



Embracing a changing society: Diversity in construction

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**Pierre
CHAPELOT**

**H2 ICE
LUBRICANT**

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H2 ICE LUBRICANT



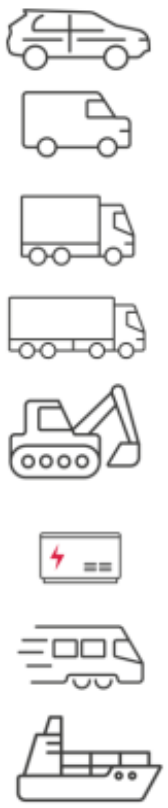
TotalEnergies

**H2-ICE Challenges and
Lubricant Opportunities**



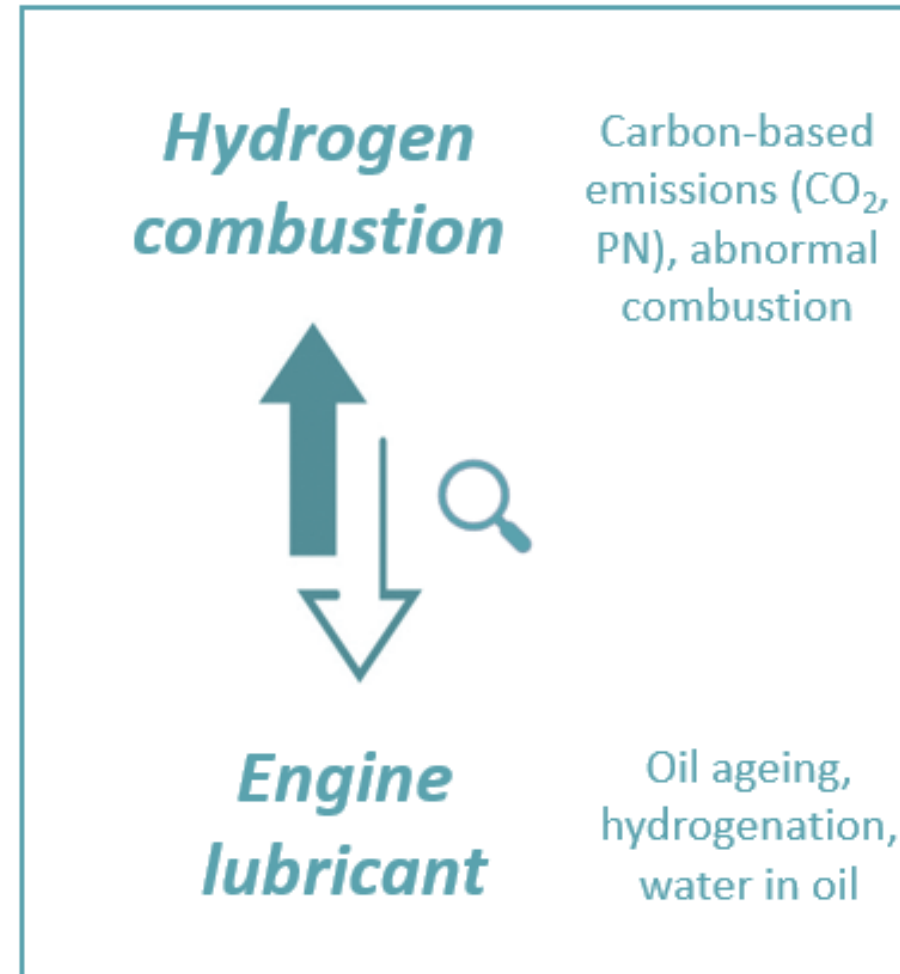
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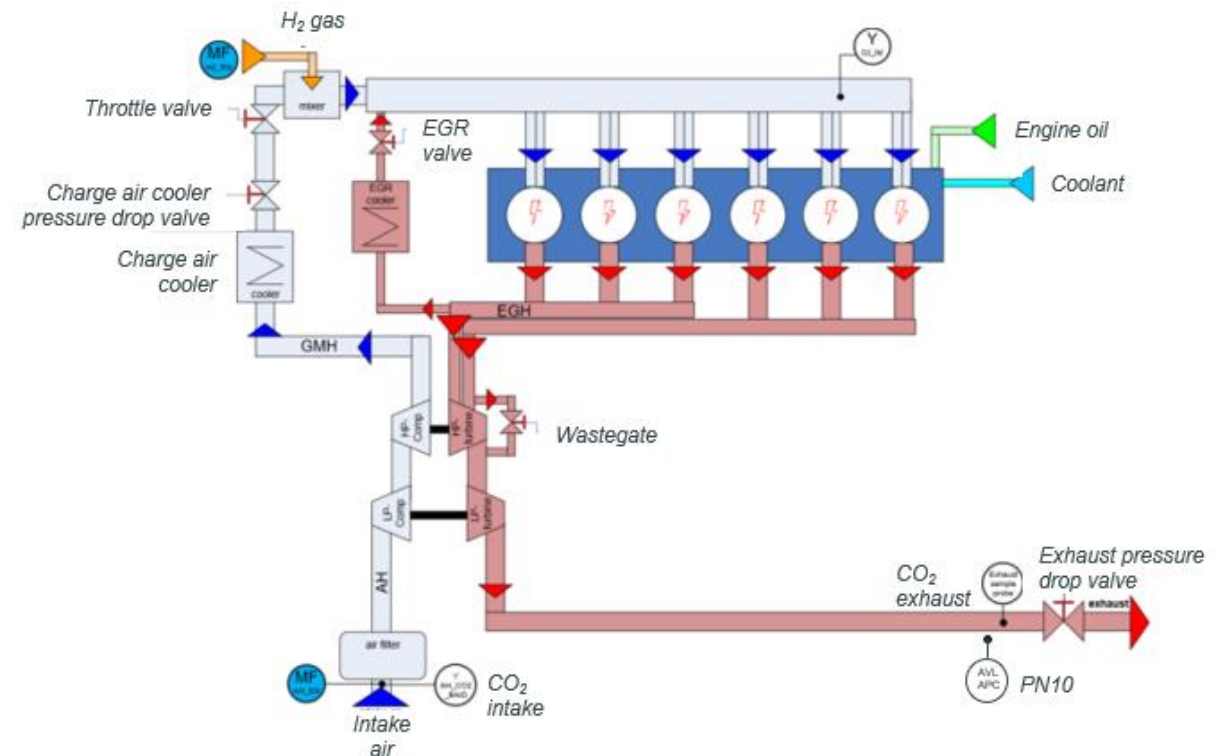
Lubricant performance to be enhanced due to **H₂ specific combustion properties :**

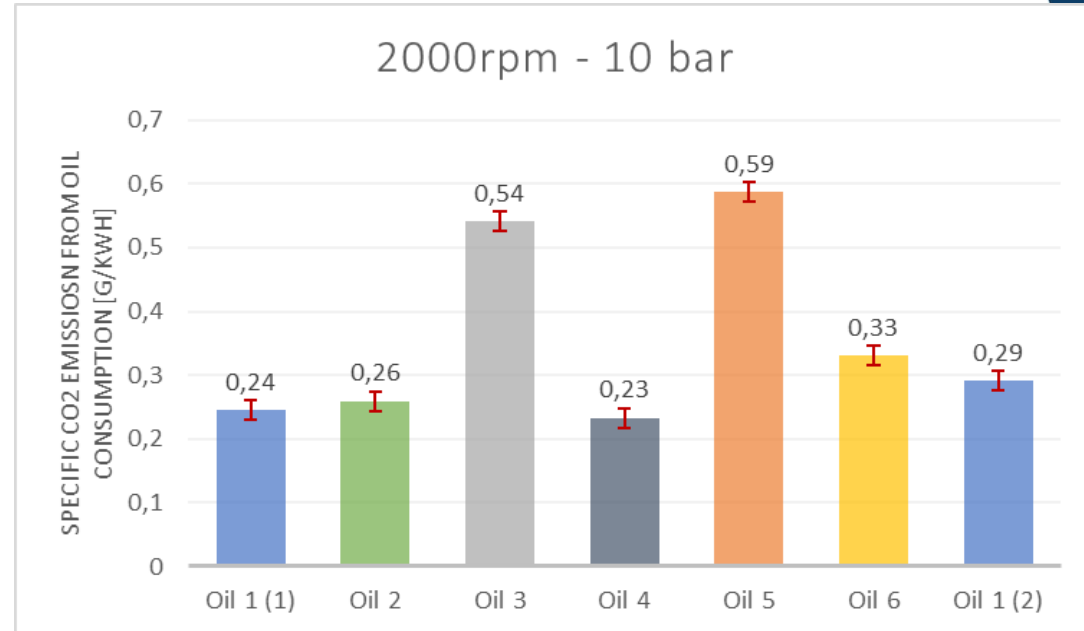
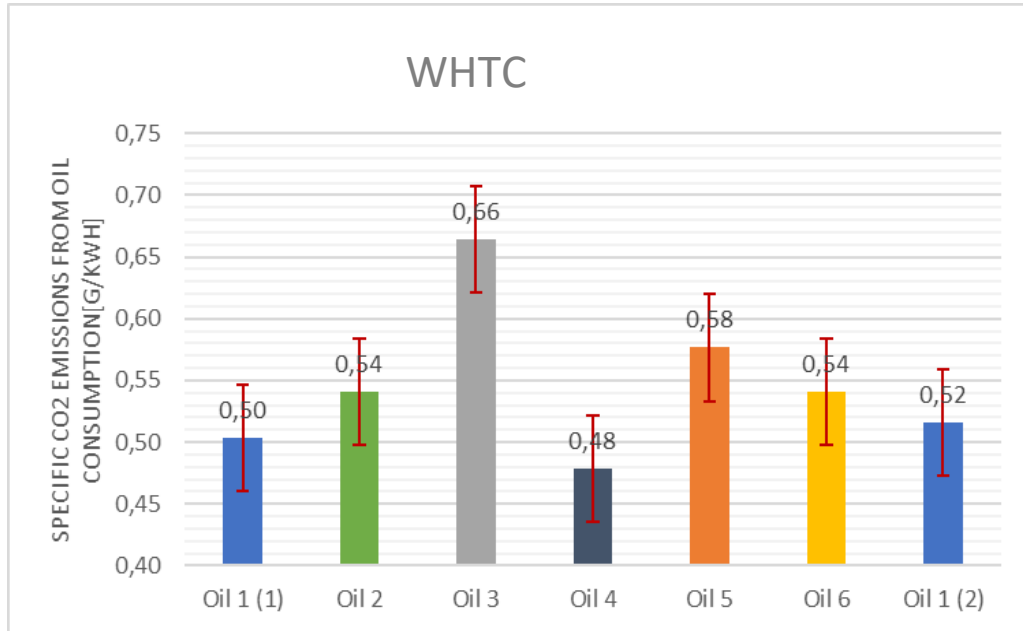
- Carbon-free combustion
- Water as combustion product
- Lower ignition energy
- H₂ high diffusion



- > **Medium-duty truck engine; lean burn** combustion for NO_x control
- > **CO₂** measurements at engine **intake and exhaust** ; calibration at 5000ppm
- > **PN10** measurement at engine outlet
- > Cylinder pressure measurements on all 6 cylinders for **pre-ignition** monitoring

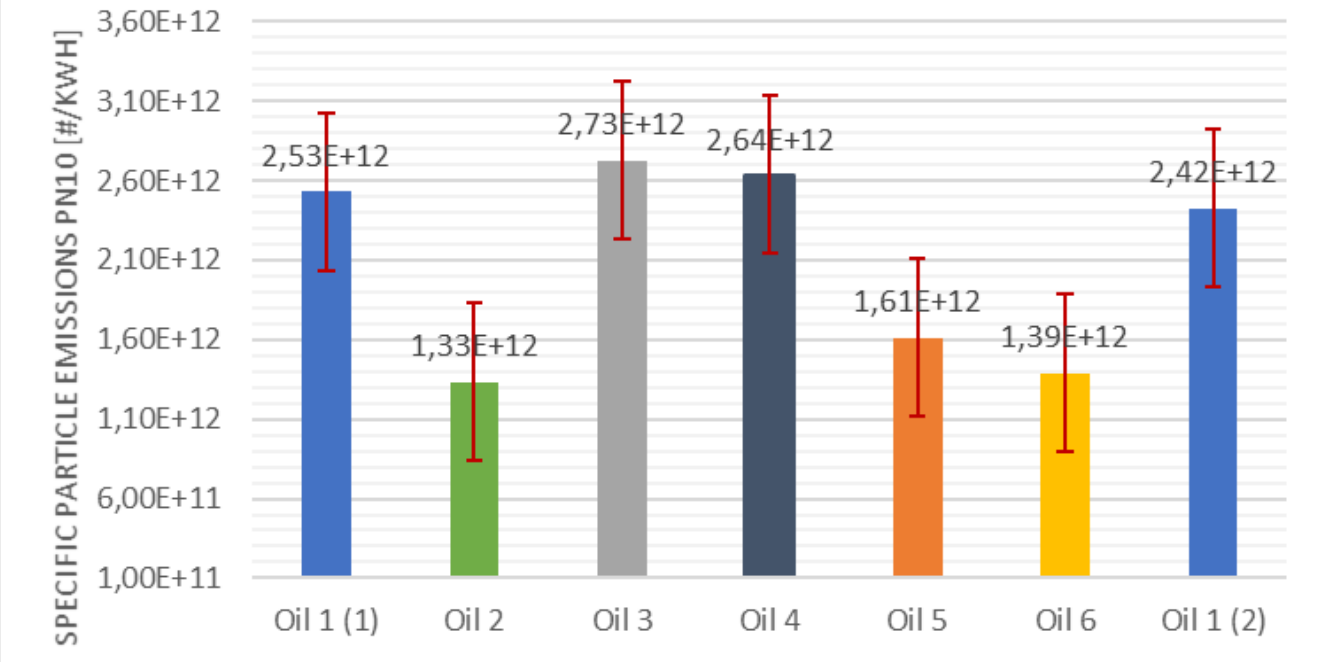
Engine type	6 cylinders in line
Displacement volume	7698 cm ³
Bore	110 mm
Stroke	135 mm
Valves per cylinder	4
H ₂ injection	PFI - Single point injection
Charging system	Dual stage turbocharger
Rated torque	1000Nm @ 1300rpm
Rated power	155kW @ 1600rpm



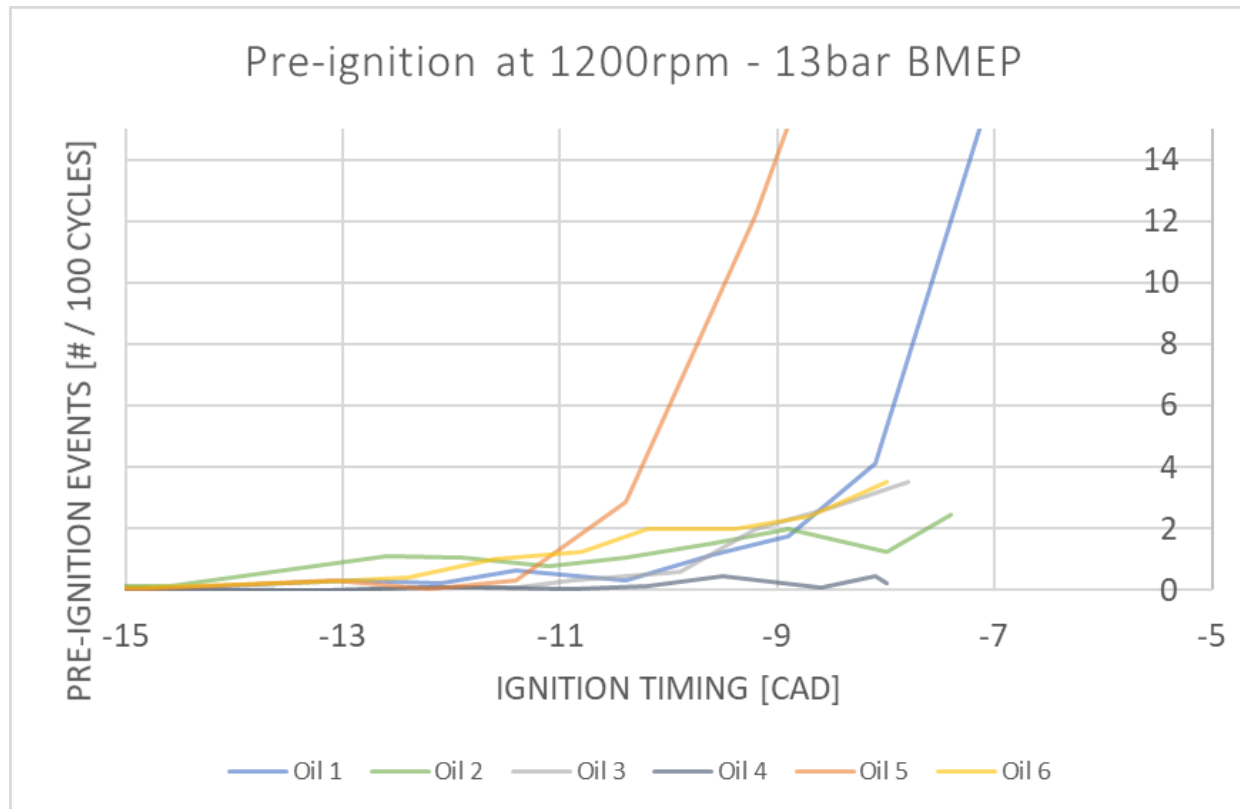


- > Measurements on WHTC and steady state operations
- > **Less than 1gCO₂/kWh** measured on all WHTC
- > Significant impact of engine oil formula on CO₂ emissions
- > Lubricant impact can depend on operating point

Particle emissions (PN10) on WHTC



- > Measurements performed on 6 WHTC
- > Good test repeatability
- > PN10 emissions above Euro VI limit
- > **Significant impact of engine oil confirmed on PN10 emissions**
 - 35 to 45% of PN10 reduction observed vs reference oil
 - Reduction of ash content (**Oil 2**) and use of alternative base oils (**Oil 5, Oil 6**) show positive effects

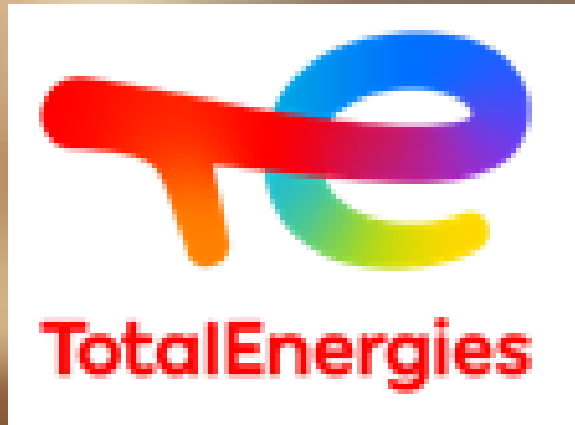


- > **Significant impact of engine oil confirmed on pre-ignition sensitivity**
 - PI mitigation with alternative oil compositions (**Oil 2**, **Oil 4**)
 - Strong PI increase with **Oil 5** despite positive effect on PN10

- > **CO2 Emissions :** below 1g/kWh
- > **Particle emissions :** Can exceed Euro VI limit for hydrogen combustion engine without specific lubrication system design (on a PN10 basis)
Engine oil composition can significantly impact particle emissions in H₂-ICE
- > **Pre-Ignition :** Significant impact of engine oil composition on pre-ignition frequency in H₂-ICE
Lubricant formulation solutions for LSPI mitigation in gasoline SI engines not as efficient in H₂ engines

→ **need to develop new lubricant solutions**

New publications to come in 2023



**Thank you for your
attention!**

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