



Assessment of the implementation of a European alternative fuels strategy and possible supportive proposals

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FINAL REPORT

Submitted by:



Subcontractors:
E3M-Lab of National Technical
University of Athens
(ICCS/NTUA)



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FINAL REPORT

FINAL REPORT TO THE EUROPEAN COMMISSION IN THE FRAMEWORK OF CONTRACT
TREN/R1/350-2008 LOT3 - MOVE C1/497-1-2011

"ASSESSMENT OF THE IMPLEMENTATION OF A EUROPEAN ALTERNATIVE FUEL STRATEGY AND
POSSIBLE SUPPORTIVE PROPOSALS"

E3MLab – 10/8/2012

SUMMARY

This **final report** consists of supporting material to the “Assessment of the implementation of a European alternative fuels strategy and possible supportive proposals”. In the context of this study, E3MLab has provided a quantitative assessment /cost-benefit analysis of the policy options using the PRIMES-TREMOVE model. Qualitative analysis was also carried out where it was required. All European Commission’s requests have been accommodated in this report. odat

Within the course of this contract, the following were also delivered:

- An **inception report** outlining the objective of the study and the methodological approach of the quantitative assessment of the policy options for the development of refuelling and charging infrastructure in the European Union.
- An **intermediate report** which included a contribution to assessing the establishment of a European alternative fuel strategy by describing the current situation through data collection and assessment, by providing a definition of the problem that requires action, as well as the policy drivers. A report from questionnaires distributed to stakeholders was also compiled and presented in this report.
- The **draft final report** which was accompanied by the full quantitative assessment/ cost-benefit analysis of the policy options considered to support the development of new alternative fuel infrastructures. The quantification was performed with the PRIMES-TREMOVE model.

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Chapter I - Relevant legislation and policies

The most relevant EU legislation, programmes and policies linked to the assessment of a European alternative fuel strategy are the following: Directive on renewable energy, energy taxation Directive, fuel quality Directive, Directive on the promotion of clean and energy-efficient road transport vehicles, European strategy on clean and energy-efficient vehicles, Regulations on CO₂ emissions for vehicles (passenger cars and light commercial vehicles), Fuel Cells and Hydrogen Joint Undertaking initiative, Flagship initiative "A resource-efficient Europe", 2001 Transport White Paper on Transport, "Horizon 2020 Programme on research and innovation" and the EC proposal for a Regulation on "TEN-T Guidelines to transform the existing patchwork into a unified transport network".

Legislation

- (1) Directive 2009/28/EC on Renewable energy establishes binding national renewable energy targets that result in an EU target of a 20% share of renewable energy sources in energy consumption in 2020, and a binding 10% minimum target for renewable energy in transport fuels used in land transport (road and rail) to be achieved by each Member State¹.
- (2) Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity allows Member States to grant favourable tax treatment on alternative fuels or complete exemption from excise duties to natural gas and LPG used as propellants. The Commission, on 13 April 2011, adopted a proposal² for the amendment of this Directive. The new rules aim to restructure the way energy products are taxed to remove current imbalances and take into account both their CO₂ emissions and energy content.
- (3) Directive 98/70/EC relating to the quality of petrol and diesel fuels, as amended by Directive 2009/30/EC of 23 April 2009 (Fuel Quality Directive) establishes specifications for petrol and diesel, for environmental and health reasons, such as limits on the content of ethanol, ether and other oxygenates in petrol. The revised Directive enables a higher volume of biofuels to be blended with petrol: a higher content of oxygen-containing additives (so-called oxygenates) is permitted for

¹ Article 3(4) states that "Each Member State shall ensure that the share of energy from renewable sources in all forms of transport in 2020 is at least 10% of the final consumption of energy in transport in that Member State.

For the purposes of this paragraph, the following provisions shall apply:

(a) for the calculation of the denominator, that is the total amount of energy consumed in transport for the purposes of the first subparagraph, only petrol, diesel, biofuels consumed in road and rail transport, and electricity shall be taken into account;

(b) for the calculation of the numerator, that is the amount of energy from renewable sources consumed in transport for the purposes of the first subparagraph, all types of energy from renewable sources consumed in all forms of transport shall be taken into account;"

² COM(2011) 169 final

petrol including up to 10% ethanol; and up to 7% fatty acid methyl ester (FAME) is permitted to be mixed in diesel. In addition, the Directive introduces an obligation for fuel suppliers to reduce the GHG emissions that their fuels cause over their life-cycle, i.e. when they are refined, transported and used. Member States shall require suppliers to reduce as gradually as possible life cycle GHG emissions per unit of energy from fuel and energy supplied by up to 10 % by 31 December 2020.

- (4) Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles aims to promote market introduction of environmentally-friendly vehicles. It requires that energy and environmental impacts associated with the operation of a vehicle over its life-time are taken into account in all purchases of public road transport vehicles.
- (5) Regulation 443/2009/EC establishes CO₂ emissions performance requirements for new passenger cars in order to ensure the proper functioning of the internal market and to achieve the overall objective of the European Community of 120 g CO₂/km as average emissions for the new car fleet. This Regulation sets the average CO₂ emissions for new passenger cars at 130 g CO₂/km, by means of improvement in vehicle motor technology, as measured in accordance with Regulation (EC) No 715/2007 and its implementing measures and innovative technologies. From 2020 onwards, this Regulation sets a target of 95 g CO₂/km as average emissions for the new car fleet, in accordance with Article 13(5). This Regulation will be complemented by additional measures corresponding to a reduction of 10 g CO₂/km as part of the Community's integrated approach.
- (6) Regulation 510/2011/EC establishes CO₂ emissions performance requirements for new light commercial vehicles. This Regulation sets the average CO₂ emissions for new light commercial vehicles at 175 g CO₂/km, by means of improvements in vehicle technology, as measured in accordance with Regulation No 715/2007 and its implementing measures, and innovative technologies. From 2020, this Regulation sets a target of 147 g CO₂/km for the average emissions of new light commercial vehicles registered in the Union subject to confirmation of its feasibility, as specified in Article 13(1)
- (7) A Fuel Cells and Hydrogen Joint Undertaking was established by Council Regulation 521/2008³. The Joint Undertaking has responsibility for executing a strategic programme of RTD and demonstration aimed at accelerating commercialisation of hydrogen and fuel cell technology. The EU contribution of € 470 million should be at least matched by industry.

³ OJ L153 12 June 2008.

Policy papers and acts

- (1) The flagship initiative of the Europe 2020 Strategy "A resource-efficient Europe" supports the shift towards a resource efficient and low-carbon economy and puts decarbonising transport as a core theme of the strategy.
- (2) The European Commission presented in March 2011, the Transport White Paper "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system"⁴, a series of 40 concrete initiatives for the next decade to build a competitive transport system that will preserve mobility, remove major barriers in key areas and fuel growth and employment. It announced proposals that aim to cut carbon emissions in transport by 60% by 2050 and abate Europe's dependence on imported oil.
- (3) The Horizon 2020 Programme (80 billion) is a package of measures proposed by the Commission on 30 November 2011 to boost research, innovation and competitiveness in Europe. It will run between 2014 and 2020. Horizon 2020 will focus funds on three key objectives. It will support the EU's position as a world leader in science with a dedicated budget of € 24.6 billion, including an increase in funding of 77% for the very successful European Research Council (ERC). It will help secure industrial leadership in innovation with a budget of € 17.9 billion. This includes a major investment of € 13.7 billion in key technologies, as well as greater access to capital and support for SMEs. Finally, € 31.7 billion will go towards addressing major concerns shared by all Europeans, across six key themes: Health, demographic change and well-being; Food security, sustainable agriculture, marine and maritime research and the bio-economy; Secure, clean and efficient energy; Smart, green and integrated transport; Climate action, resource efficiency and raw materials; and Inclusive, innovative and secure societies.
- (4) The TEN-T Guidelines: the proposal of regulation was adopted by the Commission on 19/10/2011. It aims at transforming the existing patchwork of European roads, railways, airports and canals into a unified transport network (TEN-T). The new core network will remove bottlenecks, upgrade infrastructure and streamline cross border transport operations for passengers and businesses throughout the EU. It will improve connections between different modes of transport and contribute to the EU's climate change objectives. The new core TEN-T network will be supported by a comprehensive network of routes, feeding into the core network at regional and national level. This will largely be financed by Member States, with some EU transport and regional funding possibilities, including with new innovative financing instruments. The aim is to ensure that progressively, and by 2050, the great majority of Europe's citizens and businesses will be no more than 30 minutes' travel time from this comprehensive network.

⁴ COM(2011) 144 final

- (5) The European strategy on clean and energy efficient vehicles of 24/04/2010, COM(2010)186, aims to provide a European framework for the promotion of clean and energy efficient vehicles based on conventional internal combustion engines and for the facilitation of the deployment of ultra-low carbon vehicles, such as electric and hydrogen vehicles. The primary objective is to reduce environmental impacts of road transport. The strategy contains 40 actions on a wide range of policy fields covering a regulatory framework, research and innovation in green technologies, market uptake and consumer information, trade and employment aspects as well as specific actions on electric vehicles, such as standardisation, charging and refuelling structure or recycling and transportation of batteries. The strategy covers both light-duty and heavy-duty vehicles as well as two- and three wheelers and quadricycles.

Chapter II - Public consultation - Executive Summary

Most respondents to the Public Consultation came from private companies, individuals and industry associations or NGOs. Among the main results of this consultation, the following two have particular relevance in the context of assessing a European Alternative Fuel strategy.

- 77 % of respondents believe that the public sector should intervene in the build-up of refuelling/re-charging infrastructure*
- 86 % of respondents believe that voluntary action by industry alone cannot achieve the development of the refuelling/recharging infrastructure required for travelling across the whole EU using alternative fuels.*

A Public consultation was launched by the European Commission on 11 August 2011. The questionnaire was available on-line until 20 October 2011. 123 responses were received to the online questionnaire.

The questions presented covered the following areas:

- The characteristics of the respondents and the specific identification of the participating parties.
- The respondents' perception regarding the objectives of the Clean Transport Initiative. In brief, these objectives include, inter alia, the policy of EU in terms of biofuels penetration, electricity infrastructure, synthetic fuels etc. in relation with the type of vehicle or transport mode.
- The preferred approach towards EU legislation in this area and in particular whether binding or non-binding legislation would result in a greater optimisation in terms of CO₂ abatement.
- The respondents' perception for the deployment of alternative fuels regarding the need for further funding and financing, large scale demonstration projects and/or information provision.

The respondents were asked to identify, in their view, the most important alternative fuels for each different transport mode (i.e. road vehicles, rail, air) and to express their preferences regarding the portion of private and public involvement in formulating the legislative and financing background of the imminent transition. Furthermore, the respondents were asked to provide additional comments and proposals to each question apart from selecting among the available answering options.

Almost all of the questions were presented in a multiple choice format, facilitating a quantitative review of the responses. Furthermore, most multiple-choice questions comprised a second part allowing for additional proposals and comments in free text format

The respondents can be grouped into the following categories, from the point of view of the capacity in which they responded:

- Individuals in their personal capacity;
- Private companies;
- Industry associations
- NGOs
- Local or regional public authorities
- National public authorities

The report on this consultation was drawn-up by EXERGIA/COWI and submitted in November 2011.

The main results of the consultations are:

- 66 % of respondents think that voluntary industry action is not sufficient for alternative fuels infrastructure build-up.
- 77 % of respondents believe that public sector should intervene in infrastructure build-up.
- 86 % of respondents believe that the voluntary action of industry alone cannot achieve the development of the refuelling/recharging infrastructures required for travelling across the whole EU on alternative fuels.
- Respondents were asked to indicate the alternative fuels that EU should include in a long-term strategy, having the possibility to indicate more than one. Most indicated electricity (78.9 %), biofuels (64.2 %) and hydrogen (61.8 %), followed by methane (48.0 %), synthetic fuels (46.3 %), LPG (22.8 %), and other options (17.1 %).
- The participants in the consultation were also asked to indicate whether they would welcome EU legislation requiring a minimum refuelling/recharging infrastructure for certain alternative fuels/energy, and if so, which fuels/energy they would prefer. For road transport, the preferred fuels resulted to be electricity (43.1 %), followed by biofuels (indicated by 28.5 per cent), hydrogen (26.8 %), methane (25.2 %), synthetic fuels (13.8 %) and LPG (12.2 %). For rail, electricity was indicated by 24.4% of respondents, whilst 9.8 % indicated biofuels. For waterborne transport, biofuels were indicated as the first choice (20.3 per cent), followed by hydrogen (13 %) and methane (12.2 %). The preferred fuels for airborne transport resulted to be biofuels (24.4 %) and synthetic fuels (13 %).
- With regard to the bio methane infrastructure, 83 % of the respondents considered that bio methane should be injected into a single methane grid supplying stationary and mobile consumers rather than building-up a parallel dedicated refuelling infrastructure.
- More than two thirds of all respondents (69 %) consider that the market introduction of alternative fuels should be supported by privileged access of alternative vehicles/transport carriers to transport infrastructure. Preferred measures to achieve this target include lowering of charging tariffs for

infrastructure use (57.7 %) and privileged access to access restriction zones (43.9%); 17.9 % believe that other measure should be taken into consideration.

Chapter III - Report of the targeted stakeholder consultation

The purpose of the survey was to feed into the modelling exercise for the quantification of policy scenarios in relation to infrastructure cases, in order to assess the policy options regarding the development of refuelling and charging infrastructure in the EU27. In total, 124 questionnaires were distributed to members of the Expert Group on Future Transport Fuels and other relevant stakeholders. The replies were collected by 16 December 2011. The questionnaires were divided according to each alternative fuel under consideration. The percentage of questionnaires filled out per sector is as follows: electricity 53%, hydrogen 33%, biofuels 33%; synthetic fuels 26%, CNG 30%; LNG 20% and LPG 23%. Results of the questionnaires are presented individually in the report with comments.

REPORT FROM QUESTIONNAIRES

Objective

This report aims at providing a summary of the information and data received from members of the Expert Group on Future Transport Fuels for the Infrastructure of Alternative Fuels, as well as other stakeholders. The stakeholders replied to the questionnaires specified by the European Commission (EC) which were distributed by E3MLab on November 14, 2011, according to the fuel industry each member represents. The replies were collected by December 16, 2011. The purpose of the survey is to feed in the modelling exercise for the quantification of policy scenarios in relation to infrastructure cases, in order to assess the policy options regarding the development of refuelling and charging infrastructure in the EU27.

The sample

In total, 124 questionnaires were distributed, less than 50% of which was finally responded. The questionnaires were divided according to each alternative fuel under consideration (7 in total) and may be found at the Appendix. The percentage of questionnaires filled out for each sector is as follows: 33% on biofuels; 30% on methane; 20% on LNG (Liquefied Natural Gas); 33% on hydrogen and fuel cells; 53% on electromobility; 23% on LPG (Liquefied Petroleum Gas) and 26% on synthetic fuels. It must be noted that the respondents did not always reply to all the questions and associations frequently replied on behalf of organizations.

The stakeholders that participated directly or indirectly in the survey are the following: IATA (International Air Transport Association), Epure (European Renewable Ethanol Association), EBB (The European Biodiesel Board), EBTP (The European Biofuels Technology Platform), SCANIA, Eurelectric, AVERE, SIEMENS, ERTRAC, NEW ENERGY WORLD IG, AirLNG GmbH, NGVA Europe, IVECO, AEGPL Europe, UPEI (Union of European Petroleum Independents), SHELL, ASFE, Ministry of Economic Affairs, Agriculture and Innovation Netherlands' Agency, CEDEC, HyER (Hydrogen Fuel Cells and Electromobility in European Regions).

Results of the Questionnaires

The case of biofuels

Question 1- Which blends of biofuels (E-25, E-85, B-30) with diesel or petrol would be the most appropriate to be implemented in the EU and if these blends are considered adequate to promote the development of a market for vehicles running on biofuels.

Two stakeholders replied to the above question for the case of the European Union (EU), while the rest four replied for the specific Member States (MS) in which they operate (i.e. Spain, Belgium, Czech Republic, and Germany).

For the case of the EU, one stakeholder suggests that the B-30 biofuel blend (i.e. 30% biodiesel and 70% normal diesel) is the most appropriate blend type to be implemented in dedicated fleets (excluding E25 and E85)⁵, while the other suggests the E-25 blend (i.e. 25% ethanol and 75% petrol). The B-30 blend was justified on the basis of manageable maintenance of vehicles (dedicated fleets suggested) and ability to avoid misfuelling issues at the retail sites. The way to penetrate the market and promote the development of a market for vehicles running on this biofuel would be the ability of this blend to operate on the B7 blend as well, extending like this the operating area.⁶ The opinion of the other stakeholder is that the E25 is most likely to deliver compliance with the Renewable Energy Directive (RES)⁷ provided that it is commercialized by 2017.

Those that replied for a specific Member States separately expressed different opinions in relation to which biofuels blend they consider appropriate for their country. For Spain, the stakeholder is of the opinion that higher biofuels blends than the ones specified in EN228 and EN590 (i.e. max 5% ethanol and max 5% biodiesel) would not be appropriate considering that the demand/ consumption of lower blend biofuels has been decreasing in Spain the last year (about 40% decrease). For Germany, the blend suggested, which has already been implemented, is the E85. For Czech Republic, the stakeholder suggests the B-30 blend for the EU, as the experience with it in the country gave satisfactory results. For Belgium, all the blends were proposed provided that they can participate in the current compulsory low blends and that the EN specifications of these fuel types will be implemented in Belgium as the norm, so as to facilitate a large scale market penetration.

Question 2- Number of pumps currently delivering E25, E85 and B30 and number of vehicles currently compatible with the above or other blends in each MS

The following table shows the number of pumps and vehicles for the types of biofuels blends mentioned above by the MSs for which information was available by the stakeholders.

⁵ E25 was excluded on the basis of the extra costs in vehicles and infrastructure that would be required, and E85 on the basis of the technical modifications that would be required and current lack of incentives to set up the supply chain. Instead, E20 was suggested as being a more reasonable transition, taking the current technical restrictions into consideration (E10 introduced by the Fuel Quality Directive-FQD).

⁶ B7 (i.e. 7% biodiesel content in diesel) is the current maximum blending limit for diesel, set by the FQD.

⁷ Renewable Sources Energy Directive (2009/28/EC) [http://eur-](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF)

[lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF)

Table 1 - Number of pumps and vehicles by MS

Member States	E25 Pumps	E85 Pumps	B30 Pumps	E25 Vehicles	E85 Vehicles (FFVs)	B30 Vehicles
Sweden	N/A	≈1700	N/A	N/A	≈184000	N/A
Germany	-	≈250-350	-	N/A	≈2400	N/A
France	N/A	≈300	N/A	N/A	≈15,500	N/A
Netherlands	N/A	≈33	25	N/A	≈10000	N/A
Ireland	N/A	N/A	N/A	N/A	≈7000	N/A
Austria	N/A	N/A	N/A	N/A	≈2930	N/A
Switzerland	N/A	N/A	N/A	N/A	≈3200	N/A
Great Britain	N/A	N/A	N/A	N/A	≈1660	N/A
Finland	N/A	N/A	N/A	N/A	≈390	N/A
Italy	N/A	N/A	N/A	N/A	≈750	N/A
Norway	N/A	N/A	N/A	N/A	≈600	N/A
Belgium	N/A	N/A	N/A	N/A	≈200	N/A
Luxemburg	N/A	N/A	N/A	N/A	≈12	N/A
Denmark	N/A	N/A	N/A	N/A	≈100	N/A
Greece	N/A	N/A	N/A	N/A	≈4	N/A
Portugal	N/A	N/A	N/A	N/A	≈1	N/A
Spain	N/A	N/A	N/A	N/A	≈4168	N/A
Poland	N/A	1 (Pilot)	N/A	N/A	N/A	N/A
Hungary	N/A	300	N/A	N/A	N/A	N/A
Czech Republic	-	165	200	N/A	N/A	N/A

Sweden

Sweden counts more than 1700 E85 filling stations as of 2011, as there are appropriate incentives given for the development of this fuel market, according to the stakeholder. The number of new FFVs registered since 2005 is approximately 184,000.⁸No information/ or zero number of pumps exist for E25 or B30.

Germany

According to the stakeholder, there are currently no E25 or B30 pumps in the German market. E85 pumps (filling stations) exist already in the market, serving the so called flex-fuel vehicles (FFV), and range from 250 to 350 as of 2011. The registered new FFVs as of January 2011 (counting from mid 2008) amount to approximately 2,400.⁹

⁸ According to a European (BioEthanol for Sustainable Transport) BEST project report, it is estimated that up to 500,000 vehicles (one eighth of the national flcco) could be converted to FFVs in Sweden. http://www.best-europe.org/upload/BEST_documents/info_documents/BEST_FinalReport_revfeb10.pdf

⁹ The stakeholder also notes that biodiesel as a pure fuel (B100) is offered to approximately 250 independent service stations (number of vehicles compatible unknown, but thought to be mostly freight). Vegetable oil is also offered in Germany at about 250 filling stations (mostly self-consumer systems). Series vehicles that use pure ethanol (E100) are not yet available.

France

There are currently about 300 E85 filling stations in France. The current registered new FFVs counting from 2005 are approximately 15,500. No information on the number of pumps delivering E25 or B30.

Netherlands

About 33 E85 filling stations exist as of 2011. There are 25 stations delivering B30. About 10000 FFVs sales have been registered from 2006 to 2010. The number of FFVs is big relatively to the number of E85 pumps.

Poland

There is 1 pilot project in place for E85 filling station. No information/ or zero number of pumps delivering E25 or B30.

Czech Republic

There are about 165 E85 filling stations and about 200 for B30. There is no official data on the number of vehicles compatible with the above blend.

Spain

While the stakeholder did not list numbers for E25, E85 and B30 available pumps, they advised a total of 500 biodiesel stations to exist currently in Spain and 22 ethanol stations as of 2010.¹⁰ The registered FFVs are counted from 2006 to 2010.

Hungary

About 300 E85 filling stations as of 2011. No information/ or zero number of pumps delivering E25 or B30. No information given on the number of compatible vehicles.

For the rest of the MSs listed, only the number of FFVs sales was available.¹¹

Across the EU, one stakeholder advises that E25 and E85 vehicle fleet is negligible. Many Euro 4 & 5 vehicles (especially Heavy Duty Vehicles-HDV) are tolerant to B30, but this is agreed on a case by case basis with the OEMs. Many B30 tolerant Euro 4 & 5 HDVs are already operating (exact number unknown) and if the right legislative framework establishes biofuels compatibility with the vehicles, many new Euro 6 compatible vehicles can be produced in a short period of time. The average life of an HDV vehicle means the HDV fleet enables faster biodiesel penetration than the LDV fleet.

Question 3- Realistic expectations for the development of the E25, E85 and B30 infrastructure taking the current policy framework into account

The majority of the stakeholders believe that the current policy framework, the 2009 Fuel Quality Directive limits blends of ethanol to 10%, and the OEMs current warranties, make the accessibility and further development of this market difficult in the EU. However, E20 infrastructure could in reality enter a number of sites across the network, before the grade is

¹⁰ According to the stakeholder, the official position of the Spanish Association of cars and trucks producers (ANFAC) is that producers do not recommend blends with more than 7% of biodiesel (and sometimes not more than 5% blend of biodiesel).

¹¹ Ireland: FFVs counted from 2006 to 2010; Austria: counted from 2007 to 2010; Great Britain: counted from 2006 to 2010; Finland: counted from 2007 to 2010; Switzerland: counted from 2007 to 2010; Italy: counted from 2007 to 2010; Norway: counted from 2006 to 2010; Belgium: counted from 2006 to 2010; Luxemburg: counted from 2009 to 2010; Denmark: counted from 2007 to 2010; Greece: counted from 2009 to 2010; Portugal: counted from 2009 to 2010.

introduced as a requirement, considering that the appropriate policy framework is put into place (i.e. the grade is accepted as an official fuel specification). For Czech Republic however, the stakeholder thinks that the development expectations are positive, especially in rural areas and in independent sites/networks, where there is more willingness by independents to open up to a new market. What is considered also as an impediment to the development of a market for vehicles compatible with the above fuels in the next years is the lack of harmonization across the EU market. This means that the standards for the blended fuels and those set by the OEMs must be harmonised in such a way, so as for the consumers to be reassured that they can drive and refill everywhere.

Question 4- What will be the ethanol/petrol and biodiesel/diesel blending ratio in the next years?

In respect of the **ethanol/petrol blending ratio** that is mostly expected to prevail in the next years, some stakeholders believe that E5 and E10 will be introduced in the first years with gradual transition to **E20 and E25** for gasoline with ethanol contents. Some believe that E85 could also have a share for specific fleets and car brands.

In respect of the **biodiesel/ diesel blending ratio**, the majority expects **B7** and not more to prevail in the next 5 years, while further biodiesel volumes could also be introduced via fungible fuels like HVO (beyond 7% vol.), potentially B10 in some niche markets and **B30** for specific fleets, like captive fleets in the Heavy Duty sector. In all cases, stakeholders call for harmonization of standards across the EU. Vehicle manufacturers and fuel suppliers must act on the same basis in order for the timely introduction of the higher bio-blends and the appropriate investments, with the state to coordinate such a development, mainly through achieving public acceptance of the new fuels.

Question 5 -What fuel standards, fuel equipment standards and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for biofuels vehicles in the EU.

Three stakeholders replied to this question. 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 agreement of the standards should take place soon in order to enable the appropriate technology progress through R&D and investments, taking into account the long planning cycles in engine development. One respondent considers the process of the elimination of the technical barriers for a biofuels market development to be similar to the one that took place for the transition from leaded to unleaded petrol.

More specific suggestions by one stakeholder include the E25 specifications and the E85 FFVs; for E25 a fuel specification is needed that will lead to an amendment of the 2009 FQD and the development of a CEN Standard¹²; for E85 FFVs, they suggest that the manufacturers should be allowed a CO2 credit. According to current rules on CO2 emissions for new

¹² CEN: Comité Européen de Normalisation (European Committee for Standardization)

passenger cars (Regulation on CO₂ from LDVs, 443/2009)¹³, the role of E85 in reducing CO₂ emissions is recognized. However, according to the stakeholder, the fact that the constructors of FFVs are currently not entitled to any CO₂ credit for their FFVs because there are not enough E85 filling stations available (chicken-egg problem), consists a disincentive to the production of environmentally friendly cars. A two-fold example given, that could encourage the production and market introduction of FFVs is the following: 1) change the reference fuel used for FFVs from SP95 petrol grade¹⁴ to E85 to measure their CO₂ emissions 2) The CO₂ credit for FFVs manufacturers should not be dependent on the number of E85 stations. The incentives (also tax incentives) should be given along with the construction of the first pumps, in order to develop the market.

Question 6- Infrastructure Coverage (minimum, appropriate and optimum for E25, E85 and B30 pumps) in order to facilitate the development of a market for vehicles running on biofuels in the EU (differentiation between urban and non-urban areas)

This part of the questionnaire was replied by 4 stakeholders with each one of them having different perception of the infrastructure coverage. Most of them perceived the coverage as the degree of a biofuel blend penetration into the market. Thus, they claimed that the differentiation among minimum appropriate and optimum is irrelevant, should E20 or E25 become the dominant in the market. The optimum coverage for B30, suggested by one, is considered to take place through depots for home refuelling fleets and across dedicated truck stops, while they do not suggest the development of retail sites for this type of fuel. Another is of the opinion that the present infrastructure is appropriate, but the coverage is problematic on the highways due to international operators of gas stations. The German stakeholder replied in terms of infrastructure coverage indicating the practice in Germany's case for all sorts of fuels; minimum 1000 pumps with distance between the pumps of 10 km maximum in urban areas and of 30 km in non-urban.

Question 7- Which among the following 4 criteria would be the most effective to define minimum, appropriate and optimum coverage: a) density of population b) a certain percentage of pumps on the TEN-T comprehensive network c) maximum distance between pumps d) pumps to be made available in filling stations above a certain size or annual turnover"

The majority of the stakeholders think that the most effective criterion to define the minimum, appropriate and optimum infrastructure coverage is option d) pumps to be made available in filling stations above a certain size or annual turnover. This is justified in the case of Sweden, which currently has the most developed network of biofuels infrastructure for E85. This was achieved by enforcing an Act in 2006, obliging pump owners to provide at least one alternative fuel per filling station. Like this, Sweden's larger filling stations must offer a renewable fuel for sale (mostly E85) alongside petrol or diesel.¹⁵ The second most effective criterion for defining coverage is thought to be the maximum distance between the pumps (option c).

¹³ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0001:0015:EN:PDF>

¹⁴ SP95 refers to the 95 Octane Unleaded Petrol

¹⁵ The Act initially applies to filling stations with a sales volume in excess of 3000 m³

Question 8- What is the investment Cost for E25, E85, and B30 refuelling/charging infrastructure?

Two replies were received to this question, one referred to the cost of adaptation of a conventional station and the other to the cost of a new pump. In the case of E25 no adjustments to refuelling infrastructure are needed, while for E85 adjustments as well as harmonised regulation will be needed. Thus, the suggested cost of adaptation of a conventional pump station could range between € 5,000 - 20,000, while for a new pump the cost could range between € 15,000-30,000, storage enlargement not included.

Question 9- What would be the expected impact of the proposed biofuel infrastructure on the automotive industry/equipment manufacturers?

Only two replies were received, focusing not so much on the impact of the biofuel infrastructure, but on the impact of an actual higher biofuel blend introduction into the market. In this respect, the stakeholders suggest that the introduction of new ethanol blends will be positive to the industry, as it will assist towards the compliance with the emission targets required for 2020 initially (95g/km). A potential introduction of E25 would contribute to the global competitiveness of the EU car industry, as this type of blend has been introduced already to international markets (e.g. Brazil E20/E25, USA E15). Another stakeholder suggests that some car manufacturers will follow the developments in the biofuels market, provided that the national authorities liberalize the market, after regulation has ensured its successful introduction.

Question 10- What would be the impact of the biofuels infrastructure and consequent biofuels vehicles developments on the global competitive position of the EU sector industry?

Three stakeholders replied, seeing a positive impact on the competitiveness of the EU biofuels sector globally. However, the focus of the replies was again not on the biofuels infrastructure, but on the introduction of the higher biofuel blends into the market. In specific, one considers the E25 introduction to increase the production capacity of the industry and improve the global competitiveness of the EU ethanol industry with view to its contribution to a low carbon economy. However, they believe that the EU sector industry will not grow as big as USA's and Brazil's, but it will grow strong domestically. This will potentially make the EU less dependent on the imports from third countries. Another opinion considers the impact of a B30 grade introduced in the fleet markets to be also positive, as it will enable more biodiesel volumes in the diesel pool. This volume will then have to be produced from Rapeseed Oil FAME due to blend constraints, which will in turn create a higher pull on the EU produced products.

Question 11- Do you consider that the introduction of infrastructure for dedicated fleets (buses, taxis, delivery vans) would be enough for the development of a biofuels market?

The majority of the stakeholders reply for the implementation of a higher biofuel blend in dedicated fleets, and not for the aspect of the infrastructure. In this respect, they consider the introduction of a higher biofuel blend for dedicated fleets as a first step for the development

of a market, but not a sufficient one. In order for the EU to sufficiently develop a biofuels market and meet its CO₂ targets, the higher biofuel blend must be introduced uniformly. Only one considers the dedicated fleets as an effective way to introduce high blends of biodiesel into the market due to the shorter lifetime of these vehicles and thus the faster introduction of new compatible vehicles.

Question 12- What would be the impact of the biofuel infrastructure on employment?

Only one reply was received to this question, considering the impact on employment to be negligible.

The case of the Synthetic Fuels (GtL and BtL)¹⁶ as fuel for vehicles

Question 1- Could you inform us of the number of pumps delivering synthetic fuel blends by transport mode in each Member State? Can you quote the realistic expectations for the development of this sector talking account of the current policy framework?

From the 4 replies received, there was no data available on the number of pumps.¹⁷ For BtL one stakeholder informs us that there are 0 pumps, while another mentions the BtL-bioDME¹⁸ field test in Sweden with 4 filling stations, plus tank trailer for distribution and 10 heavy duty trucks in commercial use.

In respect with the expectations, those are not expressed in terms of number of pumps. The developments will depend on taxation according to one stakeholder. GtL according to another can be integrated with diesel vehicles without modifications or additional infrastructure investment is an easy-to-implement and cost-effective alternative to conventional diesel fuel. It can make an impact on reducing emissions, especially in urban high population areas. Thus, the stakeholder expects positive development of this sector. Another stakeholder considers the BTL future difficult to predict. They mention that although wood based feedstock is available in large quantities, investment costs for BTL plants are high. Instead of the fuels above they discuss about the already distributed in large quantities **HVO (Hydrotreated Vegetable Oil)**, a paraffinic diesel fuel with similar properties to GTL and BTL. In Finland, HVO blends are distributed from 2,700 outlets, thus the stakeholder speculates that the total number at the European level has to be at least several thousands. The tax system there promotes the development of the synthetic fuels (HVO, BTL, GTL and CTL¹⁹) because of their lower tailpipe emissions.

Question 2- According to our knowledge, no specific fuel standard infrastructure is requested for the development of synthetic fuels. Do you share this opinion? Do you think some action is needed, if yes which?

The majority of the replies received (5) confirm that for most synthetic fuels (neat or blended) no specific fuel standard infrastructure is needed, which is the main advantage of these fuels

¹⁶ GtL-Gas to Liquid/ BtL-Biomass to Liquid

¹⁷ The Ministry of Economic Affairs, Agriculture and Innovation, NL agency refers us to <http://www.fuelswitch.nl>, where we find out that there is a waste processor in Netherlands that does trial with 3 garbage trucks and 6 cars that drive on neat GtL on the terminals.

¹⁸ Bio-DME (dimethylether). Its production is similar to biomethanol.

¹⁹ CtL-Coal to Liquid

that can facilitate their introduction. These fuels can be easily blended into other fuel specifications (i.e. main fuel Diesel EN590) or delivered neat into the normal diesel distribution system without modifications to the delivery system.

One stakeholder informs us that there are indications that minor engine adjustments could provide with better performance when synthetic fuels are applied neat or in higher blending ratios. Paraffinic blends have been behaving in similar ways to fossil fuels in respect with corrosion, storage stability, microbiological growth, water separation etc. in the logistics chain. Updates that have taken place in some storage tanks and pumping facilities in order to blend HVO into diesel are similar to those that take place in traditional fossil fuel systems.

Question 3- What will be, on the grounds of your experience and sector knowledge, the evolution of the synthetic fuels cost as fuel for vehicles in the next years?

Three replies were received, one of which refers to the synthetic fuel cost. This stakeholder links the evolution of cost to industry developments, competition, taxation and customer acceptance, thus it is difficult for them to speculate. For BtL fuel, another suggests that the fuel infrastructure is very similar to LPG but does not elaborate on costs.

The case of Methane and Liquefied Natural Gas (LNG)

Question 1 Number of pumps delivering natural gas (biomethane or natural gas blended with biomethane distributed through the natural gas grid) by transport mode in each MS? Can you quote the realistic expectations for the development of this sector taking account of the current policy framework?

and

Question 2 Could you inform us of the number of 1) vehicles currently running on natural gas and/or biomethane and 2) number of vessels running with LNG by MS? What is the forecast for development of this kind of vehicles/vessels taking into account the current policies?

We received 5 replies for the first question and 3 for the second. One of the replies referred to all EU Member States and the EFTA countries for road transport by type of vehicle (i.e. LDV, MD and HDV), as of 2010 or 2011, while the rest to the specific Member States which they represent. In respect with the LNG fuelled vessels, there were no numbers reported.

Table 2: NGVs and refuelling Stations in EU by Member States and EFTA countries²⁰

Country	Natural Gas Vehicles							Year	Refuelling stations					LNG or L-CNG stations	Year
	Total NGVs	Total LD+MD+HD*	LD Cars and Commercial vehicles	MD+HD Buses	MD+ HD Trucks	Other vehicles	% of total NGVs in Europe		Total	Public	Private	Under construction	% of total fuelling stations in Europe		
Austria	5,910	5,907	5,768	133	6	3	0.42%	2011	210	171	39	0	5.3%	0	2011
Belgium	241	241	235	0	6	0	0.02%	2011	10	8	2	6	0.3%	0	2011
Bulgaria	61,623	61,616	61,500	105	11	7	4.38%	2010	95	94	1	8	2.4%	0	2010
Czech Republic	3,075	3,011	2,644	326	41	64	0.22%	2011	49	34	15	8	1.2%	0	2011
Denmark	0	0	0	0	0	0	0.00%	2010	1	0	1	0	0.0%	0	2009
Estonia	69	69	60	6	3	0	0.00%	2011	3	2	1	2	0.1%	0	2011
Finland	970	950	850	85	15	20	0.07%	2011	18	17	1	2	0.5%	0	2011
France	13,500	13,500	10,200	2,200	1,100	0	0.96%	2011	300	32	268	0	7.5%	0	2011
Germany	94,890	94,890	92,100	1,590	1,200	0	6.75%	2011	900	720	180	150	22.6%	0	2010
Greece	520	520	0	412	108	0	0.04%	2010	3	0	3	1	0.1%	0	2010
Hungary	87	87	4	83	0	0	0.01%	2010	7	4	3	0	0.2%	0	2011
Iceland	255	255	237	2	16	0	0.02%	2010	2	2	0	2	0.1%	0	2010
Ireland	3	3	3	0	0	0	0.00%	2010	1	1	0	1	0.0%	0	2009
Italy	761,340	761,340	757,840	2,300	1,200	0	54.15%	2011	858	811	47	38	21.5%	1	2011
Latvia	500	227	30	10	187	273	0.04%	2008	1	1	0	0	0.0%	0	2010
Lichtenstein	104	104	72	31	1	0	0.01%	2010	3	3	0	0	0.1%	0	2010
Luxembourg	234	234	199	35	0	0	0.02%	2011	8	6	2	2	0.2%	0	2011
Netherlands	4,300	4,300	3,530	590	180	0	0.31%	2011	150	85	65	40	3.8%	0	2011
Norway	545	520	300	198	22	25	0.04%	2011	10	7	3	1	0.3%	3	2011
Poland	2,082	1,782	1,502	276	4	300	0.15%	2011	47	33	14	0	1.2%	1	2010
Portugal	504	454	46	354	54	50	0.04%	2009	5	1	4	3	0.1%	0	2009
Slovakia	823	823	429	334	60	0	0.06%	2010	11	7	4	3	0.3%	0	2010
Slovenia	8	8	8	0	0	0	0.00%	2011	0	0	0	2	0.0%	0	2011
Spain	3,051	3,007	574	1,405	1,028	44	0.22%	2011	48	4	44	12	1.2%	7	2011
Sweden	36,380	36,380	33,575	1,725	1,080	0	2.59%	2011	166	130	36	0	4.2%	2	2011
Switzerland	9,494	9,434	9,195	173	66	60	0.68%	2010	129	126	3	6	3.2%	0	2010
United Kingdom	220	170	20	0	150	50	0.02%	2010	5	2	3	5	0.1%	9	2010
European NGV countries	1,000,728	999,832	980,921	12,373	6,538	896	71.18%		3,040	2,301	739	292	76.2%	23	

* LD (Light Duty), MD (Medium Duty), HD (Heavy Duty)

Source: NGVA Europe and GRV

According to two stakeholders, worldwide the methane-fuelled vehicles increase at a two digit % rate annually and almost 19000 CNG stations are in operation. About 1 million NGV so far exist in Europe (EU/EFTA) as we see above, with the potential to reach 15-16 million units in 2020. We are informed that in total in the EU/EFTA there are about 3000 CNG refuelling points (for public and private use), of which 2,300 are for public use. Of these, as of 2011, almost 2,000 public refuelling stations are based in **Austria (171), Germany (720)²¹, Italy (811) Sweden (130), Switzerland (126), and Bulgaria (94)**. From the table we observe that most of the NGVs are LDVs and then HDVs. Italy and Germany have the biggest market share in terms of vehicles and stations. According to the stakeholder, in **Germany**, the expectations for the development of this fuel market depend on the taxation. Up to 2017 there is a lower tax for methane as a fuel in Germany. If this level of taxation lasts longer, it is possible that 2500 stations will be created by 2020. The **Netherlands** is also very positive in developing CNG infrastructure, having developed 85 CNG stations for public use in only 3 years. In **Czech Republic** there are 50 CNG pumps at present, 34 of them are public and the rest are privately used by the owning company. In addition there are about 100 “home” filling equipment units. According to the stakeholder, the **expectation** for the development of this

²⁰ NGV=Natural Gas Vehicles and EFTA=European Free Trade Association

²¹ 1200 CNG pumps in total.

sector is 350 pumps in 2020 and an increasing number of buses and garbage trucks in urban areas, based on Voluntary Agreements (expectation of yearly growth of CNG vehicles 20-25%). There are no vessels on LNG reported for Czech Republic.

In **Spain**, there are approximately 45 privately used CNG stations for urban buses and garbage trucks. CNG public stations infrastructure started to develop in 2009 and there are 14 public CNG stations at present. There are 19 stations projected to exist in 2012. Furthermore, there are 6 public L-CNG stations and there are 5 more projected for 2012.²² In addition to the number of vehicles reported in Table2 for Spain, there are 20 trucks reported to operate on LNG (prototypes, pilots or aftermarket conversions). New applications in distribution and logistics services are expected for trucks, vans and taxis, but not in private cars in the near future for the Spanish market.

The expectations

The conclusion of the Expert Group on Future Transport Fuels is that biomethane should preferentially be fed into the natural gas grid. **Injection of biomethane** (after upgrading biogas) into the gas grid is currently done only in 9 European countries: Austria, France, Germany, Netherlands, Norway, Sweden, Switzerland, UK and lately also Italy. One stakeholder expects the potentials of this process (i.e. “greening” the gas grid via biomethane in Europe) to be explored in the future, as they consider it more economical and efficient compared to dedicated compressed biogas.²³ Their suggestion is that methane powered vehicles should be refuelled by the gas grid, to avoid parallel investments in a bio-methane distribution network. However, Sweden is a special case, where there is an elementary natural gas distribution network in the south and thus the production and use of biogas in existing Natural Gas Vehicles (NGVs) is much more important (65% of the total methane used in approximately 36000 NGVs is biogas). Methane is expected to make an important contribution to achieve the CO₂ emissions reductions targets, improve local air quality and reduce noise, if the appropriate infrastructure is put into place. Large fleets of urban buses, taxis and delivery vans are particularly suitable for the introduction of alternative fuels, according to the stakeholder.

In respect to transport, MSs explained through their National Renewable Energy Actions Plans (NREAP) reports that more or less the overall 10% RES target in transport would be reached by means of E10 and B7, along with the measures and reforms that would be taken towards this target.²⁴ According to the same stakeholder however, manufacturers see a lag in the achievement of this target with few alternatives at present (i.e. electricity, biomethane from the natural gas grid). Thus, these alternatives will have to enter the market and there is the opinion that the European NGV market will grow significantly in Europe in the short, medium and long term (2020, 2030 and 2050 respectively) expecting to reach a total market

²² L-CNG (liquefied to compressed natural gas) stations supply Liquefied Natural Gas (LNG) from the cryogenic storage pump by the help of cryogenic pump, which compresses the LNG. In respect of L-CNG there are 23 stations in the EU equipped with this technology, mainly in the UK and Spain, but it is thought by the stakeholder to be emerging fast as an alternative to diesel in MDs and HDs for long distances.

²³ They mention that blending biogas with fossil natural gas allows for a gradual increase of non-fossil fuels without the need to make major investments in infrastructure.

²⁴ http://ec.europa.eu/energy/renewables/transparency_platform/action_plan_en.htm

share of 5%, 9% and 16% - 20% respectively, both in passenger and freight transport for all transport modes.²⁵

In specific, the **LNG fuel in vessels**, according to the reply we received, the number of vessels is small at present but not known, while there are a few under construction or planned mainly in the area of Baltic Sea. The maritime sector has natural gas as the only current “Low Carbon Fuel” to replace Heavy Fuel Oil (HFO) at this point. The **expectations** about the future of the LNG fuel in vessels at the European level will adapt according to the policy measures taken. If the policy measures taken are appropriate, 20-30 new LNG fuelled vessels could be expected per year. This development is important to take place according to the stakeholder, considering the International Maritime Organizations’ (IMO) marine fuel decision and the **EU Marine Fuel Sulphur Directive**, supporting 0,1% sulphur content in ship fuel from January 2015.²⁶ The enforcement of the **ECAS (Emission Control Area for Ships) zones** in several European seas is also “pushing” towards the adoption of LNG fuels. Japan’s transport ministry has already stated its intention to adopt the LNG fuel in maritime and for this reason it indicated on November 1st 2011, that it will develop Safety standards for vessels fuelled with LNG (€ 6.2 million budget planned in 2012 to create safety measures for marine renewable energy). The stakeholder suggests that provided that the policy makers will take the appropriate measures, the LNG maritime and HDV road transport can have potentials to develop synergy. They expect a similar development for the LDVs sector.

Question 3- Could you indicate which should be the minimum, appropriate and optimum coverage of natural gas/biomethane and liquefied natural gas infrastructures to facilitate the development of a market for vehicles and vessels running with natural gas / biomethane and liquefied natural gas?

For natural gas/ biomethane vehicles, please provide this information differentiating urban and non-urban areas. For LNG, please provide this information differentiating non-urban areas, sea ports and inland ports.

There were 4 replies received to this question focusing on the methane refuelling build-up and less on LNG. The most useful information was given by 1 stakeholder and referred to the EU as a whole. The perception of the infrastructure coverage is in accordance with the commercialization stages described in the Infrastructure for Alternative Fuels Report of the European Expert Group on Future Transport Fuels. There are 3 commercialization phases; 2015, 2020 and 2025.

²⁵ A Eurogas Roadmap 2050 suggests that the natural gas market share should increase between 2030 and 2050, reaching 13% and 33% respectively for passenger and freight transport and representing a volume of 33 billion cubic meters (bcm) in 2050.

<http://www.eurogas.org/uploaded/Eurogas%20Roadmap%202050%20-%20summary.pdf>

²⁶ Shipping’s airborne emissions are regulated in ANNEX VI, in MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships). In October 2008, the IMO adopted the more restrictive limit values for sulphur in marine fuels (i.e. 0.1% sulphur content limit by weight on Jan. 2015). In addition, according to the Marine Fuel Sulphur Directive (1999/32/EC, Art.4 with Amendment as per Directive 2005/33/EC) the sulphur content in marine gasoil within the territorial waters of a Member States Member States of the EU (Baltic Sea, North Sea, English Channel) may not exceed 0.1% by weight, applicable to all vessels regardless of flags [http://eur-](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:191:0059:0069:EN:PDF)

[lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:191:0059:0069:EN:PDF](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:191:0059:0069:EN:PDF)

By **2015**, the stakeholder suggests that the existing 2,300 CNG stations should be expanded to 4,000 as a minimum refuelling coverage across Europe. The 23 current C-LNG stations should extend to 200 in pilot regions. Biogas upgrading plants to biomethane and injection points of the last should be increased to 400.

By **2020**, the full commercial phase should initiate to allow for limitless circulation across a pan European CNG (for LDVs) and LNG (for HDVs) network with coverage at least along the highways. At that point, at least 800 upgrading to biogas plants are suggested to be operating with 6 billion m³ biomethane production.

By 2025: commercial phase; there should be sufficient coverage.

The infrastructure needed for LDVs is different than the one needed for **HDVs**. According to one stakeholder the minimum infrastructure coverage for **LDVs** (private passenger cars and commercial fleets using cars and vans) should correspond to the 10% of the availability of the urban filling stations and to the 25% of the stations along the motorways²⁷. This percentage threshold should be linked to the availability of methane stations at least every **150 km** along motorways (or highways). The stakeholder referring to Spain, suggests that since the range of a CNG LDV is around **300-400 km**, the minimum distance between the filling stations in this case should not be less than 150km in the main roads/ motorways. If there are geographical gaps on the way, those are suggested to be covered by home refuelling units (compressor linked to the domestic gas connection), but cost and safety issues are not discussed

For HDVs, 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 **C- LNG** should be possible **every 400km**. The station however, should be able to provide both CNG for LDVs and LNG for HDVs. Infrastructure for buses and trucks is not established across Europe yet. For Spain, the stakeholder suggests that the range of an **LNG HDV** is around **700-900 km** and the minimum distance should be less than **300km** in the motorways.²⁸ In Germany the stakeholder claims that the minimum is reached, while the maximum coverage depends on the number of cars.

Question 4- Which, among the four following criteria, would be the most effective to define the minimum, appropriate and optimum coverage for vehicles?

- (1) density of population in urban and non-urban areas;
- (2) a certain percentage of pumps on the TEN-T comprehensive network;
- (3) maximum distance between pumps;
- (4) pumps to be made available in filling stations above a certain size or annual turnover

The majority of the stakeholders chose option 2) and 3) as the most effective to define the minimum, appropriate and optimum coverage for vehicles. These options are partly justified in Question 3.

Question 5- Do you consider that the introduction of infrastructure for dedicated fleets (buses, taxis, delivery vans) would be enough for the development of a market?

²⁷ Percentage referring to the total number of filling stations.

²⁸ The stakeholder of Czech Republic suggests that the minimum in the case of this country should be 100 pumps and the maximum 400 without giving more details.

There were 4 replies to this question. The majority of the stakeholders think that although the dedicated fleets (buses, taxis, delivery vans and garbage vehicles) could be a first step to the development of this market, it is not a sufficient one. In order for this market to expand and for full commercialization to take place, public fuelling stations should be introduced broadly for the end users.

Question 6- Which, among the two following criteria, would be the most effective to define the minimum, appropriate and optimum coverage for vessels?

- 1) number of vessel docks in sea/inland ports;
- 2) a certain number of pumps against the annual filling station turnover

There were two replies to this question. One indicates option 1) number of vessel docks as the most effective criterion. The other indicates that the above options are not sufficient to define what is a minimum, appropriate and optimum LNG coverage infrastructure for vessels. In the view of the stakeholder, it is the synergy that can be developed between the maritime sector/ ports and vessels and the HD road transport sector that can shape the infrastructure coverage. As an example, it is mentioned that there are some maritime ports in the EU that receive LNG and/or use them for gasification and injection into the gas grid and some others in Spain that offer the possibility to road tankers to refill there directly. The stakeholder suggests that after a point a demand driven network should be developed with a station network that adapts to the growing demand.

Question 7- Could you indicate what fuels standards, fuel equipment infrastructure standards, and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for natural gas/ biomethane and LNG for vehicles and LNG for vessels?

We received three replies to this question. There is already national legislation in place for CNG/LNG refuelling station standards, especially in Spain, Sweden, Germany, but not on the EU level. One stakeholder suggests the development of certification procedures for LDVs and HDVs on CNG and CNG/LNG respectively, at the EU level. Standards should be developed through CEN, in a similar way that ISO does currently for CNG and L-CNG. Currently, there is the biomethane fuel quality standard being developed (standardization work started in 2011) under the M/475 mandate in the CEN/TC 408 “Project Committee Biomethane for use in Transport and injection in natural gas pipelines”.²⁹ Another stakeholder suggests that infrastructure standards should be developed in parking places for refuelling purposes and in conventional stations, so that the fossil fuel pumps are located together with the CNG pumps.

Question 8- What will be, on the grounds of your experience and sector knowledge, the evolution of the natural gas, biomethane cost as fuel for vehicles in the next years?

We received 3 replies to this question. The majority link the evolution of the natural gas/biomethane sector to the evolution of prices and the EU fiscal policy (e.g. through tax incentives), and especially the Energy Taxation Directive (2003/96/EC).³⁰ The current

²⁹ Mandate to CEN for standards for biomethane for use in transport and injection in natural gas pipelines.

³⁰ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32003L0096:en:HTML>

relatively low fuel tax is expected to remain lower than for the traditional fuels for the next 15 years according to the stakeholders. In specific, they expect that the NG prices will be lower than petrol and diesel taking the impact of the non-conventional shale gas in the EU into consideration and the fact that gas resources last longer than oil. As far as biomethane, the stakeholder suggests that the overall cost is 3 times as much as NG, because biomethane does not exist naturally, but it has to be produced from biogas and the injected into the gas grid. The stakeholder is of the opinion that the situation will remain as it is over the next years.

Question 9- What is the investment cost of the relevant infrastructures for natural gas vehicles and LNG for vehicles and vessels for sea and inland ports?

Only one stakeholder had knowledge to this question. According to them:

“CNG filling Station: this type of infrastructure can be fed from the existing natural gas grid. In this case, a compressor with the capacity of reaching a final pressure of 200 bars must be installed, and the dispensers. The **total cost** of this facility would be around € 200.000 - 400.000 depending on the compression capacity of the installation (normally 300÷500 m³/h.)

L-CNG filling Station: this type of infrastructure can supply both liquefied and compressed natural gas and biomethane. It has to be fed with liquefied natural gas via HD transport tankers. This type of LNG transport is already established in some countries like in Spain, where there are more than 40.000 movements of road tankers per year, being used mainly to bring LNG to cities not connected to the grid. It would be necessary to install a stationary LNG tanker to accumulate and feed the installation, a transfer pump to convert LNG into CNG, and the dispensers. The cost of the stationary tanker and the transfer pump is similar to the cost of a compressor. The total cost of this kind of facility would be similar to the investment of a high capacity CNG facility. The maintenance would however be expected to be lower. The cost of a L-CNG stations for trucks, buses, light commercial vehicles and passenger cars: € **700.000** for a station with one LNG and two CNG filling pumps.

Additional costs could be the laying of natural gas pipeline (in case it is not available to connect to the filling station): € **300-600 per meter** depending on land characteristics. Difference between gasoline and CNG version of a LD vehicle: € **1.500-2.500** depending on vehicle size/engine complexity. Similar costs CNG compared with diesel.”

Question 10- What would be the impact of the proposed natural gas/ biomethane/LNG infrastructure on automotive industry/ equipment manufacturers?

The impact suggested by one stakeholder is that OEMs will increase the NGVs availability and customers will consequently accept this market, a fact that will facilitate the market uptake for these fuels (CNG, LNG and biomethane).

Question 11- What would be the impact of the natural gas/biomethane/LNG infrastructure and the consequent development of vehicles running with these fuels on the global competitive position of EU sector industry?

According to the one reply we received, NG/ biomethane is penetrating into the North American market and energy policies are adapting accordingly. It is suggested that some EU actors could benefit out of this development by selling products in that market. The development of adequate infrastructure for natural gas and biomethane is expected to lead to

more NGVs which will increase the competitiveness of this sector in the EU, which now lies behind in relation to the global NGV development, which should be expected to be in terms of number of NGVs about 65 million operating worldwide in 2050 (currently being at 13,5 worldwide , of which 1 million is in Central Europe). The technology of this sector is such , that can contribute to achieving Europe’s target for independence from oil, especially in the transport sector.

Question 12- What would be the impact of the natural gas/biomethane/L infrastructure on employment?

One stakeholder replied, seeing a positive impact in employment in all the related industries (i.e. automotive, gas supply, infrastructure etc).

Additional Questions with specific focus on LNG for vessels

Part of the above replies was about the LNG as a fuel for vessels, the current situation and the expectations for this market. Some additional questions focusing on the existing and potential infrastructure in terms of numbers, costs and policy developments were also distributed, but the replies were few due to the fact that the supply chain for LNG fuel in vessels, except for the case of Norway, is not established yet in the EU.

Question 1- Could you inform us of the number of pumps existing in each Member State in sea ports and inland ports delivering LNG? Can you quote realistic expectations for development in this sector taking account of the current policy framework?

There was no knowledge from the stakeholders in relation to the existing LNG fuel pumps in the various seaports of the MSs, but only in terms of LNG import – export and regasification terminals, in Western Europe.³¹ Infrastructure for LNG fuel provision to vessels is mostly developed in Norway and then Sweden, thus one of the respondents lists a number of studies by Nordic stakeholders for consultation. According to DNV, Norway and Sweden are the only European countries that have small scale LNG production/ LNG storage terminals accessible to vessels. The reason why LNG bunkering to vessels operates only in Norway is because of lack of infrastructure.³² There are currently **14 Norwegian terminals** organized to bunker LNG to vessels, while 5 terminals are already being used as bunkering stations. The storage capacity varies between 20 m³ to 6,500 m³. A majority of the terminal has a storage capacity less than 1,000m³. According to the feasibility study by the Danish Maritime Authority (October 2011)³³, facilities for small scale LNG vessels will also be built in the terminal of Zeebrügge and Rotterdam, in Belgium and the Netherlands respectively, expected to operate in 2014. There are some more small scale terminals planned for Rostock, Gothenburg and Turku (Germany, Sweden and Finland respectively). The expectations for the development of

³¹ http://www.energy.ca.gov/lng/worldwide_western_europe.html

³²“Alternative Fuels: LNG-A short term or a medium term solution?” Det Norske Veritas (DNV), Maritime Stakeholder Event: Clean Air at Sea-promoting solutions for sustainable and competitive shipping, Brussels, June 1, 2011 http://ec.europa.eu/transport/maritime/events/doc/2011_06_01_stakeholder-event/item15.pdf

³³ North European LNG Infrastructure Project: A feasibility study for an LNG filling station infrastructure and test of recommendations (Baseline Report), Danish Maritime Authority http://www.dma.dk/SiteCollectionDocuments/Tema/LNG-tender/Final%20Baseline%20Report_%20LNG%20Infrastructure_MGG_20111020x.pdf

this market according to the policy framework were mentioned in the previous section, Question 2.

Question 2- Could you inform us of the number of vessels currently running with LNG in EU by Member State, differentiating between maritime transport and inland transport? Which are the forecasts for the development of a market of this kind of vessels in next years taking account of the current policies?

Three stakeholders inform us that there is no consolidated data yet for this sector. However, there is available data for Norway. DNV reports 22 LNG fuelled Norwegian vessels in operation and about the same number of LNG fuelled vessels on order. The majority of the existing vessels are car/passenger ferries and RO-RO vessels. The expectations are 500 LNG fuelled ships to be on order by 2015 and more than 1000 in 2020. In general it is expected that ferries are most likely to use LNG bunker, due to their fixed travels. One of the respondents is of the opinion that the LNG infrastructure and refuelling procedure is cumbersome and there have to be high security standards and big capacity for its development, thus they do not think that this market will be developed.

Question 3- Could you indicate which should be the minimum, appropriate and optimum coverage of natural gas/biomethane and liquefied natural gas infrastructures to facilitate the development of a market for vessels running with liquefied natural gas, differentiating between maritime transport and inland transport?

Which, among the two following criteria, would be the most effective to define the minimum, appropriate and optimum coverage for vessels?

- a) number of vessel docks in sea/inland ports;*
- b) a certain number of pumps on basis of the annual filling station turnover*

This question adds to Questions 3 and 6 of the previous section by asking to differentiate between maritime and inland transport. One of the stakeholders chose option a. We remind that the other had not found any of the options sufficient. According to the last, LNG refuelling facilities should be available for vessels and for trucks in all existing LNG terminals in Europe (19 operating and 52 projects). Their suggestion is that transport on inland waterways could take place by refuelling with LNG across all major city ports that exist along European rivers (e.g. Danube, Linz, Vienna). LNG could be transferred to regasification terminals through the Azerbaijan-Georgia-Romania-Interconnection (AGRI) project for LNG transport to the EU.

A third reply suggests a capacity of 500-2000m³ for inland bunkering stations, while for open sea bunkering stations 5,000-20,000m³, referring to barges and vessels that can operate as LNG bunker vessels.

According to the **Danish Maritime Authority feasibility study**, import terminals could also be used for LNG distribution to vessels. Furthermore, LNG can be transported by barges or feeder vessels. The study mentions that there are no orders for **LNG bunker vessels** currently. There is one vessel globally, the Pioneer Knutsen, which could be described as LNG bunkering vessel (LNG feeder delivering LNG to small terminals in the Norwegian coast). The LNG bunker vessels can play an important role in the LNG filling station

infrastructure according to the study, while the lack of these vessels consists an obstacle to the LNG bunkering terminals in North Europe. An **intermediary terminal** could be an option in case the bunkering has to be done at a fast pace and for local consumer (e.g. fishing vessels, tugs). Also the intermediary terminal is suggested in case the distance from the LNG terminal to the end user is longer than 40-100 nautical miles, which is the average distance that a bunker vessel can cover. Another suggestion for regional distribution is that **LNG trucks** transfer LNG between the truck and the terminal for further distribution. This can be done with flexible hoses. The capacities of the truck can vary between 20-80 m³ depending on the size of trucks allowed in a Member States. The bunkering operation can take about 2 hours, while the pumping time is about 1 hour. The capacity of the LNG bunker vessel can range between 1,000-3,000m³.

Question 4- Could you indicate what fuels standards, fuel equipment infrastructures standards, and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for LNG for vessels?

This question was replied by two stakeholders. One reply is the same with the previous section. The second indicates that security standards harmonization is the most important barrier to the development of this market. There are currently several rules and guidelines which are considered relevant, but are not directly applicable (e.g. IMO - IGC Code referring to rules for vessels receiving LNG as a fuel, SIGGTO's guidelines for LNG transfer, OCIMF's Guidelines for Oil Transfer, ship to ship bunkering procedures)³⁴. Furthermore, DNV has proposed an ISO standard on LNG bunkering to be created (i.e. ISO TC67/WG10 - ISO workgroup for the LNG industry) with expression of interest by the biggest European countries, as well as Canada, Brazil and China. In order for the large scale introduction of an LNG fuel market for vessels, international maritime standards for handling the LNG as bunker and not only as a cargo must be developed.

Question 5- What will be, on the grounds of your experience and sector knowledge, the evolution of the natural gas, biomethane cost as fuel for vessels in the next years?

We received 1 reply to this question linking the evolution of the LNG as a fuel to its price in relation to fossil fuels. In this respect, the stakeholder suggests that natural gas will cost less than 50% of the crude oil per mmBtu (million British thermal units) in the next years and its \$ price will be more stable, while oil price will grow faster. They further suggest that, looking forward, the EU gas price must decouple from oil, as is already the case in the USA.³⁵

Question 6- What is the investment cost of the relevant infrastructures for LNG as a fuel to vessels for sea and inland ports?

One stakeholder replied to this question. They suggest that the infrastructure cost for LNG vessel refuelling will be different depending on the infrastructure scheme (i.e. whether the

³⁴ IMO-IGC Code (International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk) SIGTTO (Society of International Gas Tanker and Terminal Operators) OCIMF (Oil Companies International Marine Forum)

³⁵ Coupling gas prices with oil prices means that gas prices are indexed to spot oil prices.

refuelling will take place through feeder vessels or through pumps in the port terminals) as well as the size of the vessel receiving the fuel. Some cost estimations are the following: LNG bunkering from one pump with capacity to refuel local end users (e.g. fishing boats or harbour tugs) could cost € 1,000,000. For small short-sea shipping boats (e.g. ferries), as mentioned above, LNG trucks could be used on the land side or barges on the sea side, able to attach to the docked vessel. For bigger ferry boats, LNG bunkering feeders would be needed. However, the stakeholder could not provide us with an estimated cost for the last two infrastructure schemes.

According to the stakeholder, in contrast with the one on Question 5, the LNG price is characterized by uncertainty (€ 700/ton), there is a high retrofitting cost, high engine cost and support to the appropriate investments will be necessary.

Question 7- What would be the impact of the proposed LNG infrastructure on naval industry/ equipment manufacturers?

According to the two replies received, the traditional industry will be affected positively by its entrance in the LNG fuel market, as the environmental standards that lead towards this fuel choice are of international nature.

Question 8- What would be the impact of the LNG infrastructure and the consequent development of vessels running with these fuels on the global competitive position of EU sector industry?

We received two replies. One indicates that the impact will be insignificant. According to the other Europe can grow competitive in LNG technology and, refuelling systems and regulation if more initiatives are taken to establish such facilities.

Question 9- What would be the impact of the LNG infrastructure on employment?

Two stakeholders replied with contrasting opinions, one seeing a positive impact and the other an insignificant impact on employment, without elaborating further on the replies.

The case of Hydrogen and Fuel Cells

Question 1- Could you inform us of the number of hydrogen pumps delivering Hydrogen by MS? Can you quote the realistic expectations for development taking account of the current policy framework and technological development?

Five stakeholders replied to this question. The following table summarizes the data given (no available data for all Member States and EFTA countries).

Table 3: Hydrogen pumps in EU and EFTA countries by Member States (in operation and planned)

Countries	Number of Pumps in operation	Number of Pumps planned
Austria	2	N/A
Belgium	N/A	1
Czech Republic	1	N/A
Switzerland	1	2
Germany ³⁶	29	13
Denmark	13	1
Spain	3	1
Finland	N/A	2
France	5	N/A
Great Britain	9	10
Greece	2	N/A
Iceland	2	N/A
Italy	5	16
Netherlands	2	2
Norway	5	5
Sweden	1	3

There are different expectations among the stakeholders for the development of this market. The majority thinks that the development will be slow, starting earliest in 2015 with slow increase until 2025. According to one reply, there is already a 10 years delay compared to the Battery Electric Vehicles (BEV) and Plug-in Hybrid Electric Vehicles (PHEV) market development. One of the stakeholders is of the opinion that the current state of hydrogen technology has progressed and describes the expectations according to the Infrastructure for Alternative Fuels Report of the European Expert Group on Future Transport Fuels. According to the last, there should be 3 commercialization stages in order for a European hydrogen refuelling network to be established; the **pre-commercial phase by 2015** is expected to count 200 to 300 refuelling units in various urban regions across Europe for passenger and light duty mobility locally (5000 Fuel Cell Electric Vehicle -FCEV passenger cars, 500 Fuel Cell-FC buses); the **early commercial phase by 2020**, where market penetration can be achieved by linking existing pre-commercial hydrogen infrastructure networks to build up a European

³⁶ Replies by two different stakeholders give a different range for the existing pumps, i.e. 6-10.

network connecting strategic corridors. Up to 2000 (minimum 1000) fuelling stations, 500000 FCEV passenger cars, 1000 FC busses; the **commercial phase by 2025**, where sufficient coverage should be achieved. The European hydrogen network would be effectively established if the regulatory barriers at EU and national level were removed. Measures at the European and national level are harmonised. Many of the first hydrogen refuelling stations have been co-financed by regional and local authorities operating or financing bus fleets or cars that are part of public fleets. According to one of the stakeholders, the first experiences with operating these stations have demonstrated the need for more detailed insight in future vehicle availability in order to start developing necessary investment programs that allow intelligent refuelling stations build-up in strategic areas in Europe.

Question 2- Could you indicate the number of vehicles by Member States currently running with hydrogen and fuel cells? What are the forecasts for the development of a market for this kind of vehicles in the next years taking account of the current policies?

Five stakeholders replied to the second part of the question, while one answered for the first part for some Member States. **Germany** is reported to have approximately 135 FCEVs (by the end of 2012) within the Clean Energy Partnership (CEP). **Scandinavia** currently has approximately 30 FCEVs. In **Great Britain** there are 5 FC buses operating in London and 3 more are expected to be added in 2012; 2 taxis (black cabs) and 5 more expected in 2012. Additionally to the already existing buses in the EU, 20 FC buses are expected in 2012. The expectations according to a FCH technology Roadmap³⁷ (thought to be very ambitious by one stakeholder) provided the appropriate policy framework is in place are: 5,000 FC cars and 500 FC buses in Europe by 2015. By 2020 500,000 FC cars and 1000 FC buses are expected to be in service in Europe according to this roadmap, while another stakeholder gives 200,000 FC vehicles estimation for the same period. By 2025: full commercial phase. The stakeholder suggests that the development in this market through the necessary funding schemes will be affected by the degree of certainty of the hydrogen price and the total cost of ownership.

Question 3- Could you indicate which should be the minimum, appropriate and optimum coverage of hydrogen infrastructures in order to produce a market development of vehicles running on hydrogen and fuel cells in EU? Could you provide this information differentiating urban and non-urban areas?

Which, among the four following criteria, would be the most effective to define the minimum, appropriate and optimum coverage? a) density of population in urban and non-urban areas; b) a certain percentage of pumps on the TEN-T comprehensive network; c) maximum distance between refuelling stations ; d) pumps to be made available in filling stations above a certain size or annual turnover

Four stakeholders replied to the second part, the majority considering option a) and c) the most effective to define minimum, appropriate and optimum coverage. The first part was replied by three. According to one, the minimum, appropriate and optimum coverage level

³⁷ This Roadmap has been developed by the FCH Joint Undertaking Industry Group, in close coordination with the Joint Research Centre and the FCH-JU Programme Office and according to the approach followed in the Commission Staff Working Document 'A technology Roadmap for the communication on investing in the development of low carbon technologies' (SEC(2009)1295).

will depend on the number of FCEVS available at specific locations in Europe and the type of first customers of FCEVS (private or public use). Regional and local authorities have been so far co-financing for the build-up of hydrogen refuelling stations. The continuation of coverage by these authorities will be closely dependent to the available low carbon primary energy sources. **FCH buses** and then **captive fleets** are thought by one stakeholder to facilitate the build-up of an efficient and sustainable hydrogen production and distribution system as buses consume larger quantities of hydrogen. In the **short term** existing hydrogen “hot spots” that include FCH bus operations and FCEV in captive fleets in densely populated urban areas, should be reinforced to allow deployment of larger numbers of these vehicles. The same stakeholder mentions that a large scale integration of hydrogen refuelling stations connecting the hot spots along the key corridors (and further of FCEV fleet) could be achieved by the existing EU funded programs like the TEN-T Network for Transport **TEN-T**.³⁸ Another stakeholder continues that in **the long term** the optimum coverage would be having the same hydrogen refuelling stations number as the existing conventional ones. The appropriate coverage would be 50% of the conventional fuelling stations and the minimum coverage would be a sufficient geographical coverage for refuelling between major European metropolitan areas. They then refer to the three policy sub-options for minimum, appropriate and optimum coverage recommended by the Expert Group on Future Transport Fuels for the Infrastructure of Alternative Fuels. Another reply suggests that the minimum coverage in urban areas should be **1 station per 5 km, in suburban 1 station per 25 km and on highways 1 station every 30-50 km.**

Question 4- Could you indicate what fuels standards, fuel equipment infrastructure standards, and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for hydrogen and fuel cells vehicles in EU?

Three replies were received. Hydrogen refuelling already has international standards with standardization at ISO and SAE level (**SAE J2601 and J2799**) in terms of hydrogen refuelling interface, fuel quality and refuelling station safety.³⁹ The **Regulation (EC) No 79/2009** on type-approval of hydrogen-powered motor vehicles and further Commission Regulation (EU) No **406/2010** on Implementing Regulation (EC) No79/2009 allows car manufacturers to apply for the EC whole-vehicle type-approval of hydrogen-powered vehicles on a voluntary basis.⁴⁰ The regulation also provides for harmonised rules on hydrogen tanks, including for liquid hydrogen, in all Member States to ensure that hydrogen refuelling can be done across the EU in a safe and reliable manner. While the EU Regulation for the homologation of hydrogen powered road vehicles is considered an excellent tool by the stakeholder in order to harmonize standards, they suggest that more should be done at the local level through educational programs including updating hydrogen safety information. In addition, on the industry side, the H2 Mobility commercialization initiative has put forward a

³⁸ A list of the TEN-T priority axes and projects can be found here:

http://ec.europa.eu/transport/infrastructure/maps/doc/ten-t_pp_axes_projects_2005.pdf

³⁹ http://standards.sae.org/j2601_201003

http://standards.sae.org/j2799_200705

⁴⁰ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009R0079:en:NOT> <http://eur-lex.europa.eu/Notice.do?mode=dbl&lang=en&ihtmlang=en&lmg1=en,el&lmg2=bg,cs,da,de,el,en,es,et,fi,fr,hu,it,lt,lv,mt,nl,pl,pt,ro,sk,sl,sv.&val=515898:cs&page=>

proposal to standardize hydrogen refuelling stations. It suggests three different sizes serving minimum demand patterns of 50, 100 and 250 refuelling per day and one additional smaller size of 25 refuelling per day to bridge for the market preparation phase. These standardized concepts are currently being tested in public.

Question 5- What is the investment cost for an initial hydrogen refuelling infrastructure?

Four stakeholders replied. Three replies converged on the size of cost and two of them were in accordance with the costs estimated in the Infrastructure for Alternative Fuels Report of the Expert Group on Future Transport Fuels.

Between 2014 and 2020 a total estimated amount of € 1,731 million per station is needed to build up the initial infrastructure. The costs per filling station will gradually be reduced from 1,6 € million to €

0,6 million per refilling station, depending on the size and volume. In specific, for the 1st phase by 2015 the estimated cost is **€ 0,6-2,5 million per filling station** and for the 2nd by 2020 **€ 0.6-1.6 per filling station**. The first 200 to 300 refilling units are likely to be added to existing refuelling stations. After 2015 phase, when the commercialization will scale up more stations will be needed.

The infrastructure cost estimation of one stakeholder was far out of the ranges mentioned above; € 2-3 million per filling station.

Question 6- Who should bear the cost of the relevant infrastructures (industry, governments, user, etc.)?

Four stakeholders replied. According to them, the first mover has a utilization disadvantage of the first filling stations, as utilization will not be high enough to make up for the investment cost. Thus, especially in the 1st early commercialization phase by 2015 policy measures must be taken to overcome this and projects should be co-funded. Potential funding in the new Connecting Europe Facility and EU Structural Funds should be explored to use potential funding and financing opportunities as efficiently as possible. It is estimated that in the first phase of demonstration-pilots, a public funding level (EU and Member States level) of about 50% is needed.

During the 2nd phase appropriate mechanisms should be developed to attract private investments (e.g. leverage-systems, reimbursable grants, project-bonds), since the early move risks and learning costs are reduced.

During the transition-phase, public support is needed to realize the technological shift. When moving closer to the commercial phase, risks should be borne by industry, (the whole value chain) needs to bear 75-90% of the cost of refuelling infrastructure during the transition phase.

Question 7- What would be the impact of the proposed hydrogen infrastructure on automotive Industry/ equipment manufacturers?

Four replies were received. The majority thinks that the impact in investment will be positive. The automotive industry suppliers and the equipment suppliers would invest to expand their

production capacity, but in the beginning and up to 2020 the infrastructure/vehicle fleet build-up, OEMs and suppliers will not be able to make a positive business case but invest in the technology. The positive impact of the investment in terms of pay off and profit will take place later. However, it is suggested that manufacturers of hydrogen filling equipment can already see the positive impact in the early phase of infrastructure build-up. One stakeholder is of the opinion that the longer term impact on competitiveness of this industry depends on the technological competitions between PHEV with biofuels and FCVs in the long distance passenger cars sector.

Question 8- What would be the impact of the hydrogen infrastructure and the consequent development of vehicles running with these fuels on the global competitive position of the EU sector industry?

Four replies were received. The stakeholders believe that the successful implementation of infrastructure/commercialization phase will establish a new sector with big competitive advantage for the EU, as it will attract other investors, like foreign companies that could reinforce developments especially at a regional and local level. A new refuelling network for a new energy carrier for transport could have a direct positive economic impact on these regions. Also, considering that there are European multinationals that lead the market in the hydrogen production and distribution, global opportunities could emerge.

Question 9- What would be the impact of the hydrogen infrastructure on employment?

Three stakeholders replied to this question seeing a positive impact of the hydrogen infrastructure on employment. Impacts on employment can be expected to take place along the supply chain of the FC vehicles (production, storage, distribution, infrastructure and maintenance). The creation of additional employment is more likely to take place in the 1st phase, while in the 2nd phase it is suggested that substitution in employment will take place. These jobs will be highly technological and will strengthen the competitiveness of Europe. One stakeholder suggests that there will be spill-over effects from the use of fuel technology to other applications (backup power, de-central heat & power generation, consumer electronics, shipping), effects that will become apparent over the coming years. An analysis by Ronald Berger Management Consultants (June 2011) showed that about 20,000 additional jobs could be created in Germany by 2020 from hydrogen fuel cell development.

The case of Electromobility

Question 1- Could you indicate the number of charging points (differentiating between public parking places and other sites) by Member State and the number to be expected by 2015 and 2020? Can you quote the realistic expectations for development taking account of the current policy framework?

Can you quote the realistic expectations for development taking account of the current policy framework?

Could you indicate the current number of electric vehicles (EVs) by Member State?

Ten stakeholders informed us on the first part of the question, i.e. the number of charging points in Member States and the number expected by 2015 and 2020. Data for the number of

EVs by Member States was provided by 8 stakeholders. We note that the respondents, apart from a few Member States, did not always identify between public parking places and other sites (see table below).

Table 4: Number of charging stations, points and EVs by MS

Countries	Number of Public and Private Charging Stations end 2010 ⁴¹	Number of Charging Points by Nov 2011	Number of Electric vehicles by 2011
Netherlands	400	1935-2300 ⁴²	946 ⁴³
Germany	875	≈2000	≈2500
United Kingdom	400	800 ⁴⁴	≈1000 ⁴⁵
France	178 ⁴⁶	N/A	≈1000
Belgium	N/A	N/A	300-350
Sweden	N/A	N/A	200
Denmark	45	55	N/A
Norway	2666	3070 ⁴⁷	≈5000
Finland	50	77	N/A
Austria	532	N/A	700
Ireland	N/A	N/A	N/A
Portugal	N/A	1350	500-750
Spain*	1874	3168 ⁴⁸	1600
Italy	670	N/A	N/A
Greece	N/A	N/A	48
Switzerland	N/A	N/A	1110 ⁴⁹
Czech Republic	N/A	N/A	300
Slovakia*	4	N/A	N/A
Others ⁵⁰	N/A	N/A	N/A
Total of the available data	7516	4650	2548

*Numbers as of 2011 in both columns

The expectations in terms of number of charging points and EVs

We received 11 replies to this question mostly for specific Member States, but also for the EU as a whole.

⁴¹ Charging points are more than charging locations/stations.

⁴² 1089 of which are public, 424 semi-public, 412 private.

⁴³ Only cars. There are also 143 electric vans. 706 of this number are said to be battery powered vehicles.

⁴⁴ Considered to be public.

⁴⁵ Considered to be public.

⁴⁶ Around Paris.

⁴⁷ Of which 90% is public. 20 of them are for speed charging, while the rest are for slow charging.

⁴⁸ The majority are slow charging points.

⁴⁹ Also 20,000 hybrids and 100,000 e-bikes.

⁵⁰ Croatia, Estonia, Finland, Hungary, Luxemburg, Serbia, Slovakia, Slovenia, Romania.

For the EU as a whole, some stakeholders suggest that until 2015, which is the pre-commercialization phase the market for electric transport and smart networks will be unstable, however viable. From 2017 onwards there is going to be a bigger public acceptance and commercial basis for the infrastructure. However, another thinks that the cost of the electricity solution will keep it as a secondary fuel option.

Netherlands: If the current policy framework does not change one stakeholder expects that there will be approximately 10,000 public charging points by 2015 and 30,000 up to 2020.

Czech Republic: Although we were not given an exact number for the present infrastructure, the stakeholder informs us that the aim is to have 400 charging stations installed by 2013, with expectations for it to increase beyond 2013, after the evaluation of their current E-mobility pilot project.

Germany: According to one stakeholder, Germany aims at 1,000,000 EVs by 2020. The National Platform on Electromobility has provided a number of charging points expected for 2014, 2017 and 2020 phases. Total wall-boxes expected by 2020 is about 1,000,000. The stakeholder thinks that there is no business case when it comes to public AC charging infrastructure. In terms of EVs it expects 100,000 EVs by 2014, 500,000 by 2017 and 1,000,000 by 2020. However, compared to the EVs that seem to be currently in the market, the expected numbers present a big deviation from the actual data. The table below provided by one of the stakeholders indicates the expectations for the development of the infrastructure in this market.

Table 5: Number of charging points expected in Germany -2020

Germany

	2014	2017	2020
Walbox/ private/ at home	62370	285 638	531 300
Parking Lot of business industry	35890	117707	171 700
public and public accessible (sum)	19250	107 823	227 350
public near housings	6738	55 852	150 051
public at central places in cities	1733	2588	2274
public accessible, but on private property and with private investments	10780	49383	75026
Fast Charging DC	679	3 182	7170
total	118 189	541 350	937 5020

Sweden:

The stakeholder suggests that about 600,000 car heating outlets can be retrofitted into simple slow charging stations, most of them in the Northern part of Sweden. Most private garages (number unknown) have an electric “outdoor safe” outlet. About 1000 charging stations are

estimated to be built in the next year, with some cities excepted due to lack of public acceptance. Provided that a regulatory approach to the market will enable market players to enter this infrastructure market and consequently development of EVs, by 2015, **2,000-5,000 public charging stations** are expected to be put in place (this is not a national target, but an expectation). There are no estimates of target available for 2020.

Norway: The stakeholder indicates that 10,000 more public charging points of slow charging capacity are expected until 2020 to be financed by the authorities. Also a big number (not exact given) of private funded charging points is expected. In the end of 2012, 70 speed charging points are expected, of which half will be funded the government. From 2013, this number might increase by 20-30 speed chargers annually. In terms of EVs, about 7,000 are expected by 2015 and **25,000 by 2020**.

United Kingdom: Currently there are about 1,000 public EV charging points in the UK, while there are approximately 3,000 EVs, of which 1,000 EVs sold in 2011 under the government incentive. The expectations are that public charging stations will increase to **15,000 by 2015**. Depending on how successfully the EV market uptake will be, the view for 2020 would need to be 80,000 charging stations.

Switzerland: The stakeholder suggests that **720,000 EVs will be operating by 2020** in Switzerland. In terms of infrastructure, there are about 600,000 private charge and sleep points expected by 2020; 60,000 points at the workplace; and 30,000 public charging points.

Spain: For Spain, the expectations according to the respondent are **10,500 slow charging points by 2014** and 90 fast charging. In terms of number of EVs, 250,000 vehicles are expected by 2014 and 2,500,000 by 2020.

Slovakia: According to the stakeholder, in Slovakia currently electric vehicles can recharge in four places. By the **end of 2012**, the capital city would like to build **10 more stations**. The country sees a positive development of this market and for this reason it participates in cross-border projects for electromobility.

Question 2- Could you indicate which should be the minimum, appropriate and optimum coverage of electric charging infrastructure in urban areas to produce a market development of electric vehicles in the EU?

There were no direct answers as to what should be the minimum, appropriate and optimum coverage. The replies (about 4) for infrastructure coverage focused mostly on the second part distinguishing between slow and fast charging and overnight loading facilities, as well as public and private charging stations. A few were of the opinion that the minimum and optimum number of charging points depends on national circumstances, while another indicated that infrastructure is not the only criterion to determine a market development of the electric vehicles market in the EU. Cities and municipal authorities are thought to play a major role in the urban and spatial planning of the infrastructure, while more consumer studies are needed. Some studies according to a stakeholder, point towards the home based recharging infrastructure as the preferred charging location. The next preferable would be to be able to charge at the destination (e.g. the workplace), while the least preferred would be charging along the route. Another view is that 80% of the EVs owners charge at home (private charging points) and the remaining 20% should split the recharging between office

and public charging points. However, none of the above explains whether this type of coverage pertains to appropriate or optimum.

2a. Which type of charging will be required (slow/fast) in different locations (public spaces, restricted areas, fully private places) and in which coverage?

About 9 stakeholders replied to the above questions.

The majority suggests that **private** (home charging) with the use of domestic sockets should be slow (1phase 3.3 kW as option up to 3phase AC 22 kW). Although the infrastructure at home is not designed for the purpose of charging EVs, since the infrastructure is already there, this will make the initial market uptake and later penetration easier according to one stakeholder. To this, they add the recommendation of charging at low electricity demand hours for optimum use of RES (smart grid solution). Charging at **restricted areas** should be slow and fast and in **public spaces** slow and fast (3phase AC 22 kW + DC 60 kW -up to 90 kW long term)⁵¹. Public locations have different characteristics, and additional infrastructure will be required for safety issues. In any case, interoperability among the infrastructure of the different locations must be ensured.

One stakeholder suggests that the coverage should be one station per 5km in the urban area, 1 per 25km in the suburban and 1 with several outlets every 30-50km. For local traffic, slow charging facilities are sufficient; while for non-urban fast loading facilities will be preferred. Norway's example suggests that slow charging is the basic/minimum service to provide EVs users. In the short run they negotiate for slow charging at the 6% of all private places with the goal of full coverage in 10-20 years. The goal is to equip all parking places with a charging facility for BEVs and PHEVs. Fast charging should be developed publicly in order to cover main corridors with 60-70km distance between the charging stations, increasing the points at each station with the increase of the use.

2b. Which, among the following criteria, would be the most effective to define the minimum, appropriate and optimum coverage? a) density of population in urban; b) a certain number of charging points on the basis of the annual vehicles registrations?

We counted 8 responses to this question. The majority chose option b) number of charging points on the basis of the annual vehicles registrations as the most effective to define the minimum, appropriate and optimum coverage. However, there were a few replies indicating that none of the above options are appropriate for effectively defining coverage. The reasons explained are 1) that in the early phase the minimum number of charging points is independent of the number of vehicles and population (and the density of the population is dependent on local situations, thus not a good indicator) 2) that national authorities are appropriate to make the infrastructure planning, according for example to new housing. 3) in the centre of big cities people will increasingly be moving with public transport or car sharing; the biggest demand for public or semi-public charging is suggested by 1 stakeholder to be coming from the suburbs, therefore, the necessity for charging infrastructure is not linearly dependent on the population density. Lastly, the number of charging points on the

⁵¹ A suggestion by one of the respondents is that 1% of the public charging points should be fast.

basis of annual vehicles registrations usually lags behind in time. Thus, a one to one ratio (EV-charging point) would be optimum according to two responses.

2c. Do you consider that the introduction of infrastructure for dedicated fleets (buses, taxis, delivery vans) would be enough for the development of a market?

Eight stakeholders replied. The majority consider the infrastructure for dedicated/captive fleets not to be enough for the development of a EVs market, and that a network for private EVs has to be developed, since about half the EVs sales are for private users. The creation of infrastructure in public areas and local incentives could attract consumers and help the development of the market. Another opinion is that infrastructure is not the only determinant of the market development, but also consumer's awareness.

Question 3- Could you indicate what equipment infrastructure standards and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for electric vehicles in EU?

Eight stakeholders replied on the standards but also on hardware and software requirements that need to be harmonised, highlighting the need for interoperability in the charging infrastructure across the EU Member States. Below, there is an indicative list with different suggestions that the stakeholders make in relation to harmonization:

- Use of alternate and direct current charging under the “modes” that the international community has already defined;⁵² use of charging mode 1 for small vehicles; mode 2 not recommended to be used in public infrastructure points, except for dedicated locations designed to be used by small vehicles (L1 and L7 category)⁵³; home and public AC charging of EVs of M and N category (passenger and commercial vehicles) should be done by using Mode 3 most preferably.
- Define connectors and charging capacity (AC/DC). For example, uniformity in plug (e.g. Type 2). The Type 2 is a 200-240 V, 10 A plug that is compatible with all relevant power levels worldwide (i.e. from single-phase domestic AC voltage to powerful 63A 3-phase connections, and it is prepared to operate in future DC charging stations up to 30KW).⁵⁴
- Inductive and conductive charging systems (e.g. a standard 8A charging device)
- Elimination of transport barriers for growing numbers of batteries due to safety requirements.

⁵² Mode 1: “Charging an electric vehicle from a domestic or an industrial socket-outlet without additional specific protective devices is defined as “mode 1”. Connecting an electric vehicle to a household socket outlet using mode 1 is the same as connecting any electric device using a plug and socket outlet. Mode 2: “Implies the use of additional protection mechanisms in the charging cord, thus overcoming the safety risk of using old installations without Residual Current Device”.

Mode 3: “Concerns a dedicated charging station for AC. These charging stations or devices offer all protective measures itself and may be used for the public infrastructure but also in business or even domestic environments.” Focus Group on European Electro-Mobility Standardization for road vehicles and associated infrastructure, Final Report to CEN and CENELEC Technical Boards in response to Commission Mandate M/468 concerning the charging of electric vehicles.

⁵³ Motor Cycles and certain three wheel vehicles (Revenue Category M)

⁵⁴ National Platform for Electromobility, Germany

http://www.elektromobilitaet.din.de/sixcms_upload/media/3310/Flyer_Ladestecker_DINlang_ZZ-Falz_EN_3mm.pdf

- Safety Standards harmonization (e.g. IPXXD protection in IEC 61851-1 standard which specifies electric vehicle conductive equipment).⁵⁵ This standard is required by most European countries. Safety legislation is the result of European and national requirements and national electric safety authorities could substantially take part in the standardization process

Question 4- What is the investment cost for electric charging infrastructure?

Five stakeholders replied distinguishing between the cost for public and private charging stations/ slow and fast charging. The following estimations are provided:

Private/home slow charging may vary from € 250-2,000 per station, including installation, depending on whether the installation is indoors or outdoors.

Public slow charging stations may vary from € 3,000-7,000 per station depending on the type of socket, including installation and auxiliary equipment.

Public Fast Charging stations (for DC charging units) cost may vary from € 13,000-50,000 per station (installation cost may vary from € 3,500-6,000). There is not information yet on AC fast charging cost.

In **Norway**, establishing charging stations on the street has an average cost of about € 2,500-3,000, while it is cheaper in garages. The charging equipment varies between € 1,000-4,000 for each slow charging point. Fast/speed charging stations have an average cost of € 40,000-60,000. In **Sweden**, a slow charging station indoors costs € 100-200 for simple sockets 16A/230V, while if the charging station has some sort of intelligence it can cost € 500-600. Outdoors slow charging 16A sockets cost € 1,000-2,000 or more depending on the preparatory work that needs to be done. Semi-fast (16A to 32A 3 phase sockets) € 2,000-10,000. Fast DC >50kW charging varies in Sweden today between € 20,000-70,000. The cost in the UK and Germany ranges at approximately the same levels. For **Germany**, we get the following costs: 2 Plug Station (2x max. 22kW AC, Smart Charging compatible) ≈ € 5.300; 2 Plug Station (2x max. 11kW AC) ≈ € 2.500; 1 Plug Box (1x max. 22kW AC, Smart Charging compatible) ≈ € 1.900; 1 Plug Box (1x max. 11kW AC) ≈ € 500; DC Fast Charging Station ≈ € 40.000. Connection Costs: AC Range: € 1.850 - 5.200 and DC Range: € 4.000 - 13.300.

Question 5- Who should bear the cost of the relevant infrastructures (industry, governments, users...)?

Eight stakeholders replied, the majority of which 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 EVs 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). In Norway, the investment costs have been covered by local and governmental authorities by 50-100% and the rest by building owners or landlords. One of the stakeholders suggests a market-based approach as the first option. In the beginning the market should operate under

⁵⁵ Standard IEC/EN 61851-1 requires IPXXD protection (entry test of wire with 1-mm diameter) in order to avoid accidental contact for connected and unconnected plugs in case there is a 2 way Energy transfer. This is an important requirement for non-trained users of these connectors that might accidentally come in contact with live parts.

the “user pays” principle. Like this, the users/market should bear the cost in the beginning. If this approach is not successful towards the recovery of the cost, then the last can be somehow socialized.

Question 6- What would be the impact of the proposed electric charging infrastructure on automotive industry/equipment manufacturers?

Seven stakeholders replied. Their view is a positive impact to the competitiveness of the EU automotive industry and creation of additional jobs for equipment manufacturers, considering that there is sufficient infrastructure. Lack of infrastructure and reliable framework conditions will not allow sales of charging devices and a sustainable growth of EVs. However, the higher cost to the end consumer from the use of an EV compared to an ICE consists the major barrier according to a stakeholder. In the Netherlands, the expected positive impact of developing an EVs infrastructure has been estimated to rise to 1,500 (immediate) jobs in 2020 manufacturing components, systems and vehicles, and may even increase to 7,800 jobs. Because of foreign investors attracted and the construction and running of charging points, structural employment could even grow to approximately 13,000 jobs, although these estimates have not taken a possible effect of depression into consideration, but this is expected to be small due to the growth of the total automotive market (also reply to question 8). In the case of Netherlands, the market volume for electric components is estimated to be somewhere between € 10 and 25 billion. Dutch market share for the manufacture of vehicles and components is between 1% and 3%, which the stakeholder informs us, according to Roland Berger, will be the equivalent of € 0.5 – 3.6 billion annually in 2020, while HTAS assumes approximately € 3.5 billion turnover in 2020.

Question 7- What would be the impact of the electric charging infrastructure and the consequent development of electric vehicles on the global competitive position of EU sector industry?

Five stakeholders replied positively in terms of the global competitiveness of the EU in this sector industry should the appropriate infrastructure be put in place. The charging infrastructure will attract more R&D in this field and investors. Eventually it will strengthen the economic and environmental charging infrastructure position of the EU.

Question 8- What would be the impact of the electric charging infrastructure on employment?

Nine stakeholders replied. Most expect a positive impact on employment along the supply chain. The EVs infrastructure successful implementation is expected to generate investment and create jobs. One expects that the additional jobs will be created in the 1st phase. (See also question 6 for the impact of employment in the Netherlands). However, there are those that think that the direct impact on employment from infrastructure will be limited (2 stakeholders), however there will be an indirect positive impact on services and supervising functions. According to one of them, there has been an attempt to determine gross economic effects of electromobility industry. The main effects for infrastructure are an increase in building and services sectors activity, value added services and traffic management, which are not entirely dependent on e-Vehicles.

The case of Liquefied Petroleum Gas (LPG)

Question 1- Could you inform us of the number of pumps delivering GPL by transport mode in each MS? Can you quote realistic expectations for the development of this sector in those countries where the relevant infrastructures are not/hardly available, taking account of the current policy framework?

We received information from 3 stakeholders, two of which replied for specific Member States (i.e. Germany and Spain). One of them provides us with the following table for the whole Europe.

Table 6: LPG Refuelling Stations and number of vehicles in Europe as of 2009 and 2010

Country	Consumption (Thousand tonnes)		Number of vehicles		Number of dispensing sites	
	2009	2010	2009	2010	2009	2010
Austria	15	16	1,000	3,000	15	20
Belgium	63	62	50,000	50,000	640	640
Bulgaria	331	337	222,000	220,000	3,000	3,000
Croatia	78	72	80,000	80,000	257	257
Cyprus	-	-	-	-	-	-
Czech Republic	77	76	208,300	170,000	800	850
Denmark	4	1	250	250	8	8
Estonia	1	1	<1000	<1000	-	-
Finland	-	-	-	-	-	-
France	108	115	120,000	180,000	1,826	1,792
Germany	423	480	380,000	430,000	5,500	6,000
Greece	9	18	2,200	2,200	42	65
Hungary	25	24	62,000	67,000	500	500
Republic of Ireland	1	1	575	500	49	38
Italy	1,099	1,227	1,500,000	1,700,000	2,592	2,773
Latvia	21	21	17,500	12,300	85	142
Lithuania	166	165	215,500	217,000	840	840
Malta	-	-	-	-	-	-
Netherlands	339	336	235,000	260,000	1,900	1,900
Norway	3	3	2,600	2,650	140	140
Poland	1,705	1,660	2,170,000	2,325,000	6,050	5,900
Portugal	27	26	40,000	40,000	220	222
Romania	169	153	185,000	190,000	1,200	1,200
Serbia	247	249	550,000	550,000	500	500
Slovakia	-	-	-	-	-	-
Slovenia	4	4	3,300	2,900	29	29
Spain	17	20	2,800	5,000	45	47
Sweden	1	1	400	350	10	20
Switzerland	5	5	3,000	3,100	20	20
Turkey	2,305	2,490	2,320,000	2,390,000	7,700	8,700
United Kingdom	107	99	148,900	149,500	1,400	1,400
Total	7,350	7,663	8,520,325	9,050,750	35,368	37,003

Source: European LPG Sector Overview 2011

According to the stakeholder, in some countries the distribution network is not sufficient. Leading countries in the LPG market are: Italy, Poland, Netherlands, Germany; mature countries: France, Belgium, UK; and the rest are emerging. This creates an impediment to the development of the LPG market in general in Europe, as car manufacturers expect a pan-European market to justify investment cost in R&D and homologation.⁵⁶ However, the expectations for this market, although difficult to project, are positive in terms of increasing the dispensers in emerging (in this market) countries (e.g. Spain, Greece). In Spain, incentives have already been given in the form of grants to LPG distributors in order to develop

⁵⁶ Homologation refers to the certification/ specification of products to indicate that they meet certain regulatory requirements.

dispensers. According to the German stakeholder, the expectations will depend on taxation beyond 2017.

Question 2- Could you inform us on the number of vehicles currently running on GPL per MS? What are the forecast for the development of a market of this kind of vehicles in the next years taking account of the current policies?

We received 2 replies for the 1st part of the question. The data are consolidated in the previous table.

As far as the expectations are concerned we received 3 replies. One of the stakeholders connects the expectations with the incentives given by the governments in addition to long term policies. In this respect, grants for buying an LPG vehicle or converting a vehicle to LPG or general scrapping schemes are considered important for the development of this market. The incentives should last more (annual trend), although it is difficult taking the current economic crisis into consideration with the budget constraints that it has brought about. An example is the 80% drop in LPG vehicles sales in France in 2011 after a grant scheme was withdrawn. Lack of policies will bring about stagnation in leading countries, contraction in “mature” countries and no development in the emerging ones. The stakeholder referring to Germany, indicates that the market development will depend on taxation, with a prospect for the LPG vehicles to double in 2020. There is one opinion that sees no development whatsoever for this market because of safety issues.

Question 3- Could you try and explain why a GPL vehicle market has not been developed to a larger extent despite the considerable diffusion of filling stations infrastructure in most Member States?

Two replies were received to this answer. One attributes the above issue to safety issues. The other explains that infrastructure alone is not enough for the development of the market but a more holistic approach must take place. On the one hand, legislative and regulatory measures are necessary for fuel suppliers to invest in infrastructure; on the other hand, however, these investments need to be complemented by investments from the car manufacturers’ side to make the market attractive to consumers. Some Member States have successfully created LPG network investments because of the synergies created among fuel suppliers and the automotive industry (OEMs and equipment manufacturers) with the help of the government.

Question 4- Could you indicate which should be the minimum, appropriate and optimum coverage of GPL infrastructures to facilitate the development of a market for vehicles running with this fuel in those countries where the relevant infrastructures are not/hardly available? Provide information differentiating urban and non-urban.

Only one reply was received, not differentiating however between urban and non-urban. The stakeholder suggests that the density of infrastructure in the leading countries in Europe could be a representative sample of how infrastructure should be covered for the less developed. Such, the average current LPG stations density in these countries are: Netherlands: 1/8800 inhabitants; Germany: 1/13700 inhabitant; Italy: 1/21500 inhabitants; Poland: 1/6500 inhabitants; Bulgaria: 1/2500 inhabitants. However, as each Member States has its own

characteristics, they suggest that the proper regulatory or fiscal environment should also be in place.

Which, among the four following criteria, would be the most effective to define the minimum, appropriate and optimum coverage for vehicles in those countries where the relevant infrastructures are not/hardly available?

- (a) **density of population in urban and non-urban areas**
- (b) **a certain percentage of pumps through the TEN-T comprehensive network;**
- (c) **maximum distance between pumps ;**
- (d) **pumps to be made available in filling stations above a certain size or annual turnover**

Three different replies were received by each stakeholder: a), c) and d). One of them explains their choice. According to the explanation, the density of population could be the most appropriate among the above options as the fuel must be available where the consumers are. Distance between the filling stations should complement this factor (minimum distance should not be less than what the car reserve ensures 30-40km). However, they suggest that the total number of cars on the road is a more appropriate criterion to define infrastructure coverage in countries where total car fleet is stable (new sales offset by scraps). This is the case of Italy, Germany, and France. In countries where the car fleet increases or has the margin to increase, number of inhabitants could be a more appropriate measure.

Question 5- Could you indicate what fuels standards, fuel equipments infrastructure standards, and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for GPL vehicles?

Two replies were received, indicating that standards are harmonised already via CEN standards. However they are voluntary rules. One of the stakeholders suggests that binding targets for harmonization in the LPG fuel quality can help the market develop, in order to convince car makers. A regulatory process for establishing a unique LPG connector in the EU is an example of how the market can grow (suggested by the stakeholder as supportive and by no means necessary).

Question 6- What will be on the grounds of your experience and sector knowledge, the evolution of the GPL cost as fuel for vehicles in the next years?

We received 3 replies to this question. The majority links the evolution of the GPL cost to taxation. Judging only from the market trend for the supply of LPG in the European market, there does not seem to be any major increase to cost of the fuel supply.

Question 7- Who should bear the cost of the relevant infrastructures (industry, governments, users...)?

Three replies were received. The LPG infrastructure is not as heavy as is the case with other alternative fuels, like LNG and Hydrogen. Thus the fuel suppliers can bear most of the upfront cost for setting up the infrastructure. However, an appropriate stable supportive framework should be put in place by the governments in the form of grant schemes, tax incentives, provision of plot of land etc. The users would also have to bear part of the investment cost.

Question 8- What would be the impact of the proposed GPL infrastructure on automotive industry/equipment manufacturers?

Two stakeholders replied. They see a positive impact from the development of refilling stations, which will result in a greater LPG availability, as it would lead the automotive industry to invest in more LPG technology, manufacturing facilities, marketing and R&D. Already, some car makers are developing LPG OEM models in Europe (Renault, Chevrolet, Kia, Opel) and this increases the opportunities in this market. As far as the equipment manufacturers are concerned, they are mostly small-medium enterprises (SMEs), so the impact cannot be assessed at this point, although it is thought to be positive.

Question 9- What would be the impact of the GPL on employment?

Two replies were received. The stakeholders see a positive impact on employment through sustainability of the existing man power and increase when GPL is successfully implemented across Europe.

APPENDIX

QUESTIONS ON BIOFUELS

- (1) Which blends of biofuels with diesel or petrol would be the most appropriate to be implemented in the EU? The Commission has suggested E-25, E-85, B-30 in the terms of reference. Do you consider these blends adequate to promote the development of a market for vehicles running on biofuels? Could you justify your reply?
- (1) Could you inform us of the number of pumps in each Member State currently delivering E-25, E-85 and B-30?
- (2) Can you quote the realistic expectations for development taking account of the current policy framework?
- (3) Could you inform us of the number of vehicles currently compatible with E-25, E-85 and B-30 or other biofuels blends in each Member State?
- (4) Could you detail this information by passenger/freight, category, technology, and age of vehicles? Can you quote the realistic expectations for the development of a market for these vehicles in the next years, taking account of the current policy framework and customer acceptance?
- (5) Could you indicate which should be the minimum, appropriate and optimum coverage of biofuels infrastructures (E-25, E-85 and B-30 pumps) to facilitate the development of a market for vehicles running on biofuels in the EU?
- (6) Could you provide this information differentiating urban and non-urban areas?

Which, among the four following criteria, would be the most effective to define the minimum, the appropriate and the optimum coverage?

- (a) density of population in urban and non-urban areas;
- (b) a certain percentage of pumps on the TEN-T comprehensive network;
- (c) maximum distance between pumps;
- (d) pumps to be made available in filling stations above a certain size or annual turnover

Do you consider that the introduction of infrastructure for dedicated fleets (buses, taxis, delivery vans) would be enough for the development of a market?

- (7) Could you indicate what fuel standards, fuel equipment infrastructure standards, and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for biofuel vehicles in the EU?
- (8) What will be, on the grounds of your experience and sector knowledge, the ethanol/petrol and biodiesel/diesel blending ratio in the next years?
- (9) What is the investment cost for E-25, E-85, B-30 refuelling/charging infrastructure?

- (10) What would be the impact of the proposed biofuel infrastructure on the automotive industry/equipment manufacturers?
- (11) What would be the impact of the biofuel infrastructure and the consequent development of vehicles running with biofuels on the global competitive position of the EU sector industry?
- (12) What would be the impact of the biofuel infrastructure on employment?

QUESTIONS ON SYNTHETIC FUELS (GTL AND BTL) AS FUEL FOR VEHICLES

- (2) Could you inform us of the number of pumps delivering synthetic fuel blends by transport mode in each Member State?
- (3) Can you quote the realistic expectations for the development of this sector taking account of the current policy framework?
- (4) According to our knowledge, no specific fuel standard infrastructure is requested for the development of synthetic fuels. Do you share this opinion? Do you think some action is needed, if yes which?
- (5) What will be, on the grounds of your experience and sector knowledge, the evolution of the synthetic fuels cost as fuel for vehicles in the next years?

QUESTIONS ON METHANE AS FUEL FOR VEHICLES

- (13) Could you inform us of the number of pumps delivering natural gas (biomethane or natural gas blended with biomethane distributed through the natural gas grid) by transport mode in each Member State?

Can you quote the realistic expectations for the development of this sector taking account of the current policy framework?

- (14) Could you inform us of the number of
 - vehicles currently running on natural gas and/ or biomethane ?
 - vessels running with Liquefied Natural gas by Member State?

What are the forecast for the development of a market of this kind of vehicles/ vessels in the next years taking account of the current policies?

- (15) Could you indicate which should be the minimum, appropriate and optimum coverage of natural gas/biomethane and liquefied natural gas infrastructures to facilitate the development of a market for vehicles and vessels running with natural gas / biomethane and liquefied natural gas?
- (16) For natural gas/ biomethane vehicles, please provide this information differentiating urban and non-urban areas. For LNG, please provide this information differentiating non-urban areas, sea ports and inland ports.

Which, among the four following criteria, would be the most effective to define the minimum, appropriate and optimum coverage for vehicles?

- (a) density of population in urban and non-urban areas;
- (b) a certain percentage of pumps on the TEN-T comprehensive network;
- (c) maximum distance between ;
- (d) pumps to be made available in filling stations above a certain size or annual turnover

Do you consider that the introduction of infrastructure for dedicated fleets (buses, taxis, delivery vans) would be enough for the development of a market?

Which, among the two following criteria, would be the most effective to define the minimum, appropriate and optimum coverage for vessels?

- 1) number of vessel docks in sea/inland ports;
 - 2) a certain number of pumps against the annual filling station turnover
- (17) Could you indicate what fuels standards, fuel equipment infrastructure standards, and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for natural gas/ biomethane and LNG for vehicles and LNG for vessels?
- (18) What will be, on the grounds of your experience and sector knowledge, the evolution of the natural gas, biomethane cost as fuel for vehicles in the next years?
- (19) What is the investment cost of the relevant infrastructures for natural gas vehicles and LNG for vehicles and vessels for sea and inland ports?
- (20) What would be the impact of the proposed natural gas/biomethane/LNG infrastructure on automotive industry/equipment manufacturers
- (21) What would be the impact of the natural gas/biomethane/LNG infrastructure and the consequent development of vehicles running with these fuels on the global competitive position of EU sector industry?
- (22) What would be the impact of the natural gas/biomethane/L infrastructure on employment?

QUESTIONS ON LNG

- (23) Could you inform us of the number of pumps existing in each Member State in sea ports and inland ports delivering LNG?

Can you quote realistic expectations for development in this sector taking account of the current policy framework?

- (24) Could you inform us of the number of vessels currently running with LNG in EU by Member State, differentiating between maritime transport and inland transport?

- (25) Which are the forecasts for the development of a market of this kind of vessels in next years taking account of the current policies?
- (26) Could you indicate which should be the minimum, appropriate and optimum coverage of natural gas/biomethane and liquefied natural gas infrastructures to facilitate the development of a market for vessels running with liquefied natural gas, differentiating between maritime transport and inland transport?
- Which, among the two following criteria, would be the most effective to define the minimum, appropriate and optimum coverage for vessels?
- a) number of vessel docks in sea/inland ports;
 - b) a certain number of pumps on basis of the annual filling station turnover
- (27) Could you indicate what fuels standards, fuel equipment infrastructures standards, and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for LNG for vessels?
- (28) What will be, on the grounds of your experience and sector knowledge, the evolution of the natural gas, biomethane cost as fuel for vessels in the next years?
- (29) What is the investment cost of the relevant infrastructures for LNG vessels for sea and inland ports?
- (30) What would be the impact of the proposed LNG infrastructure on naval industry/equipment manufacturers
- (31) What would be the impact of the LNG infrastructure and the consequent development of vessels running with these fuels on the global competitive position of EU sector industry?
- (32) What would be the impact of the LNG infrastructure on employment?

QUESTIONS ON HYDROGEN

- (33) Could you inform us of the number of hydrogen pumps delivering Hydrogen by Member State?
- Can you quote the realistic expectations for development taking account of the current policy framework and technological development?
- (34) Could you indicate the number of vehicles by Member State currently running with hydrogen and fuel cells?
- What are the forecasts for the development of a market for this kind of vehicles in next years taking account of the current policies?
- (35) Could you indicate which should be the minimum, appropriate and optimum coverage of hydrogen infrastructures in order to produce a market development of vehicles running on hydrogen and fuel cells in EU?

Could you provide this information differentiating urban and non-urban areas?
Which, among the four following criteria, would be the most effective to define the minimum, appropriate and optimum coverage?

- a) density of population in urban and non-urban areas;
- b) a certain percentage of pumps on the TEN-T comprehensive network;
- c) maximum distance between pumps ;
- d) pumps to be made available in filling stations above a certain size or annual turnover

- (36) Could you indicate what fuels standards, fuel equipment infrastructure standards, and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for hydrogen and fuel cells vehicles in EU?
- (37) What is the investment cost for an initial hydrogen refuelling infrastructure?
- (38) Who should bear the cost of the relevant infrastructures (industry, governments, users....)?
- (39) What would be the impact of the proposed hydrogen infrastructure on automotive industry/equipment manufacturers?
- (40) What would be the impact of the hydrogen infrastructure and the consequent development of vehicles running with these fuels on the global competitive position of EU sector industry?
- (41) What would be the impact of the hydrogen infrastructure on employment?

QUESTIONS ON ELECTRICITY

- (42) Could you indicate the number of charging points (differentiating between public parking places and other sites) by Member State and the number to be expected by 2015 and 2020?

Can you quote the realistic expectations for development taking account of the current policy framework?

Could you indicate the current number of electric vehicles by Member State?

- (43) Could you indicate which should be the minimum, appropriate and optimum coverage of electric charging infrastructures in urban areas to produce a market development of electric vehicles in the EU?

Which type of charging will be required (slow/fast) in the different locations (public spaces, restricted areas, fully private places), and in which coverage?

Which, among the following criteria, would be the most effective to define the minimum, appropriate and optimum coverage?

- (a) density of population in urban;

(b) a certain number of charging points on the basis of the annual vehicles registrations?

Do you consider that the introduction of infrastructure for dedicated fleets (buses, taxis, delivery vans) would be enough for the development of a market?

- (44) Could you indicate what equipment infrastructure standards, and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for electric vehicles in EU?
- (45) What is the investment cost for electric charging infrastructure?
- (46) Who should bear the cost of the relevant infrastructures (industry, governments, users....)?
- (47) What would be the impact of the proposed electric charging infrastructure on automotive industry/equipment manufacturers?
- (48) What would be the impact of the electric charging infrastructure and the consequent development of electric vehicles on the global competitive position of EU sector industry?
- (49) What would be the impact of the electric charging infrastructure on employment?

QUESTIONS ON LPG

- (50) Could you inform us of the number of pumps delivering GPL by transport mode in each Member State?
- (51) Can you quote realistic expectations for the development of this sector in those countries where the relevant infrastructures are not/hardly available, taking account of the current policy framework?
- (52) Could you inform us of the number of vehicles currently running on GPL by Member State?
- (53) What are the forecast for the development of a market of this kind of vehicles in the next years taking account of the current policies?
- (54) Could you try and explain why a GPL vehicle market has not been developed to a larger extent despite the considerable diffusion of filling stations infrastructure in most Member States?
- (55) Could you indicate which should be the minimum, appropriate and optimum coverage of GPL infrastructures to facilitate the development of a market for vehicles running with this fuel in those countries where the relevant infrastructures are not/hardly available?

For GPL vehicles please provide this information differentiating urban and non-urban areas.

Which, among the four following criteria, would be the most effective to define the minimum, appropriate and optimum coverage for vehicles in those countries where the relevant infrastructures are not/hardly available?

- (a) density of population in urban and non-urban areas
- (b) a certain percentage of pumps through the TEN-T comprehensive network;
- (c) maximum distance between pumps ;
- (d) pumps to be made available in filling stations above a certain size or annual turnover

(56) Could you indicate what fuels standards, fuel equipment infrastructure standards, and safety legislation should be harmonised to eliminate the technical barriers that hinder the development of a market for GPL vehicles?

(57) What will be, on the grounds of your experience and sector knowledge, the evolution of the GPL cost as fuel for vehicles in the next years?

(58) Who should bear the cost of the relevant infrastructures (industry, governments, users....)?

(59) What would be the impact of the proposed GPL infrastructure on automotive industry/equipment manufacturers?

(60) What would be the impact of the GPL infrastructure and the consequent development of vehicles running with these fuels on the global competitive position of EU sector industry?

What would be the impact of the GPL on employment?

Chapter IV - Table of existing alternative motor fuels infrastructure and vehicles

The attached tables present the current level of coverage of alternative fuel, infrastructure and the level of diffusion of alternative fuel vehicles: number of filling stations and vehicles per fuel type in all Member States

Number of refuelling infrastructures

Country	Methane	Bio-fuels (high blend)				Hydrogen	Electric Slow charge	Electric Fast charge	LPG
	Total Gas	E-25	E-85	B-30	Total Bio-fuels				
Austria	210	0			0	2	100	5	20
Belgium	10	0			0	1		6	640
Bulgaria	95	0			0				3000
Cyprus	0	0	0			0	0	0	257
Czech Republic	49	0	0	200	200	1	60	5	850
Denmark	1	0			0	14	280	5	8
Estonia	3	0			0		140		0
Finland	18	0			0	2			0
France	300	0	300		300	5	178		1592
Germany	900	0	343		343	42	2500	5	6000
Greece	3	0	0		0	2			65
Hungary	7	0	0		0				500
Ireland	1	0			0		757	28	358
Italy	858	0			0	21	353		2773
Latvia	1	0			0				142
Lithuania	3	0			0				840
Luxembourg	8	0			0				0
Malta									0
Netherlands	150	0	33	25	58	4	1750	25	1900
Poland	47	0			0				5900
Portugal	5	0			0				222
Romania									1200
Slovakia	11	0			0				0
Slovenia	0	0			0				29
Spain	48	0	8		8	4	200	12	47
Sweden	166	0	1700		1,700	4		5	20
United Kingdom	5	0	1,700		1,700	19	250	5	1400
European NGV countries	2,899	0	4,084	225	4,309	121	6,568	101	27,763

Number of vehicles

Country	Total NGVs	Methane			Bio-fuels (high blend)				Total Bio fuels	Hydrogen	Electric
		Total LD+MD+HD * vehicles	LD Cars and Commercial vehicles	E-25	E-85	B-30	B-100				
Austria	5,910	5,907	5,768	0	2,930	0	0	2,930		0	
Belgium	241	241	235	0	200	0	0	200		350	
Bulgaria	61,623	61,616	61,500	0	0	0	0	0		0	
Czech Republic	3,075	3,011	2,644	0	0	0	0	0		0	
Denmark	0	0	0	0	100	0	0	100		0	
Estonia	69	69	60	0	0	0	0	0		0	
Finland	970	950	850	0	390	0	0	390		0	
France	13,500	13,500	10,200	0	15,500	0	0	15,500		1000	
Germany	94,890	94,890	92,100		24,000	0	0	24,000	135	2500	
Greece	520	520	0	0	4	0	0	4		0	
Hungary	87	87	4	0	0	0	0	0		0	
Ireland	3	3	3	0	7,000	0	0	7,000		0	
Italy	761,340	761,340	757,840	0	550	0	0	550		0	
Latvia	500	227	30	0	0	0	0	0		0	
Lithuania	185	185	75	0	0	0	0	0		0	
Luxembourg	234	234	199	0	12	0	0	12		0	
Malta											
Netherlands	4,300	4,300	3,530	0	10,000	0	0	10,000		946	
Poland	2,082	1,782	1,502	0	0	0	0	0		0	
Portugal	504	454	46	0	1	0	0	1		0	
Romania											
Slovakia	823	823	429	0	0	0	0	0		0	
Slovenia	8	8	8	0	0	0	0	0		0	
Spain	3,051	3,007	574	0	4,168	0	0	4,168		0	
Sweden	36,380	36,380	33,575		184,000	0	250	184,250	30	200	
United Kingdom	220	170	20	0	1,660	0	0	1,660	18	1000	
European NGV countries	990,515	989,704	971,192	0	250,515	0	250	250,765	183	5,996	

Chapter V - Success stories

Three examples of policy action taken at Member States level, which has led to the successful implementation of infrastructure for alternative fuels: 1) a policy framework to promote a successful market for low emission vehicles in the UK; 2) incentives to support eco-friendly vehicles and infrastructure in Sweden; and 3) development of natural gas infrastructure for refuelling natural gas-powered vehicles.

Here follow three examples of policy action taken at Member States level, which has led to successful implementation of infrastructure for alternative fuels:

- **UK: promotion of electric vehicles**

The UK Government has established a policy framework designed to promote a successful market for low emission vehicles in the country. This strategy sets out the infrastructure plan that complements the effort to reduce vehicle cost and encourage the development of the market. Current efforts to promote electricity in transport focus mostly on the vehicles (through purchasing grants for electric vehicles and demonstration programs), while there are some government initiatives (effectively at the regional level) to promote infrastructure deployment through financial support. One of these initiatives is the Plugged-in-Places project, initiated by the UK government in order to encourage the electric vehicles market. The budget for this project is 30 million pounds, provided by the Office of Low Emission Vehicles (OLEV) for the installation of 11,000 charging points in 8 places in the country. London, Milton Keynes and North East areas successfully received funding for the installation of charging networks, as part of phase 1 of the project. The 2nd phase of the Plugged-in-Places project includes a 7 million pounds infrastructure project, with up to 2.9 million pounds match-funding coming from the government, and the rest coming from the European Regional Development Fund. The partnership included more than 100 private and public sector partners. Under the project, the East of England network will play an important role in UK's charging infrastructure by linking networks already developed in London and Milton Keynes. It focuses on 8 clusters which are supported by a wider recharging network, connecting public car parks, park and ride sites and on street locations. Fast charging facilities connected to big transport arteries are tested. A campaign will follow as part of the project to make consumers aware of the electric vehicles market in order to encourage its uptake.

These projects offer insight into the development of the market at the national level; through these projects, different recharging technologies are tested (i.e. standard, fast, rapid and inductive in a range of locations). OLEV's Plug-In Vehicle Infrastructure Strategy,⁵⁷ recognizes the role of government in setting a permanent strategic framework to support the successful provision of infrastructure into the market.

⁵⁷ <http://assets.dft.gov.uk/publications/making-the-connection-the-plug-in-vehicle-infrastructure-strategy/plug-in-vehicle-infrastructure-strategy.pdf>

UK Policy Instruments for promotion of electric vehicles and infrastructure

Expectations regarding number of vehicles	Expectations regarding infrastructure	International collaboration/interesting projects	Additional Government Instruments for Policy for vehicles and infrastructure
By 2020, every new car must be electric or hybrid and emit less than 100gCO ₂ /km	Over 11,000 charging points by 2013	Participant in Green E-motion EU demonstration project Participant in ENEVATE project	400 million pounds for “green cars” in 2008-2012, of which: 30 million pounds for charging network, 10 million pounds for test beds in 2009 and 2010, 120 million pounds for R&D (loans to market players) Tax: purchasing grants of 5,000 pounds per car (“electric vehicle consumer incentive”)

- **Sweden: Ethanol 85**

The introduction of alternative fuels infrastructure proves easier when the relevant capital costs are lower, as in the case of liquid biofuels that require separate dispensers in existing refilling stations. In this respect, a good example of success is the introduction of Ethanol 85 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.

More specifically, in Sweden, a set of user incentives to support eco-friendly vehicles and infrastructure has been introduced as from 2002. These incentives comprise of a 20-40% relief of company car taxation, and initially also complementary incentives as for instance the exemption from the Stockholm congestion charge as well as free parking for eco-friendly vehicles. As a result, clean vehicles make a share of 40% of newly purchased vehicles in 2011, and ethanol 85 and bio-methane fuelling stations have been developed to some extent also due to E85 stations investment obligations enforced since 2006 obliging larger filling stations to offer a renewable fuel for sale (mostly E85)

alongside petrol or diesel pumps.⁵⁸ From 2009 all petrol stations that sell more than 1,000 m³ annually, have to provide this as well. B15 biodiesel started to be offered at stations throughout Sweden since Spring 2011. As a result, Sweden currently has more than 180,000 E85 cars and about 1,700 E85 biofuel pumps, making the most developed network of biofuels infrastructure in the EU.

Tax reliefs were instrumental for high blend biofuels to compete with conventional gasoline and diesel given today's production costs. Swedish taxes (in SEK) as of 2009 were as follows (1SEK=0.0975 as of 31 December 2009):

	Energy Tax	Carbon Dioxide Tax	Sulphur Tax	Total Carbon Dioxide and Energy Tax	Total Tax inc. VAT
Conventional Gas (SEK/liter)	3.08	2.44	0	5.52	6.90
Diesel Oil	1.33	3.01	0	4.34	5.42
Ethanol/RME	0	0	0	0	0

Source: Swedish Energy Agency

Other tax incentives and policy instruments that promoted a successful introduction of higher blend biofuels and alternative fuels in general include:

Tax exemption of green vehicles from vehicle taxes for the first five years, while the vehicle tax will be raised by SEK 5 (€ 0.56) per gram of carbon dioxide a car emits.

Cash bonus of SEK 10,000 (€ 1,120) to individuals who purchase a new car running on alternative fuels was replaced by a long-term tax reduction. The change came into force on January 1, 2010, but was retroactive as it applied to vehicles taken into use as of July 1, 2009.

Energy tax on diesel to be raised by a total of SEK 0.40 per litre (€ 0.045/lit) by 2013.

As of February 2009, cars purchased by governmental authorities and 50% of emergency services vehicles must be environmentally friendly.

Increase of biofuels blend in gasoline and diesel (i.e. E85) in order to achieve environmental objectives.

Benefits: E85 fuel at the pump in Sweden typically costs about 30% less than gasoline. This is due to the tax breaks introduced for the use of the fuel. Since the energy content of ethanol is less than that of gasoline it means it costs about the same to consumers to drive on E85 or gas. These kind of incentives helped towards successful implementation of E85. Investment obligations for the addition of E85 pumps along with the incentives

⁵⁸ The Act initially applies to filling stations with a sales volume in excess of 3000 m³. Sweden Biofuels Annual report 2009
http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Biofuels%20Annual_Sweden_6-24-2009.pdf

and tax breaks overcame a potential coordination failure. In addition, consumers are well informed about the environmental consequences of using oil and the need to decrease oil dependency⁵⁹.

- **Italy: natural gas**

In Italy, a significant natural gas infrastructure has been developed, mainly with public support. State aid N 275/08 related to “Refuelling infrastructure for natural gas-powered vehicles” in Bolzano area was accepted by the European Commission as non-distortionary of competition, as natural gas stations were so sparsely distributed across the territory that they were not in competition with other Member States, neither with other regions in Italy.⁶⁰ For example, distance between Italy and Austria does not make attractive the option of travelling across the borders to potentially benefit of the lower gas price. The region’s contribution was justified on the basis of low profitability of the investment, which constitutes a disincentive for petrol stations to install natural gas pumps. The total budget for financing the build-up of natural gas pumps was € 3.2 million over a 3-year period (until 31/12/2011). Taking an average installation cost of € 300,000 per outlet, the grant contribution by the province was not allowed to exceed € 210,000 per outlet up to the 2nd outlet, and below € 120,000 for any additional outlet. Further infrastructure deployment efforts are made through the recent modification of the legislation, which allows for the construction of multi-fuel stations with CNG or small CNG station next to the petrol ones, as well as the possibility to install self-service refuelling systems at the CNG distribution network. CNG infrastructure deployment efforts involve:

- Liguria Region (2010): Total budget of 1.05 million euro for private or public entities interested in opening new CNG filling stations. Applicable costs can be reimbursed up to 70% of the total with a max limit of € 90,000 per CNG filling station
- Lombardy Region (2010): Total budget of 2 million euro for private or public entities interested in opening new CNG filling stations. Applicable costs can be reimbursed up to 50% of the total with a max limit of 200,000 euro per CNG filling station. In 2008, Italy had 612 natural gas outlets. In 2010 it counted 766. In addition “a recent modification of the legislation allowing the construction of multi-fuel stations with CNG or small CNG station next to petrol ones, as well as the possibility to install self-service refuelling systems at the CNG filling stations” is expected to bring a further increase of the Italian CNG distribution network (Decree 11 September 2008, Ministry of Interior).⁶¹
- Even though the implementation has been successful owing to the regional grants, central and southern regions of Italy have a lower number of stations compared to northern

⁵⁹ <http://www.ethanolproducer.com/articles/4463/ffvs-flourish-in-sweden/>

⁶⁰ Brussels, 18.VIII.2008 C(2008)4482, State aid N 275/08 – Italy refuelling infrastructure for natural gas-powered vehicles (Bolzano)

⁶¹ National Report on State of CNG/Biomethane Filling Stations – Italy

<http://www.gashighway.net/default.asp?sivuID=25922&component=/modules/bbsView.asp&recID=18993>

regions. This imbalance calls for coordination among the regional plans for a more uniform infrastructure deployment.

Chapter VI - Policies to promote alternative fuels in Member States

Some examples of national initiatives and policies implemented for the promotion of alternatively fuelled vehicles and related infrastructure are reported. Programmes, projects, standards and relevant lessons learned are featured. The electromobility survey includes a table summarising the expectations regarding deployment of fleets, charging infrastructure and financial support for the coming years.

There is currently no EU legislation on the implementation of alternative fuels infrastructure. There are the TEN-T Guidelines, which are the general reference framework for the implementation of the European transport network. The “Expert Group on Intelligent Transport Systems and New Technologies within the TEN-T framework” considers the implementation of new infrastructure required for alternative fuels in all transport modes. On a national level, there are policies implemented for infrastructure deployment. However, most of the policies have focused on the promotion of the alternative fuel vehicles, and secondly on the infrastructure.

Electricity

There are several initiatives taken at a national level, for the deployment of charging infrastructure.

Belgium

Belgium has made EVs and infrastructure deployment efforts, through the use of fiscal instruments: Tax credits since 2010 (e.g. 15% of the EV purchase price and max of 3,280 euro per vehicle) for the purchase of EVs. In addition, the government plans to buy and use EVs to stimulate further market uptake. For investment in infrastructure (i.e. public charging points) there is a 40% tax credit to individuals (max 180 euro, 250 euro for 2010). For 2010, 2011 and 2012, there are increased investment allowances for companies that invest in an electric charging station and depreciation at the rate of 15.5%. The amortization period for these stations is 2 years..

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 million euro budget until 2012), which initiated in Prague in 2009, includes the development of a public charging network.

Ireland

In terms of infrastructure deployment, the electricity Supply Board (ESB) launched 1,500 charging points (30 fast charging points included) by December 2011. There is a tax exemption (VRT) for full battery electric vehicles (BEVs) from 1st June 2011, relieving up to 5,000 Euros per EV. The VRT applies also for plug-in hybrid vehicles (PHEVs) relieving up to 2,500 Euros until December 2012. In addition, there is a grant scheme (up to 5,000 Euros depending on the price of the vehicles) for the purchase of a BEV or a PHEV.

United Kingdom

The Government has established a policy framework designed to promote a successful market for low emission vehicles in the UK. This strategy sets out the infrastructure plan that complements the effort to reduce vehicle cost and encourage the development of the market. Current efforts to promote electricity in transport focus mostly on the vehicles (through tax exemptions for electric vehicles and demonstration programs), while there are some government initiatives/ incentives to promote infrastructure deployment. One of these initiatives is the Plugged-in-Places project, initiated by the UK government in order to encourage the electric vehicles market. The budget for this project is 30 million pounds, provided by the Office of Low Emission Vehicles (OLEV) for the installation of 11,000 charging points in 8 places in the country (Map1). OLEV is working with Plugged-In Places to ensure interoperability of the schemes. London, Milton Keynes and North East successfully received funding for the installation of charging networks, as part of phase 1 of the project. The 2nd phase includes the EVlau8 project. This is a 7 million pounds infrastructure project, with up to 2.9 million pounds match-funding coming from the government, and the rest coming from the European Regional Development Fund. The partnership included more than 100 private and public sector partners. Under the project, the East of England network will play an important role in UK's charging infrastructure by linking networks already developed in London and Milton Keynes. It focuses on 8 clusters which are supported by a wider recharging network, connecting public car parks, park-and-ride sites and on street locations. Fast charging facilities connected to big transport arteries are tested. A campaign will follow as part of the project to make consumers aware of the electric vehicles market in order to encourage its uptake.

According to UK's Carbon Plan⁶², the eight projects in Central Scotland, the East of England, Greater Manchester, London, the Midlands, Milton Keynes, the North East of England and Northern Ireland aim to install up to 8,500 charge points by 2013, in homes, workplaces, car parks and on street sites. They are working collaboratively with each other and with the OLEV to identify issues and solutions in this process of creating an effective plug-in vehicle charging network in the UK. There is a geographical focus created for the early market development, with schemes which start to become operational (e.g. North East's "Charge your Car" since 2010; Milton Keynes scheme 2011 and Source London with the pan-London membership scheme launched in May 2011⁶³). Each of these projects offers insight into the development of the market at the national level; through these projects, different recharging technologies are tested (i.e. standard, fast, rapid and inductive in a range of locations); through connections to Ofgem's Low Carbon Network Fund projects, the North East and London are looking into how EVs can be connected to the smart grid; the Northern Ireland project is collaboratively with a parallel scheme in the Republic of Ireland to solve issues related to international and cross-border operation. OLEV's Plug-In Vehicle Infrastructure

⁶² <http://www.decc.gov.uk/assets/decc/What%20we%20do/A%20low%20carbon%20UK/1358-the-carbon-plan.pdf>

⁶³ <https://www.sourcelondon.net/>

Strategy,⁶⁴ recognizes the role of government in setting a permanent strategic framework to support the successful provision of infrastructure into the market. They highlight the commitment of the Coalition's Program for Government to a recharging infrastructure, as well as the coordination required among the different stakeholders (i.e. electricity suppliers, DNOs, plug-in vehicle manufacturers, charging points manufacturers, planning authorities, businesses and consumers).

The Plugged-In Places project, the Energy Technologies -Institute "Plug-In vehicles and Infrastructure Program" and the "Technology Strategy Board's Ultra-Low Carbon Vehicle Demonstrator program" can draw lessons on how to proceed with the development of this market.⁶⁵ In addition, UK is following global initiatives/ incentives to gain insights.

Efforts are also located at the municipal level, where in May 2009, the "Electric Vehicle Delivery Plan for London" was announced by Mayor of London, for building of infrastructure, EV procurement etc. Mayor Johnson announced in 2010 a single London-wide brand for EVs to be launched in the area for the citizens to identify where a charging point is located. Since 90% of the trips by car are realized within 10 miles, Transport for London expects a 25,000 charging network to be able to support tens of thousands more EVs in London (100,000 EVs are envisioned for 2020)

Netherlands

National government has made efforts for an electric vehicle market deployment and infrastructure deployment, which is recognized to contribute to the climate change goals by reducing CO₂ and air pollution (NO_x and fine dust). The government took actions for field trials and demonstration projects, stimulation and power infrastructure systems, development and manufacturing of EVs, consortiums and coalitions and policies to implement these (see Table 8). Part of Formula E-team's activities for vehicles and infrastructure deployment can be summarized as follows: test beds for hybrid and electric mobility (9 projects), establishment of a NEN standards committee (the standards organization of the Netherlands) for electric transport (Dutch 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); zero emission addition for tax purposes; extension of the environmental investment deduction/random depreciation environmental investments (MIA-VAMIL) regulations to include passenger EVs with CO₂ emission less than 50g/km.⁶⁶

In the short term, the government, in specific the Directorate-General for Public Works and Water Management (RWS), in its effort to accumulate knowledge of setting up an

⁶⁴ <http://assets.dft.gov.uk/publications/making-the-connection-the-plug-in-vehicle-infrastructure-strategy/plug-in-vehicle-infrastructure-strategy.pdf>

⁶⁵ The Energy Technologies Institute is a partnership between industry and government aiming at developing mass scale technologies that will help UK meet its 2020 and 2050 energy targets. It is investing in a research program to develop business case for mass-market deployment of plug-in vehicles in the UK and the required energy infrastructure.

⁶⁶ Action Plan for Electric Transport. En route to 1 million electric cars in2020 http://www.agentschapnl.nl/sites/default/files/bijlagen/Action%20Plan%20Electric%20Transport_tcm24-340531.pdf

energy neutral and emission neutral transport system, launched the e-mobility program (e-rijden), which focuses on operating electric vehicles and licensing charging points along motorways. Furthermore, *Amsterdam Electric*, a project launched by the municipality of Amsterdam, set aside 3 million euro in 2010 for the purchase of 260 electric vehicles. Additional funds were set aside by the municipality for charging infrastructure in public areas and installation of charging points in multi-storey car parks and offices. *E-laads Foundation* (non-profit green energy foundation) in cooperation with the Dutch National Transmission management has planned to install 10,000 public charging stations by 2012. The places are delivered and placed for free at public parking lots across the Netherlands in cooperation with Dutch municipal governments. Then data will be collected and analyzed in relation to the behaviour of people driving and charging e-cars, developing standard electric plugs and points. Public charging points should be given attention, considering that 70% of the Dutch citizens does not have private land. The government has also set-aside 16 million euro in subsidies to support test beds for smart grids applications in transport and assess the reaction of the consumers to price incentives. However, no matter the efforts, international collaborations and transnational experimentation projects (test beds) with Nordrhein-Westfalen (Germany), there are still obstacles according to the Dutch Action Plan, in the development of charging infrastructure (and EVs), as there is no market model/business case for public charging points and charging methods, and the prices of EVs are still high. Thus, it is expected that the market for electromobility will be at a fragile state until 2015. Afterwards, the review of the market development will determine if and when government intervention can be decreased.

Spain

The Spanish plan for e-mobility (Movele) plans to establish 62,000 charging points for private homes, 263,000 fleet points in car parks, 12,150 in public car parks and 6,200 on public roads until 2014. The total budget for the project is 10million euro. Within this, Madrid aims at creating 280 new public charging points. The network of charging points will be distributed through businesses and commercial areas of the city. The City Council, already installed two lines of electric -powered minibuses that run through the centre of the city, an underground car park with 36 charging points that can serve more than 50 electric vehicles and tax reductions on EVs since 2004. In Catalonia, the "Strategy to Promote Electric Vehicles in Catalonia" (Ivecat) has been set. The objective is to have 76,000 electric vehicles registered until 2015, through establishing a dense network of about 91,200 charging points (83,600 private and 7,600 publicly accessed, 6,080 of which in public parking lots and 1,520 in public roads). The budget for this project amounts at 207.5 million euro, set aside by the Generalitat of Catalonia.

Below is a table which summarises expectations and actions taken by Member States for electromobility. Expectations for development of electric vehicles and charging points are different per Member States and different weight has been given per Member States as far as the development of infrastructure is concerned. Most Member States have so far focused on the stimulation of the EVs manufacturers and the consumer for purchase of EVs.

Table- Expectations and government financial support for electromobility (vehicles and infrastructure)

Member States	Expectations regarding number of vehicles	Expectations regarding infrastructure	International collaboration/interesting projects	Government Policy Instruments for vehicles and infrastructure
Netherlands	2015: 20,000 2020: 200,000 2025: 1 million	10,000 public charging stations in 2013 and extensive network of private charging points 50 rapid charging stations	Transnational test bed with NordRhein Westfalen (Germany) Knowledge and battery testing centre in Helmond Initiator of the EU project ENEVATE Participates in Green E-motion project	Test bed program (10 million euro) for the period 2009-2014 Stimulation of construction of charging infrastructure and purchase via MIA/VAMIL Government Contribution to research and development via the two HTAS tenders (20 million euro) Exemption from BPM Zero emission addition for tax purposes Exemption from MRB
Denmark	2020: 500,000	150 battery charging stations ready before 2012	Dong Energy-experiments with links to smart grids and electric mobility to make better use of wind Dong Energy and company- Better Place-rollout of charging infrastructure	4.7 million euro for test beds (2008-2012) Purchasing grants Budgets for knowledge development (75 million euro for sustainable transport, 190 million euro for the "Future Energy Systems")
Sweden				EV with an energy consumption of 37 kWh per 100 km or less and hybrid vehicles with CO ₂ emissions of 120 g/km or less are exempt from the annual circulation tax for a period of five years from the date of their first registration. Hybrid-electric or electric: 40 percent, maximum SEK 16,000 per year. The

				maximum reduction of the taxable value is SEK 16,000 per year.
France	2015: 450,000 2020: 2,000,000	1 million charging stations ready before 2015 (both public and private)	Collaboration with Germany Working group Automobile	4 billion euro government investments before 2020 (“Plan Voiture Electric”). Investments in projects, research budgets, legislations and regulations. Focus on stimulating battery industry Government investment in knowledge development -60 million euro before 2012 Tax scheme-purchasing premium 5,000 euro for new electric transport
United Kingdom	By 2020, every new car must be electric or hybrid and emit less than 100gCO2/km	Over 11,000 charging points	Participant in Green E-motion EU demonstration project Participant in ENEVATE project	400 million pounds for “green cars” in 2008-2012, of which: 30 million pounds for charging network, 10 million pounds for test beds in 2009 and 2010, 120 million pounds for R&D (loans to market players) Tax: purchasing grants of 5,000 pounds per car (“electric vehicle consumer incentive”)
Germany	1 million in 2020	-	8 model regions for electric mobility as test bed International test bed NordRhein Westfalen with the Netherlands Collaboration with France in “Working Group Automobile”	500 million euro for R&D Passenger cars tax relief before 2015 Purchasing grant up to 500 euro per vehicle
Austria	-	-	Austrian Mobile Power National Platform –industrial collaboration to implement the ER-EVs (Extended Range Electric Vehicles) in Austria Magna Steyr-invests in battery developments	The overall budget of the Ministry for Transport, Innovation and Technology for the support of electromobility stands at 60 Million €/year Relief from fuel consumption tax of

				<p>300-500 euro when buying a clean vehicle</p> <p>Exemption from fuel consumption tax and vehicle tax</p> <p>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.</p>
Luxemburg				<p>Purchasers of electric vehicles (or other vehicles emitting 60 g/km or less of CO₂) receive a premium of € 3,000 (PRIME CAR-e) until 31 December 2011. The purchaser must have concluded an agreement to buy electricity from renewable energy sources in order to obtain the premium.</p>
Portugal	180,000 in 2020	<p>Mid 2011: 1,300 charging stations and 50 rapid charging points</p> <p>2020: 25,000 charging points</p>	<p>No important transnational projects are known</p> <p>Renault-Nissan promised to build a plant for the manufacture of batteries in Portugal.</p>	<p>Emphasis on smart grids</p> <p>The government project Mobi-E: Construction of a nationwide charging points network (in 2011, 1,350 charging points must be operational)</p> <p>€5,000 purchasing grant for a vehicle (first 5,000 vehicles), exemption from road tax; 1,500 euros subsidy for trading the old car for an EV</p>
Spain	1 million in 2014	2010: 500 charging points	The Movele project: 546 public charging points and the aim to	590 million euro for the next 2 years.

		2012: 140,000 charging points	introduce 2,000 EVs to Barcelona, Madrid and Ceville	20% subsidy of the purchase price, max. 6,000 euro
Italy				Electric vehicles are exempt from the annual circulation tax (ownership tax) for a period of five years from the date of their first registration. After this five-year period, they benefit from a 75% reduction of the tax rate applied to equivalent petrol vehicles.
Greece				Electric and hybrid vehicles are exempt from the registration tax.
Ireland				Electric vehicles are exempt from the registration tax VRT 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.

Hydrogen

Currently, there exists few hydrogen refilling stations (public and private) in 13 Member States in the EU, while this market is at a very early stage development. At a global level, the International Partnership for Hydrogen and Fuel Cells economy (IPHE), aiming at promoting demonstration and commercialization of hydrogen fuel cells technology is worth mentioning⁶⁷. At the EU level, a Fuel Cells and Hydrogen Joint Undertaking has

⁶⁷ <http://www.iphe.net/>

been established by Council Regulation (No 521/2008) which is responsible of a strategic program of RTD and demonstration projects in order to promote commercialization of hydrogen and fuel cell technology. The EN contributes with 470 million euro, while private initiatives are expected to be followed by private investors.

The efforts so far to deploy infrastructure are mainly demonstration project initiatives. According to HyER (Hydrogen Fuel Cells and Electromobility in European Regions), there are no technical barriers but many regulatory barriers at the EU and national level against the deployment of a viable hydrogen refuelling station network. For example, at the EU level, the 2009 Revision of the Integrated Pollution Prevention and Control (IPPC) Directive (2008/1/EC)⁶⁸ includes the same installation procedure for small and large reformers. Small reformers are important components of smaller Hydrogen Refuelling Stations. At national level, legal hydrogen pressure levels at hydrogen refuelling facilities are kept at lower levels than the current pressure in hydrogen cylinders in passenger cars and buses (case of Italy).

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). According to HyEr, the lessons from the operation of these stations have showed that attention must be paid on the future availability of vehicles, so as to start developing the investment programs necessary to allow intelligent hydrogen refuelling stations build-up across Europe. The first industry initiatives to establish a national network of stations, like the “H2 Mobility” initiative in Germany and similar initiatives that have started in the UK and France (e.g. Clean Hydrogen in European Cities Project), mostly focused on refuelling private cars.

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

In relation to the Clean Hydrogen in European Cities Project (CHIC), this was launched in 2010. Public operations of Fuel Cells and Hydrogen (FCH) buses have started in Cologne, Hamburg and London. Norway and Italy have also tested the first hydrogen buses. An important part of the project is the establishment of a hydrogen infrastructure network, although the focus has been more on vehicles. Progress in new building of hydrogen stations has been seen in London and Cologne, where stations were constructed and are currently in service.

⁶⁸ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:024:0008:0029:EN:PDF>

According to the national report, the industry based initiatives should pay equal attention to the refuelling infrastructure needed for captive fleets like buses and taxis in order to leverage finance from available local budgets. In the short term, existing hydrogen “hot spots” that include FCH bus operations and (Fuel Cells Electric Vehicles) FCEV, in captive fleets in urban areas with high population density, should be further enhanced to allow deployment of larger numbers of these vehicles.

At the same time, existing EU funding programs for transport infrastructure like the TEN-T Network for Transport TEN-T, may be utilized to allow integration of hydrogen refuelling station build-up along the corridors connecting these hot spots.

Biofuels

Low blend fuels can use the same distribution infrastructure as the fossil fuels. However, higher blends than E10 and B7 (e.g. E25, B30, B100) require new infrastructure equipment due to incompatibility with the current vehicle fleet. Although, there is no EU policy on the infrastructure side for the provision of the biofuels and especially the higher blend types, there are European Directives which promote the use of biofuels in order to reduce the European Energy dependence on oil imports and to reduce GHG emissions. These Directives are listed below:

- EU Biofuels Directive 2003/30/EC promoting mandatory incorporation of biofuels in road transport fuels (5.75% energetic base in 2010).
- Fuel Quality Directive (2009/30/EC) which obliges Member States to reduce carbon intensity of transport fuels by 6% by 2020. The Fuel Quality Directive (2009/30/EC) sets a target for a 6% reduction (compared to 2010 levels) of the GHG intensity of transport fuels supplied in the European Union. This reduction should be achieved through the use of alternative fuels. Biofuels may count towards the realization of this target if they comply with the sustainability criteria stated in the Directive. In addition, the Directive allows for maximum limit blends, i.e. petrol may contain 5% ethanol (E5) and diesel may contain up to 7% biodiesel with FAME (Fatty Acid Methyl Ester) norm EN 14214. This percentage is higher than the current diesel norm EN590, which quotes a maximum content of 5%.
- Article 6 of Regulation (EC) No 443/2009, states that “for the purpose of determining compliance by a manufacturer with the emission reduction targets set in the Regulation, the specific emissions of CO₂ of each vehicle designed to be capable of running on a mixture of petrol with 85 % ethanol (‘E85’) which meets relevant Community legislation or European technical standards, shall be reduced by 5% until 31 December 2015” in recognition of the greater technological and emissions reduction capability when running on biofuels. This reduction shall apply only where at least 30% of the filling stations in the Member States in which the vehicle is registered provide this type of alternative fuel, complying with the sustainability criteria for biofuels set out in relevant Community legislation.

At the EU level, approximately €160 million have been set aside for Research and Technology Development - RTD projects (FP5, FP6, and FP7 Energy Programs) on

biofuels. Two of these projects are related to introducing liquid biofuels infrastructures. These are the Bioethanol for Sustainable Transport-BEST project⁶⁹, funded by the FP6 RTD Programme. It supports the introduction of 308 Ethanol 85 pumps (120 under EC funding), 12 E-95 pumps (9 under EC funding) and 14 Ethanol 10 pumps (12 under EC funding)⁷⁰. The second concerns second generation biofuels, in specific production of Dimethyl Ether, “DME from biomass and utilisation as fuel for transport and for industrial use BIO DME”⁷¹, where 4 filling pumps were introduced.

MS have proceeded differently with respect to the implementation of the above directives, with most of the policies and support mechanisms focusing on the promotion of the biofuels vehicles. Tax reductions, in order to comply with the 2003/96/EC Energy Taxation Directive and/or incentives and obligations for blending biofuels with petrol/diesel are the two most common instruments used by Member States to promote biofuels. Some of the efforts done in relation to infrastructure deployment at the Member States level are mentioned below⁷².

Belgium⁷³

In order to achieve the biofuel targets, Belgium has implemented a quota system, which involves some administrative follow-up aiming at removing barriers to the introduction of biofuels on the Belgian market. In 2006 production quota eligible for tax exemption were fixed. However, no incentives to go beyond the quota exist for the market. There are few private initiatives (investments, capacity building). The main concerns remain administrative and tax burdens. The lack of an alternative fuels strategy on national, regional or local level is mentioned as a barrier.

France and Germany⁷⁴

As far as the E10 blend is concerned, France and Germany have been the biggest markets (few Member States have introduced the new fuel), however not both countries managed its successful implementation. France introduced E10 in April 2009 after the relevant law came into force; all BP filling stations distributed the fuel. The law stated which cars cannot use the fuel. The pumps were clearly labelled and customers were assisted to choosing the proper fuel for their cars, therefore the implementation did not face any problems. As a result, France’s market share of E10 is currently 17.6%, while 20% of the filling stations offer this fuel. In Germany, the sustainability criteria for biofuels agreed at EU level under the Renewable Energy Directive and the Fuel Quality Directive were transposed into national law in 2009. However, Germany did not experience success in the commercialization of E10, although the automotive industry was supportive of the new fuel. The consumers were not appropriately informed on the effects that this type of fuel would have to the engine of their cars. After the fuel was delivered to almost half of

⁶⁹ <http://www.best-europe.org/>

⁷⁰ Information provided by the EC.

⁷¹

http://cordis.europa.eu/fetch?CALLER=FP7_PROJ_EN&ACTION=D&DOC=1&CAT=PROJ&RCN=9034

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⁷² Biofuels: Member States Member States reports

http://ec.europa.eu/energy/renewables/biofuels/ms_reports_dir_2003_30_en.htm

⁷³ Project SD/EN/03A - Biofuels Sustainable End uSe “BIOSES” <http://www.belspo.be/>

⁷⁴ <http://www.spiegel.de/international/germany/0,1518,749199,00.html>

the 15,000 petrol stations in Germany (available since February 2011), car manufacturers released a list of non E10 compatible vehicles, which amounted to 3,000,000 cars. As a result, suppliers slowed down the delivery of this fuel, but extra quantities remained and created shortages for the traditional fuels and E5 blend, as demand for the last increased. Furthermore, pumps were labelled with warning signs about E10. At the same time, the law regulating the introduction of E10 to the German market imposes financial penalties to the industry if the biofuels target is not met (as high as 456 million euro annually), which ultimately can be passed on to consumers. Consumers' confidence in this fuel has not yet been restored. In addition, because of slight differences in the E10 biofuels used in France, the ADAC, the German Automobile Association, is recommending to the German drivers to avoid E10 fuels if they are to travel from Germany to France. E85 and B100 (pure biodiesel) pumps have also been constructed (numbers given in the next section). In this way, supply of infrastructure highly exceeds demand, as there are less alternative fuel vehicles developed compared to the infrastructure.

Netherlands⁷⁵

National Government and other authorities made efforts to expand the filling infrastructure with the program "Tankstations Alternatieve Brandstoffen (TAB)"- Alternative Fuel Filling Stations. In the 1st tender in 2008, 1.8 million euro of aid was granted for the construction of 68 ethanol filling stations and 31 natural gas filling stations. Of the above, 11 natural gas stations and 24 ethanol have been completed. In the 2nd tender at the end of 2009, 3.6 million euro of aid were granted for the construction of 53 natural gas pumps, 3 E85 pumps and 4 B30 pumps, which are currently under construction.

Slovakia

First-generation biofuels have been placed on the Slovak motor fuels market and have been distributed via existing distribution points. Replacing part of the fossil fuel with low blend biofuel is a simple method considering that it can be used for all types of motor vehicles. The obligation to place biofuels on the domestic market ("obligatory placing") was established for 2010 in Section 5(1)(c) of Government Regulation No 402/2010 amending Government Regulation No 246/2006, with reference value at 3.7 %. The stations operators were like this obliged to place biofuels on the market in a quantity matching the reference value, which was calculated on the energy content basis of the total quantity of motor fuels covered in 2010 business activities.

Sweden

Sweden with more than 180,000 E85 cars and about 1,700 E85 biofuel pumps, has the most developed network of biofuels infrastructure in the EU. In addition to tax incentives given to the biofuels powered vehicles, this development is mainly due to an Act enforced in 2006, requiring all major fuel stations in Sweden, to sell at least one type of biofuel. According to this, Sweden's larger filling stations must offer a renewable fuel for

⁷⁵ Report covering 2010 under Article 4(1) of Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport.

http://ec.europa.eu/energy/renewables/biofuels/ms_reports_dir_2003_30_en.htm

sale (mostly E85) alongside petrol or diesel pumps⁷⁶. B15 biodiesel started to be offered at stations throughout Sweden since Spring 2011.

CNG and LNG

There are about 3.000 filling stations for NG/biomethane across the EU and the Natural Gas vehicle (NGV) related industry already made investments of approximately 1.5 billion euro.⁷⁷ Also in this alternative fuel, tax reductions in compliance with the Energy Taxation Directive and/or incentives and obligations are the most common instruments that Member States use to promote natural gas and bio-methane (upgraded biogas). EC through the Sixth Framework Program-FP6 has co-financed the BIOGASMAX Project for the introduction of biomethane into the market. The total budget for the Project is about 17million euro of which 7,49 million euro is subsidized by the EC. Participating municipalities and regions are Lille (France), Rome and Lombardy (Italy), Torun and Zielona Góra (Poland), Göteborg and Stockholm (Sweden) and Bern (Switzerland).⁷⁸ Additionally, an example of coordination case is the GasHighWay project (funded by Intelligent Energy for Europe), in which Finland, Sweden, Estonia, Latvia, Lithuania, Poland, Germany, Czech Republic, Austria and Italy take part. The project aims at promoting the uptake of gaseous vehicle fuels, biogas and natural gas in Europe. The long term goal of the project is to realize a network of natural gas and biogas filling stations for the above countries. Some examples of best practice cases from this coordination in the uptake of NGVs and the expansion of the gas filling network are Sweden and Austria. Sweden has developed biogas network and expanding gridless infrastructure, while Austria experiences fast expansion of the natural gas refuelling network.

In terms of policies/legislation implemented for (CNG) and the relevant infrastructure efforts in some Member States, a description is found below⁷⁹.

Austria

The design, construction, installation and operation of a NGV 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. In terms of efforts for infrastructure deployment, the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management launched a program called “klima:aktiv”, embedded in the Austrian federal climate strategy. One of the targets of this program is to reduce CO₂ emissions from the transport sector. The purchase of the NGVs is

⁷⁶ The Act initially applies to filling stations with a sales volume in excess of 3000 m³. Sweden Biofuels Annual report 2009
http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Biofuels%20Annual_Sweden_6-24-2009.pdf

⁷⁷ <http://www.ngvaeurope.eu/transport-2050-ngva-europe-supports-the-white-paper-and-the-push-to-more-alternative-fuels>

⁷⁸ Biogasmax 2006/2010 synthesis report
http://www.biogasmax.eu/media/synthesis_report_biogasmax_web_036599500_1239_23122010.pdf

⁷⁹ National Reports on CNG/Biomethane state <http://www.gashighway.net/>

provisioned to be 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)⁸⁰.

Czech Republic

Czech Republic has established standards for the construction of CNG filling stations, through legislative framework. The following technical regulations from the Technical Committee CEN/TC326 apply:

prEN 13638 “Filling station for NGV”-basic document for TDG 304 02, which determines the conditions for the location, performance, testing and operation of quick filling CNG pump stations, considering the self-service filling by the final consumer. Self-service filling is allowed in the CNG pump stations mainly if they are equipped with NGV1 connectors. Not all CNG stations are considered eligible for self service, thus instructors must be present. For slow filling equipment there is the following standard: prEN 13945 “Filling equipment for vehicles”.

Specific trade licenses and certificates for performance of construction and equipment have to be acquired from the constructor in order to build-up the filling station. At the same time, there are infrastructure deployment efforts through indirect incentives. Among these, is the program for support of natural gas as alternative fuel in transport, which was approved by No 563 resolution of the Czech government on 11th May 2005. According to this, an obligatory agreement is made with gas construction companies to build 100 public filling stations by 2020. Czech Republic has currently about 49 filling stations. The gas construction companies shall also ensure the construction of filling stations for CNG along the main road transit direction through the country is 2 stages. Among the direct incentives for CNG pump stations construction is the option to get subsidies from the EU regional Operational Program for certain regions (i.e. Hradec Kralove Region, Pardubice and Liberec region, Moravia-Silesian and Central Bohemian Region).

Estonia

The national and regional laws, as well as technical regulations in this Member States barely cover the issue of using natural gas and biomethane in vehicles. No standards have been put in place. There are no direct benefits, incentives and support schemes for methane and biomethane filling stations development.

Finland

Since 2003, the NGV taxation follows the same pattern as the taxation of fossil fuelled vehicles, and there has been no fuel tax for gaseous fuels. However the fuel tax system was to change in 2011 and the new model of bio-methane and CNG taxation is not known yet. In terms of infrastructure deployment and standards, the technical regulations related to building a methane filling station are quite clear. The Finnish Natural Gas Association has together with the Safety Technology Authority made a guidebook of technical regulations on a gas filling station. There are 16 public filling stations for CNG in the southern part of the country. Gasum Ltd, is the national gas grid operator and plans to develop further the network of public natural gas fuelling stations (details in the next

⁸⁰ The dispensers are equipped with 1 or 2 hoses-using a standard "NGV1" connector. NGV1 is the standardised connector. Vehicles in Austria, Germany and Switzerland are fitted as standard with connectors of this type. All public filling stations are “fast-fill” fuel station with a filling time of 2 to 3 minutes per car.

section). In addition, there is one biomethane station. Finland is part of the GasHighWay project (funded by the Intelligent Energy for Europe Program 2009-2012, of 1.8 million euro budget), which tries to promote the uptake of gaseous fuelled vehicles, biogas and natural gas in Europe. Other countries participating in the project include Sweden, Estonia, Latvia, Lithuania, Poland, Germany, Czech Republic, Austria and Italy. The long term goal of the project is to realize a network of filling stations for biogas and natural gas in the participating countries⁸¹.

Germany⁸²

National laws and standards apply for the technical construction and operation of a natural gas filling station. Permission for construction of a filling station can be issued by local authorities and an explosion proof safety document must be obtained. As far as the standardization of the infrastructure is concerned, the joint technical standard for CNG filling stations G 651 A vdTÜV was introduced by the German Technical and Scientific Association for Gas and Water and the Technical Inspection Authority. Maintenance and operation of a CNG filling station has to be done according to DVGW Standard G 651. In relation to infrastructure deployment efforts, most of the incentives are indirectly related to the filling stations, through incentives for NGVs development. The incentives given to more than 120 local gas utility companies, concern new, used and/or converted CNG vehicles. The credits range from 500-750 euro. Example: CNG Credit of 400 kg on the local gas utility companies filling station; the cars must carry the approved stickers to indicate that it's a sponsored NGV. In addition, the Bank for Reconstruction KfW gives special incentives for commercial NGV's and Biomethane driven vehicles when they have the following criteria: exhaust emission standard EURO 5; filling stations for these vehicles; heavy duty vehicles with more than 12 tons with minimum Euro 5 exhaust emission standard. There are also tax incentives that promote the use of NGVs. Although incentives are in place, the lack of awareness of the general public is considered a barrier to the development of this alternative fuel market. In specific, consumers confuse the natural gas fuel with the LPG fuel. The advantages of the vehicle tax law for vehicles with lower CO2 emissions are not clear to the public. The benefits of the use of biomethane are not explicitly mentioned. Pricing of the fuel at the filling station is not very clear compared to the other fuels, because price for petrol and diesel is given in euro/lt, while the price for natural gas is in euro/kg. This may improve if all fuels were priced related to their calorific value. Frequent disadvantages mentioned in the report are the lack of filling stations. The variety of NGV models, the driving distance of the vehicles, engine sizes and the non-sufficient knowledge of the car dealers in relation to the NGVs.

Italy⁸³

Italian current regulations for CNG filling stations are summarized below:

- D.M. 24 Maggio 2002 -fire prevention regulation for CNG road filling stations

⁸¹ Further information on the project can be found at <http://www.gashighway.net/>

⁸² National Report on State of CNG/Biomethane Filling Station

<http://www.gashighway.net/default.asp?sivuID=25922&component=/modules/bbsView.asp&recID=18993>

⁸³ NATIONAL REPORT ON STATE OF CNG/BIOMETHANE FILLING STATION - ITALY

<http://www.gashighway.net/default.asp?sivuID=25922&component=/modules/bbsView.asp&recID=18993>

- D.M. 24 Novembre 1984 B-fire prevention regulation for CNG tubing
- D.Lgs. n. 93 del 25 Febbraio 2000-Attuazione
- Direttiva 97/23/CE B for CNG vessels
- Norma CEI 64B8 (IV ed.)-for electrical system
- Direttiva 94/9/CE del 23 Marzo 1994 (Atex)-for electrical system
- Norma CEI EN 60079B10-for electrical system in case of CNG installations
- Norma CEI 31B35 (classif. 31B35)-for electrical system in case of CNG installations.

Further infrastructure deployment efforts are made through the recent modification of the legislation, which allows for the construction of multi-fuel stations with CNG or small CNG station next to the petrol ones, as well as the possibility to install self-service refuelling systems at the CNG distribution network. There are incentives given not only for vehicles deployment, but also for CNG infrastructure. These are summarized below:

Liguria Region (2010): Total budget of 1.05 million euro for private or public entities interested in opening new CNG filling stations. Applicable costs can be reimbursed up to 70% of the total with a max limit of 90,000 euro per CNG filling station

Lombardy Region (2010): Total budget of 2 million euro for private or public entities interested in opening new CNG filling stations. Applicable costs can be reimbursed up to 50% of the total with a max limit of 200,000 euro per CNG filling station.

Lessons learned from the deployment of infrastructure in Italy:

According to a national report, despite the efforts, the refuelling infrastructure is lagging behind compared to other countries (i.e. about 700, with 23 gas filling stations on the motorway, one methane service station every 3,6 LPG service stations). The main problems mentioned in relation to the CNG filling stations have to do with coverage (i.e. the location of most of methane service stations are out of the cities, far away from the centre, and a very low number of stations are located on Italian motorways compared to the number of gas vehicles). It is thus necessary to develop the network of CNG filling stations both in and around the centre of the cities and on the main roads. In relation to the customers of gas filling stations and the Grid operator, one of the main problems is represented by the penalties imposed if the filling stations exceed the daily allowed consumption rate. Furthermore, a technical problem that causes dissatisfaction of the customers is the waiting period for refilling with methane in service stations. The engine of the compressors often does not support the load for the supplying from the gas grid, so the loading time could increase till 10-15 mins.

For LNG (Liquefied Natural Gas), converted temporarily to liquid to facilitate storage or transport, despite the capital intensity of LNG projects and the complexity of the value chain, LNG supply capacity is increasing at a fast pace. Existing schemes and greenfield projects are being expanded. According to the report, the operational costs (electric power and maintenance) for CNG delivered from an L-CNG station will be about 60% lower than the costs at a conventional CNG station. As a matter of fact, for a CNG station the electric power demand depends on the grid pressure; the higher the inlet pressure is, the lower the compression energy demands. Moreover the transportation costs for LNG are lower than for CNG as the report mentions.

Netherlands

Entrepreneurs in 2010 could participate in a tender under the aid scheme “Effective and Efficient Fermentation Chain”. They could submit proposals for innovative pilot and demonstration projects which would improve the profitability of renewable gas production and/or remove technical barriers for the supply of renewable gas to the gas network or filling stations. The aid granted was 7 million euro high.

LNG as a fuel for vessels

The International Maritime Organizations’ (IMO) marine fuel decision, the EU Marine Fuel Sulphur Directive, supporting 0,1% sulphur content in ship fuel from January 2015⁸⁴, the enforcement of the ECAS zones (Emission Control Area for Ships) in several European seas work as a motivation towards the adoption of LNG fuels. However, investment options are influenced by assumptions on the price development of LNG in the short term and long term. According to the Feasibility study by the Danish Maritime Authority (October 2011)⁸⁵ price development is influenced by spot market prices (traditionally price was set by oil indexed long term contracts). The LNG market will also be influenced by the price development and technology development of the alternative fuels it competes with, such as 0.1% sulphur maritime gas oil (MGO) and Heavy Fuel Oil (HFO). LNG infrastructure for fuelling vessels is at a very early stage, with only Norway and Sweden having developed small scale LNG terminals for bunkering purposes. The Baltic area seems to have promising development for this infrastructure type as a result of the supply of LNG in this region, regulations in emissions and also incentives for SOX and NOX emissions reductions in Northern Europe. Some of them are the Norwegian NOX Fund and Swedish fairway and differentiated port dues, as well as voluntary agreements (e.g. the Green Award Certification).

LPG

There exists developed LPG infrastructure across most Member States, the leaders being Italy, Poland, Netherlands, Germany, Bulgaria, while in others, like Greece and Spain it is not sufficient. Although the price is attractive for this fuel, perception of safety issues by customers (combination of car supply issue with lack of information on safety) hinders the development of a sufficient distribution network.

⁸⁴ Shipping’s airborne emissions are regulated in ANNEX VI, in MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships). In October 2008, the IMO adopted the more restrictive limit values for sulphur in marine fuels (i.e. 0.1% sulphur content limit by weight on Jan. 2015). In addition, according to the Marine Fuel Sulphur Directive (1999/32/EC, Art.4 with Amendment as per Directive 2005/33/EC) the sulphur content in marine gasoil within the territorial waters of a Member States Member States of the EU (Baltic Sea, North Sea, English Channel) may not exceed 0.1% by weight, applicable to all vessels regardless of flags <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2005:191:0059:0069:EN:PDF>

⁸⁵ North European LNG Infrastructure Project: A feasibility study for an LNG filling station infrastructure and test of recommendations (Baseline Report), Danish Maritime Authority http://www.dma.dk/SiteCollectionDocuments/Tema/LNG-tender/Final%20Baseline%20Report%20LNG%20Infrastructure_MGG_20111020x.pdf

Germany⁸⁶

Up to 2004, the refuelling infrastructure was not sufficiently developed. Then, the German Association of Liquid Gas (DVFG) motivated its members to invest in LPG infrastructure in order to compensate for the decreasing gas use in heating. The members of the association agreed to uptake investments in 2006/7 and LPG stations started to expand. Although the heating sector continues to experience decreasing demand, the members that agreed on making the investments have not experienced a decrease in their sales. The price of LPG in Germany as of 2009, was € 0.63/lt. Efforts for deployment of this alternative fuel mainly focus on the LPG vehicles, which are subject to tax reduction until 2018, according to the German Renewable Energy Act (EEG). LPG as a fuel will be taxed € 9.45/lt, while gasoline is taxed at € 65.45/lt. CNG and LPG taxation is equalised.

Poland

Poland is the leader in terms of number of vehicles and LPG stations in the EU. Policy incentives in Poland have focused on the LPG transport fuel and vehicles. Excise duties on LPG fuel are much lower than petrol and diesel. In addition, car conversions are cheaper in Poland compared to the rest Member States.

⁸⁶ <http://www.ecn.nl/docs/library/report/2010/e10037.pdf>

Chapter VII - Alternative fuel infrastructure standards

Summary of the state of the art and contributions on standards for alternative fuels infrastructure particularly in relation to key items such as fuel quality, refuelling equipment, nozzles, storage tanks, gas injection into the grid, safety and consumer information.

Electricity

Regarding electric charging points, the work of the European standardisation bodies, under mandate of the Commission, for a standardised charging interface is still on-going. This single interface solution should be adopted by all industry players, including vehicle manufacturers, electricity providers and electricity distribution network operators, to ensure interoperability and connectivity between the electricity supply point and the charger of the vehicle. There is currently no decision on a single connector. The lack of decision on the standardised plug for both AC and DC may hamper the market up-take. However, new harmonised standards should not make charging from domestic sockets complicated, as this charging method along with public slow charging, facilitates the early market introduction of electric vehicles. In general, at the early stage of market development, it is important to leave room for further market improvements. . In addition to interoperability issues, billing issues would also have to be eliminated through harmonised standards for public charging points.

At a later phase, when market will have been developed, it is important to have agreed on smart charging standards, which could facilitate load management in a smart grid at peak demand hours.⁸⁷

Hydrogen - contribution from JTI

What action has already been taken for the adoption at European level of existing draft SAE and ISO standards for hydrogen and fuel cells for the transport sector in relation to key items such the hydrogen refuelling interface, hydrogen fuel quality, hydrogen refuelling station safety?

Existing (draft) standards are currently applied voluntarily, and are already instrumental for supporting deployment and gaining acceptance by the various stakeholders. For ensuring safety, key items such as the hydrogen refuelling interface, hydrogen fuel quality and refuelling station safety will need to be specified by regulation. Thanks to an agreement between ISO and CEN (the so called Vienna agreement), the ISO standards, once published, can directly become EN standards as well, making them suitable for use in relation with European regulation. This path provides a strong connection between the European framework and international standards, developed by consensus among experts of the international community, and thus ensures access to global markets for FCH products.

⁸⁷ Load management in a smart grid context can optimise the distribution grid, however decrease of the battery's lifetime should be taken into consideration during the load management process.

For hydrogen vehicle type approval, technical requirements regarding qualification of the fuel tank and the fuelling interface have already been defined through formulation directly in European regulation, as the standard on the matter was not published. However the text is based on the draft ISO standards on these matters. It can be expected that this regulation will eventually be calling out these standards once they are published, instead of duplicating them.

What action (if any) has been taken by standardisation bodies for the adoption of standards for fuelling protocols, stationary storage of hydrogen, high pressure hydrogen trailers and delivery by trans-filling?

These standards are in varying stages of development. The idea is that these will follow the same path as the ones mentioned above

What action is necessary to implement standards already adopted

Standards are voluntary by design. However, they can readily be made compulsory through regulation where this is deemed necessary for interoperability or safety reasons, e.g. for ensuring that a hydrogen vehicle can be safely refuelled in any European refuelling station.

Note: Further Industry led coordination between stakeholders (which has been referred to as RCS Strategy Coordination) would allow not only to develop a shared vision of what standards are needed and how they should, where relevant, interact with regulation, but also strengthen future European input into the international ISO/IEC standard system resulting in increased competitiveness and improved access to foreign markets.

Hydrogen -contribution from EHA

What action has already been taken for the adoption at European level of existing draft SAE and ISO standards for hydrogen and fuel cells for the transport sector in relation to key items such the hydrogen refuelling interface, hydrogen fuel quality, hydrogen refuelling station safety

Existing (draft) standards are currently applied voluntarily. For ensuring safety, key items such as the hydrogen refuelling interface, hydrogen fuel quality and refuelling station safety will need to be specified by regulation. Thanks to an agreement between ISO and CEN (the so called Vienna agreement), the ISO standards, once published, can directly become EN standards as well, making them suitable for use in relation with European regulation.

For hydrogen vehicle type approval, technical requirements regarding qualification of the fuel tank and the fuelling interface have already been defined through formulation directly in European regulation, as the standard on the matter was not published. However the text is based on the draft ISO standards on these matters. It can be expected that this regulation will eventually be calling out these standards once they are published, instead of duplicating them.

What action (if any) has been taken by standardisation bodies for the adoption of standards for fuelling protocols, stationary storage of hydrogen, high pressure hydrogen trailers and delivery by trans-filling

The idea is that these will follow the same path as the ones mentioned above and are in varying stages of development: in the Netherlands the NPR (Nederlandse Praktijk Richtlijn) regulation has been developed by the NEN (Dutch Standardization Institute) <http://www.nen.nl/web/Normshop/Norm/NPR-80992010-nl.htm>. In Italy hydrogen station regulations still allow pressures up to only 200 bar, although recently the refuelling facilities to supply the first fleet of fuel cell hybrid buses in Milan was allowed 350 bar.

What action is necessary to implement standards already adopted

A suggestion is to qualify hydrogen as an official fuel so all public bodies dealing with motor fuels would recognize hydrogen in the same way as gasoline, diesel, LPG CNG. This would facilitate the homologation of motor vehicles, approvals for fuelling stations, public development plans (bestemmingsplan), (...) Standards are voluntary by design., however they can readily be made compulsory through regulation where this is deemed necessary for interoperability or safety reasons, e.g. for ensuring that a hydrogen vehicle can be safely refuelled in any European refuelling station.

Note: Further Industry led coordination between stakeholders (which has been referred to as RCS Strategy Coordination) would allow not only to develop a shared vision of what standards are needed and how they should, where relevant, interact with regulation, but also strengthen future European input into the international ISO/IEC standard system resulting in increased competitiveness and improved access to foreign markets.

A good example of effective industry led coordination was the relatively swift adoption of nozzle standards for hydrogen refuelling.

Biofuels – contribution from E-PURE

The equipment to be harmonised, such as nozzles, storage tanks, and so forth

What safety legislation needs to be harmonised, if any?

Question 1 and 2: In the framework of CEN/TC19 WG 38 has elaborated a draft "Roadmap for test methods and requirements for unleaded petrol containing more than 10% ethanol". Chapter 8 "Refinery, blender and logistics: Current and future constraints and opportunities" looks, amongst others, into the issues you raised in your questions 1 and 2.

Although the roadmap does not yet provide clear answers it is an important step to discuss these elements at CEN level. As you know, CEN brings together a wide range of industry stakeholders such as the oil, car and ethanol industry. As the issues related to fuelling infrastructure, storage and safety are discussed by CEN we are confident that a common ground will be found among the relevant industries to move E10+ forward in a structured and well prepared way.

The state of play with work being done by CEN for the adoption of standards for ethanol 25, and B30, or other blends

DG ENER is currently looking into the possibility of setting up a task force under CEN, again bringing together the oil, car and ethanol industry, to start work on a CEN workshop agreement. This is not precisely a full-fledged EN-norm but a crucial step towards a commonly agreed standard for E10+. Also, CEN recently created an Ethanol Fuel Task Force which has as objective to agree on some outstanding issues linked to

ethanol as a blending component with petrol. This work is progressing well and is yet another building block for a future E10+ standard.

Consumer information considered necessary a) to be displayed; b) to be provided to consumers otherwise

With regards to consumer information the introduction of E10 in France should serve as a reference point. E10 was introduced in April 2009. In 2010, SNPAA, the French association of ethanol producers, did a survey that showed that many people who could take E10 in their vehicle didn't because they feared that it could damage their cars (while the vast majority of cars in France is E10 compatible). When the customers were asked where they would wish to see the information of compatibility the overwhelming majority said at the pump. That's why comprehensive information material was produced to inform the customer such as stickers and posters.

Methane - contribution from the Natural Gas Vehicle Association

The equipment to be harmonised, such as nozzles, storage tanks, and so forth:

Currently, there is no EU applicable CEN standard for the build-up of NGV 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 because a CEN consultant in charge of the project standard kept voting against it, while the rest of the group was in agreement.

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.

Nowadays, there's an on-going process within ISO for the development of CNG and LNG/ LCNG refuelling station standards, within ISO/TC 252. The next points intend to give an overview of the legislative situation:

- 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.
- CNG Connectors/Receptacles: ECE Regulation 110, which refers to ISO 14469 parts I and II (LDV connector and HDV connector or NGV1 and NGV 2 connectors)
- LNG Connectors/Receptacles: ISO is currently working on a draft standard on this point, which is the ISO/CD 12617. Target date to deliver is mid-2014
- CNG Vehicle Components: covered by ECE R 110, which refers to different ISO standards like the ISO 15500 or ISO 15501?
- LNG Vehicle Components: some specifications being developed by ISO (i.e. LNG Tank by ISO/CD 12991, other LNG components by ISO/CD 12614). UNECE is working on this also via the GRSG LNG Task Force. The aim of the TF is to amend ECE R 110 to include LNG within the scope. Target date to deliver is 2014 - 2015

The state of play with work being done by UNECE and ISO for the equipment at point 1

See answer to last point. Special care must be taken when drafting infrastructure and vehicle standards, as full compatibility must be sought. Currently, 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.

What safety legislation needs to be harmonised:

We should pursue that, when all this on-going legislative work is finished, it doesn't show inconsistencies between the vehicle and the infrastructure point of view. Points of interest to be harmonised could be:

- Safety distances at refuelling stations. Both, for CNG and LNG
- Explosive-zones classification and characteristics
- Holding Time (time without venting) required for LNG systems on-board and off-board the vehicles
- Refuelling Stations Specifications to cope with the market needs and characteristics (as commented above)

The state of play with work being done by CEN for the adoption of standards for biomethane to be injected into the natural gas grid:

Currently, CEN is working on this subject upon Mandate M/475 submitted by the European Commission. The Mandate specifies that CEN should develop two standards, one for grid injection specification, and a second one for biomethane used as a vehicle fuel. Three meetings have been held so far, and still there are discussions within the group about the basic work being mandated by the EC.

Most of the Committee members think that the creation of a non-blended biomethane fuel specification does not answer the needs of the NGV industry, as practically no one is using nowadays pure biomethane for automotive applications. The Mandate is being discussed with the EC representative (Mr. Maniatis), and the standards are being drafted within the group.

Consumer information considered necessary a) to be displayed; b) to be provided to consumers otherwise

Currently, 17 countries within the EU are selling NG in Kg, while the rest are selling in Nm³, and the tendency for the future seems to support the current scheme. Taking into account that the average energy content of a Kg of NG is higher than the content of a litre of Diesel or Gasoline (see information below), we could conclude that the current pricing scheme could be misleading for the customer, and of course negative for the NG business:

- Average Energy Content of NG: 13.15 kWh/Kg (Density of 0,73 Kg/Nm³)
- Average Energy Content of Diesel: 9.85 kWh/l
- Average Energy Content of Gasoline: 8.8 kWh/l

Initially, there would be a few options on this regard as, theoretically, the NG could be sold by mass, volume or energy. As from a fiscal and thus legal standpoint the measurement method must be accurate, experiences in some EU countries such as Italy and Germany have proven that the mass measurement through Coriolis mass flow meters is the only reliable and economic feasible option nowadays. The energy content of NG is in some markets also communicated by marketing the price of the gas in terms of petrol equivalents, to facilitate the customer's comparison of fuel prices. Nevertheless this practice has recently been deemed unlawful in Sweden, and the Swedish NGV actors are looking into the possibility of instead selling the gas as energy, e.g. at a unit of 10 kWh.

The great variations found in NG quality across Europe would imply that, if technical measurement solutions would be put in place in order to enable measurement of energy content, the CAPEX for a NG refuelling station construction would increase by 10-20% on average.

The conclusion would be that, even though the change to energy units is deemed as something positive for the NGV business, the reliability and economic feasibility of the process is somehow blocking the change nowadays if exact measurement of the energy content would be required. In some NGV markets, the variation in NG quality is not so high as in other markets, making it possible to calculate the energy content instead of measuring it online. Under the assumption that the price would always be adjusted to make sure that the customer does not suffer economic damage, it would be greatly appreciated if this practice could be allowed as an option.

All in all, the above reasoning implies that the charging of the fuel supplied to the customer can only be dependent on traditional mass-measurement systems while, in parallel and for informative/comparative purposes, the information shown could be referred to energy units i.e. €/10kWh.

Liquefied petroleum gas (LPG)

The industry has set out a voluntary standard (EN 14678) which outlines technical and safety requirements for autogas filling stations. A key objective for this standard was to increase user friendliness and apply similar standards to those used for conventional fuels, thus facilitating integration into national legislation. The LPG industry is currently in the process of revising the standard to include specific requirements for un-manned stations and multi-dispensers. The development of these two forms of LPG filling stations, which are currently subject to unnecessarily stringent regulations in some Member States, may represent a crucial opportunity for the further growth of this alternative fuel in Europe.

In addition to the Euro connector (EN 13760) which was created in 2003 but has only shown limited uptake (Spain), three types of filling nozzle are used across Europe: Dish filling unit, Bayonet filling unit and ACME filling unit.

Although the coexistence of several filling units in Europe can possibly create inconvenience for autogas users, this does not prevent travelling across Europe as adaptors can be used. Autogas users can either buy such adaptors or borrow them at the filling stations.

The use of a single standardised connector across Europe would certainly enable the autogas market to grow further. However, such a move would have a considerable cost that could only be justified if the wider EU legislation was ensuring legal certainty for the longer term development of the sector. Obvious examples of such critical pieces of legislation are those dealing with the taxation of energy products or safety requirements concerning the installation of LPG filling stations in urban areas.

Chapter VIII - Advantages and disadvantages of policy instruments

Summary of main features and comparison of relevant policy instruments for the development of infrastructure, i.e.: granting of exclusivity rights; awarding concessions; direct public financial support; public guarantees; strategic alliances and collaborative partnerships; and public procurement.

Granting of exclusivity rights

Advantages

As infrastructure develops triggered by the first mover's investment, fuelling equipment manufacturers achieve cost reductions through learning and increased economies of scale, as unit costs fall with cumulative production. Thus, despite limited access to certain areas, depending on the extent of the rights granted, future infrastructure investors in other areas can collect the benefits of reduced capital investment cost due to learning effects at the equipment manufacturer level. In this way, first mover infrastructure investor establishes maintains leadership in the area where it was granted exclusive marketing rights, while others are able to expand infrastructure in other areas at a lower unit cost taking advantage of network effects

Obviously, there is a trade-off, which is difficult to be addressed through policy, that of protecting the first mover from free riding through exclusive rights versus exploiting positive externalities that free riders would bring at a later stage through increasing economies of scale at equipment manufacturers by their additional demand.

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. Granting a limited number of licenses to companies which would bring in the GSM technology was a policy option to overcome the market entry barriers due to demand uncertainty and has proved to be successful. Throughout the '80s the first GSM licenses were issued by 5 Member States to their Public Telephone Operators before additional licenses were granted to second operators; Belgacom, PTT Telecom Netherlands, Sip of Italy, Spain's Telefonica and Telecom Eireann were first movers "protected" by licenses from potential competitors. The limited number of licenses aimed at ensuring investment cost recovery of the infrastructure, protecting first investors from competition forces which would lower the prices taking into consideration that the expectations about demand were uncertain. Over time, however, the initial investors brought positive externalities to the market by removing uncertainty about future demand which has subsequently increased substantially; in view of these relaxed market obstacles, authorities have granted additional licenses in an effort to increase competition in the telecommunications market and achieve lower prices. The new mobile communication

providers used more advanced technologies (e.g. higher frequencies and additional services) which have created technology-related positive externalities which acted in favour of customers and have facilitated market entry. However, the initial investors have been locked-in the first generation technology and faced difficulties in modernizing their technology portfolio. In that sense, the initial limited licensing has proved to be disadvantageous to full exploitation of technology progress in later stages of market development. Nevertheless, the experience from other countries that have acted later, has proved that without such limited licensing the mobile communication market would have developed later with negative effects on consumers' utility. Therefore, the above example from the mobile communications market shows that a balanced approach is appropriate for addressing the issue of overcoming initial barriers to first moving investors and at the same time ensuring least possible effects from technology lock-ins.

Disadvantages

If the initial investment is excessive in area coverage, as a result of exclusivity rights, then the monopolistic first mover will not have interest in developing an appropriate coverage and provide better services. The market entry of 'follower' infrastructure investors would be prevented despite their use of possibly more up-to-date technology, or offer of services of better quality and lower cost. In other words, a technology lock-in, monopolistic profits and lower service quality may result by granting exclusive rights to first mover investors. This is the case in mobile telecommunications, where licenses granting led to the introduction of the GSM technology, but also a lock-in for certain period of time, delaying newer technologies (e.g. 3G) from entering the market. As far as 3G technologies, Western-European countries assigned radio spectrum for the provision of 3G mobile telecommunications services over the years 1999-2003. "The assignment of 3G licenses was the implementation of a decision taken at European Union (EU) level in 1998. However, the licensing process was not coordinated across countries. At the post-entry stage, new entry was expected to increase competition, leading to lower prices and better service. However, there was little prior investigation on whether the market would accommodate more firms in a competitive setting."⁸⁸

Attention should be given to the fact that when technology is at a very early stage, and there are no signals (e.g. through binding infrastructure targets) to boost anticipations about future demand for equipment by infrastructure investors, learning effects may not fully take place. As mentioned before, granting licenses with excessive exclusivity rights to first movers will have the drawback of locking into an early technology, out of which positive externalities can be limitedly exploited. In this case, entrants at a later stage, when technology has matured and reduction of unit costs of equipment production has taken place, are most likely to bring positive externalities to the society, provided that they can overcome market entry barriers, which depend on the extent of initial granting of exclusivity rights.

⁸⁸ Harald Gruber (2007), "3G mobile telecommunications licenses in Europe: a critical review". <http://www.emeraldinsight.com/journals.htm?articleid=1626670>

Awarding concessions

The case of ports

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.) The case of ports is different than telecommunications as regards the nature of the facility (i.e. port is a physical facility, it can handle a certain number of ships). Ports can qualify as “essential facilities” - a facility or infrastructure without access to which competitors cannot provide services to their customers. Taking the above into consideration, when a concession is granted to a private port operator, an asymmetric relationship is produced between the operator that actually manages the ‘essential facility’ and the companies that use it. In this context, a vertically integrated port operator could deny or discriminate the provision of access to its competitors. Exclusion of competitors leads to sub-utilization of the infrastructure and higher prices and goes against competition rules. Therefore, the port authority must guarantee under the concession access to the port’s essential facilities by third parties. The private operator has the duty to provide third party access according to the doctrine of essential facilities, which prohibits abusing dominant position in the common market.⁸⁹

The case of natural gas distribution

A different case is that of local distribution of natural gas in cities. Distribution companies are awarded territorial exclusivity rights (concessions) for a specific geographical coverage and certain period of time since there is limited scope for competition due to the natural monopoly characteristics of this sector. The concession allows the distributor to undertake investment in infrastructure without facing uncertainty about its market share in final demand; competition would discourage such infrastructure investment. However, once the infrastructure gets a certain degree of coverage, risk of abuse of monopoly power by the distributor raises concerns. For that purpose, regulatory authorities apply price supervisions. The risk of technology lock-ins is limited in the case of gas distribution because the technologies are commercially mature in most cases. Similar examples about concession practices exist for building motorway infrastructures, development of touristic areas, etc.

Advantages

Concessions create regulatory certainty for investors, without directly committing public funds, which frees-up government funds for other projects. In the ports case, the result of concessions has been more efficient management by the private port operators.

Disadvantages

Possible obstruction to competition in coordinated markets, which is often addressed by regulatory policies imposing third party access to essential facilities.

⁸⁹ Article 82 of the EC Treaty.

Under a concession, state has to supervise the progress of the concession, and intervene through regulatory controls for ensuring progress in infrastructure development and for avoiding abuse of monopoly power. Also, regulatory intervention is sometimes needed to impose modernization and technology standards in order to ensure high quality services. In addition, if the concession awarding process is not successful, inefficiencies may arise in the form of excess costs, insufficient coverage or inferior technology. It can end up a financial burden both for the public authority and the private investor, as there are high transaction costs involved. Possible adverse effects on future market entry under the concession are treated by the duty to grant third party access or by extending the concessions if physical constraints allow for.

Direct public financial support

Advantages

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.

Disadvantages

Thus far, the financial support framework to build up alternative fuel infrastructure has been insufficient to encourage new investors. First mover's investment could be encouraged through direct financial support; however, concession or exclusivity rights schemes would entail less burden to the state. It must be ensured, however, that direct financial support by the state does not go against state aid rules and cause distortion of competition and affect trade among the Member States.

State aid has to do with all forms of assistance that is provided by the state to investors/ industries (state grants, interest relief, tax relief, state guarantees). The EU controls state aid through a central pillar of the "acquis" which complements EU's antitrust and merger control regimes. State aid is incompatible with internal market according to the TFEU and it is not allowed if it distorts competition. There are however exemptions, i.e. regional development aid, aid to "sensitive" sectors where state aid can be granted. There are exemptions for transport state aid under Council Regulation 1107/70 for certain aid to coordinate transport in the context of liberalisation. Member States are required to notify the Commission in advance as per Council Regulation (EC) No 659/1999. They have to present an annual report to the Commission giving the total amount of state guarantees outstanding, the total amount paid in the previous year by the State to borrowers and the premiums paid for state guarantees in the same year.

Public guarantees

These are dedicated to the implementation of infrastructure with high risks of non-profit.

Advantages

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.

Disadvantages

This aid might lead to competition distortions, which however the European Commission has addressed through a notice on Directive 80/723/EEC on the transparency of financial relations between Member States and public undertakings. This notice sets the conditions for exemption from the competition rules.⁹⁰

State aid that complies with the following conditions is compatible with the competition rules and thus exempt:

- “The borrower is not in financial difficulty”
- “The borrower, in principle is able to obtain a loan on market conditions without any state intervention.”
- “The guarantee is linked to a specific financial transaction.”
- “The guarantee gives rise to payment of a premium on the market price.”

The same rules apply when the guarantee scheme is public. Additionally, the premiums cover both the normal risks associated with granting guarantees and the administrative costs of the scheme and allow for a normal return on capital.

Further self-regulation through strategic alliances and collaborative partnerships

Advantages

Strategic alliances can strengthen competitiveness and eliminate first mover's disadvantage. The first mover can develop through a joint venture or strategic alliance innovation with other companies; if the firm lacks complementary assets, barriers to imitation are high, and there are several capable competitors. A joint venture partner is a firm that possesses the complementary assets to achieve innovation. This is a vertical integration strategy which allows for extending the competitive scope of the first mover within the industry (economies of scope). Strategic alliances can refer also to horizontal integration, whereby economies of scale can be exploited. In strategic alliances there are the benefits of jointly contributing to the resources, exploiting economies of scale, sharing the investment risk and control.

Disadvantages

The potential disadvantage of the strategic alliances is that high concentration might hinder competition.

⁹⁰ Rules applicable to state aid:
http://europa.eu/legislation_summaries/competition/state_aid/126083_en.htm

Public procurement

Public procurement has the advantage which is also a disadvantage at the same time, that of 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 investor⁹¹.

Disadvantages

Due to principal-agent conditions, public procurement for infrastructure providing services is certainly less cost-effective than concessions approaches, where private investors have incentives to procure equipment at low cost and maintain the infrastructure in good operational quality.

⁹¹ “The great transformation: Decarbonising Europe’s energy and transport systems” Bruegel Blueprint Series, February 2012.