Wärtsilä

What it takes…

Nautisch-Technischer Inspektorenkreis HH e.V.

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06 May 2025

AGENDA

- Who we are - Wärtsilä
- Green transformation in shipping
- Integrated system solutions
- Approach on future fuel technology
- Best time to act

190 years of innovation

1834

Our story begins when a sawmill is established in a Finnish village, Värtsilä.

1950s

Our first marine engines.

1970s

The first-ever 4-stroke engine operating on heavy fuel oil.

We enter the energy sector.

1995

Our pioneering dual-fuel engine can switch between fuels during operation.

2012

World's first hybrid system on-board a vessel.

2015

Guinness World Records names Wärtsilä 31 as the most efficient 4-stroke diesel engine in the world.

First engines of a customer are converted to run on methanol.

2022

Our first newbuild methanol engines.

2023

As we stand among TIME's 100 most influential companies, our story continues with world's firsts:

- 4-stroke engine-based ammonia solution for marine.
- Wärtsilä engine runs on 25 vol% hydrogen blend.

2024

As one the world's most sustainable companies* we launch the world's first 100% hydrogen-ready engine power plant concept.

*recognition by TIME magazine

A new phase in Wärtsilä's development

2002–2010 — 2011–2015 — 2016–2020 — 2021

Lifecycle power solutions

- Providing customers with lifecycle power solutions
- Expanding our propulsion portfolio
- Strengthening our Services business through numerous acquisitions

Becoming a total solutions provider

- Selling solutions to targeted customers
- Expanding our portfolio of environmentally sustainable products
- Strengthening our presence in Electrical & Automation

Smart marine and 100% renewable energy

- Moving towards digital solutions
- Affected by negative deviations in high-risk projects
- Creating end-to-end value chains

Shaping the decarbonisation of marine and energy

- Shaping the decarbonisation transformation
- Becoming customers' preferred technology partner
- Taking a thought leadership position in the Marine and Energy industries
- Adding steps to our service value ladder
- Using digitalisation throughout our value chain
- Growing profitably and continuously improving our performance

A global team of experts fuelling change since 1834

18,300
people

230+
locations

128
nationalities

77
countries

6,449
net sales, MEUR

53%
service sales
of total

Figures from 2024

Our purpose

Enabling sustainable societies through innovation in technology and services

We are shaping the green transition in marine and energy with our advanced technologies, expertise in sustainable fuels and lifecycle service offering.

Uniquely positioned to drive global transformation in our industries

1 in 3 of the world’s vessels

are equipped with Wärtsilä solutions. That’s over 30,000 ships.

Over 180 countries

where Wärtsilä energy installations provide reliable power.

53% of sales come from services

and 90% of our lifecycle customers renew their service agreement.

Our decarbonisation targets for 2030

- Provide a product portfolio which will be ready for zero-carbon fuels
- Become carbon neutral in our own operations
- 25% reduction of direct suppliers GHG emissions

Håkan Agnevall,
President & CEO

Green is not black or white

No single solution will get us through the transition alone
Fossil fuels will play a role for decades
Most of the needed technologies already exist

Our solutions help our customers towards success by reducing emissions, improving efficiency and cutting costs

We innovate along with our ecosystems

We work to make decarbonisation both environmentally sustainable and financially viable

The marine industry’s three pathways for decarbonisation

Burn less fuel
More efficient operations and solutions

Clean up emissions
Carbon capture, exhaust treatment

Use alternative energy sources
Sustainable fuels, hybridisation and electrification

A 100% reduction in greenhouse gas emissions will require the adoption of sustainable fuels

You are not alone ..

Data is key for transitioning in a new era in shipping

Old way of working:

- Sticking to conventional fuels
- Sticking to conventional operation
- Following the principal “we did it like this in the past”

To get the most efficiency out of a vessel (NB and existing) following steps are necessary:

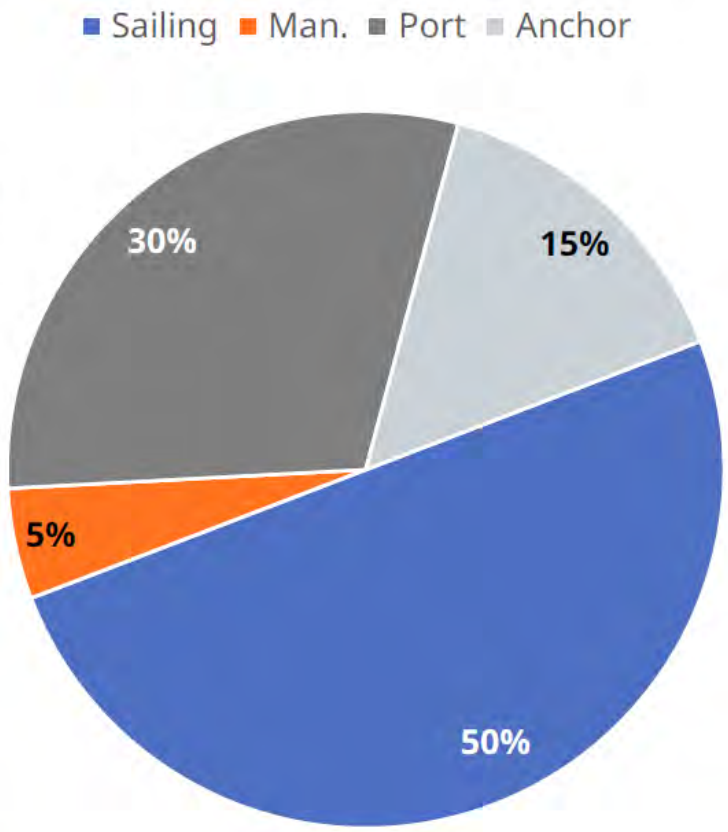
- Data sharing is essential for effective collaboration
- Do not rely on outdated technology
- Engage with designer / supplier at early stage to find suitable solutions
- Trust in results from collaborative investigations –> Trust the numbers, they are yours
- Together, we can achieve sustainable solutions.

Integrated system solutions (ISS) – Colab. investigation

Background

- 5x vessels
- TEU container vessel with 2S ME + PTO + 4x gen sets @ 60 Hz
- The scope of this study is to compare 3x different gen sets configuration for the vessel:

- Basis of the study:
  - No 2S consumption is considered in this study. Only auxiliaries consumption are showed in the results.
  - The comparison is carries out by studying 3x different operational profiles depending on the use of the PTO **while sailing**:
    - **OP1: 80% of time using PTO (20% of time using gen sets)**
    - **OP2: 60% of time using PTO (40% of time using gen sets)**
    - **OP3: 40% of time using PTO (60% of time using gen sets)**



Wärtsilä 25 – the engine with true flexibility

	Wärtsilä 25		Wärtsilä 25DF		Wärtsilä 25 Ammonia	
Cylinder bore (mm)	250		250		250	
Piston stroke (mm)	340		340		340	
Nom speed (rpm)	900	1 000	900	1 000	900	1 000
Power / cyl. (kW)	345	375	315	345	280	305
BMEP (MPa)	2.72	2.70	2.52	2.48	2.24	2.19
6L power (kWm)	2 070	2 250	1 890	2 070	1 680	1 830
7L power (kWm)	2 415	2 625	2 205	2 415	1 960	2 135
8L power (kWm)	2 760	3 000	2 520	2 760	2 240	2 440
9L power (kWm)	3 105	3 375	2 835	3 105	2 520	2 745
Application	DM, DE, AUX		DE, AUX	DM, DE, AUX	DE, AUX	

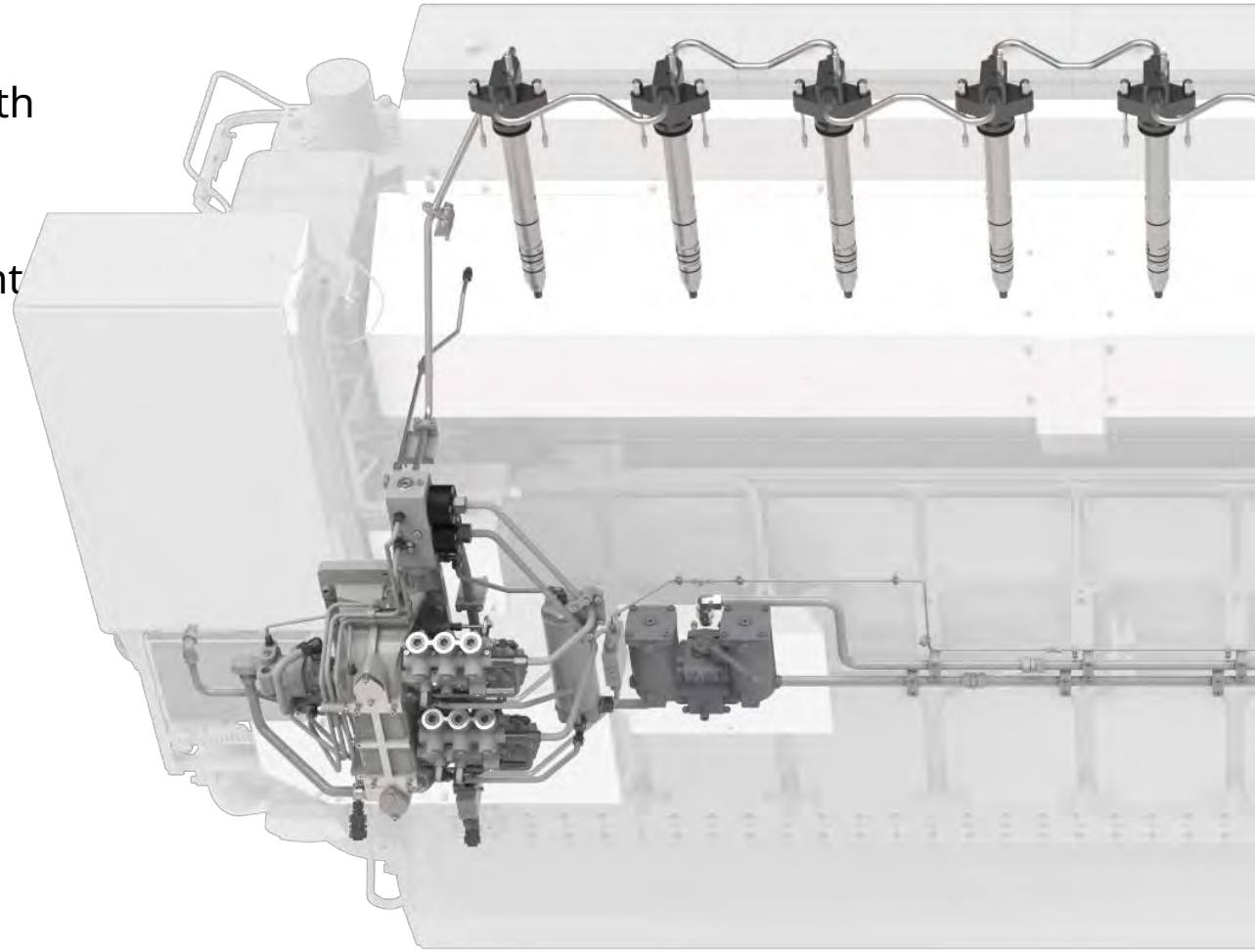
Modular engine platform with latest technologies

Fuel systems

- New generation common rail fuel injection technology with high pressures for ideal combustion
- No separate pilot injector
- Optimized gas admission settings for each operating point with cylinder wise combustion control
- Smokeless operation in all conditions

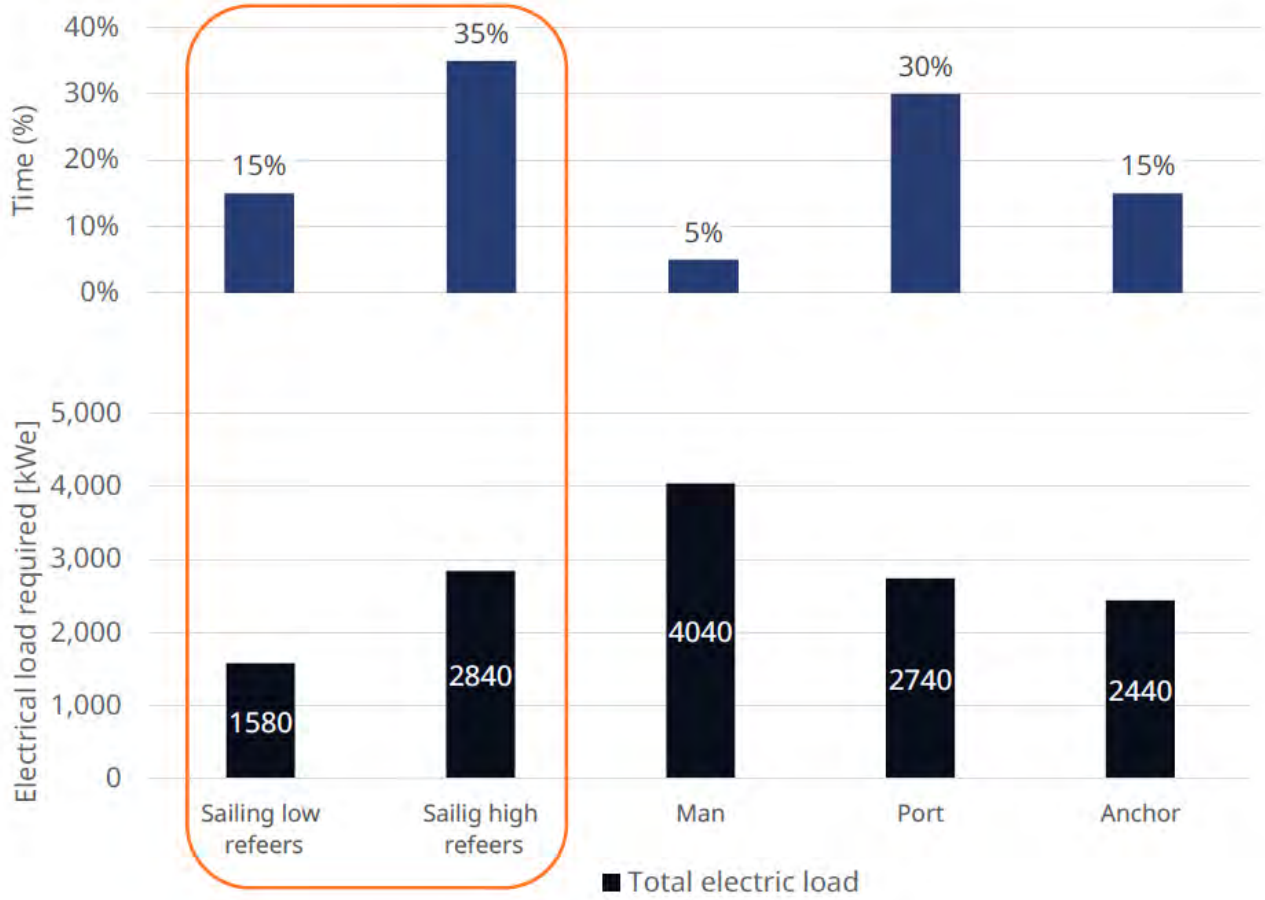
Valve train

- Variable valve timing providing flexibility is an enabler for combustion of future fuels and low emission optimization



Integrated system solutions (ISS) – Colab. investigation

Loads studied



Time

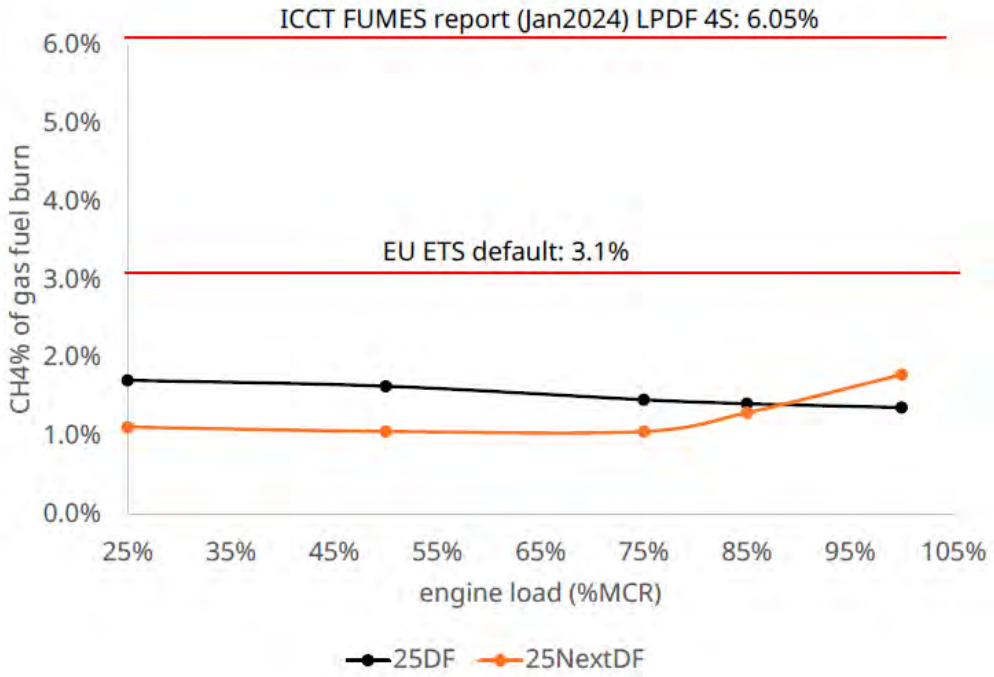
- Based on previous studies
- Operation considered 1 year.
- Highlighted in orange the operations that changes in the different operational profiles

Power

- Total electrical power required by electrical consumers.
- In this study the electrical losses have been considered.
- Reefers:
  - High: 650 @ 3.6 kWe
  - Low: 300 @ 3.6 kWe
- General hotel in sailing: 650 kWe
- Additional manoeuvring: 200 kWe
- Thrusters load: 1000 kWe

Integrated system solutions (ISS) – Colab. investigation

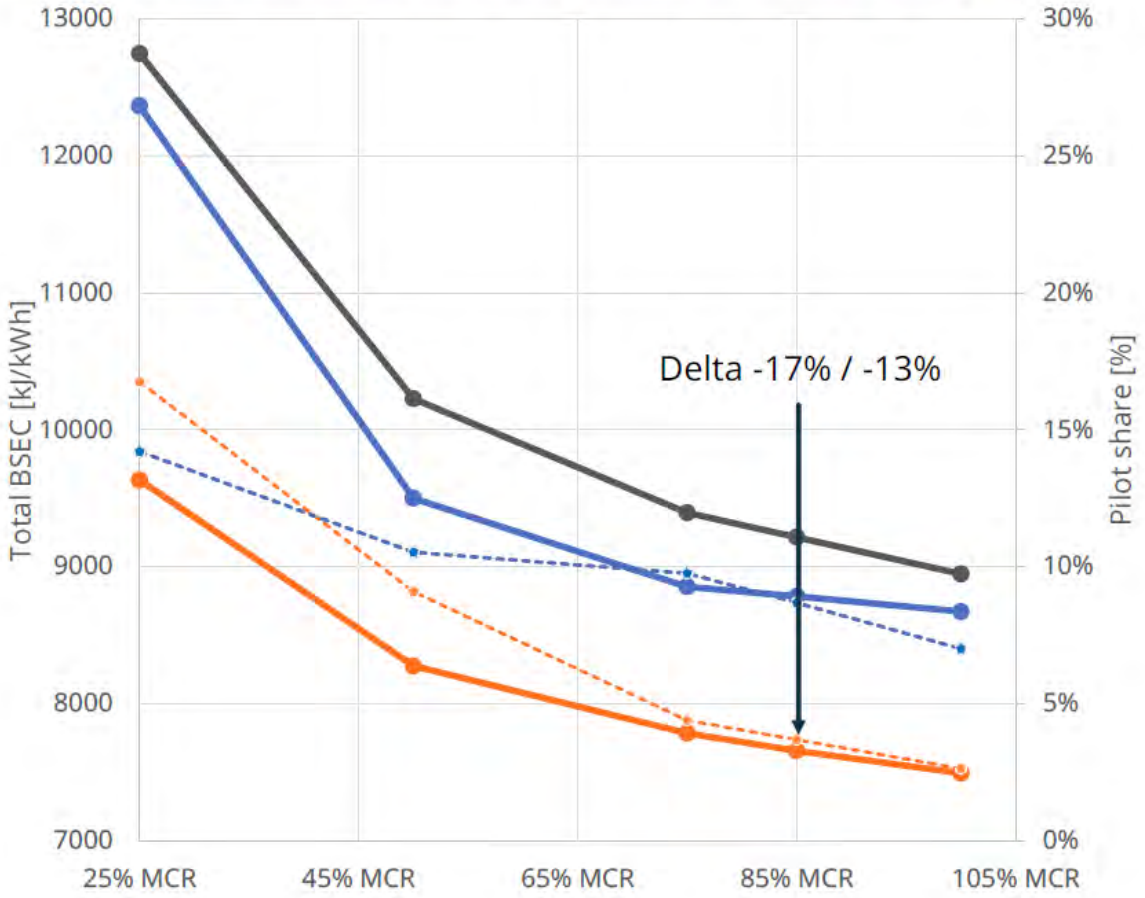
Wärtsilä 25DF sets a new industry benchmark in CH4 emission, and NextDF option cuts it further at all loads below 100 %.



- The present EU regulation stipulates a default methane slip value of 3.1% and IMO regulation work is also underway
- Less advanced DF engines are expected to be above and therefore use this default value
- 25DF: 1.6% at 50% load
- 25NextDF: 1.1% at 50% load
- In addition to CH4, also part load NOx emissions are reduced avg. of 46% with NextDF

Integrated system solutions (ISS) – Colab. investigation

Wärtsilä 25DF has superior efficiency



Assumptions made due to lack of information:

- pilot consumption data available only at 100 MCR (7%), Part load are estimated based on W9L20DF pilot fuel share.

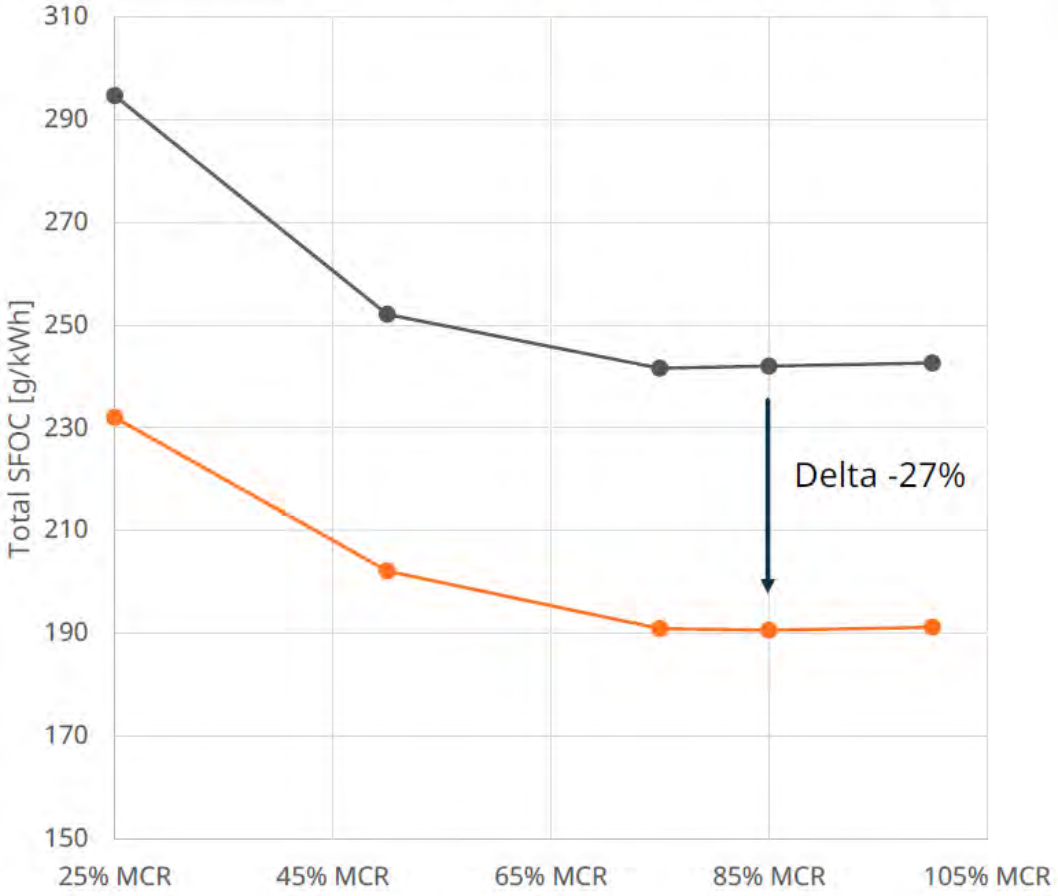
All engines consumption with 5% tolerance and including engine driven pumps

W 6L25DF - BSEC

W 6L25DF - pilot share

Integrated system solutions (ISS) – Colab. investigation

Wärtsilä 25DF has superior efficiency – MGO running

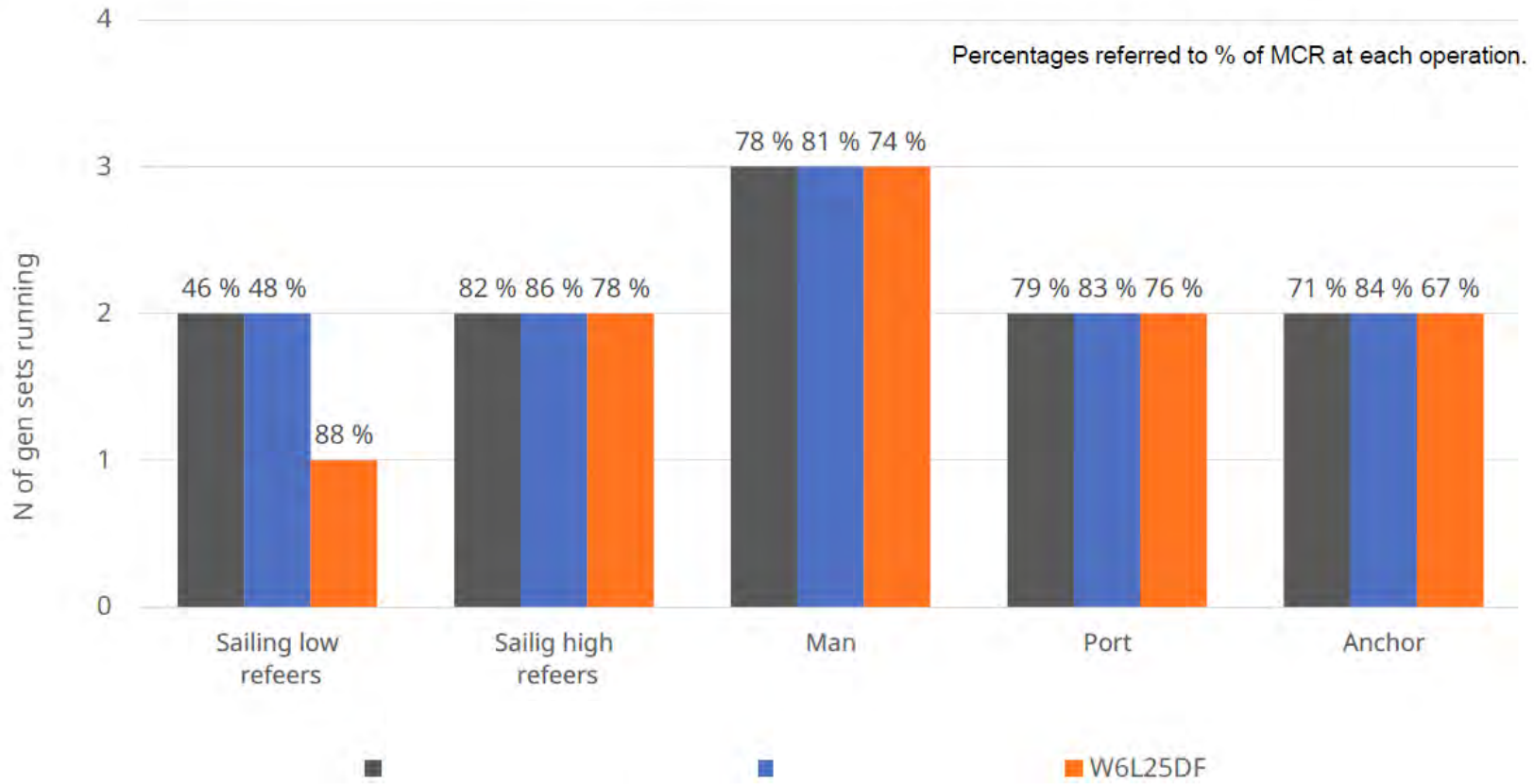


All engines consumption with 5% tolerance and including engine driven pumps

W 6L25DF - MGO

Integrated system solutions (ISS) – Colab. investigation

Way of working comparison

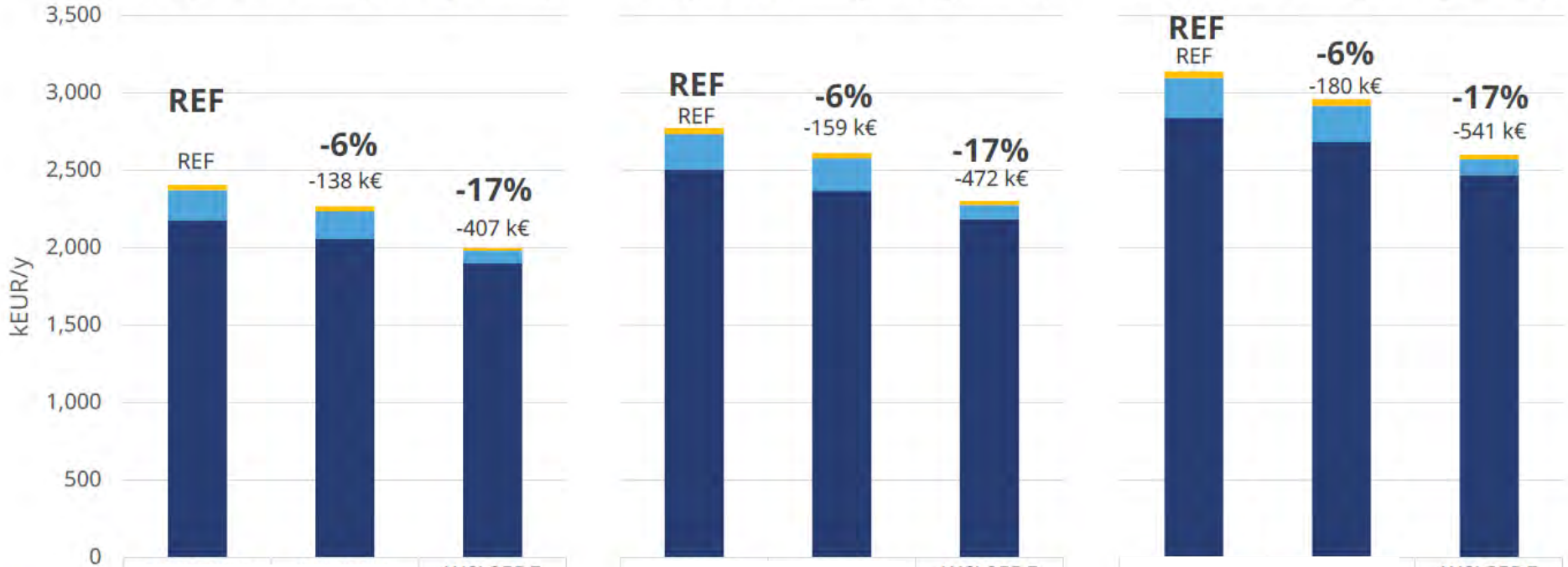


Integrated system solutions (ISS) – Colab. investigation

Annual consumption cost - LNG

consumables particulars (Rotterdam 04/2025)

LFO (pilot)	630 EUR/ton; LHV: 42,7 MJ/kg
LNG	840 EUR/ton; LHV: 49.2 MJ/kg
Lube Oil	2300 EUR/ton



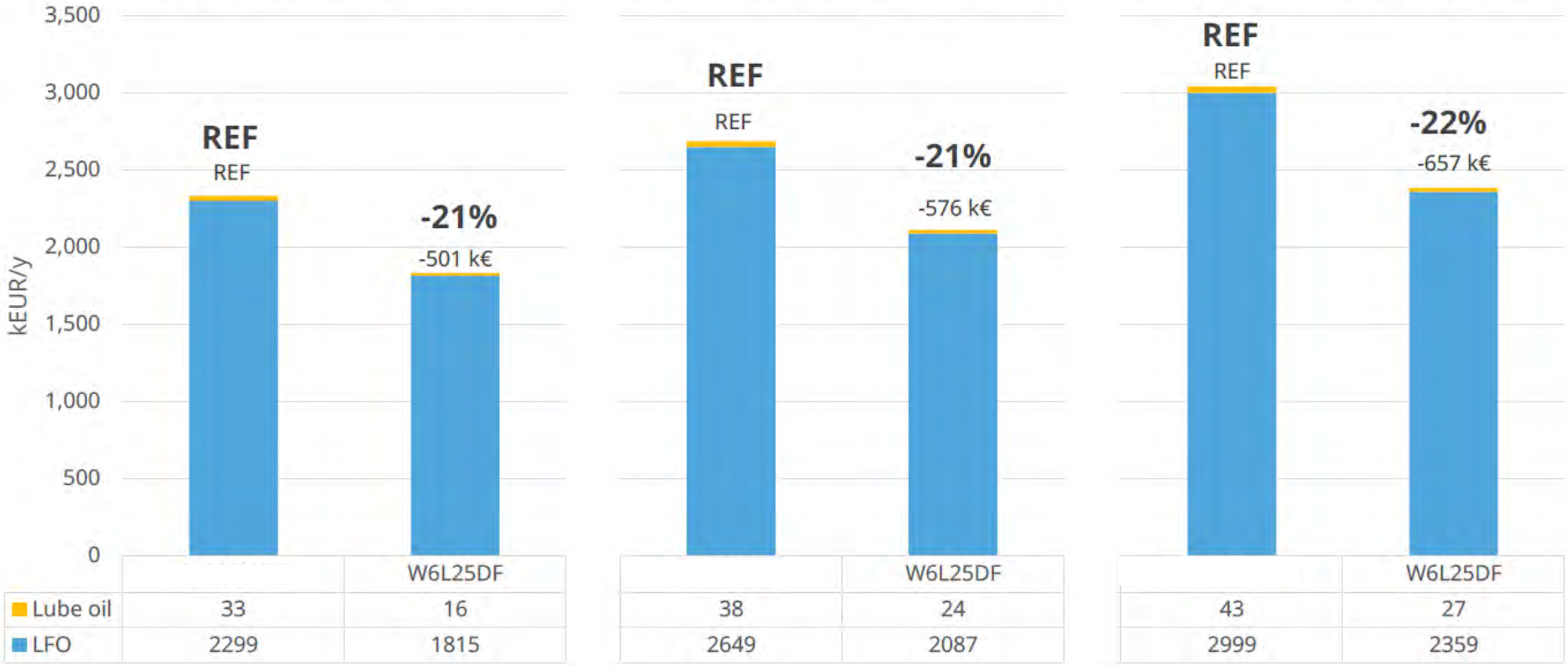
	OP1 REF	OP1 -6%	OP1 W6L25DF	OP2 REF	OP2 -6%	OP2 W6L25DF	OP3 REF	OP3 -6%	OP3 W6L25DF
Lube oil	33	31	16	38	36	24	43	41	27
LFO	197	180	81	227	207	91	258	234	102
LNG	2174	2055	1900	2506	2369	2185	2838	2683	2470

Integrated system solutions (ISS) – Colab. investigation

Annual consumption cost - LFO

consumables particulars (Rotterdam 04/2025)

LFO	630 EUR/ton; LHV: 42,7 MJ/kg
Lube Oil	2300 EUR/ton

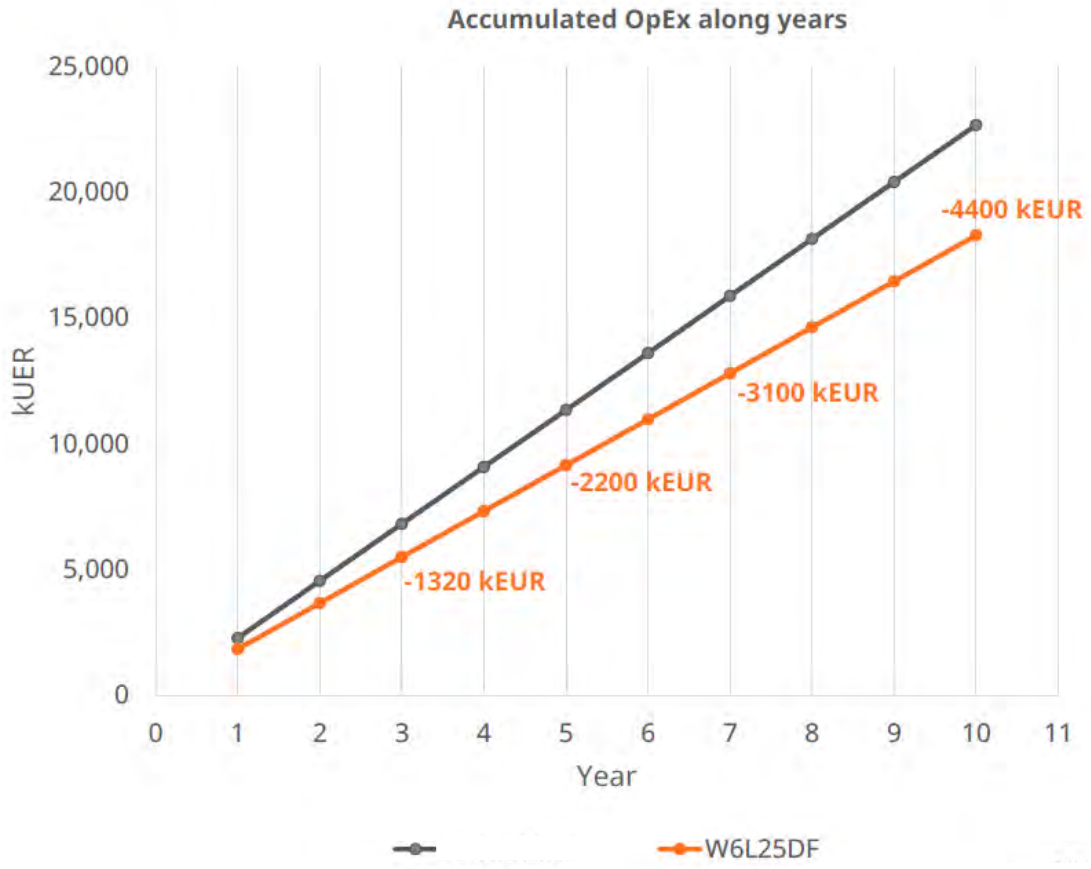


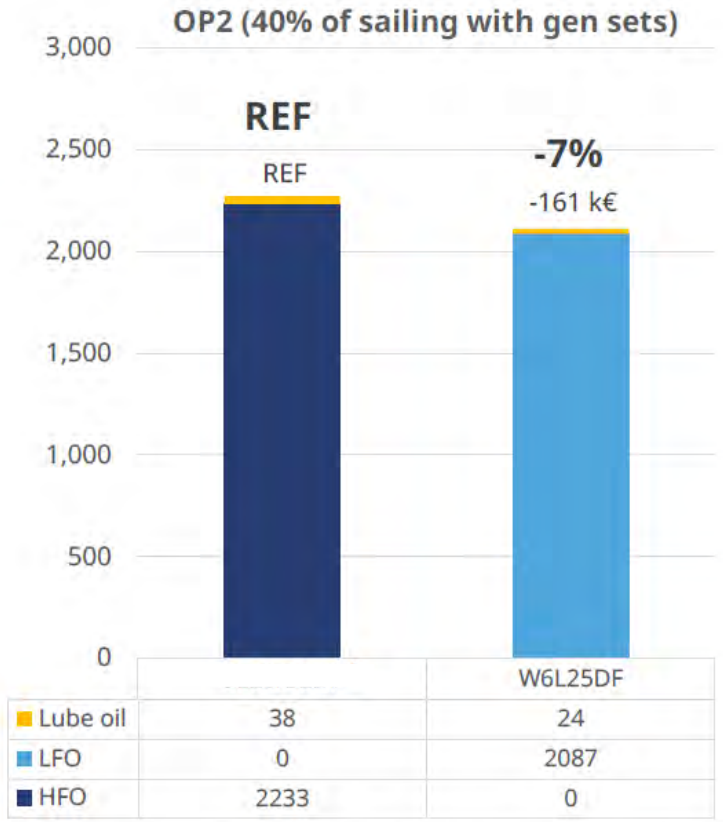
Integrated system solutions (ISS) – Colab. investigation

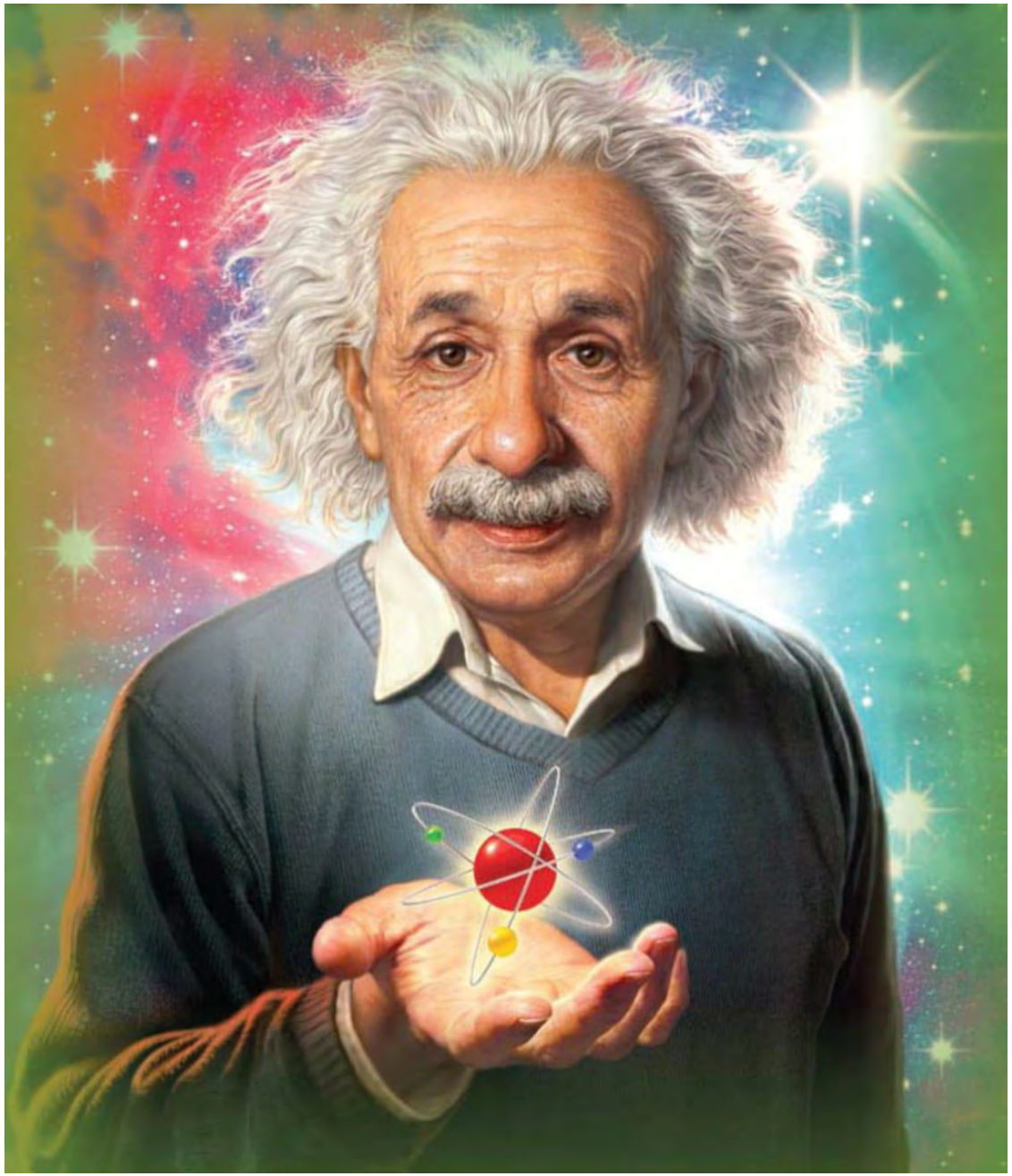
Annual consumption cost – LFO/HFO

consumables particulars (Rotterdam 04/2025)

LFO	630 EUR/ton; LHV: 42,7 MJ/kg
HFO	500 EUR/ton; LHV: 40,6 MJ/kg
Lube Oil	2300 EUR/ton







No Problem can ever be solved from the same level of consciousness that created it. *

*Albert Einstein

Leading the way with our customers

Selected references

Customer case

The world’s first
ammonia-fuelled in-service ship

After the fuel conversion, Viking Energy is to start operating on ammonia in 2026.

Eidesvik offshore

Customer case

The marine industry's first
conversion of dual-fuel engines to spark gas operation

The conversion of six LNG carriers will significantly reduce methane slip, reducing greenhouse gas emissions.

Chevron Transport Corporation Ltd.

Customer case

Aurora Botnia is one of the
world’s most efficient and sustainable ships

Engine upgrades and hybrid propulsion have delivered double-digit reductions of fuel consumption.

Wasaline

Customer case

The world’s largest hybrid vessels

Can operate with zero emissions during manoeuvring operations and when in port

Brittany Ferries

Copyright: © Brittany Ferries

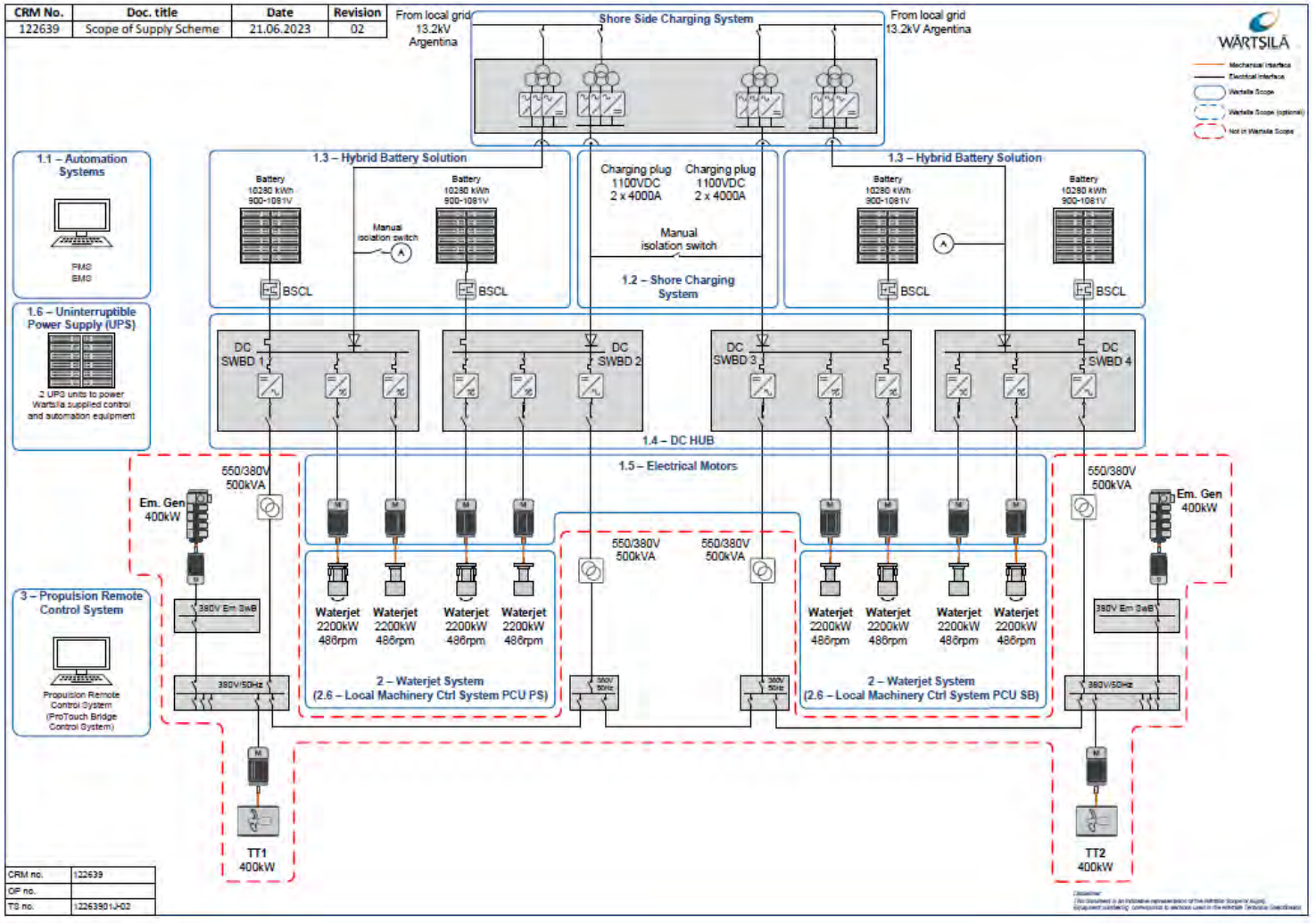
Customer case

A digital twin ship
helps Carnival Corporation

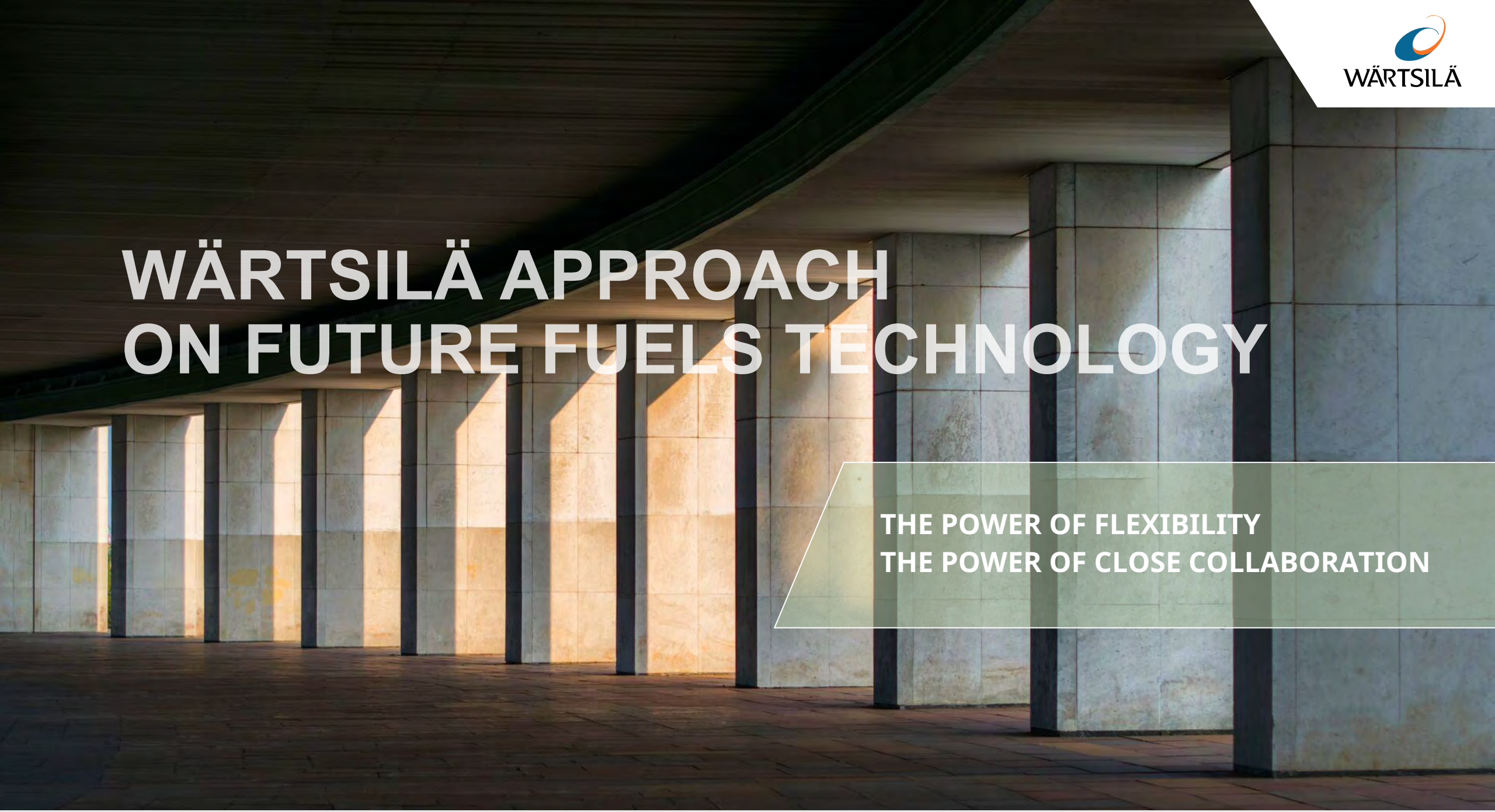
- Identify optimal solutions to meet sustainability targets
- Plan its fleet decarbonisation programme

Carnival Corporation

The biggest full electric vessel



- 130m LOA, capacity up to 2100 Passenger and crew, 225 cars and over 2000 Sqm of duty free shops
- Lightweight high speed aluminium catamaran
- Cruise speed 25 knots
- 1.5 h sailing, 1.5h charging (~20 MWh)
- 41MWh battery
- 8 x permanent magnet electrical propulsion motors, 2200kw (peak 2400kW)
- 4 DC Hubs plus battery short circuit limiters
- 2 x high speed Charging connectors, 15MW



WÄRTSILÄ APPROACH ON FUTURE FUELS TECHNOLOGY

THE POWER OF FLEXIBILITY
THE POWER OF CLOSE COLLABORATION

Decarbonisation transformation

Decarbonisation will transform the marine industry at an unprecedented pace

Fuel flexible engine technology allows for an opportunity balancing decarbonisation targets with financial viability

Collaboration and partnership are essential in resolving the challenges we will face in upcoming decades

2050: -50% GHG emissions from shipping
EEXI, CII, ETS, RED II, FuelEU Maritime etc.
Green financing, Green cargo, ESG policies

Multifuel combustion engines let you adopt green fuels at your own pace

Technical feasibility enables progressive adoption of green fuels

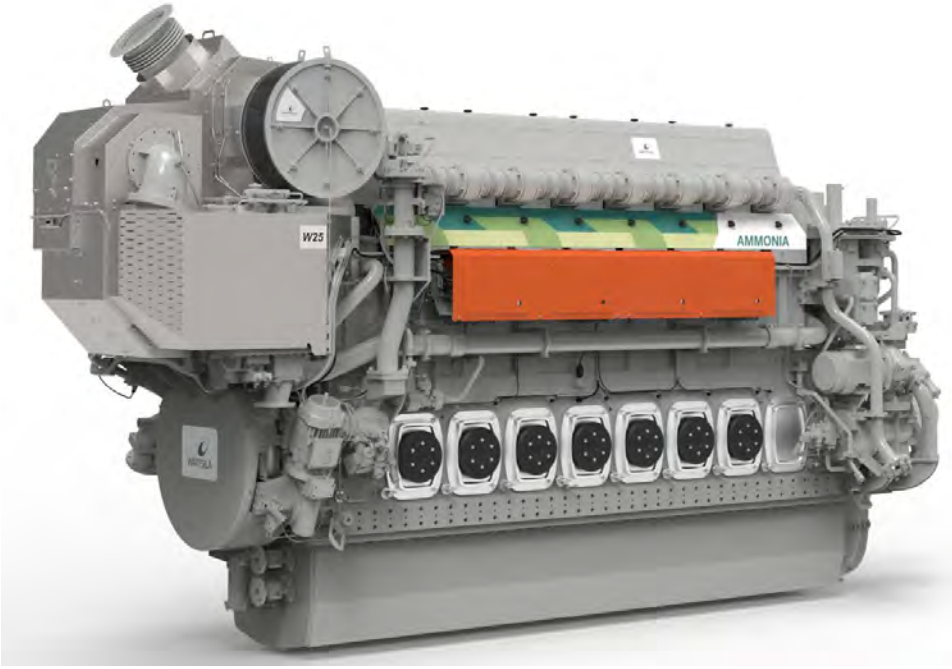
Drop-in | Drop in the tank compatible biofuels e.g. LNG and liquid bio-methane

▼

Blending | Injecting different fuels e.g. fuel oil and green ammonia into the engine

▼

100% Pure | Pure green fuels which leads to maximal carbon emission reduction



Best Total Cost of Ownership makes transition financially viable [1)]

- Low CAPEX and vessel-long lifespan
- Predictable operational and maintenance costs
- Upgradeable, modular structures mean faster conversions

Source: 1) DNVGL Maritime Forecast ed. 2020 and Lloyd's Register Techno-Economic Assessment of Zero Carbon Fuels ed. 2020

Bio LNG

or Synthetic methane

Can readily be used with equipment made for fossil LNG and blended in all ratios

Verified: 2003
Cryogenic LNG operations are well-known (IGF code of safety for ships since 2016)

MeOH

Green Methanol

Stena Germanica started operation on Methanol in 2015

Verified: 2015
Volume ramp-up: 2023
Non-pressurised tanks.
Toxic, Local (NOx) and GHG emissions

EtOH

Green Ethanol

An Ethanol engine is being investigated. Ethanol tested in March 2024.

Verified: 2024
Volume ramp-up:
Non-pressurised tanks.
Toxic, Local (NOx) and GHG emissions

NH_3

Green Ammonia

Combustion concepts to maximise engine performance and related safety technologies are currently being investigated

Tech ready: 2023
Volume ramp-up: 2025
Non-cryogenic but toxic.
No rules & regulations
Local (NOx) and GHG emissions

H_2

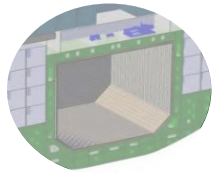
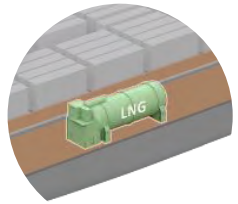
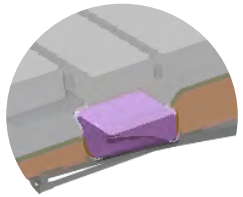
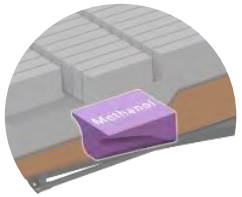
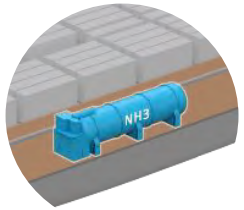
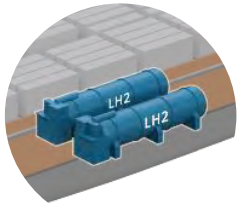
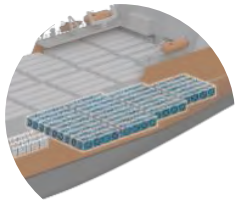
Green Hydrogen

Our gas engines are already able to blend up to 25% hydrogen in LNG, and combustion concepts under work for 100% hydrogen. Pure Hydrogen on 70% of typical marine engine load achieved already

Pilots with blends: 2021
Tech for pure H2 ready 2025
Volume ramp-up: 2027

Storage of LH2 at -253 C
Local emissions (NOx)

Marine Fuels Today and in the Future

Fuel type	 **Low Sulphur Fuel Oil** @ 20°C	 **Liquified Natural Gas** @ -162°C	 **Ethanol** @ 20°C	 **Methanol** @ 20°C	 **Ammonia** @ -33°C	 **Liquid Hydrogen** @ -253°C	 **Compressed Hydrogen** @350bar
Key considerations	▪ Standard tank arrangement	▪ Cryogenic system	▪ Lower toxicity compared to methanol ▪ Flexible tank arrangement	▪ Mildly toxic ▪ Flexible tank arrangement	▪ Toxic ▪ Corrosive	▪ Highly flammable ▪ Cryogenic system	▪ High pressure ▪ Multiple tanks arrangement ▪ Highly flammable
Regulation readiness	✓	✓	✓	✓	✗	✗	✗
Volumetric energy equivalent	1x	1,6x	1.7x	2.3x	2,9x	4.3x	11.7x
Tank hold space compartment volume	1x	1.7x – 2.4x *)	1.3x	1.7x	3.9x	7.3x	19.5X

Gross tank estimations based on Wärtsilä experience considering inspection spaces needed around the tanks. Cylindrical tanks only considered for LNG, if stored in prismatic tank then LNG gross tank size factor is better for LNG than for methanol.
*) 1.7x membrane tanks, 2.4x type C tanks

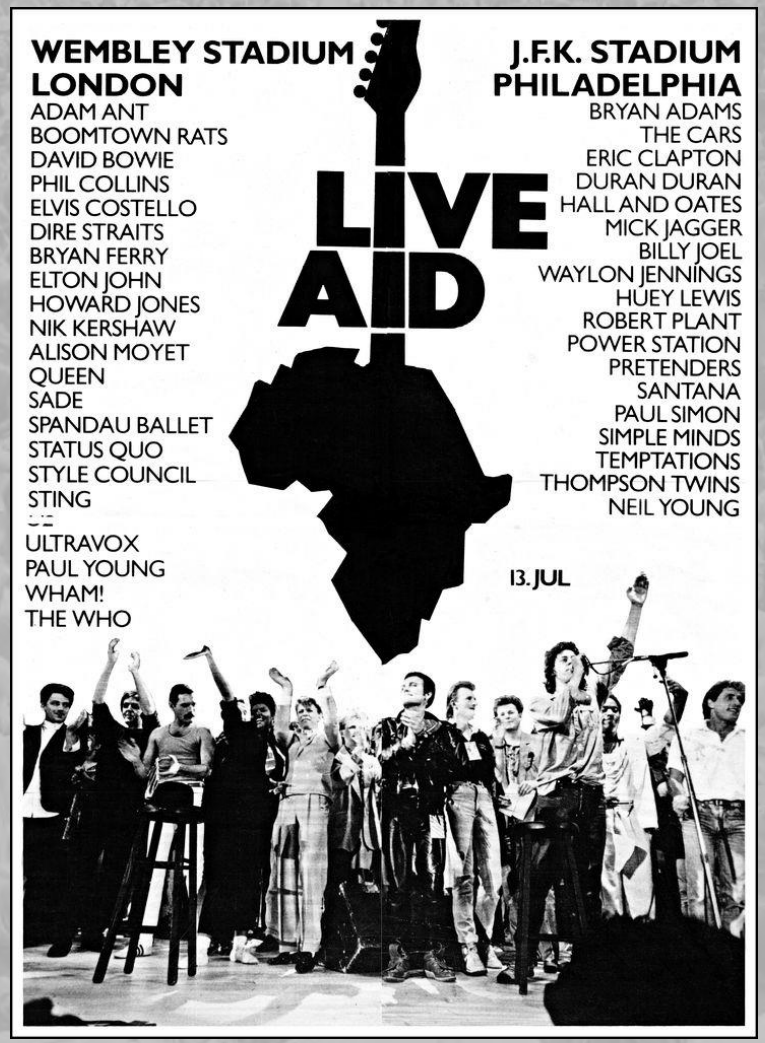

THE WORLD
DEMANDS
A CHANGE.
True leaders shape a better
tomorrow.

Can you remember?

man on the moon - July 1969

Have you been?

Woodstock - August 1969



Lief Aid - July 1985

What do those items have in common?

Motorola DYNA TAC 8000X

$8500.- srp

Apple iPhone Gen 1.

$191,372.- auction

IBM personal computer 5150

$18,500.- srp

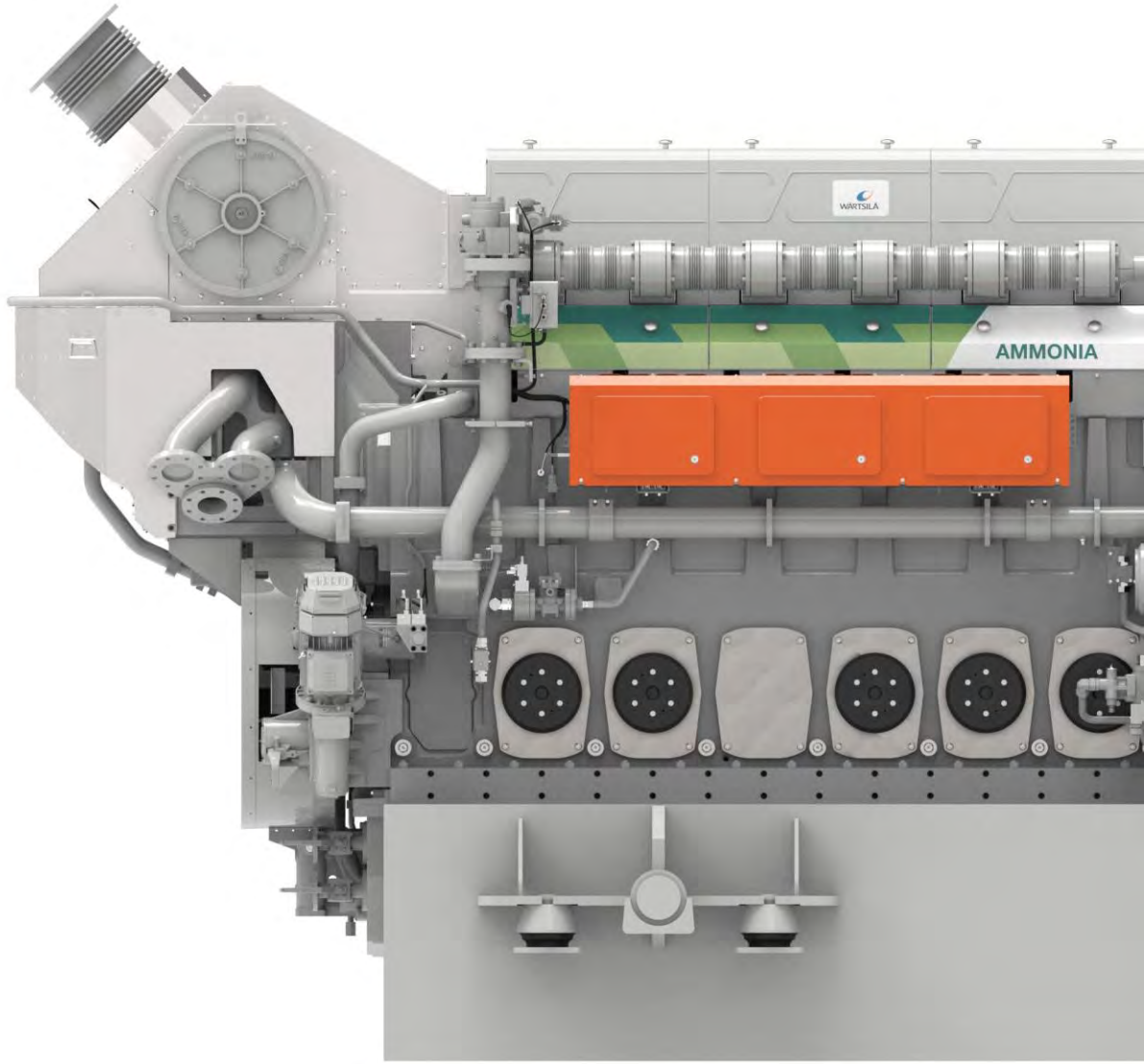
First Movers Coalition

- Coalition of global players to gather purchasing power to lower GHG emissions
- Shipping as one strong pillar of the FMC
- Members from shipping:
  - Maersk, Aker Biomarine, Amazon, BHP, Hanwha Ocean, Höegh Autoliners, Mitsui O.S.K. Lines Wallenius Wilhelmsen, Yara International
- More than 100 members to support each other in the race for global sustainability

Key takeaways

- ✓Today's technology can already reduce greenhouse gas emissions significantly (Ammonia up to 70%)
- ✓Dual-fuel technology with full flexibility to run in ammonia/methanol mode or diesel mode
- ✓Complete solution - fuel gas supply system, engine and aftertreatment system
- ✓Integrated automation system ensuring safe operations
- ✓Wärtsilä offers training services and a global service network available 24/7

- ✓Acting now will require courage and true entrepreneurial thinking
- ✓Use the momentum and be the first – it will pay out




Every
second
counts


WÄRTSILÄ