

Emission Reduction Technologies – towards zero emissions

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Our business areas



MARINE SOLUTIONS



What we bring to the market



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Wärtsilä strives for emission reduction

- Exhaust emissions have both climate related impacts, and local air quality and health impacts.
- Wärtsilä is committed to reducing the environmental impact of its engines to a minimum.
- We continuously develop new technologies and upgrade existing ones in order to limit harmful emissions into the atmosphere.



Emissions from engines can be divided in two categories



Category 1: Local emissions: health & environment related

- Contribute to deterioration of human health, loss of wellbeing
- Mainly NO_x, SO_x and particulates
- Also impact the natural environment (flora & fauna) on short term
- Impact depends very much on location of emission. Focus on densely populated areas and sensitive ecosystems



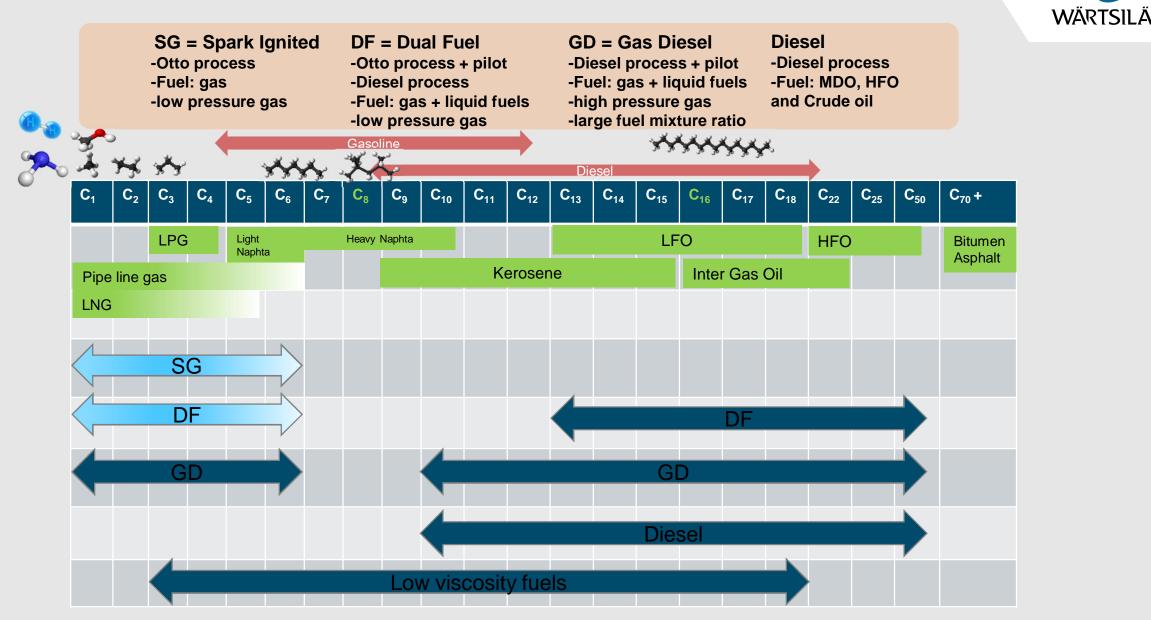
Category 2: GHG emissions: climate related

- Contribute to global warming / climate change
- Mainly CO₂ and CH₄ (methane)
- Low to no impact on human health or the natural environment on short term
- Impact is not dependent on location of emission, as climate change is a global problem

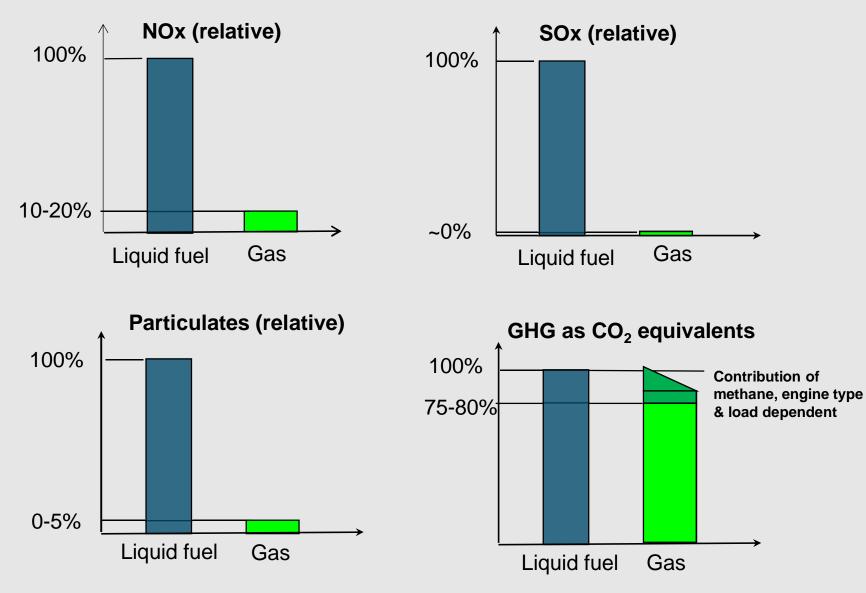
Sometimes conflicting interests exist between the two. Optimize for one or the other?



Hydrocarbon variations in Wärtsilä ICE



Why lean burn gas engines \mathfrak{O} Low emissions



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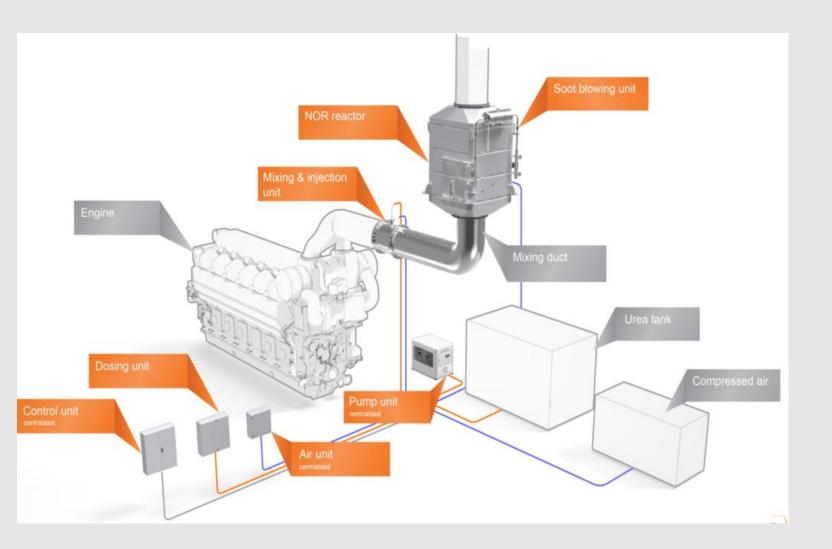
 There is continuous development for reducing methane slip

- Minimizing crevices in combustion chamber
- Minimizing scavenging lossed
- Testing of catalytic aftertreatment (main challenge is the deactivation by sulphur)



NOR – SCR for liquid fuels

- Certified solution for NOx reduction in liquid fuel operation
- Typically Tier II => Tier III NOx reduction, also other level can be tailored
- Hundreds of installations on distillate and residual fuels





CSO – Combined SCR and Oxidation Catalyst for gas engines

- Tailored aftertreatment solution to meet the most stringent local emission regulations
- Very high emission reduction from already low emissions of lean burn gas engine
- Smart integration of engine and aftertreatment for peaking and grid support applications
- Importance of ammonia mixing and reducing agent injection control





IMO initial GHG strategy (April 2018, MEPC72)

Vision

- IMO remains committed to reducing GHG emissions from international shipping and, as a matter of urgency, aims to phase them out as soon as possible in this century.
- carbon intensity of the ship to decline through implementation of further phases of the energy efficiency design index (EEDI) for new ships
- carbon intensity of international shipping to decline to reduce CO₂ emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008

• GHG emissions from international shipping to peak and decline

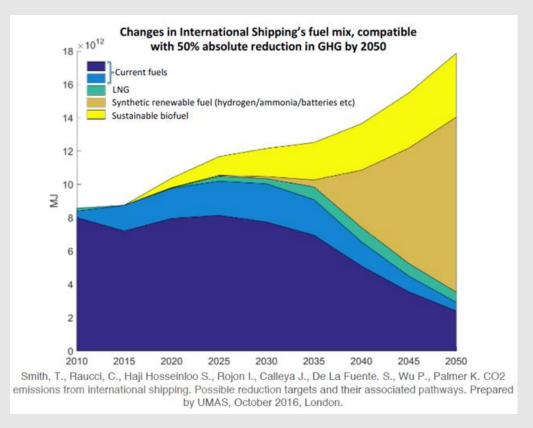
 to peak GHG emissions from international shipping as soon as possible and to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008



GHG – Candidate methods

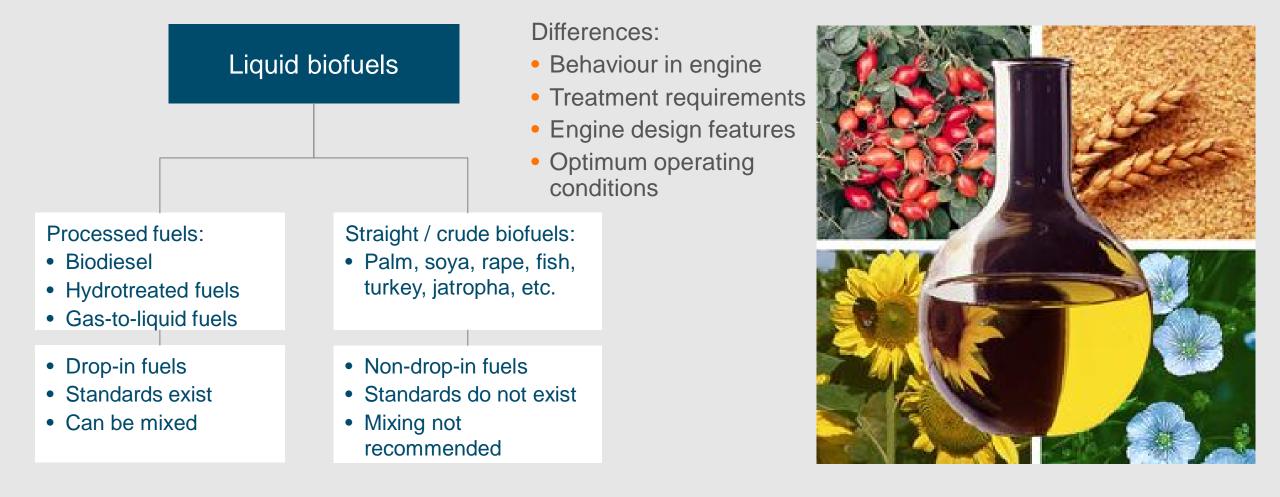
• Short term

- EEDI, SEEMP
- Operational improvements, speed optimization
- Mid- and long term
 - Introduction of low or zero carbon and fossil free fuels
- What it means in practice
 - Only way to reach 2050 target is to introduce low carbon or zero carbon fuels
 - Fuel flexibility Renewable liquid and gaseous fuels
 - Hydrogen, ammonia, electrofuels?





Variety of liquid biofuels exist today – Availability and volumes?





Alternative fuels

- Long experience in gas engine technologies has provided strong background for developing new solutions
- In the future methane or methanol can be based on renewable sources

• Hydrogen?

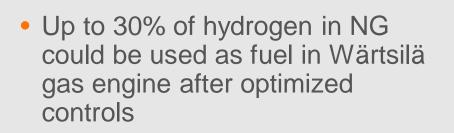




Hydrogen mixed in natural gas

- Target to study the effect of hydrogen mixed in NG in leanburn DF and SG engines
- Specific caution on safety
 - Hydrogen sniffers for gas pipes
 - Protective hood above the engine
 - Improved gas ventilation





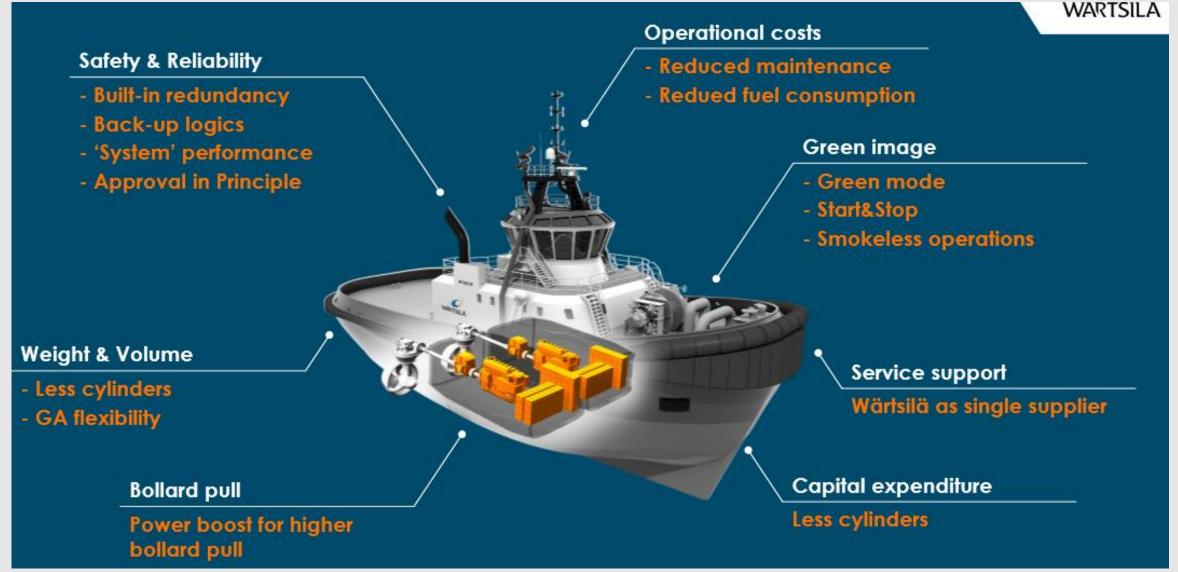






Hybrids – Wärtsilä HY (Intergrated engine, energy storage and power management system solution)

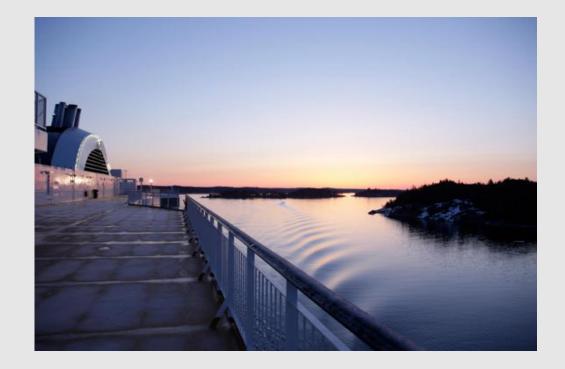
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Conclusions

- GHG is an important topic, but local emissions should not be forgotten
- Advanced aftertreatment solutions enable close to zero emissions
- Natural gas operation result significantly lower emissions, and provides gaseous fuel infrastructure for future fuels
- GHG reduction enablers
 - Fuel flexible engine technologies
 - Renewables both on liquid and gaseous fuels
 - Hybrid solutions



THANK YOU

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