An Automotive Perspective on Biofuels - Quality and Standards

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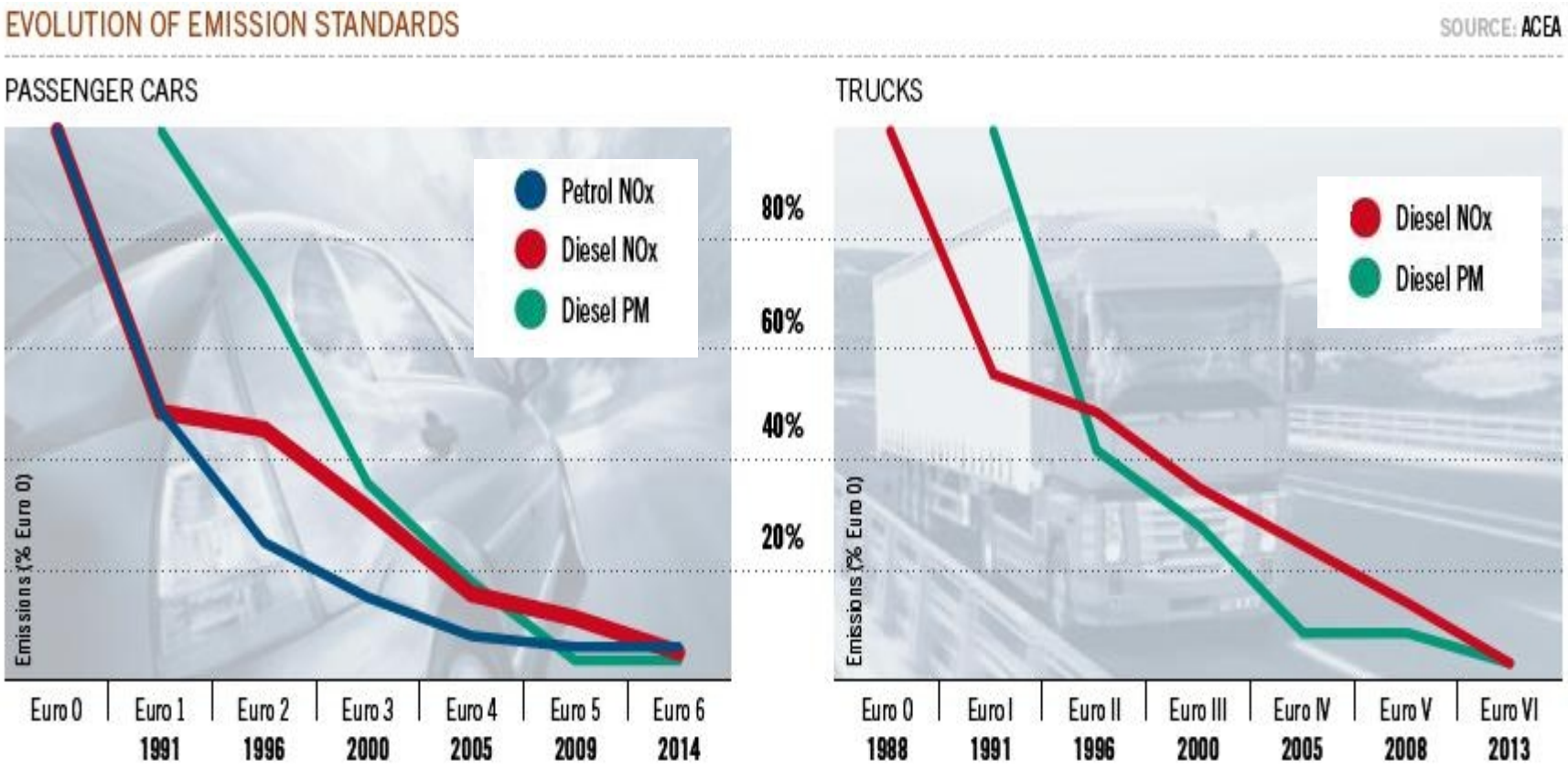
The Volvo Group

Volvo Trucks	Renault Trucks	UD Trucks	Mack Trucks	Eicher *

Buses	Construction Equipment	Volvo Penta	Volvo Aero	Financial Services

*) 50% of the joint-venture company with Eicher Motor Limited was consolidated in the Volvo Group from August 1st 2008

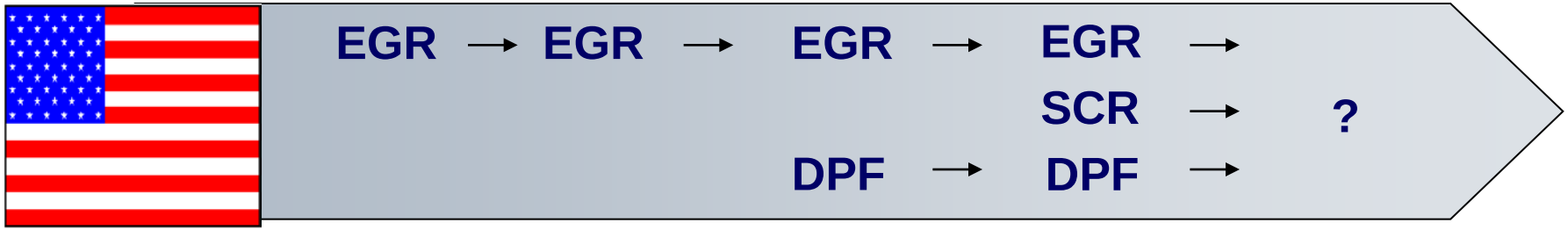
EU emissions legislation - On-road vehicles

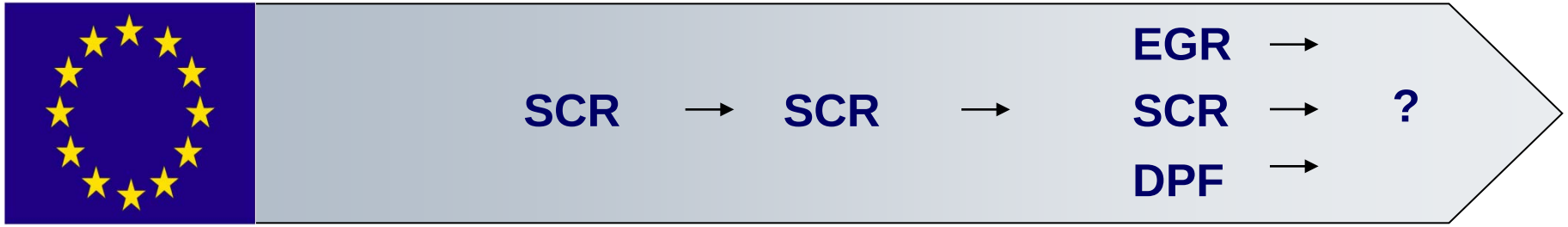


Primary emissions reduction options – Heavy Duty

EGR = Exhaust Gas Recirculation
SCR = Selective Catalytic Reduction
DPF = Diesel Particulate Filter

Increasing sensitivity to fuel quality!





Importance of Fuel Quality

- ***The fuel is an engineering element - an essential part in the engineering process***

  - choice of ***materials***: metallic materials, polymers, lubricants…
  - the fuel properties dictate limits for ***engine calibration and optimisation***: emissions, power output, driveability….

- ***The fuel is an integrated part of the quality assurance system***

  - ***technical functionality and performance***: we have a responsibility towards our customers
  - ***emissions***: no deterioration over engine life (in-use compliance)
  - ***warranty*** issues

Importance of Fuel Quality

- ***How to secure good performance over the whole engine life?***

  - vehicle manufacturers should give ***clear instructions*** on what fuel to use

  - our customers should always ***use specified/recommended fuels***.

  - the fuel marketers (oil-companies) should always and everywhere ***provide good quality fuels***.

Key to success:

standardisation and ***international harmonisation***

Important Automotive Fuels Standards – Europe

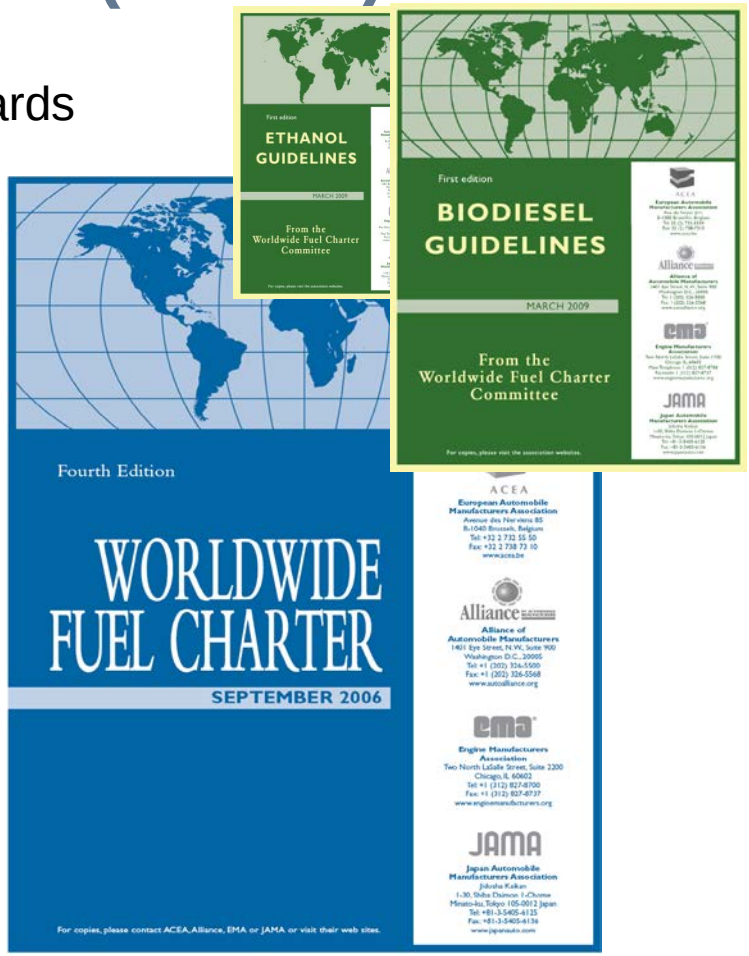
Fuel	ISO (Global)	CEN (Europe)	SIS (Sweden)
Gasoline ***Diesel Fuel*** Diesel Fuel "Env. Class 1" LPG		***EN228*** ***EN590*** EN589	SS-EN228 SS-EN590 SS-155435 SS-EN589
FAME (biodiesel) - B10, B30		***EN14214*** - work on-going	SS-EN14214
Ethanol - ***up to 10% in gasoline*** - E85 - ED95 (diesel engines)		***EN15376*** prEN15293	SS-EN15376 SS-155480 SS-155437
Methane - biogas - natural gas	ISO 15403	EU mandated worked on-going in TC408	SS-155438 SS-EN ISO15403
DME	TC28/SC4/WG13		
Hydrogen (for FC)	ISO TS14687-2: 2008	(monitored)	
Methanol (for FC)	(monitored)		

Match between Emissions Legislation and Fuel Quality is mandatory - the European Developments

	Emissions	Fuel quality - EU Directives	Fuel quality - CEN Standards
pre 1993		Gasoline: benzene, lead Diesel fuel: sulphur	only national standards
1993	**Euro 1**	Gasoline: benzene, lead Diesel fuel: sulphur	EN228:1993 (gasoline) EN590:1993 (diesel fuel) ***First European standards!***
1996	Euro 2	Gasoline: benzene, lead Diesel fuel: sulphur	EN228:1996 EN590:1996
2000	**Euro 3**	***Dir 98/70/EC*** ***Environmental parameters!***	EN228:1999 EN590:1999
2004	Euro 4/ IV	revised: 2003/17/EC	EN228:2004 EN590:2004
2009	**Euro 5/ V**	revised: 2009/30/EC ***All gasoline and diesel fuel < 10 ppm sulphur!***	EN228:2008 (revision on-going prEN228:2012) EN590:2009 (revision on-going prEN590:2012)
2013/14	Euro 6/ VI	revised: xxxx?	EN228:yyyy EN590:yyyy

World Wide Fuel Charter (WWFC)

- The Automotive industry's guiding document towards improved and harmonized market fuel quality (gasoline and diesel fuel)
- Latest version from Sept 2006, ***next revision in progress, target for finalization: by end 2012***
- *Gasoline and diesel fuel quality in four quality levels (Category 1,2,3,4), to* ***match emissions requirements (presently up to Euro 5/US10 or equivalent)***
- Supporting documents: ***Biodiesel and Ethanol Guidelines*** *(for blending up B5 and E10)*
- WWFC can be downloaded from
  www.acea.be
  www.autoalliance.org



ACEA

Alliance OF AUTOMOBILE MANUFACTURERS

ema

JAMA
JAPAN AUTOMOBILE MANUFACTURERS ASSOCIATION, INC.

Market fuel standards for existing and future vehicles – the challenge of change

1. ***Development of future vehicles for future fuels***

→ ***Evolution of fuel specifications and new fuel grades are taken into account in the developing process*** ☺

2. ***Compatibility of vehicles in the fleet with***
   - Higher biofuels blends (for instance FAME, ***B7 -> B10 -> Bxx***)
   - New limits for existing fuel specifications (for instance lubricity in diesel fuel)

→ ***Backward compatibility of fuel changes is a very difficult issue*** ☹

- Not in line with the normal engine development process
- Difficult to cover all the vehicle generations and models
  - Reliability risks for the customers
  - Risk for vehicle manufacturers in meeting legal commitments
  - Costly

- We need protection for the existing fleet at any point in time
- We need sufficient lead-time and clear commitments regarding future fuel specifications.

Euro VI Heavy Duty Certification (2013/14)
Reference Fuels (Annex IX)

- *Fuels for compression ignition engines*

  - Diesel fuel "B7" (6-7% FAME, EN14214 quality)
  - Ethanol ED95

- *Fuels for positive ignition engines*

  - Petrol E10 (9.5-10% ethanol, EN15376 quality)
  - Ethanol E85 (83-85% ethanol)
  - LPG
  - NG/Biogas (three gases: GR, G23, G25)

Euro VI certification diesel fuel - HD engines
(ref: Annex IX)

Parameter		Euro V	Euro VI
Cetane number		52 - 54	***52 - 56***
Density	kg/m3	833 - 837	→
Sulphur, max	ppm	10	→
Distillation T95	C	345 - 350	→
Polyaromatics	% V/V	3 - 6	***2 - 4***
FAME	% V/V	***not allowed***	***6.0 – 7.0***

Euro VI - “Universal fuel type-approval”

1. REQUIREMENTS ON FUEL RANGE

1.1. Requirements on universal fuel range type-approval

A universal fuel range approval shall be granted subject to the requirements specified in Sections 1.1.1. to 1.1.6.1.

1.1.1. The parent engine shall meet the requirements of this Regulation on the appropriate reference fuels specified in Annex IX Specific requirements shall apply to natural gas fuelled engines, as laid down in Section 1.1.3.

1.1.2. If the manufacturer permits to operate the engine family to run on market fuels not included in Directive 98/70/EC ([5]) and the relevant CEN standards ([6]) applicable at the time of type-approval, such as running on B100, the manufacturer shall, in addition to the requirements in Section 1.1.1.

(a) declare the fuels the engine family is capable to run on in Section 3.2.2.2.1. of Appendix 4 to this Annex;

(b) demonstrate the capability of the parent engine to meet the requirements of this Regulation on the fuels declared;

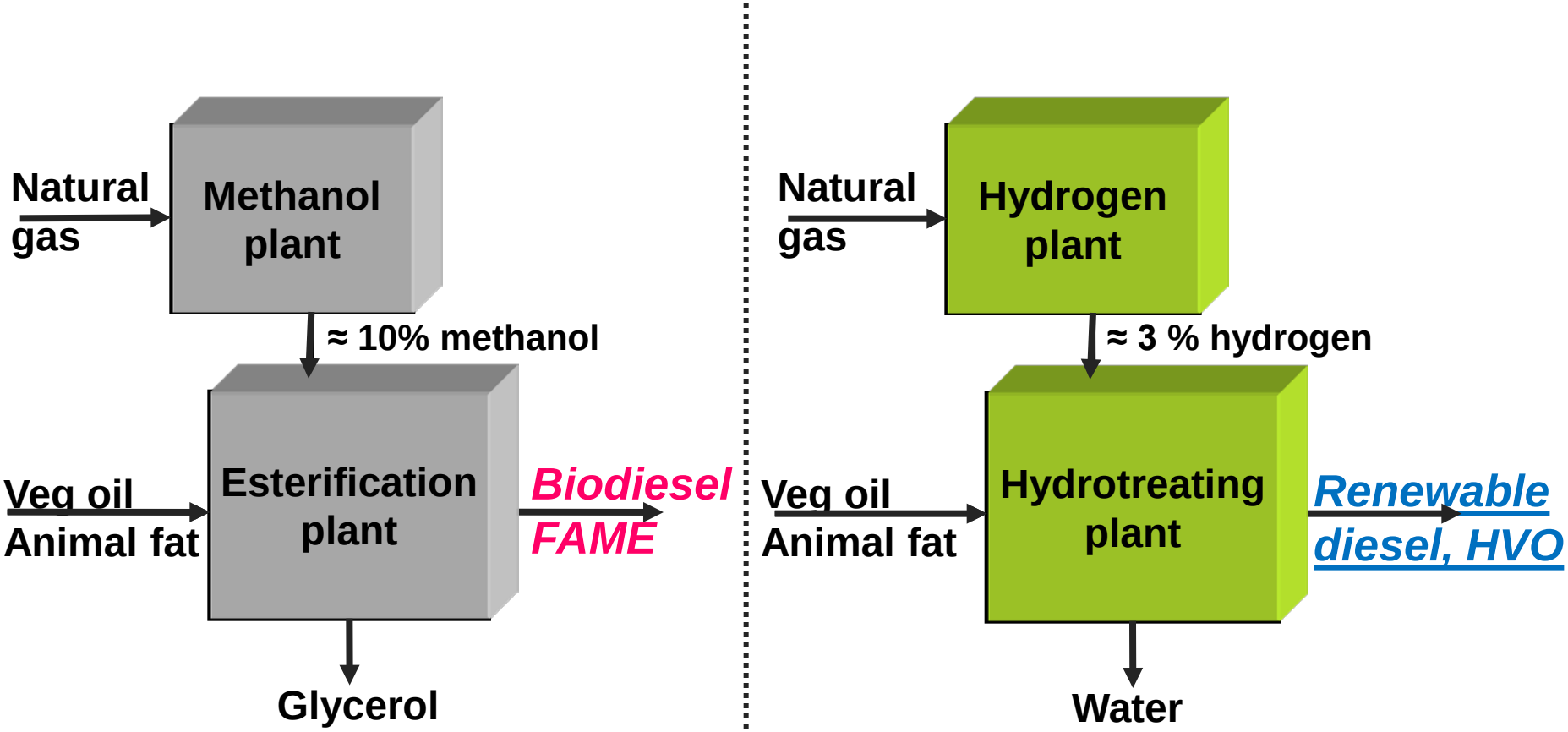
(c) be liable to meet the requirements of in service conformity specified in Annex II on the fuels declared including any blend between the declared fuels and the market fuels included in Directive 98/70/EC and the relevant CEN standards.

Biodiesel (FAME) – EN14214 is improving….

…but there are still technical issues, particular if going beyond B7

- ***Stability (deposits)***
  - both in the fuel ***distribution system*** and in the ***vehicle fuelling system***
  - ***filter plugging***
  - test method(s) are available but not protecting fully
- ***Material compatibility need to be checked***
  - ***polymers, elastomers (seals)***
  - degradation products increase ***corrosion***
- ***Cold temperature operability***
  - ***filter plugging***
  - ***correlation between CFPP and real operability*** not fully secured
- ***Engine lubricant dilution***
  - ***Late post-injection of fuel*** (active PM-trap regeneration) is used widely in passenger cars to meet ***Euro 4/5/6*** emissions legislation.
  - ***FAMEs are high boiling: will accumulate in the engine oil,***
  - result: ***lubricant degradation, poor engine cleanliness***
- ***Exhaust aftertreatment systems***
  - ***phosphorous < 1 ppm*** needed (presently max 4-10 ppm in most FAME standards)
  - ***other contaminants becoming more critical for Euro V/VI: K, Na, Ca, Mg***
  - long term effects not known well enough, particularly for higher FAME levels
- ***Bacterial growth***
  - increasingly an issue with FAME-containing fuels

Hydrotreated vegetable oils (HVO) are preferred over esterified (FAME)



Fossil natural gas input about the same in both routes

- ***in the future biogas (HVO, FAME) or ethanol (FAEE) could be used***

Volvo and Alternative Fuels

- Main Volvo fuel options for the future:
  - ***Methane fuels:*** biogas, natural gas (CBG/CNG, LBG/LNG)
  - ***DME (dimethyl ether):*** bio-based or fossil

New engines required

- Other alternatives of interest:
  - ***Synthetic diesel (F-T), Hydrotreated vegetable oils (HVO)*** and ***FAME*** (up to specified & acceptable blending levels) are accounted for within normal engine development
  - these fuels & components ***should be within regular market fuel standards***

~ Business as usual

Concluding remarks

- ***Appropriate market fuel standards are absolutely necessary***
  - to ***support emissions*** requirements & technologies and to ***ensure legal compliance***
  - for ***good technical functioning*** of all vehicles on the road ***(should always fit for purpose!)***
  - to ensure ***smooth introduction of new fuels/ blends***
  - to ensure ***customer satisfaction***

- ***The whole vehicle fleet should be able to use the standard market gasoline and diesel fuels at any point in time***
  - ***special precautions for present/older vehicle fleet may have to be taken if/when bio-contents are increased ("protection grades"!)***

- ***The aim should be world-wide harmonization of standards and fuel regulations, both for conventional and biofuels***
  - ***fuel quality and emission regulation should go hand in hand***
  - automotive industry contribution: ***World-wide Fuel Charter***

- ***Future fuel choices have to be based on best possible well-to-wheels energy efficiency and GHG reduction***
  - ***sustainable*** energy raw materials and production methods
  - long term ***supply security, stable regulatory conditions***

Thank you for your attention!