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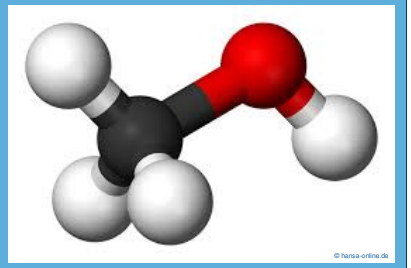

Methanol in combustion engines

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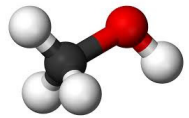
IAV GmbH

ZES-Net expert‘s workshop „Methanol“, 29th of April 2020

Fuel properties – potentials & challenges

SI … spark ignition
DF … dual fuel
DDC … dual diffusive combustion
DI … direct injection
PF … pilot fuel



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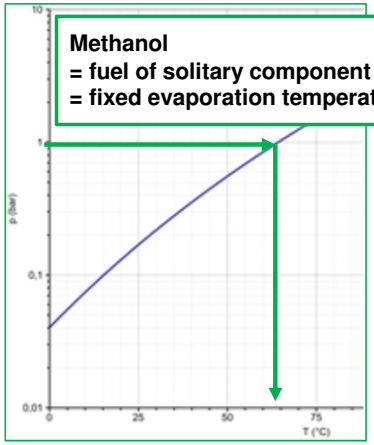
LHV = 19,9 MJ/kg	< 40% LNG	→ to be addressed by high efficiency
$CO_{2,\,spec}$ = 69,09 g/MJ	> LNG = 55 g/MJ	
RON = 109	< LNG = 120 … 130	→ Methanol = high performance fuel
q_{evap} = 1,103 MJ/kg	>>> LNG = 0 (gaseous admission)	



+

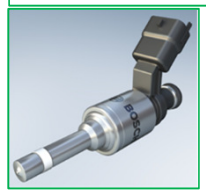
LHV = 19,9 MJ/kg

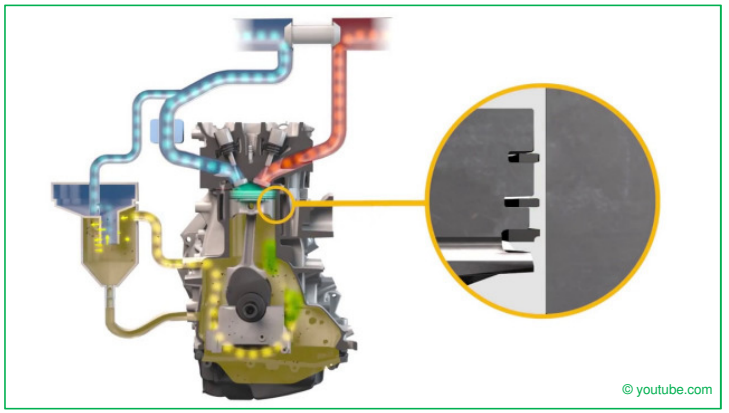
=

Ca. 200% injected fuel mass*

*(cmp. HFO)

→ Solution 2/2: high pressure direct injection (cmp. gasoline) for
→ SI
→ DF
→ DDC





→ Contamination of lubricant
+
→ Instantaneous evaporation

→ Solution 1/2:
performant crankcase ventilation & lambda/fuel mass control

Perspective

SI … spark ignition
DF … dual fuel
DDC … dual diffusive combustion
DI … direct injection
PF … pilot fuel

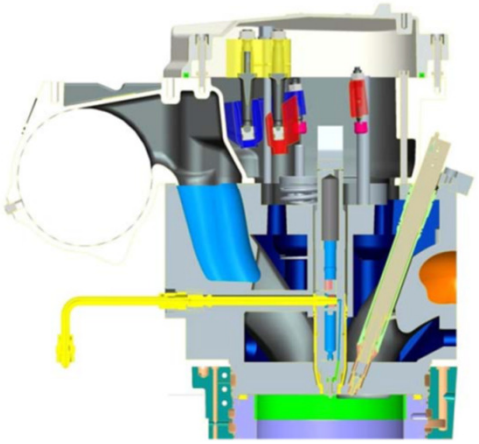
source: Dr. C. Poensgen, MAN Diesel&Turbo, 06.09.2012

A look back …

… how to transform a DF gas engine.

BUT …

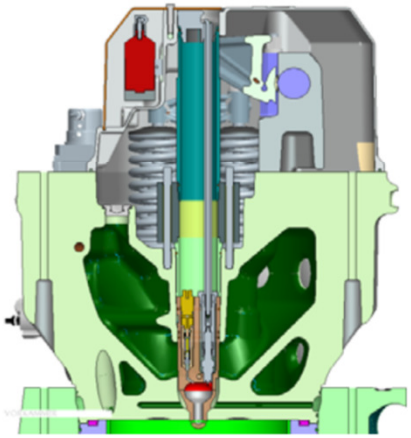
Today DF



Not a matter of if, but by when

η increase

Future Spark Ingition???



… not only LNG also Methanol is a basically „SI“ fuel …

- Proven SI technologies from „Power generation on gas“ can be transferred
- Monofuel engines are simpler and easier for maintenance
- High potential for TCO & emissions

Setup

SI … spark ignition
DI … direct injection
DF … dual fuel
PF … pilot fuel
DDC … dual diffusive combustion

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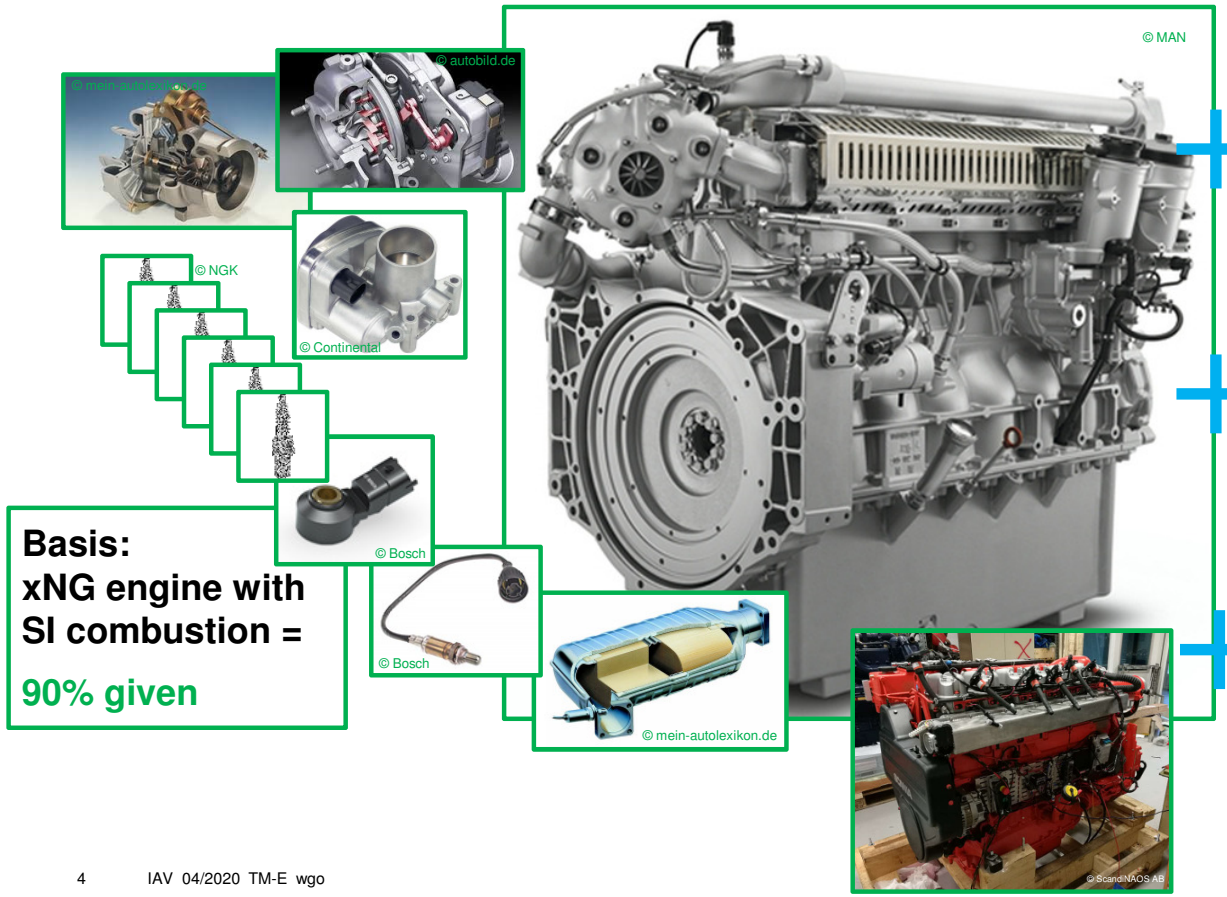
Example: 4SHS for smaller units or as AuxEngs



Basis:
xNG engine with SI combustion =

90% given

Bunker and crankcase ventilation

Methanol injectors (water injectors)

Methanol-water- and methanol-lubricant-sensors

GO FOR IT!

Fuel Matrix

SI … spark ignition
DF … dual fuel
DDC … dual diffusive combustion
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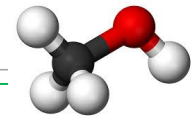
PF … pilot fuel



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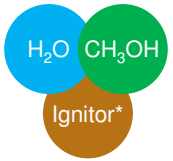
The combinations determine the combustion systems … and vice versa.

Ignitor*:
- Diesel
- HFO/MDO/MGO
- FAME
- DME
- HVO



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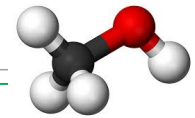

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- HFO/MDO/MGO
- FAME
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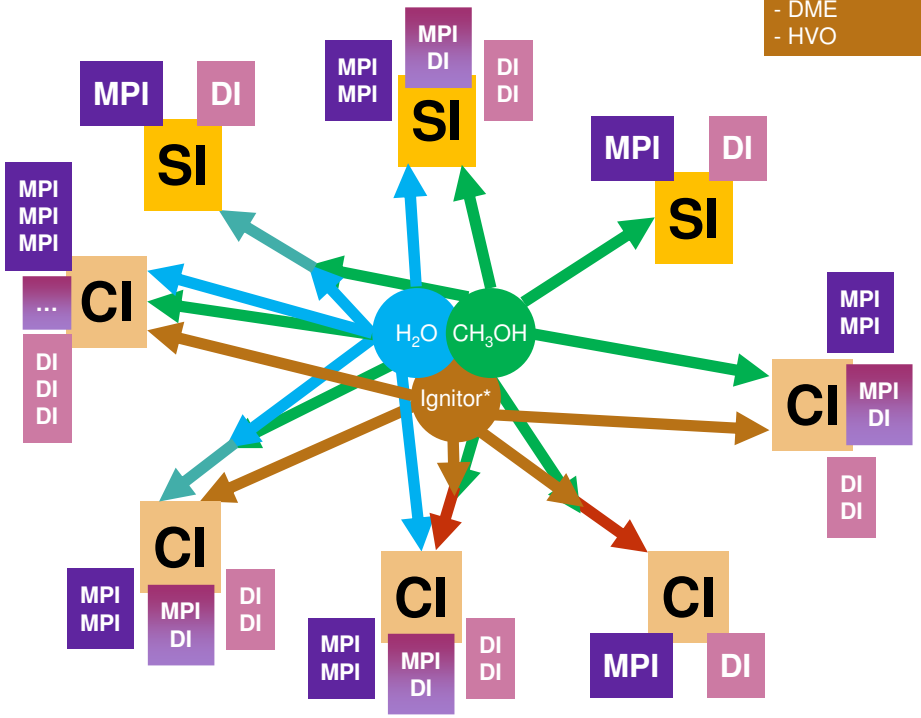
The potentials of water injection are not reliably investigated yet for every promising combustion :

→ SI: very competitive high load efficiencies; protection against irregular combustion

→ CI: internal NO_x reduction by a cheap medium (supplied independently on board)



Outlook

SI … spark ignition
DF … dual fuel
DDC … dual diffusive combustion
DI … direct injection
PF … pilot fuel

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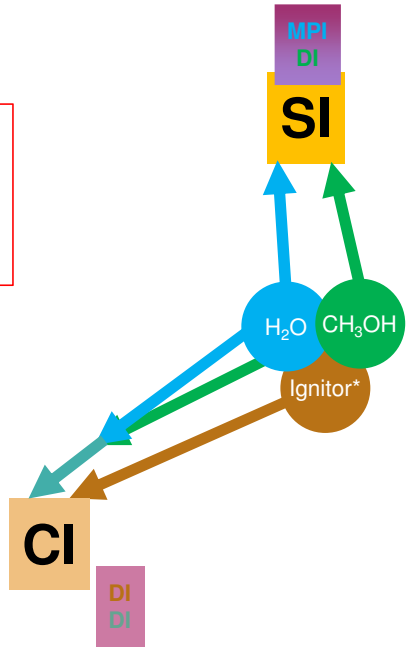
What is still missing … and to be developed

Applications:

- 4SHS (4SMS) units
- base engines = gas engines
- most severe emission legislation
- Monofuel solution
- (DF as alternative)

Methanol DI → cylinder heads with 2 accesses:
→ SI + DI
→ (PF + DI)



Applications:

- 4SMS/2SLS units
- high technologic effort but good TCO
- EAT must be tolerant against sulphur from pilot fuel
- DDC infrastructure necessary

Simple and cost-effective two-fuel injectors

Winning team 1/2

„SI Flex Performance“

variabilities =

- **2x rail pressure**
- **2x injection timing**
- **portion of water**

Winning team 2/2

„CI Mix Performance“

variabilities =

- **2x rail pressure**
- **2x injection timing**
- **portion of ignitor**
- **portion of water**