

Car industry and bio fuels

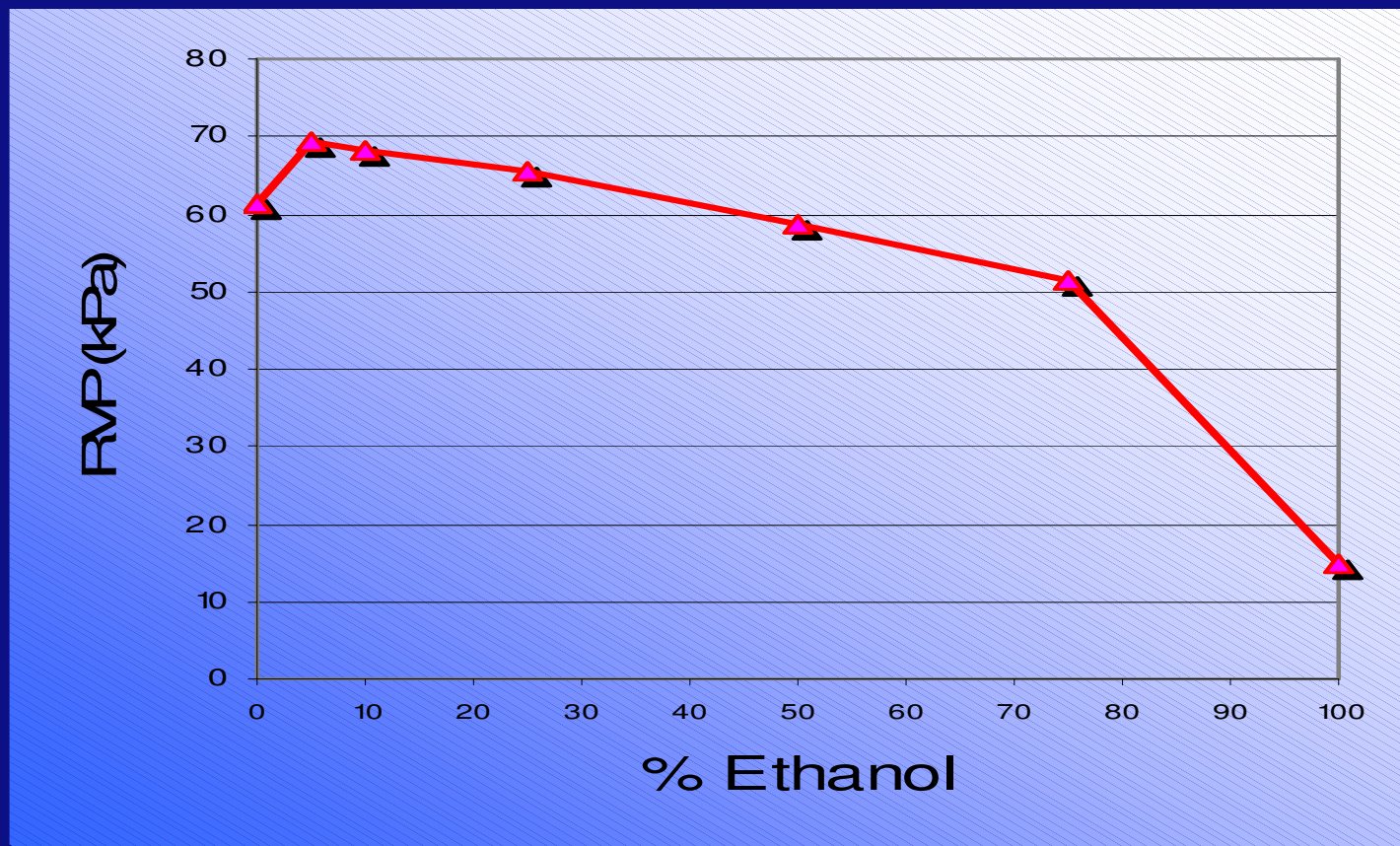
TNO | Knowledge for Business



Biofuels workshop Romania

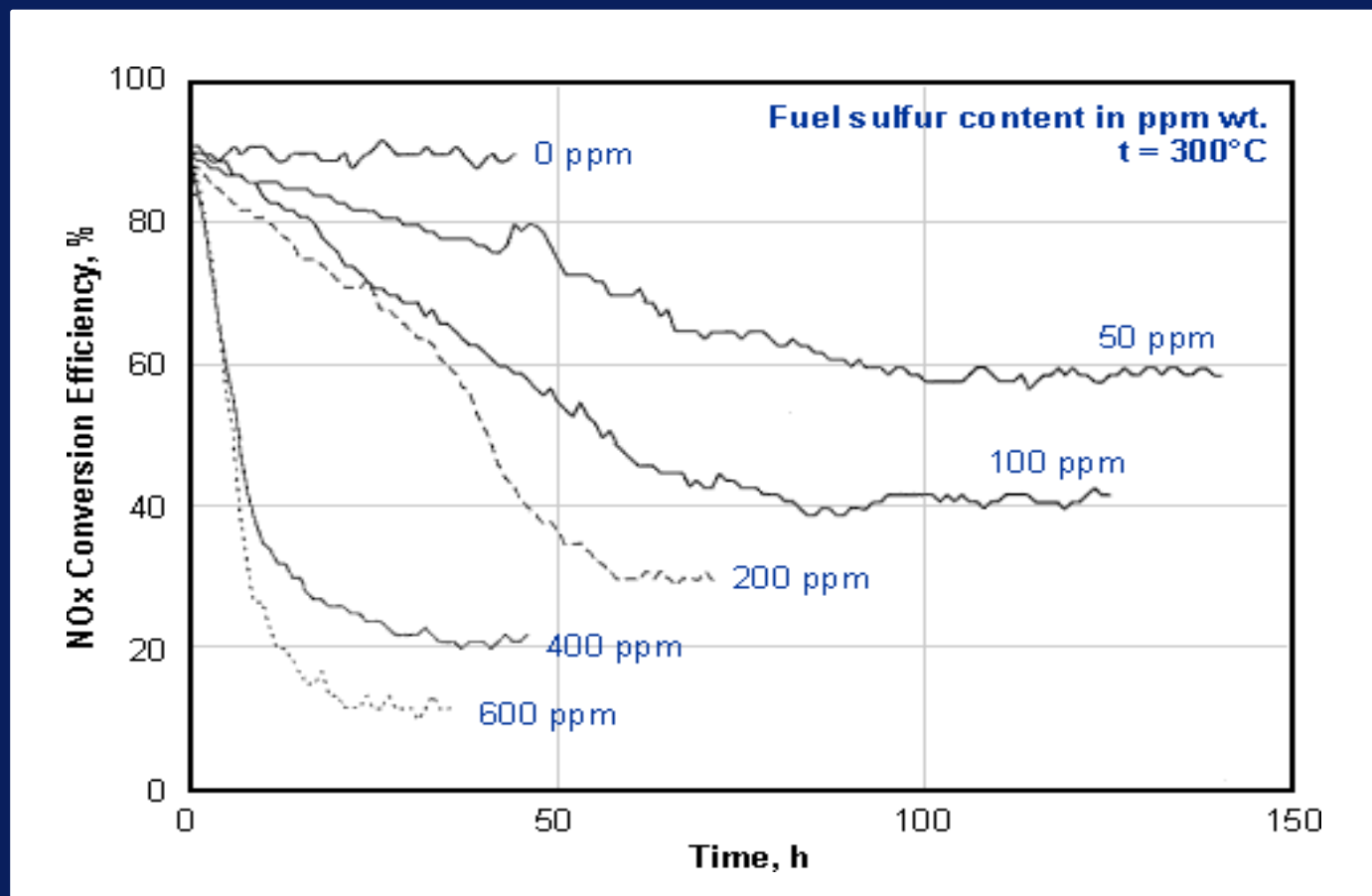
Typical problems with low % blends

Volatility limits - Reid Vapour Pressure of gasoline + ethanol blends

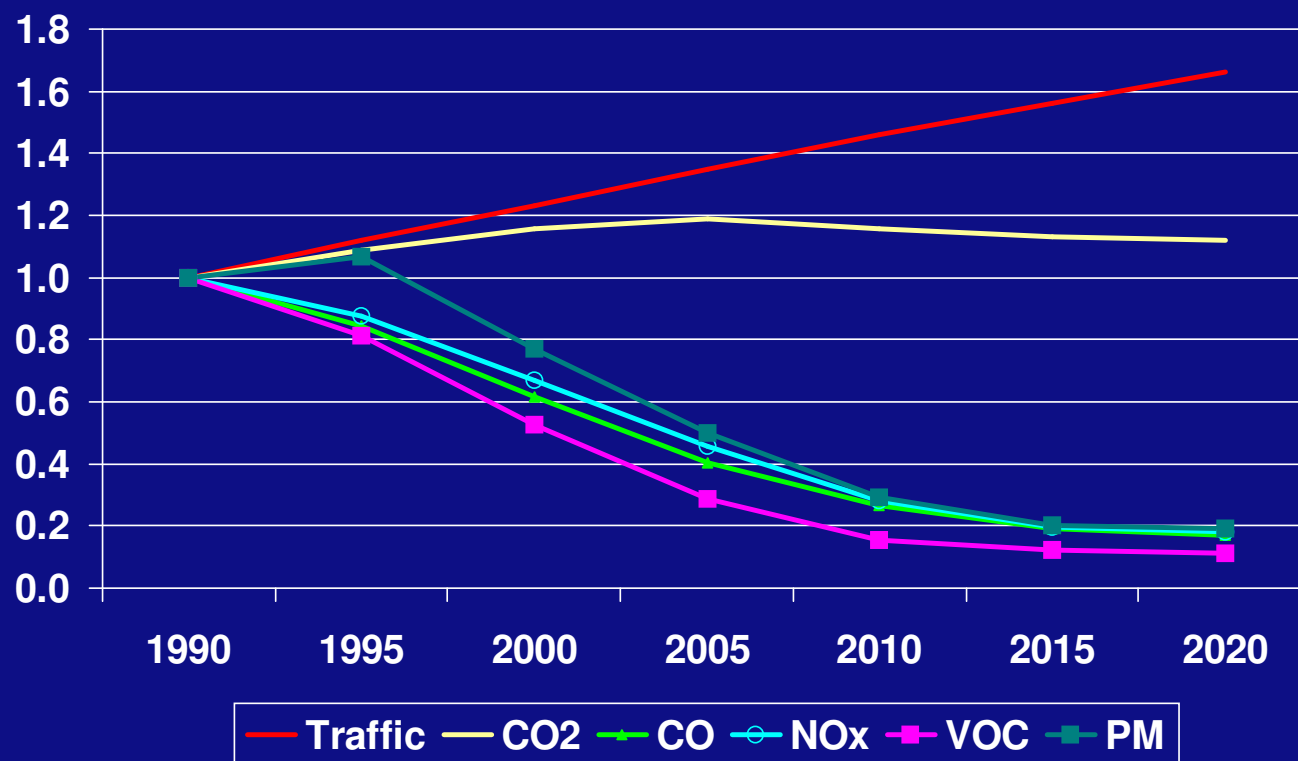


Solution: ETBE (replacing MTBE)

The impact of Sulphur content on catalyst reduction efficiency



But : Low blending will not solve the GHG problem!



• Therefore ***high blending*** is an absolute necessity !

High blending :

- Legislation
- Technology

First problem to be solved : legislation

energy content vs Ethanol v/v

Directive 2003/30/EC

5.75% energy content
(ethanol)



8.4 % v/v

Directive 98/70/EC

3.4 % energy content
(ethanol)



5 % v/v maximum

energy content vs O₂ m/m

Directive 2003/30/EC

5.75 % energy content
(ethanol)



3.1 % O₂ m/m

Directive 98/70/EC

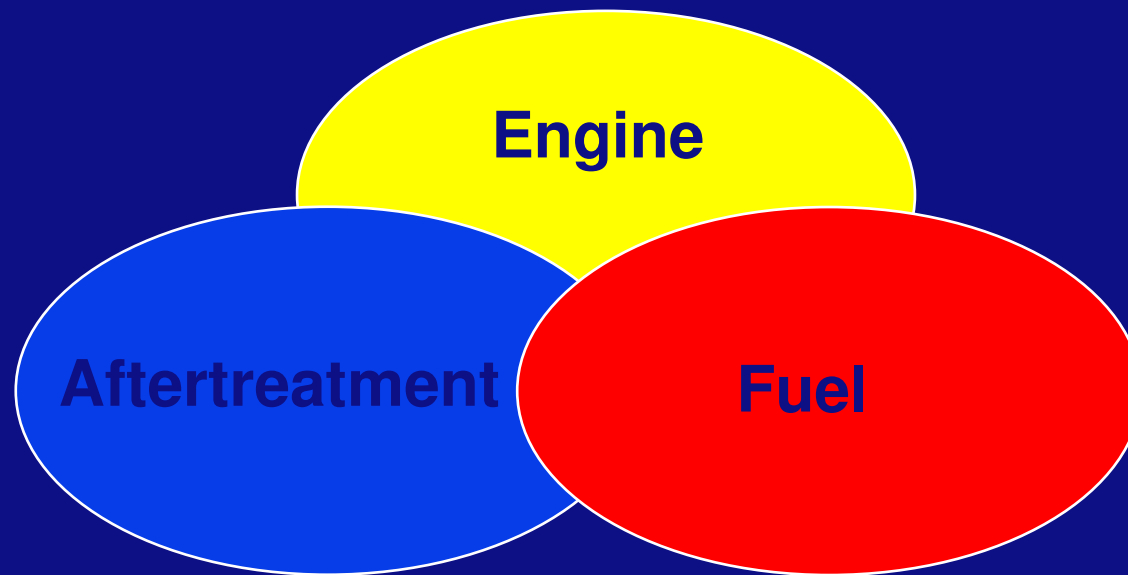
5 % energy content
(ethanol)



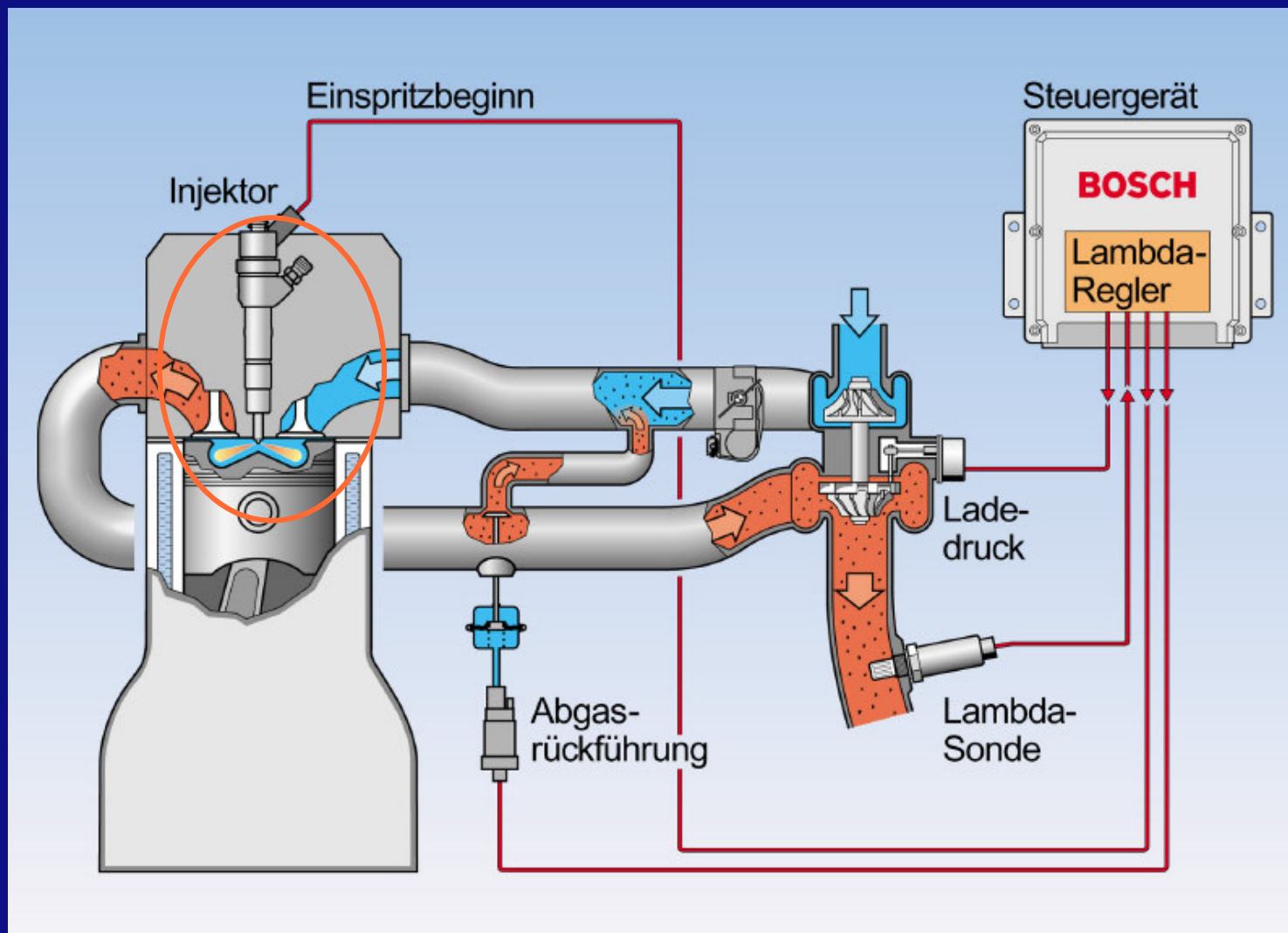
2.7 % O₂ m/m



Engine technology

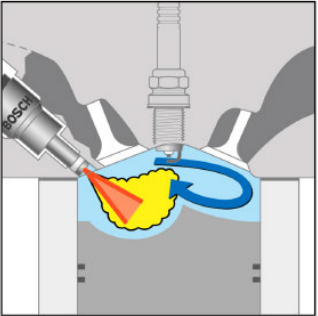


Understanding the engine of modern vehicles



Injector spray patterns become a major part of the engine performance

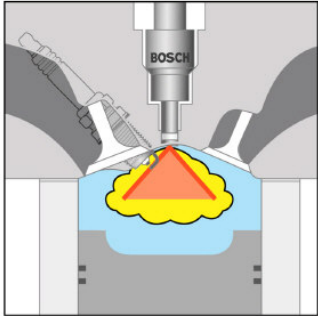
→ wandgeführt



Merkmale:

- Verbrauchsvorteil im Vergleich zur Saugrohreinspritzung 10 %
- am Markt eingeführt

→ strahlgeführt



Merkmale:

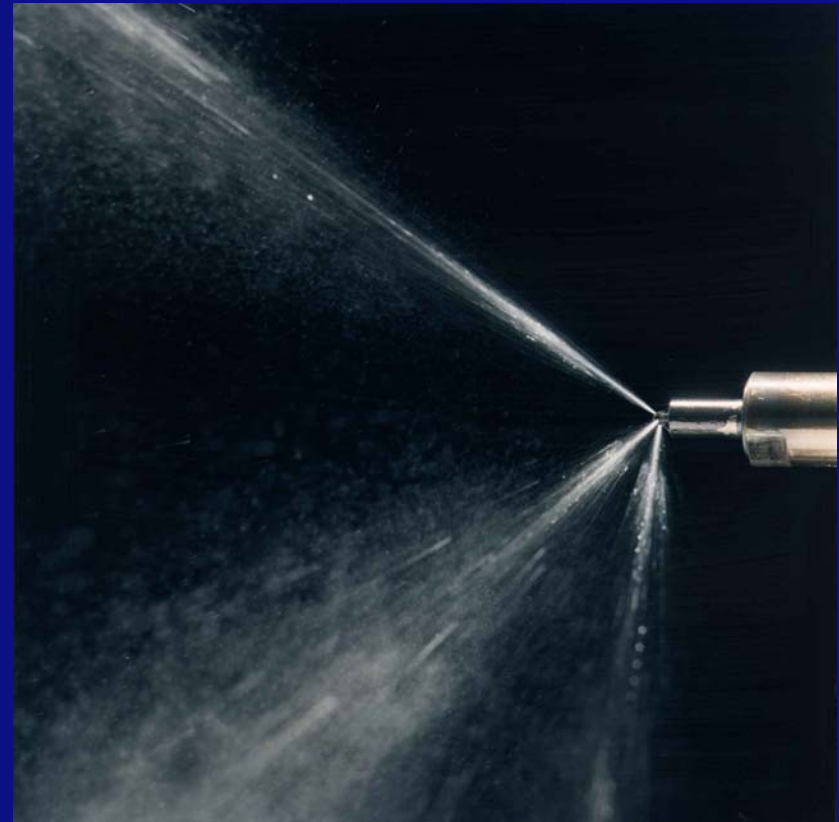
- Verbrauchsvorteil im Vergleich zur Saugrohreinspritzung 15 %
- geringere Emissionen (gegenüber wandgeführt)



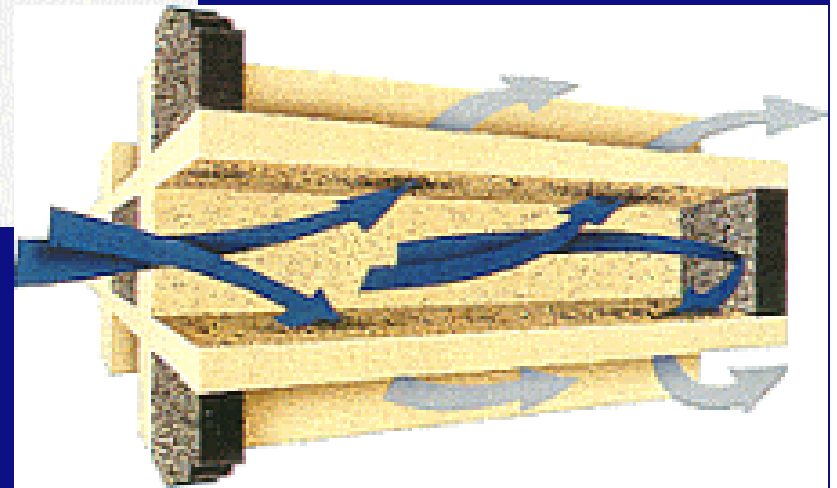
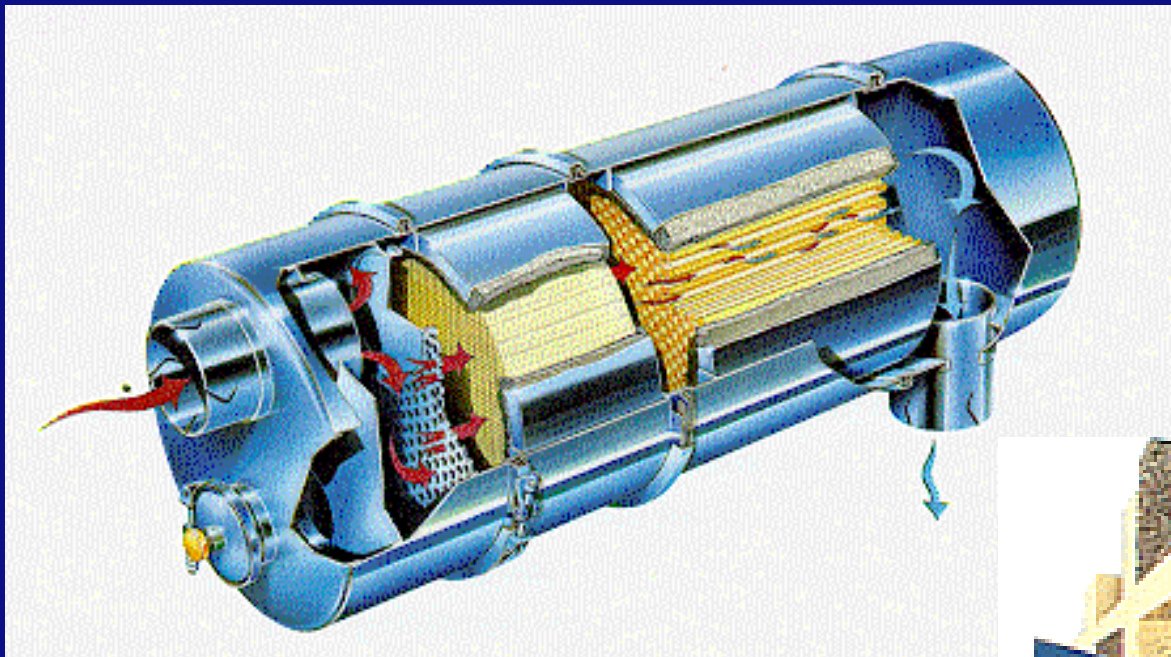
Diesel Injector Spray Pattern

Clean

Dirty



Exhaust gas aftertreatment



Typical vehicle related properties of fuels (1)

- General: CI (diesel) and SI (Otto)
 - low sulphur gives long catalyst life, but lubricity problems
 - Fuel density changes lead to need for engine modification
 - Corrosive fuels lead to the need for changes in seals and metal types
 - Increased oxygen content leads to increased NOx emissions
 - Viscosity changes lead to need for preconditioning fuels on-board
 - Varying fuel properties lead to the need for advanced engine control
 - Additivation of fuels becomes essential (keep clean of modern engines and injectors)

Typical engine related properties of fuels (2)

- Compression ignition (diesel)
 - High cetane gives smooth running and low NO_x
 - Lubricity of fuel in relation to high pressure fuel injection
 - High vapour pressure gives smoke free combustion
 - low vapour pressure/viscosity can lead to filter/injector clogging
 - High ash content of fuel (or lubricant) clogs filters ⇒ no bio fuels allowed yet for particulate trap fitted vehicles!
- Spark ignition (Otto)
 - High octane gives high engine efficiency
 - Custom build “high compressions” engines become possible

Options for high blending (>10%) of bio fuels

- Main options:
 - Compression Ignition (CI)
 - *bio-ethanol*
 - *bio-diesel*
 - *virgin plant oil (VPO)*
 - *Dimethyl-ether (DME)*
 - *bio-FT-diesel (or BTL, biomass-to-liquid)*
 - Spark Ignition (SI-Otto)
 - *bio-gas*
 - *bio-ethanol*

Specific properties

- ***Bio-ethanol***

- very low emissions possible (especially in optimised engines)
- increased emission of aldehyde, lower emission of 1,3-butadiene
- injector modifications necessary to compensate power loss
- materials change needed (partly solvable by fuel additives)

- ***Bio-diesel***

- decreased emissions of CO, HC (aromatics) and PM
- higher emission of NOx
- good lubricity (although Sulphur content is very low)
- some problems with cold start (compensate with additives)
- normally no loss in driving performance

Specific properties

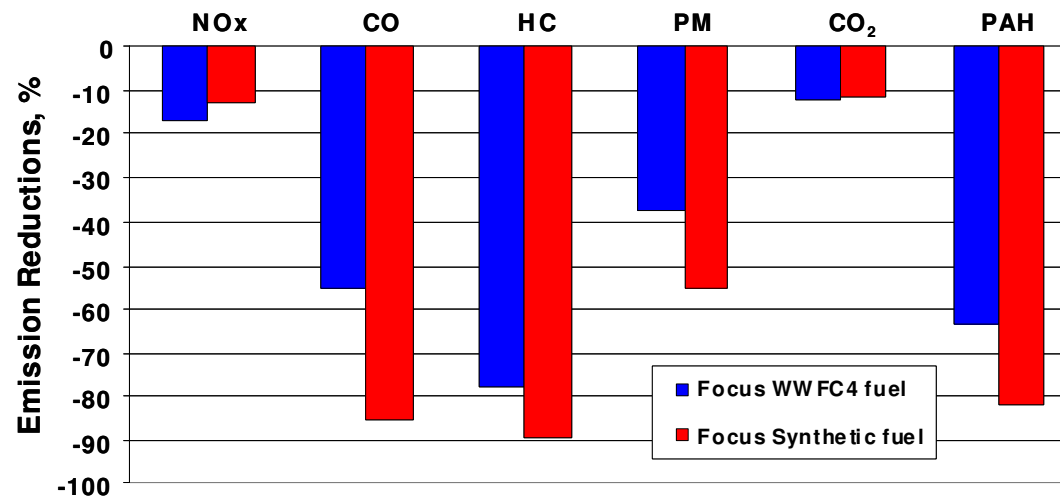
- ***Virgin plant oil (VPO)***
 - lower NOx, increased PM
 - potential problems with fuel injector clogging (newer engines)
 - limited power en torque decrease
 - Sulphur content could become critical for modern engines
- ***Dimethyl-ether (DME)***
 - needs completely new injector system and engine calibration
 - very low PM emissions and low NOx, CO and HC emissions
 - very good for engines and aftertreatment because of purity
- ***Bio-FT-diesel (or BTL, biomass-to-liquid)***
 - advantages of DME, but without need for engine modifications

The impact of “designer fuels” on emissions



Emission reductions for a Euro 3 Diesel Passenger Car, NEDC cycle

Source: CLEAN-project, Ford



Conclusions

- The automotive industry needs Bio Fuels in order to live up to their environmental obligations
- Low blends of (good quality) Bio fuels can be used in all older and modern vehicles without problems/modifications
- Before being enabled legally to use high blend of bio fuels EU legislation needs some changes
- High blends of Bio fuels in most cases need modifications on the engines fuelling system
- High blends of Bio fuels need to be of controlled quality to obtain durable (running and environmental) operation
- Latest engine (and aftertreatment) technology is more sensitive to the use of Bio fuels

A large, stylized graphic in shades of blue and white. It depicts a person with their arms raised in a celebratory or enthusiastic gesture. The person's head is a large circle, and their body is composed of various geometric shapes like rectangles and triangles. The background is a solid dark blue.

Thank you for your
attention.