The Eurocouncil of the Fédération Internationale de l'Automobile
European Bureau

Cars21: EUROPEAN STRATEGY ON CLEAN AND ENERGY-EFFICIENT VEHICLES

Organisation : FIA

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Response to consultation

15th March 2010

QUESTIONS

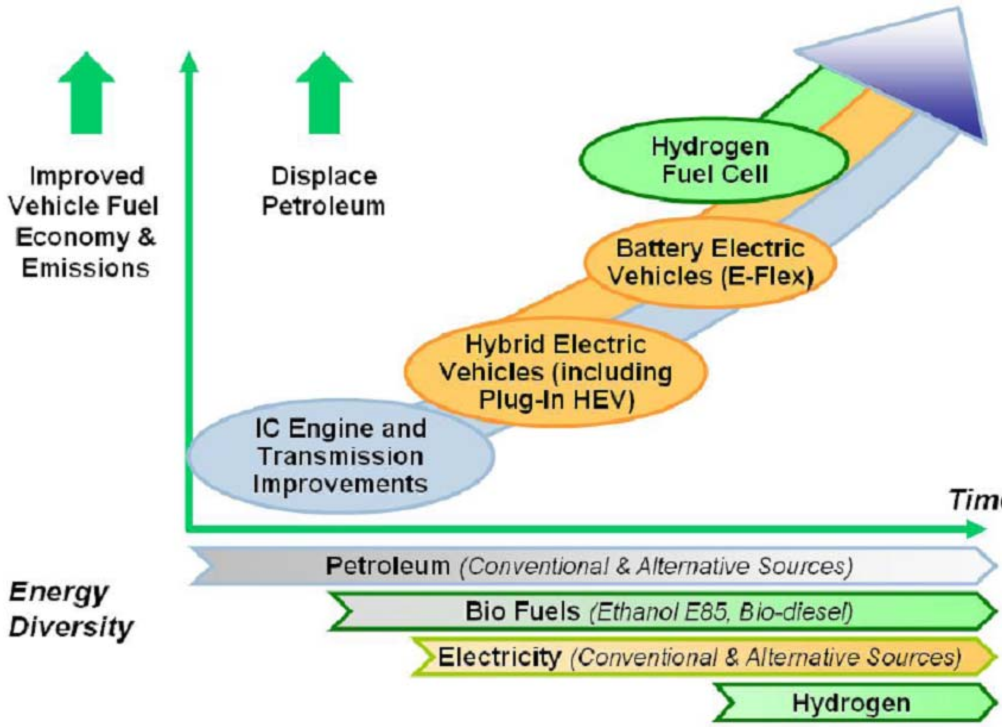
The first four questions aim to provide grounds for mapping and evaluating the technology and market potential of both conventional but increasingly fuel-efficient vehicles and of alternative powertrains (electric and hydrogen). In particular, the Commission wishes to identify the opportunities and risks associated with the development of the mass market for the electric and hydrogen vehicles. These questions are without prejudice to the ongoing work in preparing for the revision of Regulation (EC) No 443/2009 in accordance with Article 13(5) of that Regulation. Answers to these questions provide the rationale for public policy action that is tackled by the last two questions.

1. **Should the vision agreed in the CARS 21 mid-term review be adjusted? (i.e. 2020 perspective of improved combustion engine's market dominance combined with growing market penetration of electric and hydrogen vehicles and hybridisation conceived as the bridging technology and 2050 perspective of transport decarbonisation)**

   The vision agreed in the CARS 21 mid-term review should not be adjusted.

2. **What is the potential of different clean automotive propulsion technologies (improved fuel efficiency, hybridisation and alternative powertrains) for contributing to decarbonisation objective in the short, medium and long term?**

Future development of propulsion and fuel technologies [GM]



The following description gives an overview of the pros and cons of the individual technologies.

	FOSSIL FUELS	BIO FUELS	
Spark ignition ICE and HEV	Natural gas (CNG) Autogas (LPG)	1rst generation Bioethanol 2nd generation Bioethanol	Hydrogen
Compression ignition ICE and HEV	GTL (Gas to liquid)	1rst generation Biodiesel (RME) 2nd generation Biomass to liquid (BTL)	
FC			Hydrogen
BEV and PHEV			Electricity (for PHEV add. fuel)

Natural Gas (CNG) and Biogas

- Ca. 85% Methane
- After modification of engine periphery applicable in gasoline ICE, bivalent propulsion (gasoline or CNG)
- Low carbon combustion

Pros

- alternative resource to crude oil, already available
- ca 20% less CO2 emission than petrol
- price benefit due to tax incentive (in Germany up to 2018)
- diversification of energy sources

Cons

- no renewable energy (NG), limited resource, niche product
- lower range
- low supply on car market
- heavy and space consuming tank
- today only 700 fuel stations in Germany

Liquefied Petroleum Gas (LPG)

- Propane – Butane blend, liquefied under pressure (max 10 bar)
- Side product of crude oil and gas production
- after modification of engine periphery applicable in gasoline ICE, bivalent propulsion (gasoline or LPG)

Pros

- already available
- 10% less CO2 emission than petrol
- price benefit due to tax incentive (in Germany up to 2018)

Cons

- no renewable energy – limited resource – niche product
- low supply on car market
- increased consumption (15 – 30%) due to lower energy capacity
- today only 1.900 fuel stations in Germany

Gas to Liquid (GTL), ("SynFuel")

- Synthetic (liquid) fuel made from natural gas by catalytic reaction (Fischer Tropsch)
- Worldwide 3 plants (2007)
- Applicable for diesel engines
- Blending with fossil diesel possible (today 5 % GTL in Shell V power)

Pros

- lower CO2 emission than conventional diesel, due to NG
- lower pollutants
- no new engine technology required
- current infrastructure usable
- diversification of energy sources

Cons

- no renewable energy-limited resources
- production plants building up just starting
- high production costs

Bioethanol

- 1rst Generation: Fermentation of plant sugars (from sugar cane, corn,…)
- 2nd generation: enzymatic hydrolysis, based of non food feed stocks (e.g. Lignocellulose (LC))
- E100 only for special ethanol engines applicable (Brazil), E85 in "Flexible Fuel Vehicles" (e.g. Saab)
- Blending with conventional gasoline possible

Pros

- Renewable energy, CO2 neutral up to 30 resp. 90 % (1rst resp. 2nd gen.)
- price benefit due to tax incentive
- diversification of energy sources
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Cons

- limited availability, since in competition to food production (at least 1rst generation), bio diversity issue
- high production costs (improvement expected for 2nd generation)
- special engine technology for EM 80 or EM100 necessary
- 33 % increased consumption due to lower energy capacity

- High energy expenditure for production
- extra infrastructure necessary

Biodiesel (RME)

- 1rst generation Biodiesel
- Bio esters from rapeseed or soybean oil, by chemical reaction with alcohol
- Blending with conventional diesel possible

Pros

- renewable energy, up to 50 % CO_2 neutral, reduced particle emission
- price benefit due to tax incentive (in Germany up to 2012)
- diversification of energy sources

Cons

- limited availability due to crop rotation and limited area under cultivation, in competition to food production
- high production costs
- increased NO_x emission
- 10 % increased consumption due to lower energy capacity
- only a few models released for using RME

BTL "Biomass To Liquid" ("SunDiesel")

- 2nd generation Biodiesel, synthetic (liquid) fuel from biomass
- Several non food bio-feed stocks applicable (straw, wood, algae), utilization of the whole feedstock (in contrast to 1rst generation bio fuels based on crops), gasification +GTL
- Applicable to conventional diesel engines

Pros

- renewable energy, not in competition to food production
- up to 90% CO_2 neutral
- no new engine technology required
- current infrastructure usable
- reduced production costs compared to 1rst generation
- diversification of energy sources

Cons

- under development, 5 to 10 years development time

Hybrid Electric (HEV), incl. Plug-in (PHEV)

- Combination of ICE and electric engine with the objective to make use of the specific advantages of both propulsion technologies, e. g. high range for ICE and high efficiency for electric engine
- PHEV allows consumers to complement the energy in the fuel tank with the energy from the electrical grid, e. g. in the home garage

Pros

- low consumption/CO_2 emission, specially in urban traffic
- low pollutant emission
- current infrastructure usable (HEV), reasonable infrastructure costs

for PHEV
- diversification of energy sources (PHEV)

Cons
- complex technology with higher prime costs

Fuel Cell (FC), hydrogen based

- Fuel cells with hydrogen is seen as a long term solution
- Technology advancements are needed to reduce costs and improve durability of fuel cells

Pros
- no tank to tire pollutants and CO2 emissions
- low energy consumption potential
- diversification of energy sources

Cons
- increased primary energy consumption for hydrogen production
- complex hydrogen tank system, marginal range
- new infrastructure necessary

Battery Electric Vehicles (BEV)

- Well to wheel CO2 emission depends on electricity generating process
- Most future power plants will be based on nuclear energy, coal, and fossil fuels. To solve the CO2 emission issue, the introduction of a Carbon Capture Sequestration (CCS) seems unavoidable

Pros
- low consumption and no tank to wheel CO2 emission
- Reduced dependency on crude oils
- diversification of energy sources

Cons
- marginal range due to low battery capacity, high vehicle weight
- high battery charge time
- high expenditure of time and high costs to explorate and introduce CCS technology
- new electricity generating plants needed

Shares of the individual technologies in new car's fleet 2030

fuel technology	propulsion technology	% new cars
gasoline (~20 % bio-fuel 2nd generation)	**ICE** **HEV**	**30%** **18%**
diesel (~20% bio-fuel 2nd generation)	**ICE** **HEV**	**30%** **6%**
CNG/LPG	**ICE**	**2%**
Hydrogen	**ICE** **FCV**	**1%** **1%**
gasoline/electr.	**PHEV**	**10%**
electricity	**BEV**	**2%**

All future technologies show reasonable potential for reducing both CO_2 emissions and dependency on fossil oil, and so it is likely that the future car fleet, also due to diversification, will be a mixture of different technologies.

In the near future the rate of **Hybrid Electric Vehicles** will increase but also Plug in Hybrids will enter the market soon.

With the help of 2nd generation **Biofuels** the today's competition to food production will be mitigated. However Biofuels cannot cover the requirements of mobility alone. So the future will show a blending of Biofuels with fossil oil, with an increasing bio-amount, likely some 20 % in 2030.

Electricity will become a car fuel with the introduction of Plug in Hybrids, but even will become more important, when, in medium term, Battery Electric Vehicles and in long term also **Hydrogen** vehicles will come to the market. Also **natural gas** will become important for the production of Hydrogen.

With the help of the new technologies the CO_2 emissions can be reduced so far that a stabilisation of the world climate seems likely, as long as the other emitter groups can be similarly successful.

CO2 REDUCTION POTENTIAL FOR 2020 *(estimation based on the 2010 technologies):*
ICE: 10% … 15%
Hybridisation: 10%
20% share second generation bio fuel (compared with 5% in 2010): 10%
Plug in Hybrid Electric: 25%
Example: VW Golf ICE gasoline production year 2010: 124g CO2/km
VW Golf ICE gasoline production year 2020: 105g CO2/km
…, with 20% share bio fuel: 95 g CO2/km
…, with 20% bio fuel + hybridisation: 85g CO2/km
…, with 20% bio fuel + plug in hybrid: 73g CO2/km

What is the decarbonisation potential of the complementary measures in the short, medium and long term (e.g. guidelines on eco-driving, application of Intelligent Transport Systems) and how reliable are these potentials?

On-board technologies, for example Gear Shift Indicator (GSI), can provide a significant contribution to reduce fuel consumption. However, the market for fuel economy devices is estimated to be rather limited. Identified market segments with high potential are fleet owners and driving instructors. The car industry and their suppliers take the lead in developing standard and optional in-vehicle systems like fuel economy devices.

Concerning eco-driving, the following can be said:

- There is sufficient information about **the short-term effects** (< 1 year) of training measures. Fuel consumption can be reduced on average between 15 and 25%.
- There are some studies which indicate **a long-term effect** (> 1 year) of training measures between 4, 7% and 8% (in terms of reduced fuel consumption). The long-term effects are less than the short-term ones as the old driving habits of these experienced drivers tend to re-emerge.
- The effect of **combined measures** is greater than the effect of single measures.

3. What are the implications of new propulsion technologies in a lifecycle analysis perspective as regards vehicles, and in a well-to-wheel perspective as regards energy supply chains?

Concerning Battery Electric Vehicles (BEV), two points deserve a special attention:

- it is of great importance that a country's power generation mix is taken into account when evaluating the CO2 balance of a vehicle. Otherwise, a wrong image could be communicated

- a lot of countries have huge coal reserves at their disposal and it is therefore expected that coal will be used to produce electricity. Consequently, Carbon Capture and Storage (CCS) is very likely to play an important role in the future.

What are the resource implications in introducing innovative propulsion technologies?

Some resources, such as minerals used in the batteries, because of today's BEV hype drive might become scarce in the future, leading to the BEV becoming unaffordable and therefore phasing-out a technology.

4. What are the state of play and the future scenarios of technological developments in alternative powertrains (electric and hydrogen) and their market penetration?
What are major risks and opportunities associated for different stakeholders?
What will be the economic, societal, employment and environmental impacts brought by these developments?

Both BEV and fuel cell vehicles need to be crash-tested has vehicles with internal combustion engines.

BEV are faced with two challenges: durability and range. If these are not solved, consumers will not adopt the technology.

5. **How can a trade-off situation be avoided where electrifying the power train would reduce or reverse improvements made in conventional technologies in the framework of existing and upcoming legislation on the CO_2 emissions of road vehicles?**

A trade-off situation can be avoided by adopting an integrated approach, taking into account technical and emission related parameters.

6. **What actions should be best taken at regional/ national /European or international level to promote technology development and market uptake of alternative powertrains (electric and hydrogen)?**

Research and development is still very important since many technologies are still in the development phase. Other, for example the internal combustion engines are mature but there performances can still be increased.

Brussels, March 2010