104552/EU XXIV.GP
Eingelangt am 28/01/13

EUROPEAN
COMMISSION

Brussels, 24.1.2013
SWD(2013) 5 final

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}

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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"[1] 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:

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

   (1) Consultation of representatives of the Member States;

   (2) Public Consultation;

   (3) 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

[1] COM(2011) 144 final

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.

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[2] the Group agreed with the fuel mix recommended by the (EEGFTF). High potential in 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.

Stakeholders' Consultation

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.

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

- 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.

<u>Public consultation</u>

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 1, Table 2, Table 3) 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 1: 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[3]: 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)[4]: - 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

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

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

			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 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.[5]
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[6]	2012-2013: 2,000[7]	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[8].
Denmark	2015: 10-15,000 stock 2020: 50,000 stock[9] 2020: 200,000 stock[10]	2020: 20,000 charging points[11]	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,

5 Idem footnote 4.

6 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.

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

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

9 Idem footnote 6.

10 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

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

			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. • 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[12]	-	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

[12] Idem footnote 4.

			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.
Spain	2012: 72,000 stock[13] 2014: 1,000,000 stock[14] 2020: 2,500,000 stock[15]	2014[16]: 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.[17]
France	2015: 450,000 2020: 2,000,000 stock[18]	1,250 public stations to be installed by 2012 in 20 cities 2015: 900,000	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

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

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

[15] 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

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

[17] Idem footnote 4.

[18] National French roll-out plan

http://www.developpement-durable.gouv.fr/Point-d-avancement-du-plan-avril,26840.html

		private and 7,500 public charging points 2020: 4,000,000 private and 400,000 public charging by 2020[19]	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.
Ireland	2020: 230,000 stock[20] 2020: 350,000 stock[21]	2015: 6,000 charging points 2020: 25,000 public charging points[22]	*E-car Ireland*[23] 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[24]	1,000 charging points 2013: 588 public charging stations 2014: 150 public[25]	*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.

19 Idem footnote 16;

http://www.cleanvehicle.eu/info-per-country-and-eu-policy/member-states/france/national-level/

20 Sustainable Energy Authority of Ireland

http://www.seai.ie/Renewables/EV_support_programme_launched/

21 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

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

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

24 Idem footnote 15.

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

Luxemburg	2020: 40,000 stock[26]	-	€ 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[27]	2013: 10,000 public charging stations 50 fast charging stations[28]	Formula E-team's[29] 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); 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.[30]
Poland		2013: 300 charging points[31]	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

[26] Policy and Activities in electric mobility in Luxembourg

www.janson.be/var/media/site/presentaties/ENOVOS 05012012 Presentation e-mobility.pptx

[27] 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

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

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

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

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

			adequate charging infrastructure together with RWE Poland.[32]
Portugal	2020: 200,000 stock[33]	2020: 25,000[34]	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.35
Romania	-	-	The Government set up a special working group for developing the e-mobility strategy in Romania, subsidies for EV purchase recently introduced (up to € 3,700).[36]
Sweden	2020: 600,000 stock[37] 2020: 18,000 sales[38]	-	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[39].
Slovenia	2030: 23% (14,062) stock[40],[41]	-	No current public support at national or regional level for charging infrastructures.

[32] Idem footnote 4.

[33] Idem footnote 15.

[34] Idem footnote 15.

[35] http://www.ieahev.org/by-country/portugal-policy-and-legislation/

[36] http://www.rolandberger.cz/media/pdf/Roland_Berger_CEE_emobility_study_20111020.pdf

[37] 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

[38] Idem footnote 15.

[39] http://www.ieahev.org/by-country/sweden-charging-infrastructure/

[40] European Commission, Directorate-General Mobility and Transport, 2012, Statistical pocketbook 2012.

			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[42] category) - for remodeling of vehicles with IC motor to electric drive between € 4,000 (M1 category) and €1,000 (L6e category)[43]
United Kingdom	2020: 1,200,000 stock EVs 350,000 stock PHEVs 2030: 3,300,000 stock EVs 7,900,000 stock PHEVs[44]	By 2020 : 8,500 charging points[45]	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 2: Overview table of Member States' targets for electric vehicles

Member state	2015	2020	2030
Austria[46]	-	250,000 (stock)	-
Belgium	-		-
Bulgaria	-	-	-
Cyprus	-	-	-

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

42 Quadricycles whose unladen mass is not more than 350 kg -

http://ec.europa.eu/transport/road_safety/vehicles/categories_en.htm#L

43 Idem footnote 4.

44 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

45 http://assets.dft.gov.uk/publications/making-the-connection-the-plug-in-vehicle-infrastructure-strategy/plug-in-vehicle-infrastructure-strategy.pdf

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

Czech Republic	-	-	-
Germany[47]	-	1,000,000 (stock)	5,000,000 (stock)
Denmark[48]	10,000 – 15,000 (stock)	50,000 (stock)[49] 200,000 (stock) [50]	-
Estonia	-	-	-
Greece	-	-	-
Spain[51]	1,000,000[52]	2,500,000 (stock)	-
Finland	-	-	-
France	450,000 (stock)	2,000,000 (stock)[53]	-
Hungary	-	-	-
Ireland	-	230,000 (stock)[54] 350,000 (stock) [55]	-
Italy	130,000 (stock) [56]	-	-

[47] 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.

[48] Idem footnote 6.

[49] Idem footnote 6.

[50] 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

[51] http://www.ieahev.org/assets/1/7/IA-HEV_2010_annual_report_6MB.pdf Spain

[52] http://www.ieahev.org/by-country/spain-policy-and-legislation/

[53] National French roll-out plan, available at:

http://www.developpement-durable.gouv.fr/Point-d-avancement-du-plan-avril,26840.html

[54] Sustainable Energy Authority of Ireland

http://www.seai.ie/Renewables/EV_support_programme_launched/

[55] 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

[56] http://www.ieahev.org/assets/1/7/IA-HEV_2010_annual_report_6MB.pdf Italy

Lithuania	-	-	-
Luxembourg	-	40,000 (stock)[57]	-
Latvia	-	-	-
Malta	-	-	-
Netherlands	20,000 (stock)	200,000 (stock)[58]	-
Poland	-	-	-
Portugal	-	200,000 (stock)[59]	-
Romania	-	-	-
Sweden	-	600,000 (stock)[60] 18,000 sales[61]	-
Slovenia	-	23% (approx. 14,062 stock - based on existing new vehicles registration for 2011)[62,63]	-
Slovak Republic	-	-	-
UK	-	1,200,000 stock EVs 350 000 stock PHEVs[64]	3,300,000 stock EVs 7,900,000 stock PHEVs[65]

[57] Policy and Activities in electric mobility in Luxembourg

www.janson.be/var/media/site/presentaties/ENOVOS 05012012 Presentation e-mobility.pptx

[58] 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

[59] http://www.ieahev.org/assets/1/7/IA-HEV_2010_annual_report_6MB.pdf Portugal

[60] 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

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

[62] Idem footnote 40.

[63] http://www.rolandberger.cz/media/pdf/Roland_Berger_CEE_emobility_study_20111020.pdf

[64] Idem footnote 43

[65] 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 3: 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[66]	-	-	**Semi-public 4,500**[67]
Belgium	188[68]	-	-	**Public: 35,000 – 130,000** **Public Fast 1,000 – 4,000**[69]
Bulgaria	1[70]	-	-	-
Cyprus	-	-	-	-
Czech Republic	Private 3 Public 20[71]	**Public 250**[72]	-	-
Germany	Private 613 Public 836 Semi-public 488[73]	**2,000**[74]	-	-
Denmark	Public 280[75]	30		**Public 20,000**[76]
Estonia	2[77]	-	250[78]	-
Greece	-	-	-	**Public 6,900**[79]

66 http://openchargemap.org/

67 http://www.verbund.com/cc/en/news-media/news/2012/04/10/e-mobility-provider-verbund-siemens

68 http://www.asbe.be/en/locations

69 Idem footnote 4.

70 http://openchargemap.org/

71 EURELECTRIC, 2012, EURELECTRIC views on charging infrastructure – Facilitating e-mobility.

72 http://www.ceskapozice.cz/en/business/companies/cez-plugs-electric-cars-charging-network

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

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

75 Idem footnote 71.

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

77 http://openchargemap.org/

78 http://www.successcharging.com/content/eastern-european-country-has-pledged-set-nationwide-network-250

Spain	Public 731 LDVs: 625[80],[81]	-	**Private: 325,000[82]** **Public parking : 12,150** **Public road-side : 6,200**	-
Finland	1[83]	-	-	-
France[84]	236	STET 1,250	Private 900,000 Public 7,500	**Private: 4,000,000** **Public: 400,000**
Hungary	7[85]	-	-	-
Ireland[86]	Public: 640 of which are 27 fast charge points		6,000	**Public: 25,000**
Italy[87]	1,000	Public: 588	150	
Lithuania	-	-	-	-
Luxembourg	7[88]	-		-
Latvia	1[89]	-	-	-
Malta	-	-	-	-
Netherlands	1,700	**Public: 10,000** **Fast: 50**[90]	-	-
Poland[91]	Public: 27[92]	**300**	-	-

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79 Idem footnote 4.

80 Of which: normal load 616 and rapid charging 9, Motorcycles: 96, Disabled: 10.

81 http://www.movele.es/index.php/mod.puntos/mem.mapa/relmenu.20

82 Idem footnote 16.

83 http://openchargemap.org/

84 Idem footnote 16; and http://www.cleanvehicle.eu/info-per-country-and-eu-policy/member-states/france/national-level/

85 http://openchargemap.org/

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

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

88 http://openchargemap.org/

89 http://openchargemap.org/

90 http://www.emobilitymagazine.nl/EmobilityeCarTec2011.pdf

Portugal[93]	Public 1,300 Fast 50 charging station			**Public 25,000**
Romania	-	-	-	-
Sweden	-	-	-	-
Slovenia	-	-	-	-
Slovak Republic	3[94]	-	-	-
UK	703[95]	-	-	**8,500**[96]

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[97] and France[98] (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

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

92 14 normal open-access, 1 fast charging stations and 12 commercial points 1 demonstration in front of their headquarters in Warsaw Polenergia

93 Idem footnote 15.

94 http://openchargemap.org/

95 http://openchargemap.org/

96 http://assets.dft.gov.uk/publications/making-the-connection-the-plug-in-vehicle-infrastructure-strategy/plug-in-vehicle-infrastructure-strategy.pdf

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

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

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[99].

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.100

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.

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.[101]

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

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

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

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

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.[102]

United Kingdom – Isle of Wight[103]

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 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[104]"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

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

[103] http://www.eco-island.org/hub/page/press

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

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).[105] 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.[106]

The Scandinavian Hydrogen Highway Partnership (SHHP)[107]

24. The SHHP is a partnership between local, regional and national authorities and private industries and research institutions. The national networking institutions

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

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

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

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[108]

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[109]

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

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108 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

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

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

Danube Region Masterplan[110]

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[111]

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[112]

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,

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

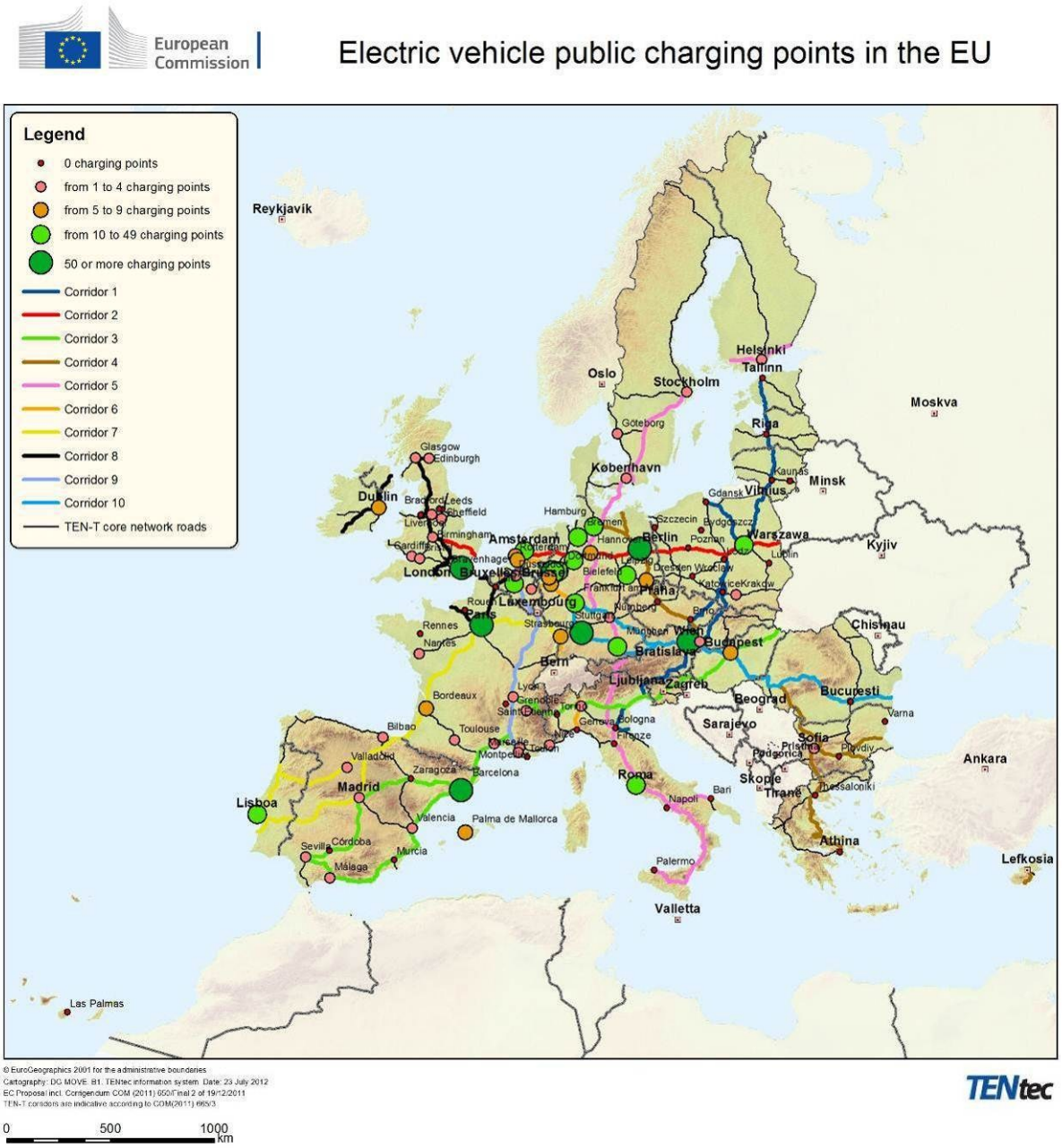
111 http://www.dnv.com/press_area/press_releases/2012/dnvtomapthefutureoflngbunkeringinbelgium.asp

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

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.

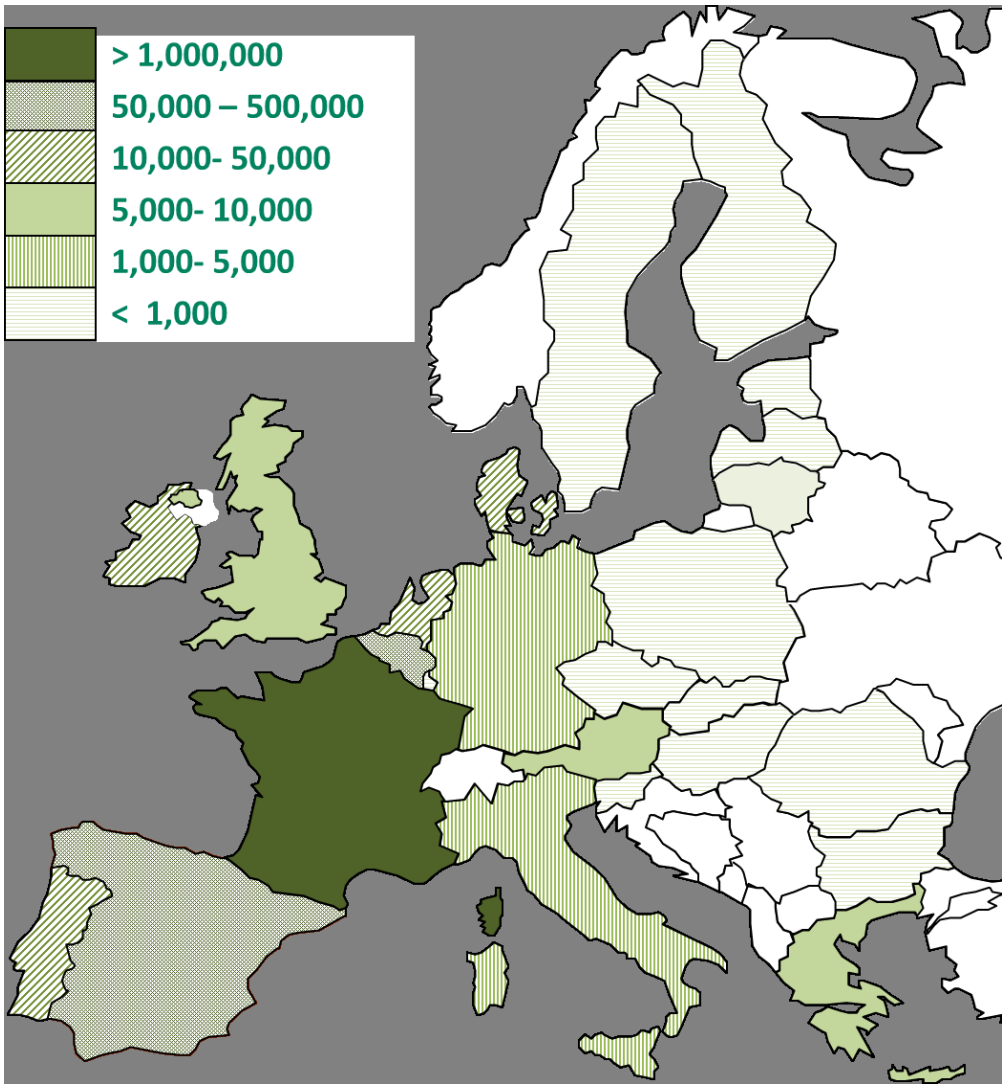
Appendix 5: Existing and expected alternative fuels infrastructure in the EU

Figure 1: Public charging points in the main urban areas of the EU[113]



[113] 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[114]



[114] Cyprus and Malta have not announced any plans for the deployment of charging points. Further details on the data sources are provided in Table 3 in Appendix 2.

Figure 3: Existing and planned hydrogen fuelling stations in the EU[115]

[115] 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[116]

[116] 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

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

Electricity

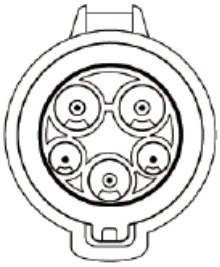
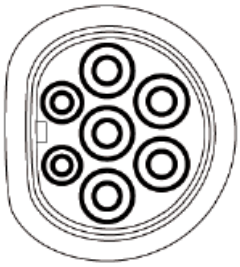
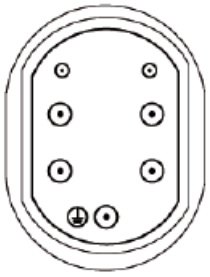
1. In June 2010, the Commission mandated[117] three standardisation organisations, the European Committee for Standardisation (CEN), the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI) to develop European standards or to review existing ones in order to ensure interoperability and connectivity between the electricity supply and the EVs, including appropriate smart-charging issues[118], 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.

[117] 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

[118] 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[119]

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			

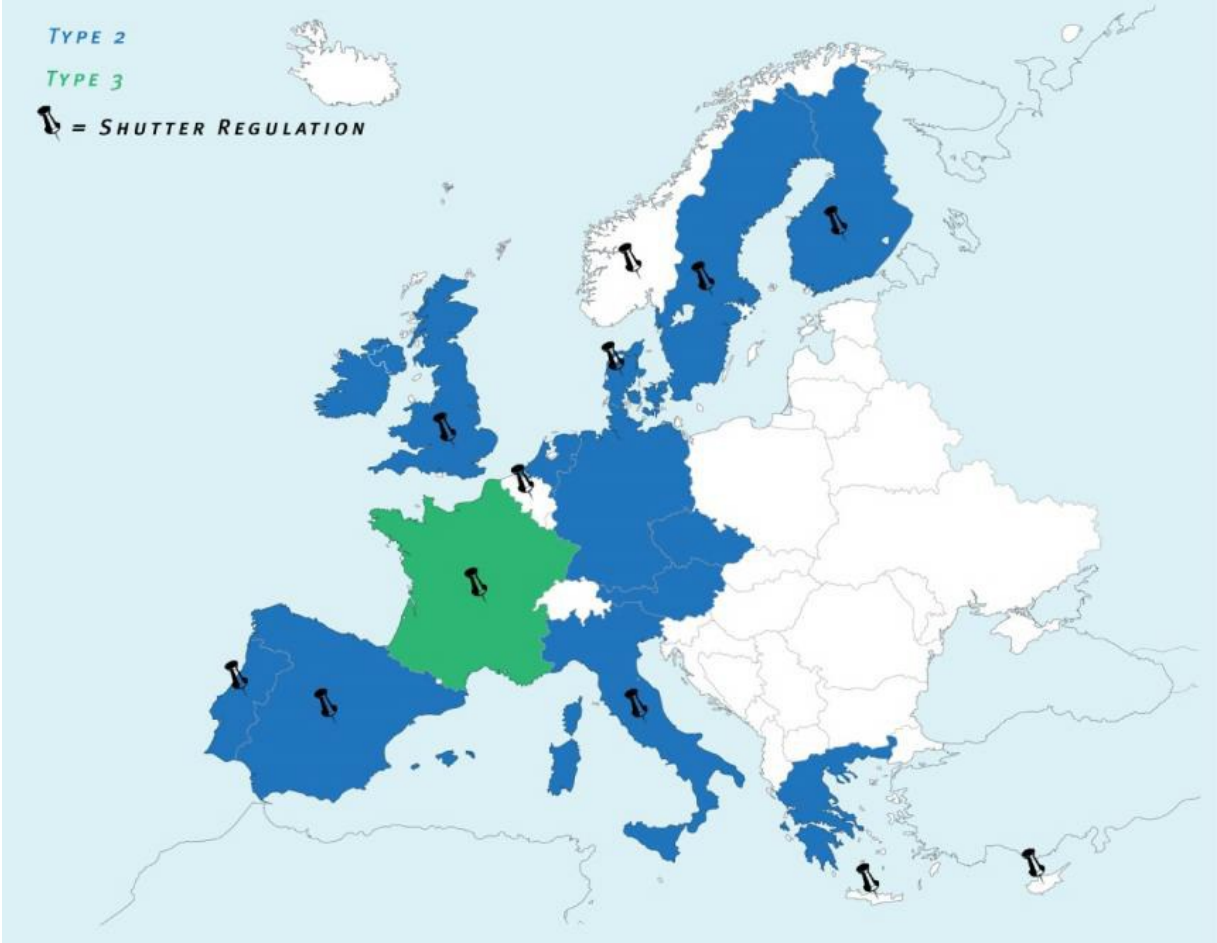
2. This situation led to, on the one hand, the deployment of both charging sockets at the same time with France deploying Type 3 and other Member States deploying Type 2 sockets (Figure), on the other hand, the delay by certain countries to deploy charging infrastructure at all. Stakeholders have repeatedly called for ending this deadlock, fearing that "*this situation is not beneficial to e-mobility development*"[120].

[119] 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

[120] 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[121]



Hydrogen

1. The International Organization for Standardization (ISO)[122] and the Society of Automobile Engineers (SAE)[123] 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

[121] 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.

[122] 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).

[123] 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

hydrogen fuelling stations and on gaseous hydrogen land vehicle refuelling connection devices. The existing standards are currently applied voluntarily, and stakeholders have confirmed that 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[124].

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

[124] 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.

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.

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[125] private charging point can be estimated to be around € 520; while for a publicly accessible charging point it is approximately € 5,280[126].

Figure 7: Estimates for investment and installation cost for single charging outlets[127]

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

[125] 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.

[126] Source: Kaneko et al., 2011, EV/PHEV charging infrastructure analysis.

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

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)[128].

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 at large[129]. 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[130].

Hydrogen

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[128] 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.

[129] 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).

[130] 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. 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)

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[131], 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 €[132]. 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.

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

[132] 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 4 below.

Table 4: 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 5, 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 5: 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 5, 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[133] confirmed that the likelihood of vested interests in certain technologies preventing cross-industry agreements would be very high.

[133] 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 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

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.

1. 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 7: 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

Protection of first mover investors on infrastructure

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[134]

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".

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[134] 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)

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[135] 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 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)[136]

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

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

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

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.

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[137]. 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[138].

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

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[137] 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

[138] https://fullcharger.chargepointportal.eu/index.php/device/devicelocation.html

electromobility[139]. 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[140]. 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[141].

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 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.

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[139] *Europost*, June 8, 2012 "Additional 19 EV charging stations to be built"

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

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

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.

<u>Set-up of alternative fuels' networks</u>

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):

   (1) the IA accompanying the White Paper - Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system[142];

   (2) the IA accompanying A Roadmap for moving to a competitive low carbon economy in 2050[143]; and

   (3) the IA accompanying the Energy Roadmap 2050[144].

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

   (1) 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).

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

   (3) 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)[145].

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

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

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

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

[145] 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.

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 modalities for reaching the 2020 target to reduce CO_2 emissions from new light commercial vehicles[146].

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)[147], the PROMETHEUS and GEM-E3 models[148].

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 8.

Table 8: 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

146 SWD(2012) 213/2, available at: http://ec.europa.eu/clima/policies/transport/vehicles/cars/docs/impact_assesment_en.pdf

147 Model description available at.: http://www.e3mlab.ntua.gr/e3mlab/PRIMES%20Manual/The_PRIMES_MODEL_2010.pdf

148 Model description available at: http://147.102.23.135/e3mlab/index.php?option=com_content&view=section&id=8&Itemid=56&lang=en

8. The population projections draw on the EUROPOP2008 convergence scenario[149] from Eurostat, which is also the basis for the 2009 Ageing Report[150]. 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 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[151]. 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 9.

Table 9: 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[152], 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

[149] EUROpean POPulation Projections, base year 2008

[150] 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.

[151] Communication from the Commission: Europe 2020. A strategy for smart, sustainable and inclusive growth. COM(2010)2020, Brussels, 3.3.2010.

[152] Model description available at: http://www.e3mlab.ntua.gr/e3mlab/PROMETHEUS%20Manual/prometheus_documentation.pdf

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[153], while the additional policy measures, included in Scenario 1 relative to the 'Reference scenario' are provided in Table 10. These are measures adopted by November 2011.

Table 10: 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[154]	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).

[153] Idem footnote 142. 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).

[154] 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

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.

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 11.

Table 11: 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%

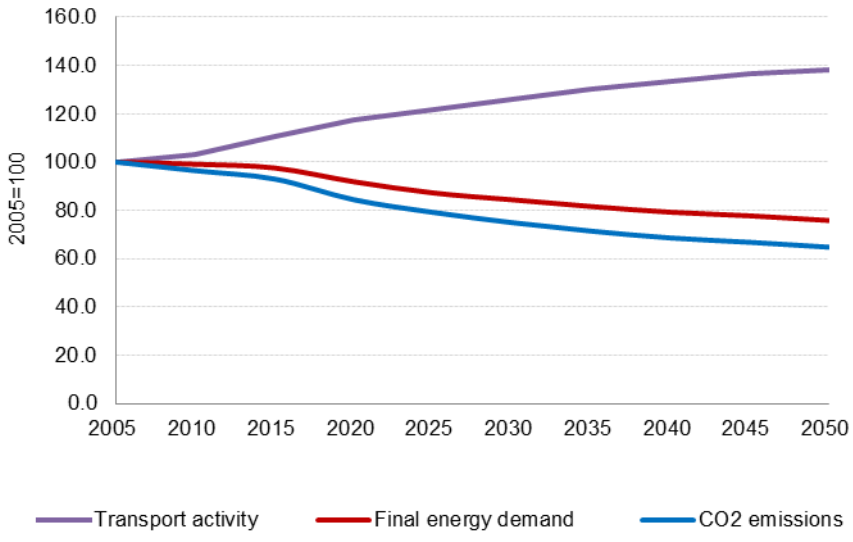
Inland navigation	0.9%	0.8%	0.5%	0.3%
Freight transport activity in Gtkm	1.3%	1.5%	1.3%	1.3%
Trucks (HDVs) & LCVs	1.5%	0.6%	0.7%	0.5%
Rail	2.0%	1.3%	0.8%	0.6%
Inland navigation	1.0%	1.4%	0.6%	0.3%
Maritime	1.3%	1.7%	1.4%	1.4%

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

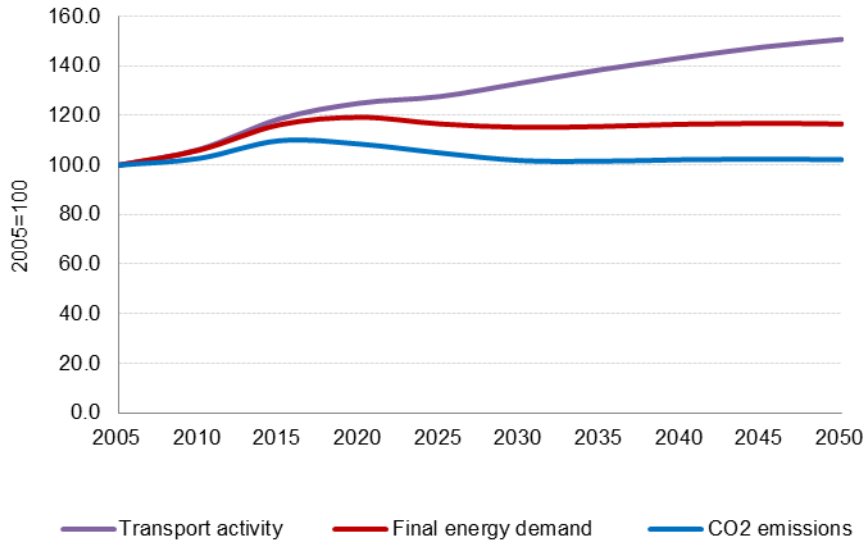
17. The energy use of passenger cars and LCVs would drop by about 8% between 2005 and 2020 due the implementation of the regulations setting emission

performance standards for new passenger cars and vans[155], 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.

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[156]. CO_2 emissions from HDVs and freight LCVs

[155] Regulation (EC) 433/2009 and Regulation (EU) 510/2011.

[156] 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

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 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[157].

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

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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.

[157] The illustrative modelling exercise did not cover the environmental impacts on maritime transport.

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:

(4) Identify the investment costs associated with the deployment of alternative fuels infrastructure.

(5) 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 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.

(6) 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.

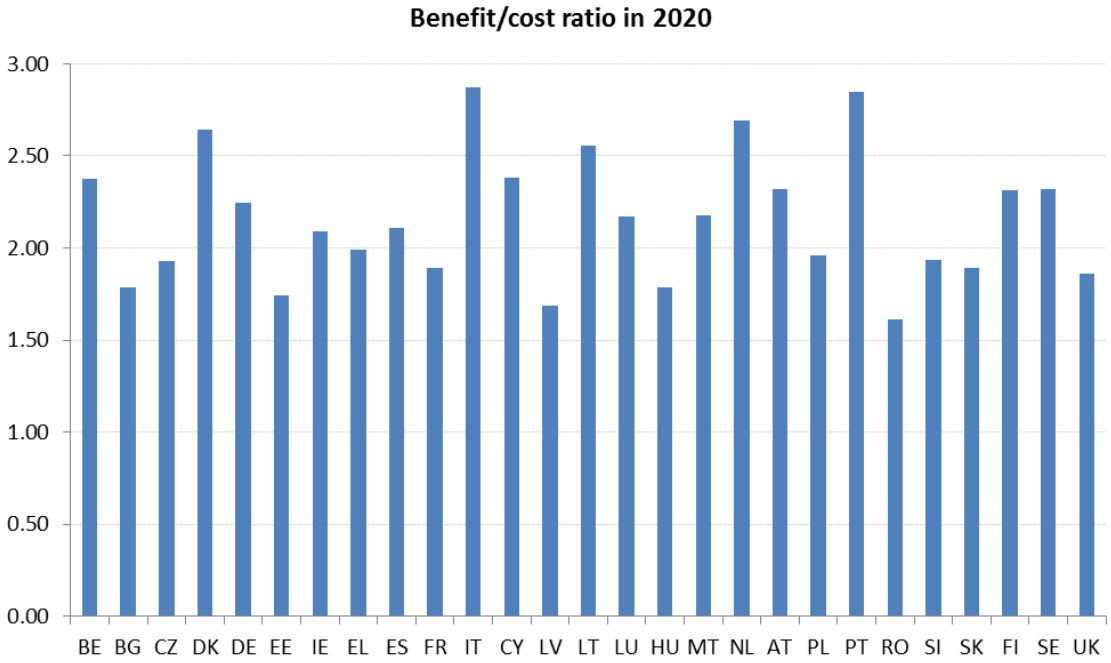
(7) Estimate the costs of deploying the same number of vehicles and vessels as determined in Step 3, by simultaneously intensifying the policies assumed in Step 2 and lowering the intensity of action on infrastructure deployment.

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.

(8) 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 12: 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[158]	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[159]	12 (on the site)

[158] For the 13- month period ended 31 March 2012

Source: "Elektromotive Group Limited 2012 Annual Report"

http://lexicon.listedcompany.com/misc/ar2012.pdf

[159] Source:

http://www.bayern-international.de/en/business-in-bavaria/key-technologies-in-bavaria/company-details/technagon-gmbh-1002972/

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
RWE-eMobility	DE	Germany utility supplier and supplier of charging infrastructure*	€ 52bn (2011)[160]	50[161]
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[162]	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

[160] 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

[161] "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/

[162] Source: http://www.alibaba.com/member/pl1008005510/company_profile/trade_capacity.html

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
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[163] €1100 million[164]	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?[165]	
AeroVironment	USA	Manufacturer of charging infrastructure	$292.5 m. (2011)	768

[163] 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

[164] Data for General Cable Europe&Med.

Source: http://www.sileccable.com/Compa%c3%b1%c3%ada/Qui%c3%a9nessomos/tabid/599/Default.aspx

[165] Source: http://www.globes.co.il/serveen/globes/docview.asp?did=1000737723&fid=1725

Coulomb Technologies	USA	Manufacturer of charging infrastructure	≈$2 m. (2009)	100-200
GE Charging Solutions	USA	Manufacturer of charging infrastructure	$21 bn. (2011)[166]	
EV-Charge America	USA	Manufacturer of charging infrastructure		11-50
Eaton Corporation	USA	Manufacturer of charging infrastructure	$16.0 bn.	73 000
ITT Cannon	USA	Manufacturer of EV charging connectors and components	$11 bn. (2011)[167]	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? [168]	
*Note: * unknown if these companies only supply or also manufacture charging infrastructure*				

Table 13: 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.[169] (2010)	122 615

[166] 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

[167] For ITT as a whole.

[168] Source: http://www.globes.co.il/serveen/globes/docview.asp?did=1000737723&fid=1725

[169] 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

BMW (project I, Mini)	UK/DE	Manufacturer of electric vehicles	€ 68.8 bn[170] (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		
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[171]	
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. [172]	101 - 500

[170] 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

[171] Source:

http://www.mainpost.de/ueberregional/wirtschaft/mainpostwirtschaft/Insolvenz-Bei-der-Smiles-AG-gehen-die-Lichter-aus;art9485,6643793

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[173]	
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)[174]	155 099
Daimler (eSmart)	DE	Manufacturer of electric drive smart car	€ 106.5 billion (2011)[175]	271 370
Fiat(e500)	IT		€ 56.3 bn.[176]	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)[177]	700[178]
Opel/Vauxhall (Hybrid - Ampera)	DE		€ 9.994 bn. (2010)[179]	39 958

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[172] Source: http://www.indiamart.com/company/3769296/

[173] Source: http://www.dalyselectricvehicles.co.uk/about/

[174] For Nissan as a whole.

Source: http://www.nissanglobal.com/EN/DOCUMENT/PDF/AR/2011/AR2011_E_All.pdf

[175] For Daimler as a whole.

Source: http://ar2011.daimler.com/management_report/profitability/employment

[176] For Fiat group as a whole. Source: http://annualreport2010.fiatspa.com/en/report-operations/highlights

[177] For Magna international as a whole.

[178] 111 000 for Magna International as a whole.

[179] For Opel as a whole.

VW (E-Up!)	DE		€159.3 bn (2011)[180]	399 381
Porsche 918 Spyder (PHEV)	DE		€ 10.9 bn. (2011)[181]	15 307
Mercedes Benz (EV/REEV)	DE		€ 57.4 bn (2011)[182]	99 091
Audi (A2 - EV)	DE		€ 44.1 bn.[183]	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		

[180] For VW Group as a whole.

[181] For Porsche AG as a whole.

[182] For Mercedes-Benz Cars as a whole.

[183] For Audi group as a whole.