IEA Bioenergy

European Commission

ADVANCED MOTOR FUELS
IEA-AMF
Technology Collaboration Programme on
Advanced Motor Fuels

The Contribution of Advanced Renewable Transport Fuels to **Transport Decarbonisation** in 2030 and beyond

Biofuels and vehicle compatibility

Transport decarbonisation workshop

Brussels 18.11.2019

Nils-Olof Nylund

Outline

- Definitions and terminology
- Alternative ways to introduce biofuels
- Legislation and standardization
  - Why are there limits for certain biocomponents?
- Fuel markings and biofuels on the market
- Activities aimed at updating European fuel standards
- Summary

Definitions and terminology

- **Material compatibility:** the fact that the material withstands exposure to the fuel (type) without negative effects **concerning the durability and performance of the exposed material if the fuel (type) would be used.**
  - *COMMENTS: 'functioning' needs to be prescribed as being, at least, durability & performance of the material(s) as exposed to any amount of continuous or intermittent use of the fuel (type).*

- **Tolerance:** compatibility based on lifetime running on the fuel (type) **without compromising** vehicle **safety or performance** issues **when using the fuel (type)**.

- **Vehicle compatibility:** guarantee that the vehicle is **declared to be** tolerant for **the use of the** fuel (type) and fulfils **vehicle manufacturer defined conditions in respect of** customer expectations **for day-to-day vehicle operation**.

- **Compliance of a vehicle:** **when using the fuel (type) the vehicle fulfils** all EU regulatory requirements concerning **pollutant** emissions **and safe vehicle use** assessed on the basis of **tests using** regulated reference fuels **for the fuel (type)**.

Source: Andreas Kolbeck/Shell Global Solutions, ACEA

Definitions and terminology

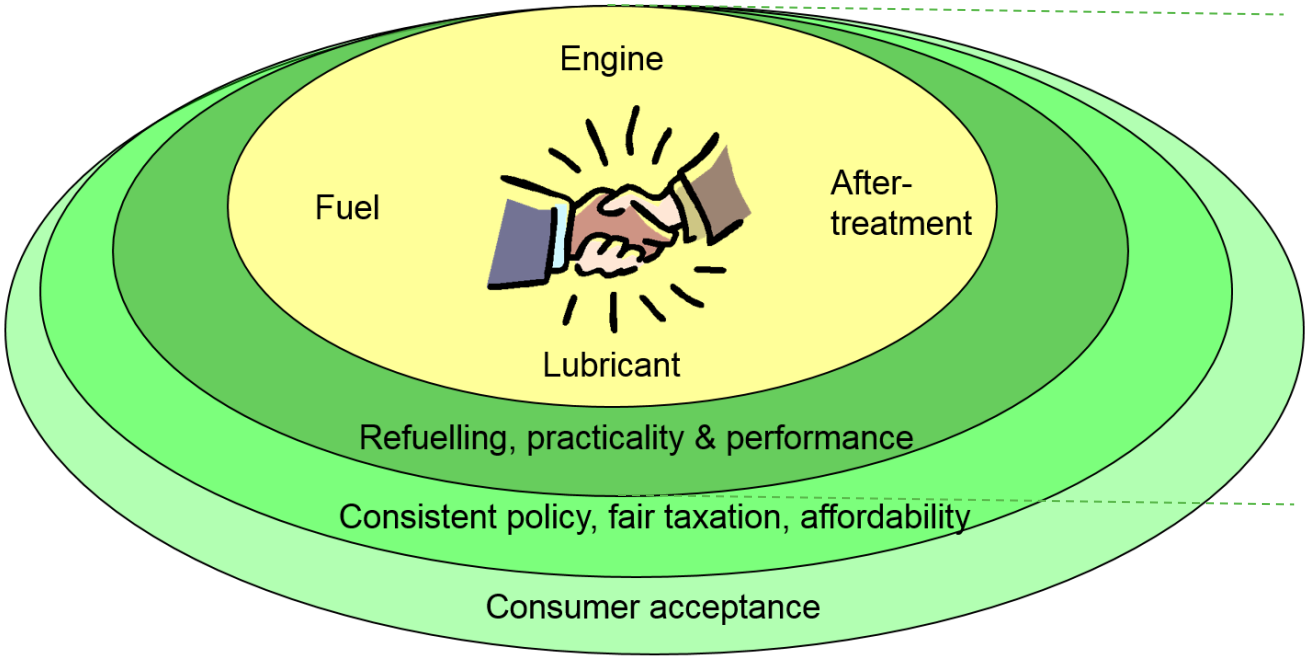
- ”Blending wall”
  - technical limitations for component concentrations to secure e.g., vehicle and infrastructure durability, vehicle emission performance and vehicle operability
  - In Europe, currently max 10 % ethanol in petrol (E10) and max 7 % in diesel (B7)
- ”Drop-in” fuel
  - A fuel that is compatible with the existing refuelling structure and existing vehicles even at high concentrations without any need for modifications (e.g. paraffinic fuels like BTL and HVO)
- ”Adapted or dedicated vehicle”
  - A vehicle that has been adapted to high concentration alternative fuels
  - Monofuel, bi-fuel, dual-fuel or flex-fuel
  - New vehicles and new refuelling infrastructure needed

How to introduce biofuels for the vehicle fleet?

Three major options:

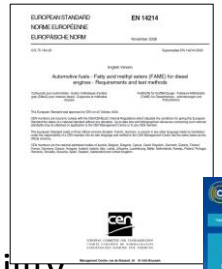
1. Low level blending of traditional biocomponents (e.g., EtOH, FAME within existing fuel standards)
   - Simple solution, but limited impact, typically only 10 – 15 % energy replacement
2. Drop-in type components for high level blending
   - Simple solution, impact can be high, up to 100 % replacement
   - Paraffinic diesel (HVO, BTL) is a kind of silver bullet for diesel
   - No really good options available for petrol, bio-petrol HC compounds tend to have low octane
3. Dedicated fuels for dedicated vehicles
   - Gaseous fuels, high concentration alcohol fuels
   - ”Chicken and egg” dilemma, what comes first, infrastructure or vehicles?

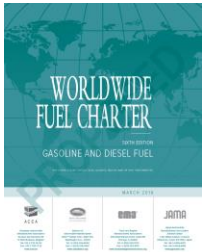
Prerequisite for the success of alternative fuels: Everything has to work together!



Legislation and standardisation

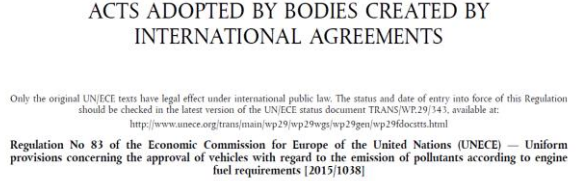
- First level: Laws, Directives (EU) and regulations, legally binding, e.g.,
  - US Code of Federal Regulations
  - For EU, the Fuels Quality Directive 2009/30/EC and regulation concerning vehicle emissions
- Second level: Standards
  - Industry practice
  - Representing a consensus among all interested parties
  - E.g., ISO, ASTM and EN fuel standards
  - Add parameters related to functionality, e.g., vehicle durability (lubricity, corrosion, ash, sediments, oxidation stability…) and cold operability
  - Not legally binding (although national legislation can refer to fuel standards)
- Third level: ”Code of practice” documents and recommendations, e.g.:
  - CEN and Concawe guidelines
  - Worldwide Fuel Charter, the ”wish list” of the auto manufacturers
    - Fuel quality recommendations by region





Reference fuels for emission certification

- Can be special certification fuels (reflecting market quality) or fuels fulfilling a certain standard
- International level, UNECE WP.29, Regulation 83
  - Special certification fuels
  - E5, E10, E85, E75 (“winter quality E85”), B5, B7, gaseous fuels
- US EPA emission certification fuels
- EU basically falls back on UNECE, specs for certification fuels included in the regulations, in some cases a reference is made to EN fuel standards
  - Euro VI requires HD engines to be certified on the fuel they will be running on
  - Possible alternatives e.g., B20/B30, B100, 100 % paraffinic diesel and also ED95


ACTS ADOPTED BY BODIES CREATED BY INTERNATIONAL AGREEMENTS

Only the original UN/ECE texts have legal effect under international public law. The status and date of entry into force of this Regulation should be checked in the latest version of the UN/ECE status document TRANS/WP.29/343, available at: http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29fdocstts.html

Regulation No 83 of the Economic Commission for Europe of the United Nations (UNECE) — Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements [2015/1038]

Green light for HVO-use in Scania Euro 6 range

8 OCTOBER 2015

Press releases · Press room

Scania has given the green light to hydrotreated vegetable oil (HVO) being used to power its Euro 6 range, provided the fuel used meets technical specification TS15940. Vehicles using HVO – which chemically mimics fossil-fuel-based diesel – can under optimal condition achieve up to a 90-percent reduction in CO2 emissions. HVO does not affect a vehicle's characteristics or its maintenance

Fuel Quality Directive 2009/30/EC - Petrol

Parameters directly related to oxygenated biocomponents:

- Oxygen content (3.7 % m/m)
  - Air-fuel ratio control
- Ethanol (10 % v/v)
  - Oxygen content (10 % v/v ethanol equals 3.7 % m/m oxygen)
  - Material compatibility
    - Ethanol is corrosive and polar, can attack metals and elastomers
- Methanol (3 % v/v)
  - Material compatibility (methanol worse than ethanol)
- Higher alcohols and ethers (12…22 % v/v)
  - Oxygen content, less material issues than with ethanol

Fuel Quality Directive 2009/30/EC - Diesel

Parameters directly related to biocomponents:

- FAME content (7 % v/v)
  - Some material issues
  - High end of distillation temperature
    - Possible issues with engine oil dilution

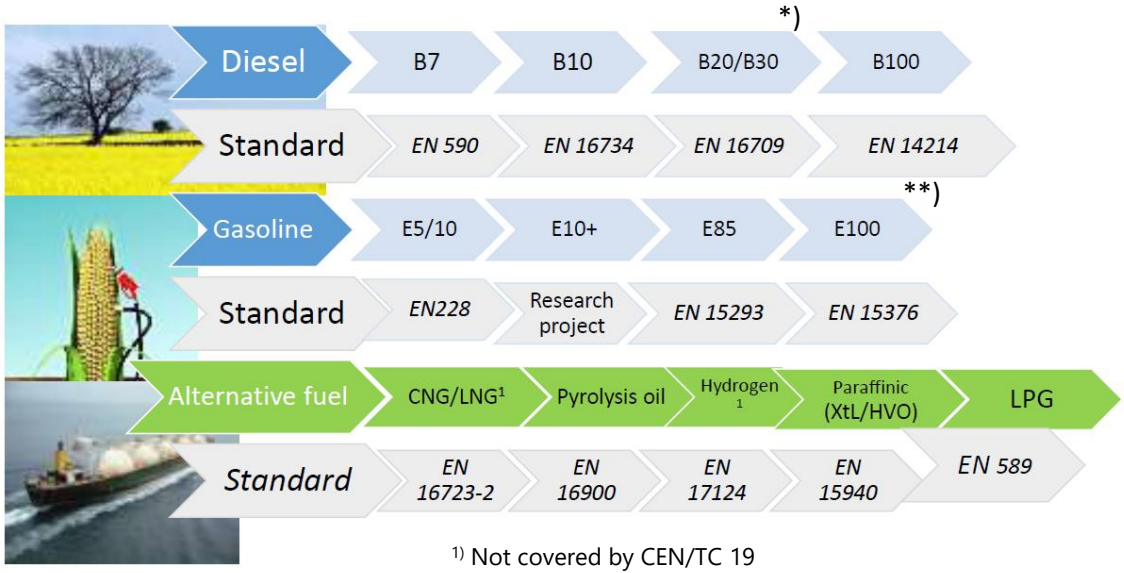
A limit for the fatty acid methyl ester (FAME) content of diesel is required for technical reasons. However, such a limit is not required for other biofuel components, such as pure diesel-like hydrocarbons made from biomass using the Fischer-Tropsch process or hydro-treated vegetable oil.

Notwithstanding the requirements of Annex II, Member States may permit the placing on the market of diesel with a fatty acid methyl ester (FAME) content greater than 7 %.

Current European fuel standards

Much more detail than in the FQD

Actual fuel specification standards



*) Captive fleets only
**) Use as a blending component

1) Not covered by CEN/TC 19

C. Vigneron/O. Costenoble 6/2019

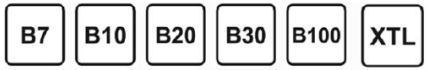
New fuel marking

- Aimed at avoiding confusion for consumers and businesses
- Markings on fuel pumps as well as on vehicles
- Stems from Directive 2014/94/EU on deployment of alternative fuel infrastructure
- Guarantees compatibility, not necessarily bio content

Gasoline-type fuels: circle. E5, E10, etc. ("E" stands for specific bio-components present in petrol);

Copyright and Source European Committee for Standardization

Diesel-type fuels: square. B7, B10, XTL, etc. (" B" stands for specific biodiesel components present in diesel, the XTL stands for synthetic diesel and indicates that it is not derived from crude oil);



Copyright and Source European Committee for Standardization

Gaseous-type fuels (e.g. CNG, LNG, LPG and hydrogen): diamond.

Examples of fuels with biocomponents on the market

Bioenergy content in brackets

- Brazil
  - E27 (19 %), E100
  - B15 (14 %)
- Europe
  - E5 (3.5 %), E10 (7 %), E85 (78 %)
  - B7 (6.5 %), B10 (9 %), B20/B30 for captive fleets (18/28 %), B100, XTL100 (HVO)
  - Biogas
- US
  - E15 (11 %), E85 (78 %)
  - B20 (18 %)

European activities to facilitate uptake of biofuels

Work executed by NEN on behalf of CEN, the European Standardization Committee, under a specific EC Horizon 2020 call under the Secure, clean and efficient energy programme: B.2.5. "Engine tests with new types of biofuels and development of biofuel standards under Framework Partnership Agreement with CEN-CENELEC".

Overall objectives

1) E20/25 gasoline fuel (1,77 M€)
   Study the sensitivity of the RON and MON relationship, to changing octane level and volatility sensitivity for a possible mid-blend oxygenate gasoline. Develop an emission testing plan for future acceptance
2) CI concepts using gasoline/oxygenate blends (1,05 M€)
   Demonstrate feasibility of a CI engine using ignition assist (spark plugs or glow plugs) to make high octane fuels ignitable and the combustion controllable over a wide operational window
3) Stability and robustness of actual FAME (245 k€)
   Make FAME standard EN 14214 more robust to ensure B7 is fit for purpose and in case of higher blends B10 - B30
4) BTL and HVO drop-in high blends' effects (172 k€)
   Check whether a latest engine concept might present issues regarding quality requirement (durability, driveability) for paraffinic diesel (blends) to present data on density lowering possibilities for EN 590

NEN

5

https://www.nen.nl/Evenementen/Presentaties/20190625-Presentaties-Future-fuels.htm?utm_medium=email

CEN/NEN conclusions

E20/25:

- According to a literature review, manufacturers suggest that the majority of cars produced from 2011 onwards are E20 tolerant
- The key OEMs consider the introduction of E20 more suitable than the introduction of E25
- Investigations do not identify any bottles neck preventing steps towards a mid-blend oxygenate specification development (E20)
- The first step would be to increase the oxygen/oxygenates concentration limits in the FQD, enabling CEN to initiate a fuel specification process

CEN/NEN conclusions

FAME:

- Diesel fuels containing FAME have caused problems in the field, e.g., filter blocking
- However, some B30 fuels have shown good cold driveability and behavior
- Undistilled biodiesels tend to cause filter plugging
- A new filter rig test predicts cold condition behavior of biodiesel fuels
- Proposals for modifications to the testing of biodiesel fuels

CEN/NEN conclusions

BTL & HVO:

- Density of diesel fuel can be lowered without compromising emissions or vehicle behavior
- The recommendation is to lower EN590 minimum summer grade diesel density from 820 to 800 kg/m3
- No modifications would be needed to vehicles or fuel supply system
- Despite of lowering density down to 800 kg/m3, all other EN590 specifications will still be met

Comment: Minimum density 800 kg/m3 would allow blending up to 50 % paraffinic components to EN590 diesel

Summary

- Compatibility of biofuels means that the fuels do not in any way compromise the emission performance, operability, safety and durability
- You cannot choose freely what fuel you operate a vehicle on
- For a road vehicle to be operated on roads, the vehicle needs to be certified for emissions and safety for a certain type of fuel
- Prerequisite for certification is that a defined reference fuel or a fuel standard exists
- In the case of Europe, the Fuel Quality Directive, legally binding, sets the minimum quality requirements for petrol and diesel
- The FQD is complemented by a number of standards, defining additional fuel parameters and also additional fuel options
- A new labelling system for fuel pumps as well as for vehicles is aimed at reducing confusion
- When aiming at increased uptake of biofuels, legislation and standards have to be in congruence with the objectives

IEA Bioenergy

European Commission

ADVANCED MOTOR FUELS
IEA-AMF
Technology Collaboration Programme on
Advanced Motor Fuels

The Contribution of Advanced Renewable Transport Fuels to **Transport Decarbonisation** in 2030 and beyond

More information: https://iea-amf.org/content/news/TD-WS

Contact: dina.bacovsky@best-research.eu