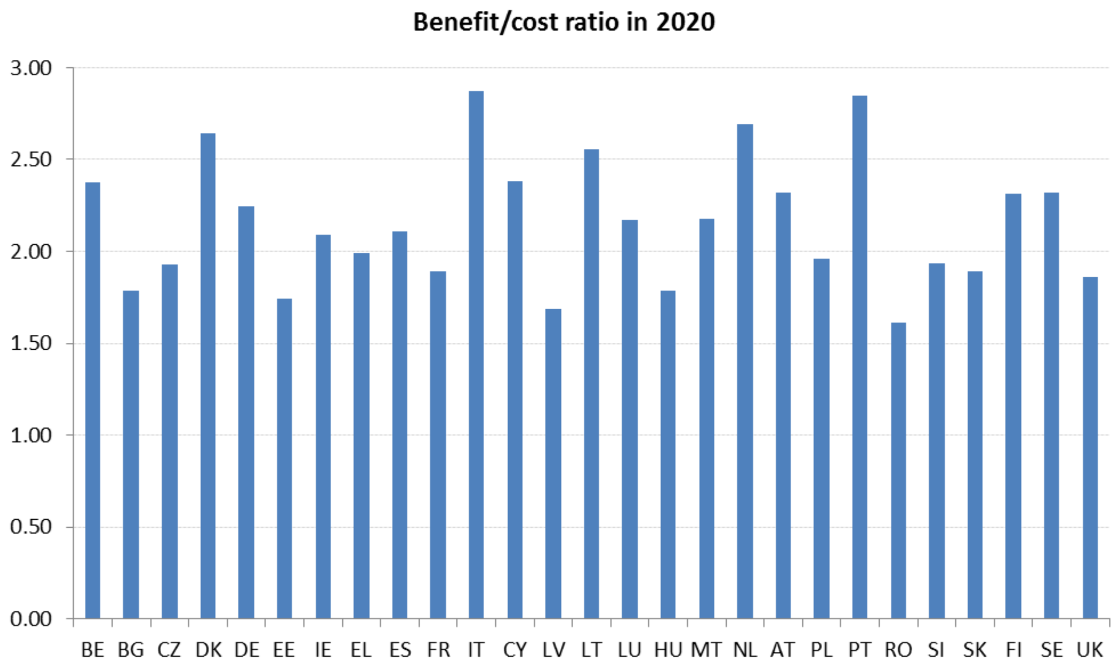
(17) Estimate the costs of deploying the same number of vehicles and vessels as determined in Step 3, by simultaneously intensifying the policies assumed in Step 2 and lowering the intensity of action on infrastructure deployment.

A practical example behind this step is the possibility to spend more on R&D to improve the range performance of EV batteries, which would result in less dense infrastructure needed to cover the same distances.

(18) Compare the costs estimated in Step 1 with those estimated in Step 5.

31. The results of this cost-benefit analysis are shown on Figure . In all Member States, the ratio of benefits to costs is higher than 1.3, with several Member States (Denmark, Italy, Lithuania, the Netherlands, Portugal) having ratios exceeding 2.5.

Figure 10: Indicative benefit-to-cost ratios across Member States



Source: PRIMES-TREMOVE transport model

Appendix 11: Manufacturers of alternative fuels infrastructure equipment, and of alternative fuel vehicles and vessels

Table 26: Manufacturers of EV charging equipment

Company	Country	Activity	Annual turnover	Number of employees
Companies located in the EU				
ROLEC	UK	Manufacturer of charging infrastructure		90
Elektromotive	UK	Manufacturer of charging infrastructure	$ 5,4 m[314]	61
Chargemaster	UK	Manufacturer of charging infrastructure		11-50
PodPoint	UK	Manufacturer of charging infrastructure	£ 2m	11-50
Charging Solutions	UK	Manufacturer of charging infrastructure		
APT Technologies	UK	Manufacturer of charging infrastructure		
Reuben Power	UK	Manufacturer of charging infrastructure		11-50
British Gas	UK	UK utility supplier and supplier of charging infrastructure*	£12,730m (2010)	27,298 (2010)
PMS Elektronik	DE	Manufacturer of charging infrastructure		
BRZ Bauer	DE	Manufacturer of charging infrastructure		
HTS Elektronik	DE	Manufacturer of charging infrastructure		
Technagon	DE	Manufacturer of charging infrastructure	€ 5m - <50m[315]	12 (on the site)
Mennekes/Bosch	DE	Cooperation between the companies to design and manufacture charging infrastructure	Mennekes: € 100m (2010) Bosch: € 47.3bn (2010)	Mennekes: 900 Bosch: 285,000

314 For the 13- month period ended 31 March 2012
Source: “Elektromotive Group Limited 2012 Annual Report”
http://lexicon.listedcompany.com/misc/ar2012.pdf

315 Source:
http://www.bayern-international.de/en/business-in-bavaria/key-technologies-in-bavaria/company-details/technagon-gmbh-1002972/

RWE-eMobility	DE	Germany utility supplier and supplier of charging infrastructure*	€ 52bn (2011)[316]	50[317]
Leoni	DE	Manufacturer of EV charging cables	€ 3,7 bn. (2011)	63,500
Hei	AT	Manufacturer of charging infrastructure		
365 Energy	AT	Partner of Coulomb Technologies (USA)		
Ekoenergetyka-Zachod	PL	Manufacturer of charging infrastructure	< $ 1m[318]	11 - 50
Alva Technologies	PL	Manufacturer of charging infrastructure		
Ensto	FI	Manufacturer of charging infrastructure	€ 215-240m. (2011)	1600
Alfen	NL	Manufacturer of charging infrastructure		
CIRControl	ES	Manufacturer of charging infrastructure	€ 140m. (2008)	850
Blue Mobility	ES	Manufacturer of charging infrastructure		
SGTE Power	FR	Manufacturer of charging infrastructure	€ 200m.	1300
DBT CEV	FR	Manufacturer of charging infrastructure	€ 10m.	47
Schneider Electric	FR	Manufacturer of charging infrastructure	€ 22.4bn (2011)	130 000+
Saintronic	FR	Manufacturer of charging infrastructure	€75m.	300
Legrand	FR	Manufacturer of charging infrastructure and other components	€4,25bn. (2011)	33 000+
Citelum	FR	Manufacturer of charging infrastructure	€287m. (2011)	3019
Marechal Electric	FR	Manufacturer of components for EV charging infrastructure (heavy duty plugs and socket outlets)	€60m. (2009)	300
Nexans	FR	Manufacturer of components for EV charging infrastructure (cables and cabling systems)	€7 bn. (2011)	24500

316 For RWE Group as a whole. Source: http://www.rwe.com/web/cms/mediablob/en/1299140/data/110822/10/rwe/investor-relations/reports/RWE-annual-report-2011.pdf

317 "The implementation of specially tailored e-mobility solutions is currently handled by a workforce of 50." Source: https://www.rwe-mobility.com/web/cms/en/1157924/rwe-emobility/

318 Source: http://www.alibaba.com/member/pl1008005510/company_profile/trade_capacity.html

Radiall	FR	Manufacturer of components for EV charging infrastructure	€203 337 000 (2011)	2513
Silec Cable (subsidiary of General Cable Group)	FR	Manufacturer of components for EV charging infrastructure (power cables)	€3000 million[319] €1100 million[320]	11000 4500
Scame	IT	Manufacturer of charging infrastructure and components	€121.4m. (2010)	800
Fanton	IT	Manufacturer of components for EV charging (cables, plugs and sockets)		
GeWiss	IT	Manufacturer of components for EV charging infrastructure - electrical systems/units	€ 322 101 000 2010)	1600
Vimar	IT	Manufacturer of components for EV charging infrastructure - electric/electronic installations, wiring devices, plugs, sockets, adaptors etc.	€200m.	501-1000
ChoosEV	DK	Manufacturer of charging infrastructure		30
ABB	CH/SE	Manufacturer of charging infrastructure	$38 bn. (2011)	134 000
Companies located outside the EU				
Greenlots	SG	Manufacturer of charging infrastructure		
Better Place	USA	Manufacturer of charging infrastructure	Does not generate revenue yet?[321]	
AeroVironment	USA	Manufacturer of charging infrastructure	$292.5 m. (2011)	768
Coulomb Technologies	USA	Manufacturer of charging infrastructure	≈$2 m. (2009)	100-200
GE Charging Solutions	USA	Manufacturer of charging infrastructure	$21 bn. (2011)[322]	
EV-Charge America	USA	Manufacturer of charging infrastructure		11-50
Eaton Corporation	USA	Manufacturer of charging infrastructure	$16.0 bn.	73 000

319 Data for General Cable Group as a whole. Source: http://www.sileccable.com/Compa%c3%b1%c3%ada/Qui%c3%a9nessomos/tabid/599/Default.aspx

320 Data for General Cable Europe&Med. Source: http://www.sileccable.com/Compa%c3%b1%c3%ada/Qui%c3%a9nessomos/tabid/599/Default.aspx

321 Source: http://www.globes.co.il/serveen/globes/docview.asp?did=1000737723&fid=1725

322 For GE´s Ecomagination portfolio as a whole, of which GE Charging Solutions is a component Source: http://www.ecomagination.com/ar2011/index.html#!section=Progress

ITT Cannon	USA	Manufacturer of EV charging connectors and components	$11 bn. (2011)[323]	40 000
Clipper Creek Inc	USA	Manufacturer of EV charging infrastructure		
Plugless Power	USA	Manufacturer of wireless EV charging infrastructure		
Evoasis	USA	Manufacturer of EV charging infrastructure		
Brusa	CH	Manufacturer of battery chargers for charging infrastructure		
Alpiq	CH	Manufacturer of charging infrastructure	CHF 14 bn. (2011)	11 443
Better Place	IL	Manufacturer of charging infrastructure, also provides a battery swap service	Does not generate revenue yet? [324]	
*Note: * unknown if these companies only supply or also manufacture charging infrastructure*				

Table 27: EV manufacturers

Company	Country	Activity	Annual turnover	Number of employees
Lecsón	DE	Manufacturer of electrical bicycles		
Zoz Mobility	DE	Manufacturer of electrical bicycles		
Renault ZE	FR	Manufacturer of electric vehicles	€ 39 bn.[325] (2010)	122 615
BMW (project I, Mini)	UK/DE	Manufacturer of electric vehicles	€ 68.8 bn[326] (2011)	100 306
Axiam-Mega	FR	Manufacturer of electric vehicles		300
Electric Car Corporation (ECC)	UK	Converts Citroen CI into electric vehicles		
Metro Electric	UK	UK distributor of Comarths	£ 476 000 (2011)	
Comarth	ES	Manufacturer of electric vehicles		
Euauto	HK	EV Stores are UK distributor of Hong-Kong made EUAuto MyCar		

323 For ITT as a whole.

324 Source: http://www.globes.co.il/serveen/globes/docview.asp?did=1000737723&fid=1725

325 For Renault Group as a whole, no data is available for Renault ZE yet, as the first electric cars from this group were launched in the second half of 2011.
Source:
http://www.renault.com/en/lists/archivesdocuments/renault%20-%202010%20annual%20report.pdf

326 For BMW Group as a whole.
Source:
https://www.press.bmwgroup.com/pressclub/p/pcgl/pressDetail.html?title=bmw-group-annual-report-2011&outputChannelId=6&id=T0125598EN&left_menu_item=node__2201

Vectrix	PL	US company which could be bankrupt now but may have had a production facility in Poland; this company is the Polish distributor		
Think EV	NO	Norwegian manufacturer of EVs, may be exporting to the EU		
LUIS	DE	Manufacturer of electric cars		
GEM Car	US	US Producer of Electric Vehicles with sales in the EU		
Smiles AG	DE	Manufacturer of electric vehicles (e.g.City EL)	Insolvent since February 2012[327]	
Trefiţmnkt Zukunft AG (Hotzenblitz)	DE	Manufacturer of electric vehicles	€ 25 870 220	99
Fine Mobile (Twike)	DE	Manufacturer of electric vehicles		
Tazzari	IT	Manufacturer of electric vehicles		
Cree	CH	Swiss company producing a three-wheeled electric car in Poland		
Reva	IN	Indian company with sales in Europe	≈ $ 0.25 m. [328]	101 - 500
Micro-Vett	IT	Conversi Fiat (and other) vehicles into EVs		≈50
Heizmann	DE	Manufactures components for electric bikes		
Urban Mover	UK	Probably manufacturer of electric bikes		
Dalys Electric Vehicles Pic	UK	Manufacturer of electric vehicles	No information as the company is new[329]	
Twike	UK	Manufacturer of electric vehicles		
Xero Technology	UK	Manufacturer of electric vehicles (cars/motorbikes)		
Zepii		Manufacturer of electric scooters		
Nissan (Leaf)			¥ 8,773,093 (2010)[330]	155 099

327 Source: http://www.mainpost.de/ueberregional/wirtschaft/mainpostwirtschaft/Insolvenz-Bei-der-Smiles-AG-gehen-die-Lichter-aus;art9485,6643793

328 Source: http://www.indiamart.com/company/3769296/

329 Source: http://www.dalyselectricvehicles.co.uk/about/

330 For Nissan as a whole. Source: http://www.nissanglobal.com/EN/DOCUMENT/PDF/AR/2011/AR2011_E_All.pdf

Daimler (eSmart)	DE	Manufacturer of electric drive smart car	€ 106.5 billion (2011)[331]	271 370
Fiat(e500)	IT		€ 56.3 bn.[332]	199 924
NICE	UK	UK arm of AIXAM-MEGA		
Venturi	FR/Monaco	Limited production of electric vehicles - designed like sports cars		400
Magna E Car Systems	AT	Components and systems for hybrid and electric vehicles.	$ 28.748 bn. (2011)[333]	700[334]
Opel/Vauxhall (Hybrid - Ampera)	DE		€ 9.994 bn. (2010)[335]	39 958
VW (E-Up!)	DE		€159.3 bn (2011)[336]	399 381
Porsche 918 Spyder (PHEV)	DE		€ 10.9 bn. (2011)[337]	15 307
Mercedes Benz (EV/REEV)	DE		€ 57.4 bn (2011)[338]	99 091
Audi (A2 - EV)	DE		€ 44.1 bn.[339]	62 806
Spijkstaal	NL	Electric low tractors, platform trucks and special vehicles	€ 10 m	65
Mobicar	PT	Portuguese electric car developed through MobiE program		
ESORO	CH	Concept vehicles including electric		18
Matra	FR	Manufacturer of e-bikes, e-scooters and e-quads		

331 For Daimler as a whole.
Source: http://ar2011.daimler.com/management_report/profitability/employment
332 For Fiat group as a whole. Source: http://annualreport2010.fiatspa.com/en/report-operations/highlights
333 For Magna international as a whole.
334 111 000 for Magna International as a whole.
335 For Opel as a whole.
336 For VW Group as a whole.
337 For Porsche AG as a whole.
338 For Mercedes-Benz Cars as a whole.
339 For Audi group as a whole.