

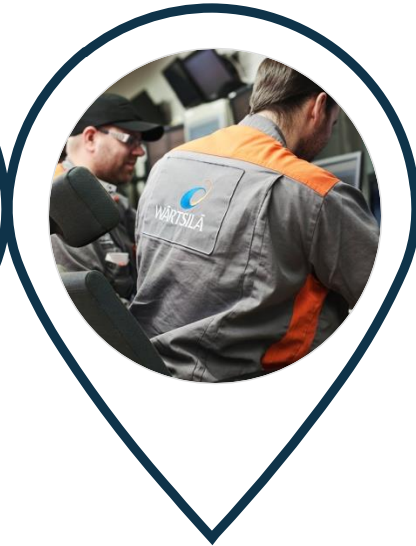
Propulsion systems and energy carriers and the role for liquid and gaseous biofuels

IEA Bioenergy TCP ExCo96 Workshop
19.11.2025
Kaj Portin, Wärtsilä





**Wärtsiläs role in
the journey
towards a
sustainable future**



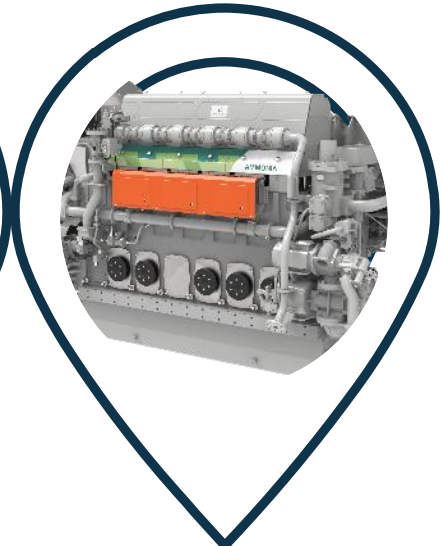
Biofuels



Biogas



Methanol/Ethanol



Summary

Set for 30 – our decarbonisation targets for 2030

Provide a product portfolio ready for zero-carbon fuels

Our investment and long-term research efforts have resulted in several milestones and industry firsts. Our engines can already now run on low- and zero-carbon fuels – such as ammonia, hydrogen, and methanol.

Become carbon neutral in our own operations

By the end of 2024, we have decreased our greenhouse gas emissions by 50% compared to the 2021 baseline.

25% reduction of direct suppliers' greenhouse gas emissions

A new target set in 2024.

Håkan Agnevall,
President & CEO



Local and global emissions



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

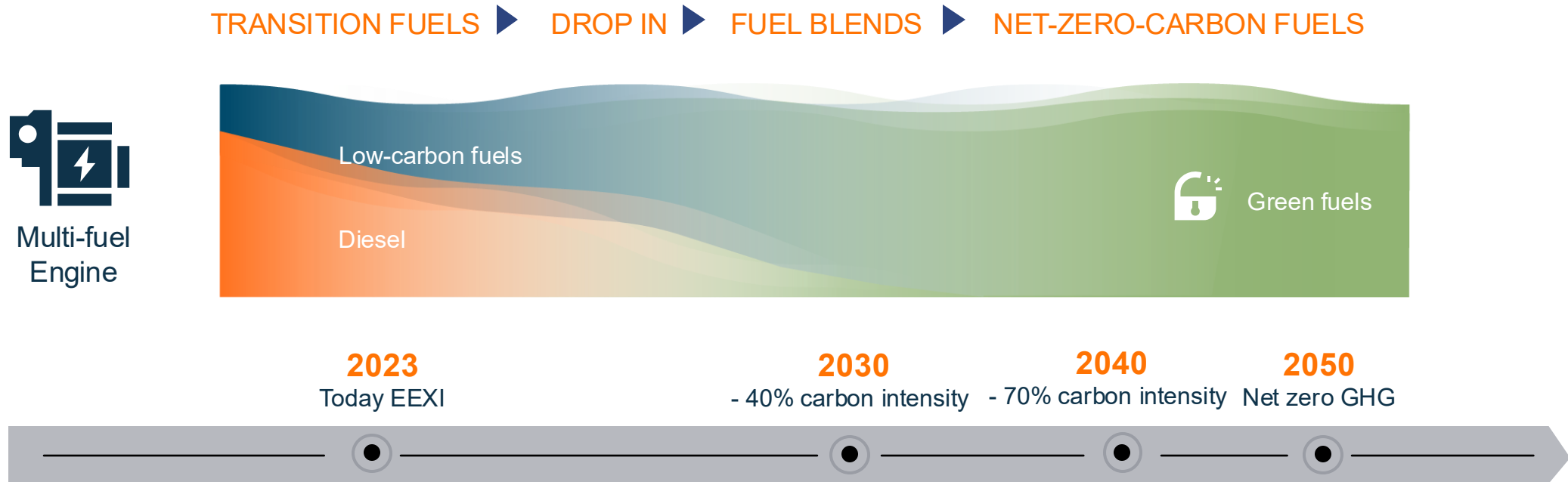


Category 2: GHG emissions: climate related

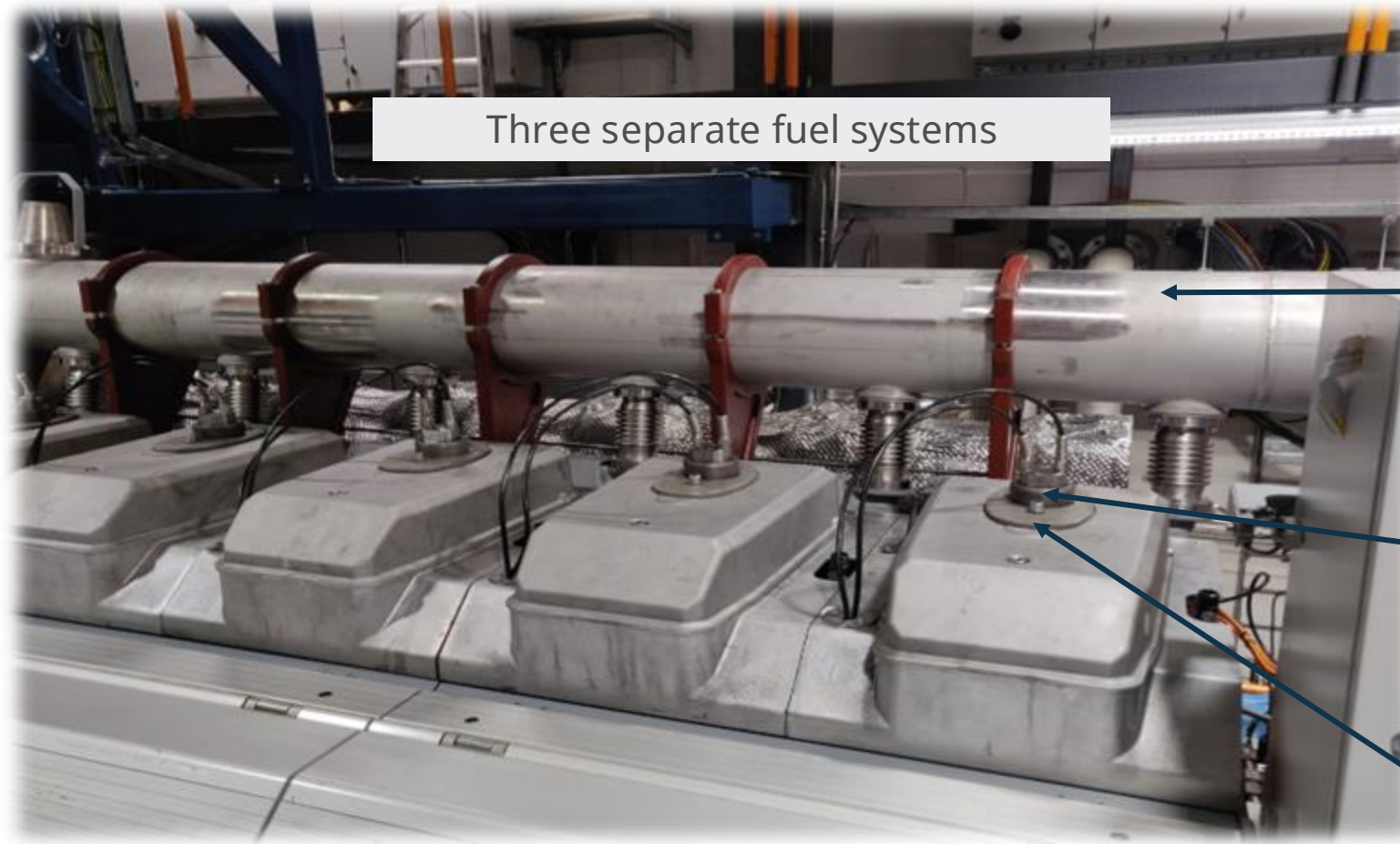
- Contribute to global warming / climate change
- CO₂, CH₄ (methane), and N₂O (laughing gas)
- Low to no impact on human health or the natural environment on short term
- Impact is not dependent on location of emission, as climate change is a global problem

Certainty in transition

Infrastructure and availability of green fuels need time to mature - current Wärtsilä multi-fuel technology offer a future proofed upgrade path



The multifuel engine



Three separate fuel systems

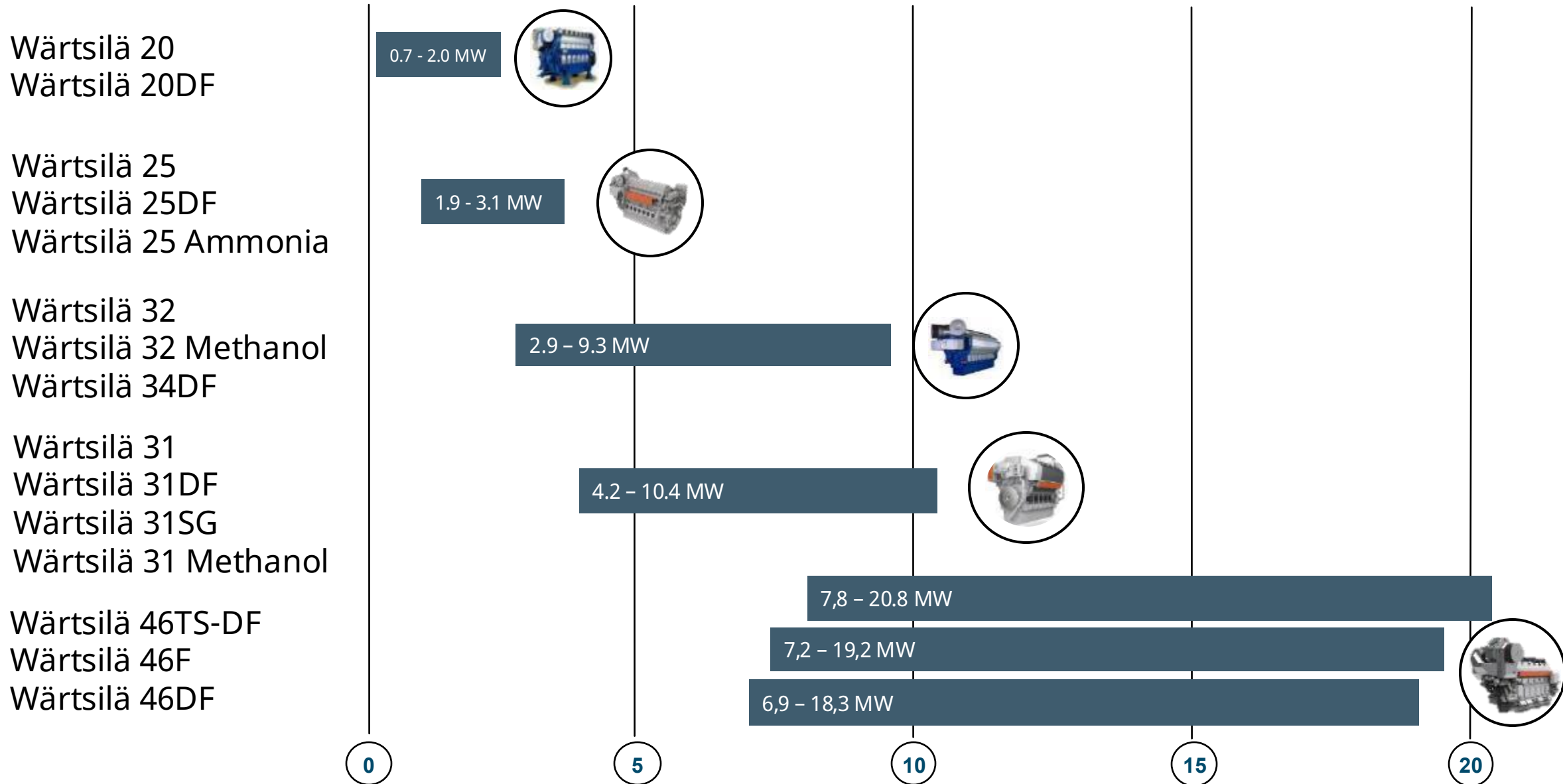
- Gaseous fuels*
- LNG
 - LPG
 - Ammonia
 - Hydrogen

- Liquid fuels*
- HFO
 - MDO
 - LPG
 - Ammonia
 - Methanol
 - Ethanol

- Pilot fuel*
- MDO

* Including corresponding bio and synthetic fuel

Wärtsilä 4-stroke marine engines, wide power range available



Wärtsilä has a long history of introducing new fuels



Natural gas
LNG
LBG



Natural gas: Composition

Example of natural gas composition (Spain)

- Methane 91,44 % mole
 - Ethane 5,35 % mole
 - Propane 1,22 % mole
 - Butane 0,41 % mole
 - Pentane 0,03 % mole
 - Heavier Hydrocarbons...
-
- Composition of natural gas can vary significantly depending on natural gas origin and treatment process.



Biogas upgrading

Raw biogas is produced through the breakdown of organic matter in the absence of oxygen, which is referred to as Anaerobic Digestion. (AD)

TYPICAL COMPOSITION:

- 50-70% Methane
 - 30-50% Carbon dioxide
 - < 0.1% Oxygen
 - < 0.1% Nitrogen
 - Hydrogen sulphide, water and small amounts / traces of harmful and aggressive elements depending on feedstock.
- NOT a suitable fuel quality for the engines!**

Biomethane is produced by separating and cleaning the raw biogas.

TYPICAL COMPOSITION:

- 99,9% Methane
 - 0.1% Carbon dioxide
 - < 0.1% Oxygen
 - < 0.2% Nitrogen
 - < 5mg/m³ Hydrogen sulphide
- Good gas quality for the engines!**

Liquid biofuels



Renewable Diesel (HVO) and Biodiesel (FAME): Pros and Cons

Pros	Cons
<ul style="list-style-type: none"> + Sulphur oxide emissions closed to zero + Low particulate emissions + Reduction in CO₂ emissions (from well to tank) + They mixes well with fossil fuels (HFO & MGO) + Can be used in the existing engines w/o modifications + The EN 15940:2016 (HVO) and EN 14214:2012 (FAME) standards are available 	<p>FAME:</p> <ul style="list-style-type: none"> - Contains ~ 13% less energy than fossil diesel - Water separation from biodiesel is more challenging - Solvent characteristics - Can foster the risk of microbial activity - Long term storage period limited - Cold flow properties may be a problem <p>HVO and FAME:</p> <ul style="list-style-type: none"> - Price and productions volumes



Liquid biofuels: Experience

Renewable diesel (HVO)

- ❑ Neste My tested in a Laboratory engines
- ❑ BioVerno tested in a Laboratory engine.
- ❑ Documented long-term field experience does not exist.
- ❑ Gas-to-Liquid (GTL) synthetic diesel manufactured with Fischer-Tropsch process is from quality point of view similar compared to Neste My & BioVerno but not a renewable fuel if fossil natural gas is used as a feedstock.

Biodiesel (FAME)

- ❑ Biodiesel B100 tested in a Laboratory engine
- ❑ Documented long-term field experience for 100% FAME does not exist.
- ❑ 2 – 10% biodiesel / fossil diesel blend used in various countries. No big drawbacks recorded. Blending ratios have increased up to 20 – 30%.

Customer interest in liquid biofuels

- ❑ Both internal / external discussions are indicating that the interest towards the use of biofuels has increased
- ❑ Most customers are interested in drop-in-fuels like biodiesel (FAME) and renewable diesel (HVO)
- ❑ Both the blends with fossil fuels and the use as a pure 100% biofuel are in customer's interest
- ❑ Typical questions from customers:
 - Are biofuels miscible with other fuels and what are the allowed blending ratios
 - In which engine types is the use allowed
 - Are modifications required
 - Influence on engine overhaul intervals
 - Influence on engine component lifetime
 - Influence on engine performance
 - Influence on emissions



METHANOL: DELIVERING CAPABILITY TO POWER MARINE ENGINES AND ACHIEVING CARBON NEUTRALITY



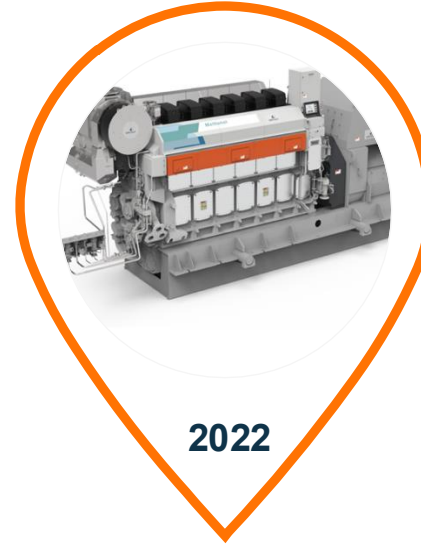
2015

Conversion of Stena Germanica ZA40 engines



2020

Development & demonstration of methanol technology



2022

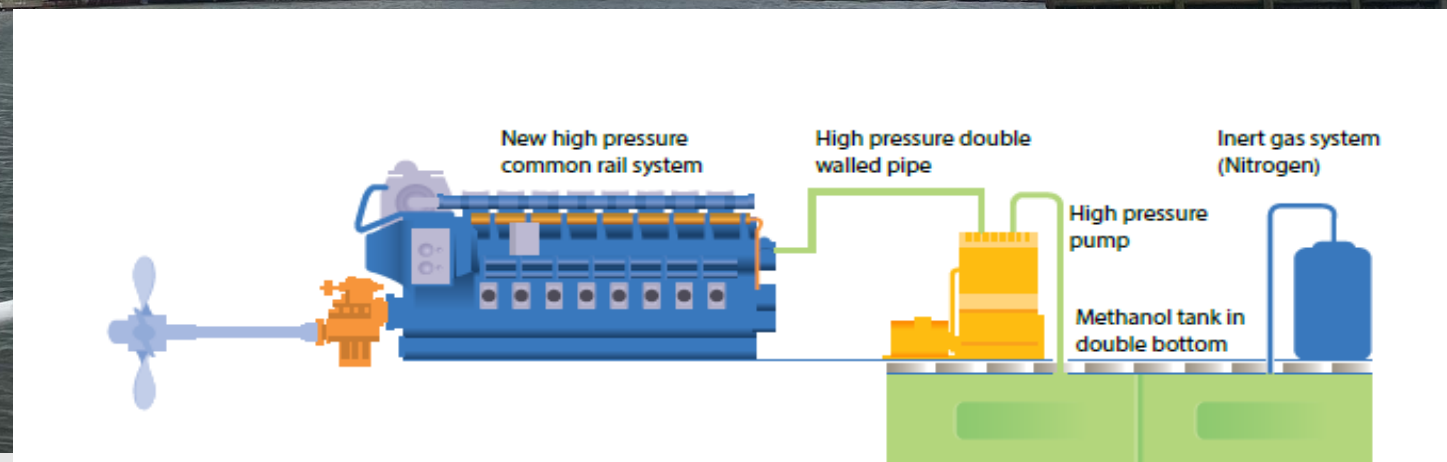
W32 Methanol engine launch & MethanolPac



2023

Launch additional methanol engine types & retrofit options

Methanol adaptation of Stena Germanica



Wärtsilä 32M references

261 / 32M engines



MERCHANT
63 vessels /
238 engines

- LNG Carrier
- Container Vessel
- Asphalt Carrier



CRUISE & FERRY
3 vessels /
8 engines

- Cruise Vessel
- RoRo Vessel



OFFSHORE
5 vessels /
11 engines

- Offshore supply vessel
- Offshore Construction Vessel
- Wind Turbine Instal Vessel



**SPECIAL,
OIL&GAS, OTHER**
1 vessels /
4 engines

- Cable layer and repair vessel



ENERGY
plants /
engines

Press release Ethanol

Raízen's commitment to reducing marine sector's GHG emissions

Wärtsilä Corporation, Trade press release 23 October 2023 at 10:00 UTC+2



Technology group Wärtsilä has signed a strategic partnership agreement for [Decarbonisation Modelling](#) with Raízen, a major Brazilian energy company. The agreement focuses on both newbuilding and existing operation upgrade plans. Its aim is to build and implement a fleet-wide decarbonisation plan with a particular interest in the future marine introduction of ethanol as a marine fuel.

Summary

- Decarbonising of the marine and energy sectors is urgent and requires a wide range of measures
- A successful development requires expertise and actions from many contributors
- Wärtsilä's portfolio provides several solutions towards a net-zero future
- Fuel flexibility secures a future proofed solution
- Concepts for ICE operation on the future fuels like Biofuels, Ammonia, Hydrogen, and (M)ethanol are already being developed and demonstrated.





WÄRTSILÄ

kaj.portin@wartsila.com