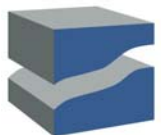


VOLVO

Emissions & Performance Requirements for Cars and Trucks The Importance of Fuel Quality

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The Automobile Industry in Europe

Key figures

- ⇒ 16 major international companies
- ⇒ 12+ million direct and indirect jobs
- ⇒ €26+ billion in R&D spending, largest private investor
- ⇒ €29+ billion of net trade contribution
- ⇒ €380+ billion of tax revenues (EU15)



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**.

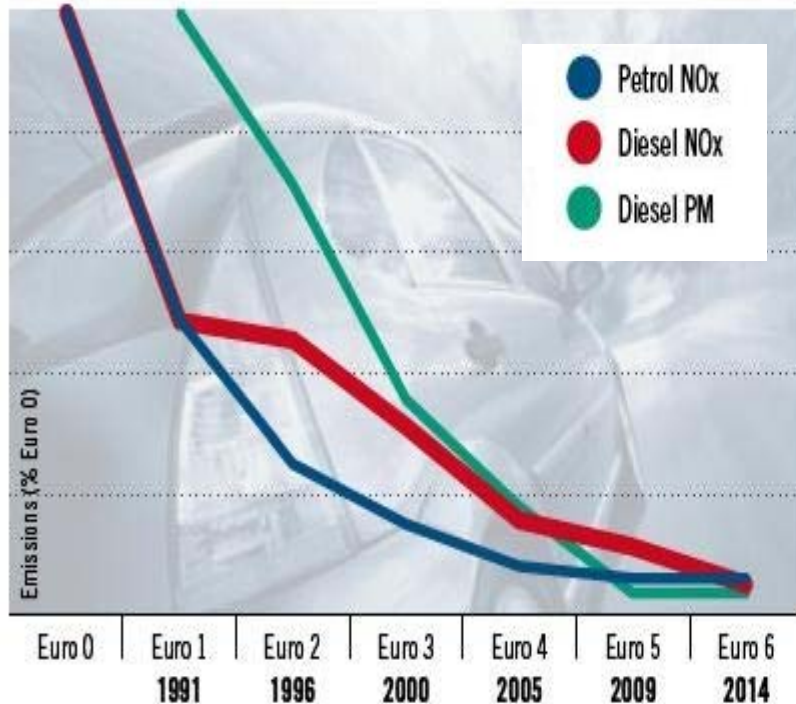
Key to success: *standardisation* and *harmonisation*

EU emissions legislation - On-road vehicles

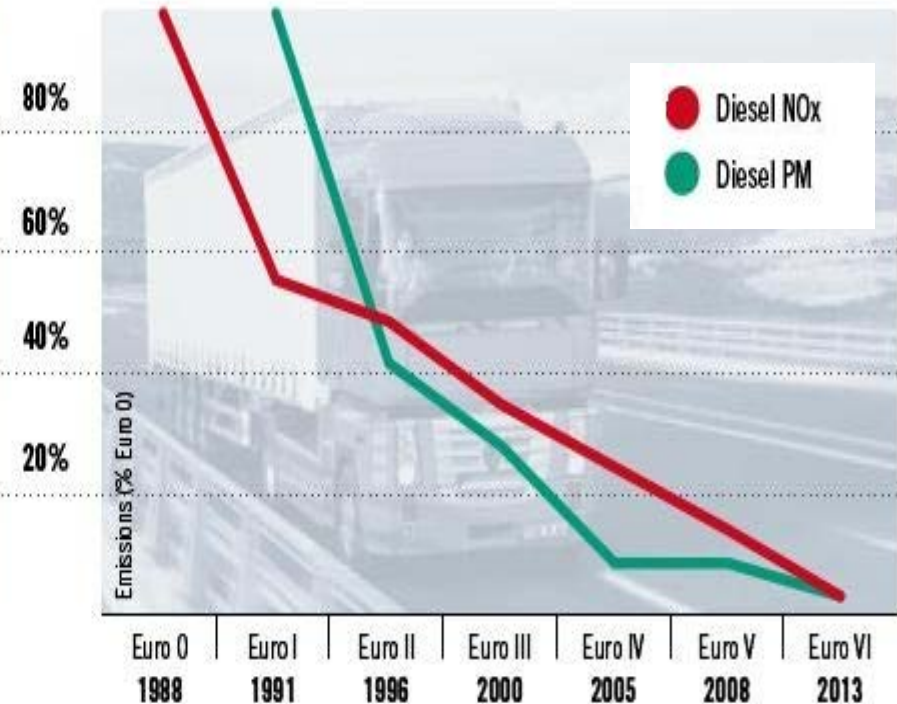
EVOLUTION OF EMISSION STANDARDS

SOURCE: ACEA

PASSENGER CARS



TRUCKS



Drivers for CEN fuel standards

Engine, emission control system and fuel are an integrated system.

1. European legislation:

- Air quality improvements (Euro 4, 5, 6...);
- Reduce energy dependence on fossil fuels;
- Reduced CO₂ emissions;

2. **Vehicle operability issues in the market due to poor fuel quality.**

3. **Development of test methods.**

Evolution of OEM technology:



- Vehicle systems;
- Powertrain - fuel injection equipment;
- Exhaust after-treatment systems;



Evolution of fuel quality:

- Composition / Refinery changes;
- Fuel Quality Directive
- Biofuels;
- Renewable Energy Directive;

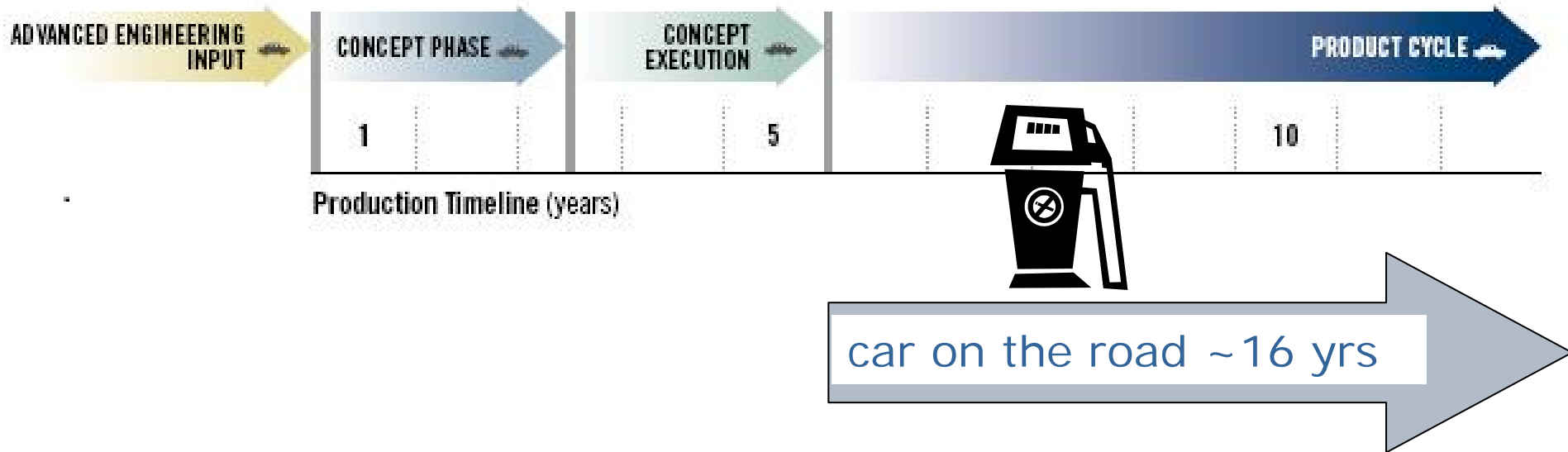
Fuels for future and for existing vehicles

1. Develop *future vehicles for future fuels*
 2. Compatibility of vehicles in the fleet with:
 - Higher biofuels blends (e.g. B5-> B7)
 - New limits for existing specifications (e.g. “E70” and “E100” distillation for E10 petrol)
 -
1. Evolution of *fuel specifications and new fuel grades are taken into account in the developing process* 
 2. *Backward compatibility of vehicles is a very difficult issue:* 
 - Not in line with the “natural” development process (=low priority)
 - Extremely difficult to cover all the vehicle generations and models
 - Reliability risks for the customers
 - Risk for OEMs in meeting commitments (CO2, emissions, etc)
 - Costly

Vehicle manufacturers

- *need to have sufficient protection for the existing fleet at any point in time*
- *need sufficient lead-time and clear for future fuel specifications.*

Leadtime needed in engine/vehicle development



Lead-time required for future vehicle developments -
“rolling” protection grade required for existing fleet.

Automotive fuels standards – Global, EU, national

<u>Fuel</u>	<u>ISO (Global)</u>	<u>CEN (Europe)</u>	<u>SIS (Sweden)</u>
Gasoline Diesel Fuel Diesel Fuel “Env Class1” LPG		EN228 EN590 EN589	SS-EN228 SS-EN590 SS 155435 SS-EN589
FAME (biodiesel) - 30% FAME in diesel (B30)		EN14214 - started early 2010	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	- mandate in progress EN ISO 15403	SS 155438 SS EN ISO 15403
DME	TC28/SC4/WG13		
Hydrogen (for FC)	ISO TS14687-2: 2008	(monitored)	
Methanol (for FC)	(monitored)		

EU Gasoline Requirements

Dir 98/70/EC (amended 2003/17/EC, 2009/30/EC) and CEN EN228

Parameter	Dir 98/70/EC (2009/30/EC) <i>(2009/30/ EC, to be implemented by 2010-12-31)</i>	EN228
Sulphur, ppm	max 10	
RON	min 95	
MON	min 85	
Benzene, % V/V	max 1.0	
Total aromatics, % V/V	max 35	
Olefines, % V/V	max 18	
Density, kg/m ³		720-775
Oxygen content, % V/V	max 3.7	max 2.7 (additional grade" until 2013)
Ethanol, % V/V	max 10.0	max 5.0 (- " -)
Methanol, % V/V	max 3.0	
Ethers, % V/V	max 22.0	
Lead, mg/l	max 5.0	
MMT - Manganese, mg/l	max 6.0 (from 2011-01-01) max 2.0 (from 2014-01-01)	

CEN WG21

comments to ongoing revision of EN228

- **Legal parameters (from Dir 2009/30/EC) being included in EN228**
 - “E5” (protection grade) and “E10” to be clearly separated
 - Test methods for MMT determination < 2mg/l being balloted in CEN (ACEA position: MMT should be banned)
 - Ethanol standard EN15376 now fit for use up to 10% in EN228
- **Oil-industry proposes increased max E70/E100 distillation points**
 - ethanol increases volatility (Vapor Pressure, E70 and E100 distillation points)
 - some refineries apparently have difficulties adapting their base gasoline formulations
- **Based on presently existing data, automotive industry (ACEA) cannot accept increased E70/E100 volatility!**
 - indications of poor cold start and drivability performance
 - indications of higher emissions (changes in lambda control)
 - car manufacturers' acceptance of E10 is based on present volatility limits in EN228
- **Test programs on E70/E100 volatility are commencing**
 - Three separate programs: Concaawe, CEN/NEN (EU-funded) and individual automotive companies
- **Agreement needed at TC19 meeting in May 2011, to have new EN228 available by mid 2012**

EU Diesel Fuel Requirements

Dir 98/70/EC (amended 2003/17/EC, 2009/30/EC) and CEN EN590

Parameter	Dir 98/70/EC (2009/30/EC) <i>Dir 2009/30/ EC_ to be implemented by 2010-12-31)</i>	EN590
Sulphur, ppm	max 10	
Cetane number	min 51	
Cetane index		min 46
Density, kg/m ³	max 845	820-845 (arctic 800-)
Destillation T95, deg C	max 360	
PAH, %vol	max 8	
Water content, mg/kg		max 200
Viscosity, cSt at 40C		2.0-4.5 (arctic 1.5-4.5)
Lubricity, μ wear (HFRR)		max 460
FAME, %	max 7	
Stability ("modified Rancimat")		min 20 hrs
Cold flow		Cloud/CFPP classes

CEN WG24

comments to ongoing revisions of EN590, EN14214

- **Legal parameters (from Dir 2009/30/EC) being included in EN590**
 - “B7” already in EN590:2009
 - no controversial changes to the base EN590
- **WG34 recently formed to evaluate the correlation between CFPP and real vehicle operability**
 - main basis for this correlation goes back to the 1980’s
 - *major changes in fuel system technology (UI, CR) and fuel formulations (sulphur free fuels, introduction of bio-components) since the 1980’s*
- **Issues to be resolved for FAME blends (B7, B10, B30)**
 - EU mandate to standardize “B10”: EN14214 quality and stability of final blend is being assessed
 - Automotive industry wants separate standard for “B10”: *a clear majority of the cars in the market can only accept up to B7*, in line with present EN590 and Dir 2009/30/EC
 - CEN WG24 TF B30 (feasibility study, for dedicated vehicles): necessary FAME quality and other fuel parameters are being assessed.
- **Issues to be resolved for EN14214**
 - cold flow classes: *recent agreement in WG24 TF Biodiesel: cloud/CFPP and monoglycerides to be included*
 - stability: *required level of stability*, test methods (Rancimat, Petroxy, DeltaTAN)
 - ash/deposit forming compounds: *stricter limits needed for Na, K, Ca, Mg, P, particularly for higher FAME-blends*

EN228 and EN590 into the future

- **Overall, we have been successful in developing adequate fuel quality standards for Europe**
 - before 1993: **10-15 national fuel standards**
 - in 1993: **first versions of EN228 and EN590 was agreed**
 - **improvements** of these minimum fuel quality standards **in several steps** (incl. Fuels Directive in 1998) to facilitate the introduction of **Euro 2, 3, 4, 5...**
- **.....but there are some worrying present developments and signs for the future**
 - political tendency to **ignore the reasons for and importance of agreed fuel quality standards.**
 - until now: **stricter** and **more narrow** parameters in EN228 and EN590 (= **improvements!**)
 - present trend: **broadening** of parameter spans, less robust standards
 - **national initiatives/regulations overtaking the EU Fuels Directive and CEN standards**
- **In 2015.... do we again have >10 national “standards” in Europe?**

Euro VI Certification Fuels

(specifications in draft Euro VI Directive, Annex IX)

- *Fuels for compression ignition engines*
 - **Diesel fuel B7 (6-7% FAME, EN14214)**
 - **Ethanol ED95**
- *Fuels for positive ignition engines*
 - **Petrol E10 (9.5-10% ethanol, EN15376)**
 - **Ethanol E85 (83-85% ethanol, EN15376)**
 - **LPG**
 - **NG/Biogas (three gases: GR, G23, G25)**

Euro VI certification fuel - HD engines (final draft)

(ref: Annex IX)

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

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.

Concluding remarks

- **Appropriate market fuel standards are essential**
 - to support the **emissions** requirements/technologies and to ensure **legal** compliance
 - to ensure proper **technical functioning** of all vehicles in the market place (new and old), in all applications and over all seasons
 - to ensure smooth introduction of **new fuels/ fuel blends** when applicable
 - to ensure **customer satisfaction**
- **The trend to neglect CEN standards in favor of national decrees and national standards should be reversed**
 - we do not want to go back to pre 1993 situation with no EU-wide standards
 - introduction of **bio-components cannot be an excuse to compromise quality**
- **Truly international standards should be developed longer term**
 - Vehicle industry is a global business
 - **UN ECE (WP29) and ISO** could be the “vehicles” for introducing these regulations/standards



Thank you for your attention!



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