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Report of the STTP Stakeholder Workshop on Fuels and Energy

Participants:

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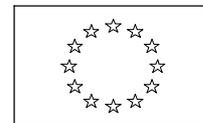
Venue: Brussels, 15 February 2011

1. SCOPE OF THE WORKSHOP

The European Commission is currently developing a Strategic Transport Technologies Plan (STTP) with a time horizon 2020-2025. The STTP is conceived to comply and contribute to the implementation of the policy objectives and strategic goals set out in the 'White Paper on Competitive and Sustainable Transport'. The adoption of the STTP is foreseen for mid-2011 and it will play a main role in the definition of the Commission's future transport research and innovation priorities. The aim of the STTP is to match the most appropriate policy instruments to the needs of different technologies at different stages of the development and deployment cycle. It will address the entire innovation chain, from basic research to market uptake. The STTP will facilitate coordination of European and national public and private efforts and help achieve greater leverage through flagship EU instruments.

The STTP will include roadmaps for a set of leading edge technological solutions, including the supporting organisational, financial and governance frameworks, which are necessary for a future competitive and clean European transport system. The availability of appropriate research coordination structures has been identified as a potential critical issue for the transition to such a transport system.

The involvement of the stakeholder community is crucial to reach a shared European vision on the role of transport technologies as a follow-up to the White Paper and to produce a credible and widely supported STTP. At the same time, the process of preparing the STTP will help to identify the measures needed from the different stakeholders to attain their goals, and will exploit synergies across them.



2. SETTING THE CONTEXT

A presentation on the STTP provided the stakeholders with insights on: rationale, objectives, structure, preparatory phase and indicative planning as well as expectations from stakeholders' hearings. It was emphasised that the term 'technology area' within the STTP is a comprehensive set of methods, practices and technologies with a shared focus of application. It encompasses all elements of the research and innovation chain (from research and demonstration including appropriate measures for the protection of intellectual property to market uptake and standardisation).

Discussion has been structured in accordance with the circulated questionnaire in 4 rounds of interventions: (1) Transport Vision and Activities: current status, development perspectives and expected impacts in first block; (2) competitive solutions; (3) Achieving the Vision, essentially focussing on: barriers, shortcomings, funding and organisational requirements; (4). Specific Questions on alternative fuels, including perspective solutions, limitations to development (including energy supply) and expected impacts.

Building on these elements for discussion as well as on received and incoming written contribution, the aim is to use stakeholders' input to contribute to a realistic view of what is the vision 20 years in advance and what are the technologies, including organisational and regulatory aspects, that will allow us to get there.

The guiding principle (*leit-motiv*) of the discussion is therefore: how technologies are expected to help the European Commission achieve its transport policy and transport research policy objectives, on the one hand, and how the European Commission can optimise resource use by investing in properly selected and prioritised technology areas via properly designed governance and funding schemes.

Stakeholders' advice is one of the inputs to the scientific process leading to the STTP Communication, as work is now focussed on identifying key technology areas in the ITS domain. Additional input was requested by the end of February. Stakeholders were also informed that opinions are also welcome via the Internet public consultation to be launched soon for 8-week duration or by sending emails to move-sttp@ec.europa.eu. The Commission will take into due consideration any input received within given time constraints.



3. SUMMARY OF MAIN DISCUSSION POINTS

3.1. Transport Vision and Activities

- Key technologies expected for development (incl. identified barriers)
- Penetration targets (i.e. ‘By when?’)
- Expected impacts
- Interaction with other sectors (competition/synergies)

1. By 2020 the mix of fuels is not expected to change significantly, therefore the role of improved/incremental energy efficiency in ICE engines is relevant. It is relevant to devote attention on costs and cost-effectiveness of innovative ways of purchasing personal mobility services taking into account consumer acceptance and infrastructural needs.

Despite the progressive introduction of fuel alternatives (biofuels and electricity) and the increasing fleet renewal towards low-carbon solutions, long-distance transport is expected to remain largely dependent on liquid fuels: how much of that is displaced by promising alternatives such as synthetic fuels and liquefied natural gas (LNG) depends on investment patterns including feedstock availability at economic cost.

The current diesel-gasoline unbalance in European refining is expected to remain and investment decisions for both production switch and technology upgrading require a clear anticipation of expected demand profile. With respect to security of energy supply, it was noted that Europe imports not only crude oil and biofuels but also refined fossil products, namely diesel and jet fuel from the Middle East and Russia: these concerns need to be accounted for when identifying promising technology areas, including consideration of the fact that compressed natural gas (CNG) and LNG displace diesel consumption.(see #5)

2. The pace of market introduction of electric vehicles was discussed with different views ranging from the expected market introduction % to the types of electric technologies comprised and to the types of mobility demand /needs replaced by electromobility, which – overall – is expected to have limited effects towards reaching EU decarbonisation and oil substitution targets. Conversely, long-term (beyond the time horizon of the STTP) impacts are expected to be important.

Electrification of given segments of road transport is considered as one of the main trends ahead moving at medium speed, also thanks to a regulatory environment providing the required support to a thrust in deployment of the technology pathways.

An array of electric plug-in hybrid electric vehicles (PHEV) is expected to represent a very good bridging solution before battery electric vehicles (BEV) approach/reach market maturity stage. This holds true for passenger cars but also for light-duty



commercial vehicles and urban buses as well as two-wheelers both electric assisted-peddalling bicycle and hybrid scooters.

3. When discussing hybrid vehicles, a clear distinction needs to be made between vehicles using electric as additional source (e.g. range extenders) or as main energy source and only the latter are to be included in the picture of electrification of mobility).

4. Synfuels¹ are a promising pathway (energy and greenhouse gas (GHG) well to wheel (WTW) performance depending on feedstock though), as they (a) represent an alternative to diesel, (b) can use existing distribution/re-fuelling infrastructure, (c) can be used neat or blended; (d) do not face sustainability concerns due to reliance on residues and certainly non-food feedstocks, although concerns about supply of given feedstocks – such as hydro-treated vegetable oil and animal fats (HVO) – exist, (e) represent one of the very few alternatives suitable to several modes (maritime, aviation, road) where high density fuels are required by current powertrain technologies.

Also at refining, (f) they may represent a pressure valve to the current (and expected to grow) unbalance of gasoline-diesel production in European refineries.

All synfuels enable advanced engine technology and therefore enable a reduction in the consumption of fuel. HVO and BTL fuels provide scope for CO₂ emissions reduction, with HVO offering -40 to -80% and BtL -6- to -90% compared to conventional fossil fuels. According to the JEC Well-to-Wheels study the GTL pathway has slightly higher CO₂ emissions than conventional pathways, but this could be improved by CCS and/or future engine adaptation.

5. CNG and LNG represent a ‘ready available’ technology with minor needs in terms of RTD funding. CNG performs well both in terms of costs and environmental behaviour (regulated emissions and CO₂) and serving both passenger cars and heavy duty urban fleets (urban buses and utility trucks).

LNG is expected to be an expanding alternative for both heavy duty vehicles and inland waterways/maritime. RTD funding is needed to explore the widespread uptake of LNG.

Infrastructure is the key barrier to widespread development of NGV fleet as are harmonised rules to have bio-methane % either allowed in the gas grids or at service stations as well as investment in bio-methane production for both LNG and CNG pathways. Public procurement, fleet operators and public transport companies are the facilitators for market uptake. RTD funding is needed to assess costs and viability of LNG and CNG refuelling infrastructures across Europe.

¹ Synfuels are non-fossil diesel fuels made from various feedstocks including biomass (Biomass to Liquid, BtL and Hydrogenated Vegetable Oil, HVO), gas (GtL) and Coal (CtL).



Current expectations for both CNG and LNG are in the range of 5% fleet share in 2020 and 9% by 2030 whereas 9% is the rest-of-the-world average in 2020. Support to bio-methane production represents an economic engine for employment in rural areas but also an opportunity for production from urban waste landfills. Bio-methane is a promising pathway in that it is the only biofuel having the same composition than methane from fossil sources and therefore not subject to blending limitations.

6. LPG is today's main alternative to diesel and gasoline and the lowest GHG in WTT. Increasing grades of bio-LPG blending looks like the pathway ahead possibly slightly beyond the time horizon envisaged for the STTP (2030). No shortages of supply are envisaged despite steady growth trends in LPG vehicle fleet being expected. Expected fleet share is 10% by 2020, possibly rising to 15% by 2030.

7. Hydrogen as an energy carrier in fuel-cell vehicles is seen as a close-to-market alternative in view of the EU de-carbonisation target. Vehicle sales is expected to start as of 2015 with an estimated production capacity build up to 100.000 vehicle/year per original equipment manufacturer (OEM) by 2020, which would sum up to a few million vehicles in the fleet share by 2020 (i.e. 1.3% of vehicle fleet approximately).

Estimates are supported by the fact that, within the vehicle development cycle, the planned cost and performance targets are have been achieved by car manufacturers. Further research funding for vehicle technology development is required to a limited extent. The main barrier is refuelling infrastructure: where economies of scale need to be reached despite unit cost reductions becoming progressively within reach according to current feasibility and commercialisation studies by FCH JU. Nevertheless, wide-scale infrastructural build-up issues are still outstanding with respect to how, by when and where hydrogen refilling can be facilitated. Social acceptance of the fuel cell and hydrogen technology depends on the driving range where different electric powertrain technologies can co-exist for small (low-mileage) passenger cars, whereas for the mid-size upwards, FCH technology has the lowest Total Cost of Ownership (TOC) and the lowest CO₂ emissions for the mid-size and large vehicles with larger annual mileage, as indicated in the study 'A Portfolio of powertrains fro Europe'².

Hydrogen fuel cell (FCH) based range extenders in electric powertrains are yet another option: market introduction/success depends on costs and customer acceptance. In fact, FCH-based powertrain technology is mature for mass production, the introduction together with the infrastructural requirements hinders market introduction, which is a comparable situation with electric vehicle technologies.

NG vehicle technology provides an additional opportunity to combine with the development of the HFC vehicle technology and logistics by the mixed use of hydrogen mixed in proportion of up to 30% in volume with natural gas.

² <http://www.fch-ju.eu/page/portfolio-power-trains-europe-fact-based-analysis>



8. Liquefied petroleum gas (LPG) can be used not only in mono-fuelled vehicles but also in dual-fuelled vehicles (namely for HDV). LPG is also fully compatible with the trend towards hybridisation of the ICE. Concomitant burning of petrol and LPG is today being contemplated as a way to reduce pollutant emissions and to increase energy efficiency, particularly in view of EURO6 emission standards. This is not considered in general terms to be a transition situation but rather a long-term trend towards diversification in the mix of powertrain as well as fuel technologies.

9. Competition is twofold: upstream: feedstocks for synfuels production, where regional/national contexts impact on production sources available to produce the same fuel; downstream with diesel vehicles. Compatibility with CO₂ standards and no costs associated to vehicle adaptation allow optimistic perspectives. In any case, a mosaic situation in terms of fuel diversification is expected.

All alternative fuels will be needed to replace liquid fossil fuels in Europe and countries and regions will select portfolios from the multiple solutions based on: the most cost-effective options available; CO₂ concerns; security of supply. Improvements in CO₂ emissions per unit travelled are expected to be brought about via improved vehicle efficiency (including hybridisation, advanced engines and transmission of ICE), fuel technology and behavioural change.

10. Considering fleet renewal rates, changes in entire stock are necessarily slow. Focus on CO₂ emissions is likely to be misleading: CO, NO_x, particulate are relevant matters to improve tailpipe emissions with the objective of improving local air quality but also to enhance European industry competitiveness vis-à-vis an increasing concern in the fast developing economies. Noise reduction is another area where EU technological development funding would prove beneficial. NGVs offer a promising alternative to diesel, particularly for urban fleets (buses and utility trucks). Costs and energy efficiency of engines are the limiting factors for the deployment of existing new technologies: the new test cycle may have a substantial impact on those limiting factors.

11. A diversification of powertrain technologies and fuels as well as ICE energy efficiency improvements are likely to determine a slower-than-expected, disorderly-despite-intentions and – most likely – costly process. Public acceptance of alternative technologies depends on cost and performance. Deployment of alternatives cannot be considered sustainable if cost reductions of innovative solutions are based on subsidies. Today, fuel taxes represent one of the biggest tax incomes for European Member States and the induced change due to the introduction of alternatives (requiring incentive/subsidy schemes to reach critical market shares) needs to be carefully considered when defining priorities. Synergetic development of NGV and FC vehicle and fuel technologies are expected (see #7, last para.).

12. WTW energy efficiency for appropriate comparisons and also carbon pricing/ETS, focusing on decarbonisation of power supply, are expected to be important tools for bringing forward low carbon solutions. Based on European CO₂ emissions reduction policy objectives in fact, consumer acceptance is not the only variable at stake.



As appropriate comparisons are expected to be an increasing need, then the WTW approach is a suitable tool. A plural approach is needed to reach targets on emissions efficiency, so the competition between alternative powertrain and fuel technologies is expected to evolve: electric vehicles and FC vehicles are expected to develop simultaneously, be complementary for a relatively short transition time to end up competing in a specific market segment, which calls today for treatment on equal footing for required infrastructure investments and energy taxation regulation in both technology areas to allow large volume introduction and closing the gap between pre-market and market readiness levels.

13. Well to tank (WTT) represents 15% of the overall WTW, it certainly needs improvement but again some relevant trade-offs need being considered: improving the WTT balance by increasing biofuels share means reducing crude throughput by lowering European production which is not so good when overall demand is growing or, alternatively, implies turning to growing imports. The situation in other world regions is different for instance when it comes to the development of hydrogen refuelling infrastructure: due to the diesel-gasoline refining ratio in Europe using the vast majority of produced hydrogen to comply with diesel specs. EU policy objectives focussed on CO₂ emissions reduction targets favours diesel. At the same time, available alternatives such as LPG and CNG have already the best WTT performance compared to conventional fuels.

3.2. Achieving the Vision

- Recommended actions at EU level in terms of measures in support to innovative technologies
- Governance mechanisms with a reasoning on current situation and suggestions for future arrangements, including the EU, national and regional levels.

1. Level playing field and technology-neutral approach required at regulatory level, with less focus on the part of the Commission on one single route rather than a portfolio approach: market forces need to be given room to act. At the same time, industry has long term needs for defining targets and STTP perspective is not long enough so clear and defined targets in support of long term investment objectives of industry: lasting programmes at both MS and EU level towards AMF are expected to be both technology-neutral and clear in their targets so as to favour investment and structuring of continuous alternative refuelling infrastructure. A clear roadmap is missing for the next decade and then between 2020 and 2050 targets: incremental, intermediate targets would be beneficial to know: higher certainty level for 2025 targets is urgent as investment decisions are taken now.

Best practices' dissemination is to be exploited better beyond the pre-commercial dialogue established via ETPs. Broaden the scope of ETPs to a wider range of fuel alternatives to be part of forthcoming strategies. But also propose regulatory measures to offer at MS level AMF in stations above certain size, free parking, CO₂-based taxation.



Coordination based on the timely sharing and pooling of information is crucial to avoid double funding, among others, for incentive schemes adopted at national level. Incentives may be better utilised in the form of RTD funding. Also, better coordination with parallel initiatives, e.g. SET-Plan, and reinforced cooperation with Member States is a need.

The opportunity of a common strategic planning, PPP (as the FCH JU) are very good tools to bring technology deployment onto market via innovative technologies that are responsive to both industrial demand and societal needs. Care is required to resolve entry level barriers in PPPs.

More generally, an integrated approach is required in the road transport sector to achieve transport de-carbonisation and all relevant actors must share the same project: providers of energy, providers of vehicles, users of vehicles (both private and commercial users) focusing in particular on reduction of mobility intensity, local and national authorities to support an appropriate infrastructure and manage transport flows efficiently.

2. Gaseous fuel technologies have been neglected in terms of EU RTD funding but it is now relevant for new injection technologies, including concomitant injection of petrol or diesel with LPG or CNG to enhance efficiency and reduce after-treatment devices. Attention needs to be paid to all pollutants and not CO₂ only at EU and not at the national scale. With respect to supply chain, more support would be beneficial on bio-LPG facilities, including bio-refineries co-producing bio-LPG.

With respect to synfuels, RTD support is beneficial to enhance efficiency of processes like GtL and HVO and emphasis on supporting BtL from pilot scale to market deployment, for example in the form of a clear and timely indication of expected revised default values in RED and FQD so as to allow step-by-step approach to production investments. Reducing investment costs is critical, as current plants are challenged by relatively high capital costs. This can be achieved by optimising the collection, preliminary processing and gasification of biomass, as well as the purification of synthesis gas. Also, need for a coordinated support at European level with regard to supporting enabling technologies towards decarbonisation (CCS could in fact play a role in further improving the lifecycle emissions from GtL and BtL plants), which is actually a colliding objective with the technology-neutral approach.

Efficient energy storage is among the biggest outstanding challenge: to achieve CO₂ emission reduction targets and promote renewable resources, production technologies for green hydrogen and energy storage technologies would benefit from funding at EU level; a harmonised infrastructure planning at EU level would also be an important contribution to thrust deployment.

3.3. Sector-specific/additional points

1. Huge funding has been devoted to battery research, which increases the chance for a breakthrough within a short timeframe, particularly on Lithium-ion battery upgrading. Such a breakthrough would oblige to revise projections in plug in hybrid electric



vehicle (PHEV) – battery electric vehicle (BEV) prospective ratio. Today's technological limiting factors are: decarbonised electricity, including carbon capture and storage (CCS), renewable and nuclear pathways. Today's key technological barrier is energy storage and battery technology, focusing on range, energy density, energy recuperation.

2. For synfuels a clear and stable regulatory environment is needed at both EU and national level for encouraging investment in plants which are significantly more expensive than FAME production plants (10-15 years for ROI).

Research funding is needed for deployment but also to accelerate BtL technology development. In addition, long-term research funding should be envisaged to achieve non-food vegetable oils and algae oils for HVO production in significant cost-effective volumes for third generation fuels.

3. Retrofit technologies of petrol powered vehicle stock require attention at EU level and harmonised requirements for both LPG vehicles and filling stations.

Additional points.

4. Pre-normative collaboration on product standardisation seems to be effective but there is obviously fierce competition once products are on the market. The standardisation process should be led by EC. That is why for intellectual property rights (IPR) it is sometimes a hindrance to industry to induce cooperation. At the same time, when public funding leads to IPR then a licensing agreement should be foreseen to give access to technological breakthroughs, which is difficult to implement when other world regions do not comply. Therefore a further development of the already existing international patent system within the framework of the Patent Cooperation Treaty PCT and the European Patent Convention EPC in the direction of more transparency and cost efficiency is very much appreciated.
5. Rapidly increasing total energy consumption trends at world level need to be considered when defining both RTDI funding and collaboration as well as technology deployment in rapidly changing markets with regard to supply (availability and related costs).

Increased biofuel production should focus on maximising biomass output while limiting any negative environmental impact of its production as well as appropriate measures to prioritise the supply of high energy density alternative fuels to the sectors having no immediate fuel alternatives: aviation, long-distance road transport, freight transport.

The expected diversification of both vehicle and fuel technologies call for careful consideration of strategic materials' supply.



A WTW analysis allowing for a fair comparison of energy and GHG balance for all fuel and powertrain pathways is mentioned as a useful decision support tool.

6. Lack of safety would be a showstopper for any technology including the definition of standards and controls. Same would be for resources and know-how: indeed, people supporting the transition are crucial, so education and knowledge management are crucial.

4. CONCLUSIONS AND NEXT STEPS

The expectation that the mix of fuels will not change significantly by 2020 implies that a range of fuel options for different transport modes will be present in European energy research and economics. Strategic added value of EU support at both research funding and regulatory level will be part of the Scientific Assessment accompanying the STTP.



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APPENDIX 1

Stakeholder hearing Fuels and Energy

Tuesday, 15 February 2011, 09.30 – 13.00
Meeting Room DM24 (EAS) SDR1

- AGENDA -

Chairpersons: F. Soeldner, DG MOVE
M. Maggiore, DG RTD
C. Knezu, DG INFSO

- | | |
|---------------|-----------------------------------------------------------------------------------|
| 09.30 – 09.40 | Welcome and introduction of the participants
(<i>All</i>) |
| 09.40 – 10.00 | Objectives of the STTP, purpose of the hearings
(<i>R.Juriado, DG MOVE</i>) |
| 10.30 – 11.30 | General questions (Part 1 of questionnaire)
(<i>All</i>) |
| 11.30 – 12.30 | 'Fuels and Energy' specific questions (Part 2 of questionnaire)
(<i>All</i>) |
| 12.30 – 12.50 | Open floor for further stakeholder interventions
(<i>All</i>) |
| 12.50 – 13.00 | Summary
(<i>chairpersons</i>) |



APPENDIX 2

Fuels and Energy Questionnaire

1. INTRODUCTION

These questions are designed to facilitate the stakeholder hearings. We would appreciate, if you could send us your answers to the questions 1 week before the hearing. Please answer them in the way you consider most appropriate to convey your key messages. It would be helpful, if you could identify to which mode/technology area your answer relates to. To help answering the questions some suggestions are given regarding what could be explained under each question.

2. GENERAL QUESTIONS

2.1. Transport Vision and Activities

2.1.1. *Current state of play within transport?*

Indicate: market readiness/penetration of the different technologies within the activity area for each mode or cross-modal issues; on-going or planned public, public-private or private initiatives relevant for the STTP; type and scale of initiatives at which level - International/EU/MS/Regions

2.1.2. *Likely evolution of transport?*

Indicate: major trends in the transport sector (technology and actors); evolution of transport needs (volume and quality); likelihood of structural changes as a result of new business models, globalisation, competition; influence of the market structure on future market potential; possible effects of legislation etc

2.1.3. *Key technology penetration targets (2020, 2030, and 2050)? What are the main assumptions underlying these estimates? What are the main barriers to overcome to achieve them?*

Indicate: main constraints and showstoppers, risks, needs for technological breakthroughs, resource/feedstock availability, consequences for the current infrastructure, etc

2.1.4. *If these targets are met, what will be the contribution to EU policy goals in the field of transport?*

Indicate: Contribution to (1) achieving low-carbon transport (reducing CO₂ emissions and dependency on imported oil), (2) achieving seamless mobility in a Single European Transport Area (establishment of a seamless European TEN-T network that is intelligent, efficient, and green, single European 'transport ticket' for passengers and freight), (3)



competitiveness and innovation (e.g. future market sizes for a given technology, European share of new market, additional jobs, export revenues), (4) other policy goals (such as reduction of congestions, local/urban pollution, noise reduction, damage to cultural heritage, etc.)

2.1.5. Contribution to the overall ('well to wheel') energy efficiency?

Indicate: Effects on energy efficiency in electricity and fuels supply, as well as in use; evolution over time and depending on market penetration, etc

2.1.6. Are there any interactions with other community policies and initiatives?

Indicate: Potential contribution of the technology to other EU policies; need for measures and initiatives in other policy areas to support the market penetration of the technologies

2.1.7. Which are the main competing or synergetic technologies within the activity area? (in relation to the indicated market penetration targets)

2.2. Achieving the Vision

2.2.1. Is your vision achievable under a 'business as usual' scenario?

Indicate: Current support programmes and policy measures and their expected impact

2.2.2. Are there barriers to innovation? Is there a need for change in the innovation system?

Indicate: For the mode in question any weaknesses in the current system

2.2.3. Does the considered mode/sector already benefit from or plan to set-up initiatives to bridge the gap between the current state of technology and a cost-effective market entry? What would be the critical mass (e.g. investment) needed for such initiatives? What new approaches could be considered to accelerate innovation?

Indicate: i.e. how could the STTP help the sector; which actions of it would be most effective; what impact could be expected with respect to 'business as usual (i.e. No STTP)?



2.2.4. *What actions need to be carried out at European level? What actions would be better implemented at national and or regional level? Is there a need, or a potential benefit, to integrate or to better coordinate action carried out at different levels?*

2.2.5. *International Dimension - Is there a potential for international cooperation? What type of cooperation?*

Indicate: Major initiatives in other countries; assessment of specific opportunities for international cooperation

3. SECTOR/ISSUE SPECIFIC QUESTIONS

Fuels and energy:

1. Alternative fuels/energy carriers have been focussed upon by RTDI activities for passenger cars and for heavy duty vehicles to a lesser extent. Research is not far from its inception stage for other transport modes. What are the hindering factors you identify? How relevant are regulatory/financial incentives at EU level? How relevant is enhanced coordination between public and private research funding?
2. Alternative fuels/energy carriers are expected to be a niche market up to 2020-25. How do you value the opportunity and feasibility for a multiplicity of fuels (and related fuelling/distribution infrastructures) serving the transport mode in which you specialise? How do you value the opportunity and feasibility of a multiplicity of vehicle/vessel technologies served by the same fuel type? How do you envisage the longer-term future (based on today's EU CO₂-reduction mandatory targets) in the light of MS budgetary constraints and the feasibility of restructuring fuel tax revenues?



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APPENDIX 3

List of respondents

EARPA – European Automotive Research Partners Association

EUROPIA – European Petroleum Industry Association

FCH-JTI – Fuel Cells and Hydrogen Joint Technology

NGVA Europe – Natural Gas Vehicle Association