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Maritimes Zentrum
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Neue Entwicklungen und Betriebserfahrungen in der Schiffsbetriebstechnik

45. ISF-Tagung

23. und 24. Mai 2024

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VOGELSANG
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W.D.R. WYKER DAMPFSCHIFFS-REEDEREI FÖHR-AMRUM GMBH
M. JÜRGENSEN A Promise Kept
MITVERANSTALTER maritimes cluster norddeutschland
PROPULSION ENGINEERING
VESSELITY MARITIME ANALYTICS
TX Marine Messsysteme
OWN THE FLOW AQUAMETRO

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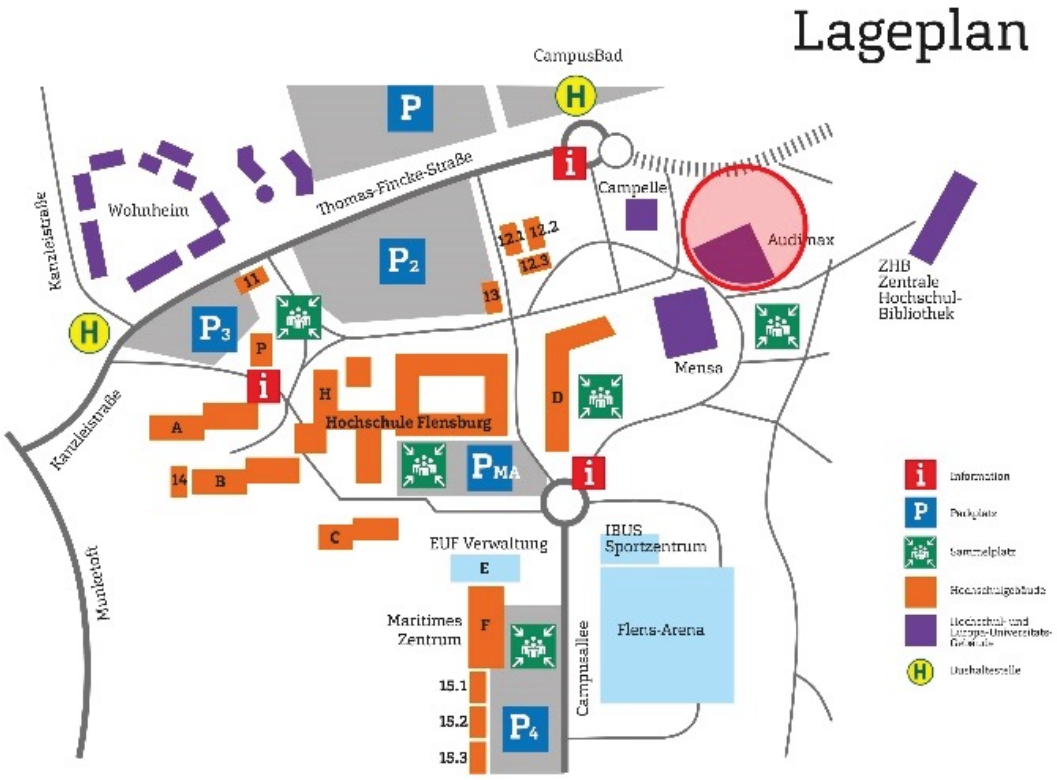
Grußwort

Herzlich willkommen zur 45. ISF-Tagung im Hörsaalzentrum der Hochschule Flensburg!

Wir freuen uns auf interessante Vorträge, anregende Gespräche und einen regen Austausch auf verschiedenen Fachgebieten.

Wir wünschen Ihnen einen angenehmen und spannenden Aufenthalt in unserem Haus!



Programm

45. Informationstagung zur Schiffsbetriebsforschung (ISF-Tagung)

Freitag, 24. Mai 2024

09:00 Uhr	Grußwort Prof. Dr.-Ing. Dodwell Manoharan, Hochschule Flensburg
09:05 Uhr	Grußwort Andreas Burmester, Maritimer Koordinator der Landesregierung Schleswig-Holstein
09:15 Uhr	Grußwort Peter Moller, Geschäftsstellenleiter des MVN Norddeutschland in Schleswig-Holstein
09:25 Uhr	Eröffnung Prof. Dr.-Ing. Michael Thiemke, Hochschule Flensburg

Vortragsgruppe 1: "Energieeffizienz und Emissionsminderung"

Chairman Prof. Dr.-Ing. Peter Boy

09:30 Uhr	Insights from the first year of CII verification Adam Budzynski, Project Manager - Decarbonization, DNV
10:00 Uhr	ENERGY EFFICIENCY REGULATIONS - the challenge of measurement, management, treatment and monitoring of fuels - online process optimization in ship operations on board Dr.-Ing. Ralf Moeck, Technical Director - Aquametro Oil & Marine GmbH
10:30 Uhr	Kaffeepause
11:00 Uhr	Unterwasserdrohnen und KI in der Schifffahrt - Ein Praxisbericht zur ersten unbemannten Klasseinspektion und marine fouling Erkennung Michael Stein, Vesselity

Vortragsgruppe 2: "Weiterentwicklungen in der Schiffstechnik"

Chairman Dipl.-Ing. (FH) Rasmus Brandt

11:30 Uhr	The latest updates to maritime WHR technologies from Alfa Laval David Jung, Business Development Manager, Alfa Laval
12:00 Uhr	Mittagspause Während der Mittagspause wird eine Besichtigung des SPS-Labors mit Anwendungsbeispielen und Erläuterungenzum neuen maritimen MTP Standard im nahe gelegenen Raum DU 022 angeboten. Transfer aus dem Foyer mit Prof. Dr.-Ing. Michael Thiemke um 12:05 Uhr und 12:35 Uhr.
13:10 Uhr	Innovative Lub Oil Filtration Concept for combustion engines David Jüssen, Boll & Kirch

Vortragsgruppe 3: "Alternative Energiequellen"

Chairman Prof. Dr.-Ing. Holger Watter

13:40 Uhr	Operation experience with an innovative street-trailer based LNG-bunkering system and MaK 8M46 DF engines Tony Johnson, SeaRoad Shipping Pty Ltd
14:10 Uhr	Kaffeepause
14:30 Uhr	First experiences with ammonia combustion in two stroke engines Kristian Mogensen, MAN ES
15:00 Uhr	Operational experiences with battery hybrid systems and flettner rotors Rasmus Nielsen, Naval Architect, Scandlines
15:30 Uhr	Schlusswort Prof. Dr.-Ing. Michael Thiemke

45. ISF-Tagung 24.Mai 2024

Grußwort

Andreas Burmester

Maritimer Koordinator der Landesregierung Schleswig-Holstein

Grußwort des maritimen Koordinators

bei der ISF Tagung in Flensburg

Sehr geehrter Herr Thiemke, sehr geehrter Herr Boy, lieber Holger Watter, lieber Rasmus Brandt und natürlich auch ein herzliches Willkommen an den Mitveranstalter, das maritime Cluster Norddeutschland, vertreten durch Herrn Peter Moller.

Ich darf den Dank des Landes an die zahlreichen Sponsoren und Unterstützer überbringen, ohne dieses Engagement wären solche Veranstaltungen heute nicht möglich.

Liebe Gäste und maritime Gemeinschaft, eigentlich ist das Wort Familie in diesem Rahmen besser angebracht.

Die 45. Informationstagung zur Schiffsbetriebsforschung ist jedoch weit mehr als ein Familientreffen am nördlichsten Standort einer Ausbildungs- und Forschungsstätte für die maritimen Belange der Schiffsbetriebstechnik und Nautik. Es ist mittlerweile ein Netzwerktreffen, welches aus dem maritimen Kalender nicht mehr wegzudenken ist und erfüllt zugleich die Anforderungen an eine Jobbörse. In Zeiten des Fachkräftemangels ist diese Veranstaltung ein nicht zu unterschätzender Wettbewerbsvorteil für Schleswig-Holstein. Gerade die Ausbildung für maritime Nachwuchskräfte braucht Zeit und stellt eine strategische Aufgabe dar, die weit über Legislaturperioden hinausreicht. Dies gilt sowohl für die Ausbildung der Nachwuchskräfte als auch natürlich für das Personal, das in Forschung und Lehre tätig ist. Gerade bei den maritimen Studiengängen ist ein hohe Praxisrelevanz zu sehen, da Dozenten und Lehrkräfte hier immer auch ein „Vorleben“ in der maritimen Wirtschaft oder der Seefahrt haben. Dies stellt sicher, dass hier nicht nur die bloße Theorie gelehrt wird, sondern echtes Praktikerwissen vermittelt wird.

Wenn man sich nun fragt, wo bleibt dann die Forschung, dann sind an der Stelle die folgenden Aktivitäten der Hochschule sicher zu nennen. Angefangen bei dem scheinbar schon längst abgeschriebenem Thema Schweröl, wo es darum geht, entsprechende Emissionsminderungsverfahren für die Nachrüstung zu entwickeln, denn die auch heute gebauten Schiffe werden in 30 Jahren noch schwimmen, und mit diesen oder ähnlichen Treibstoffen betrieben werden. Das ist leider die Realität. Aber auch an den Themen Ammoniak, H2 und E-fuels wird hier geforscht, um die für uns alle so notwendige Schifffahrt emissionsärmer bzw. emissionsfrei zu gestalten. Nicht zu vergessen: die dringend notwendige Effizienzsteigerung durch Abwärmenutzung, Energierückgewinnung und optimierte Routenprogramme können kurzfristig dieses Ziel vorantreiben. Erwähnen möchte ich an dieser Stelle das Engagement der Fa. Bachmann für das SPS-Labor, wo die Ergebnisse weit über die Landesgrenzen von Schleswig-Holstein hinaus für Aufmerksamkeit sorgen.

Neben diesen eher klassischen Themen wird hier auch an der autonomen Schifffahrt gearbeitet. Dies gilt sowohl für das in Kielseng laufende Projekt einer autonomen Fähre als auch für den Einsatz von Unterwasserdrohnen die zur Inspektion von maritimer Infrastruktur dienen. Ein in diesen Zeiten mehr als notwendiges Unterfangen um den Fachkräftemangel zu lindern.

Um diese Herausforderungen in Zeiten immer knapper werdender Mittel zu stemmen, ist es sicherlich notwendig, nicht nur technische Innovationen voranzubringen, sondern auch die Art und Weise, wie wir unsere maritimen Fähigkeiten im Lande konzentrieren und bei den Hochschulen auf Effizienzsteigerung und Kooperation setzen, neu zu denken.

Als Ingenieur würde ich von Steigerung des Wirkungsgrades sprechen.

Schleswig-Holstein, wir können Mee(h)r.

45. ISF-Tagung 24.Mai 2024

Grußwort

Peter Moller

Geschäftsstellenleiter des MVN Norddeutschland in Schleswig-Holstein

maritimes cluster
norddeutschland

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www.maritimes-cluster.de

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A Promise Kept

Mitveranstalter:
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PROPULSION ENGINEERING

VESSELITY MARITIME ANALYTICS

TX Marine Messsysteme

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- **Vermittlung von Kontakten und Wissen**
- **Kooperationen**
- **Innovationsprojekte**

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wallaby boats

Bildrechte: Wallaby Boats

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EcoShip60

ZIM-Netzwerk des Jahres 2023

BAW Bundesanstalt für Wasserbau

CAU Christian-Albrechts-Universität zu Kiel

itk ENGINEERING

LÜBECK YACHT

MARX

Piening Propeller

ABEKING & RASMUSSEN

ARMATUREN WOLFF

Danfoss

Fraunhofer IFAM

SDT

Maritimes Zentrum Hochschule Flensburg

Guideline-Ship-Efficiency

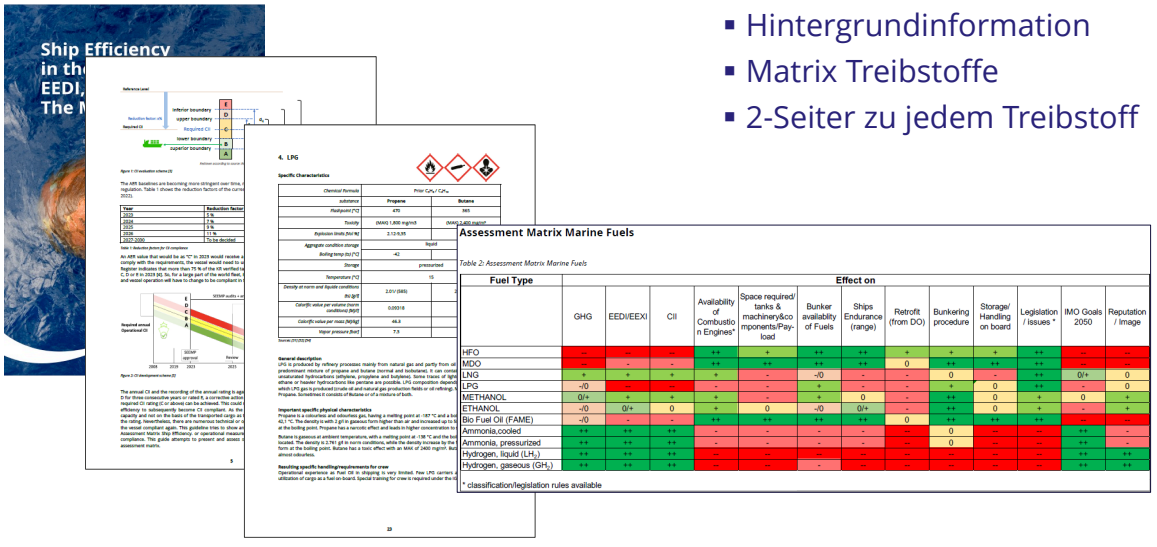
der MCN Fachgruppe Schiffseffizienz

Überblick:

1. Aktuelle Regularien
2. Treibstoffe
3. Maßnahmen zur Verbesserung der Schiffseffizienz

Eine dritte und erneut erweiterte Auflage ist für September 2024 zur SMM geplant

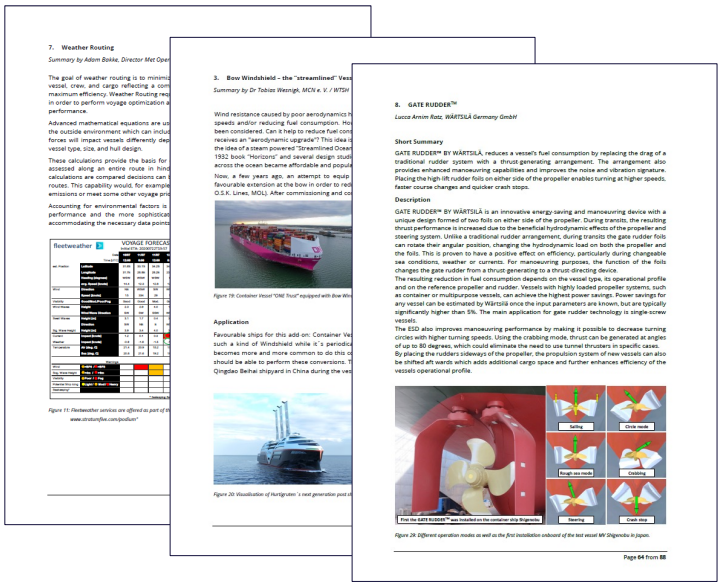
Guideline-Ship-Efficiency



- Hintergrundinformation
- Matrix Treibstoffe
- 2-Seiter zu jedem Treibstoff

Guideline-Ship-Efficiency

maritimes cluster norddeutschland



- Technische Maßnahmen
- Retrofits
- Wind assisted propulsion
- Digitalisierung/Software

maritimes cluster norddeutschland

Veranstaltungen

maritimes cluster norddeutschland

29. April 2024

Energieeinsparung auf Schiffen durch Retrofit-Maßnahmen

Um das Thema Schiffseffizienzmaßnahmen in der Praxis zu vermitteln und zu diskutieren, lud die MCN-Fachgruppe Schiffseffizienz am 25. April 2024 auf die Scandlines Fähre „Berlin“ ein. Die Fahrt führte bei spiegelglatter Ostsee von Rostock nach Gedser und zurück. Mit 43 Gästen war die Veranstaltung ausgebucht, was das starke Interesse an nachhaltigerer Schifffahrt verdeutlicht.

Fachvorträge von

Marko Möller	Scandlines
Prof. Dr. Volker Bertram	DNV
Ingo Schiller	Ampereship
Sascha Nitz	Danfoss Maritime

Besichtigung der Brücke und des Flettner-Rotors

Maritimes Zentrum Hochschule Flensburg

EcoShip60
ZIM-Netzwerk des Jahres 2023

45. ISF-Tagung 24.Mai 2024

Vortragsgruppe 1: "Energieeffizienz und Emissionsminderung“

Insights from the first year of CII verification

Adam Budzynski

Project Manager - Decarbonization, DNV

Carbon Intensity Indicator

Insights from the first year of verification by DNV

Adam Budzyński – Project Manager

Short recap

CII & SEEMP III regulatory basis

Carbon Intensity Indicator and SIII requirements are based on IMO resolutions:

RESOLUTION MEPC.352(78) - **CII GUIDELINES, G1**

RESOLUTION MEPC.353(78) - **CII REFERENCE LINES GUIDELINES, G2**

RESOLUTION MEPC.338(78) - **CII REDUCTION FACTORS GUIDELINES, G3**

RESOLUTION MEPC.354(78) - **CII RATING GUIDELINES, G4**

RESOLUTION MEPC.355(78) - **CII CORRECTION FACTORS GUIDELINES, G5**

IACS also prepared **SEEMP/CII Implementation Guidelines** that addresses issues in relation to SEEMP/CII verification.

DNV

What is CII?

The CII (Carbon Intensity Indicator) measures ship's energy efficiency [gCO_2/capacity*NM]

Capacity as per ship type:

DWT – Bulk Carriers, Gas Carriers, Tankers, General Cargo ships, Combination Carriers, LNG Carriers

GT – Ro-ro Cargo ships (Vehicle Carriers), Ro-Ro cargo ships, Ro-ro passenger ships, Cruise Passenger ships

DNV

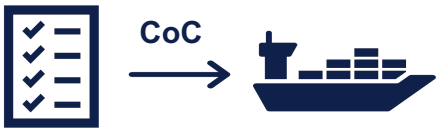
What is SEEMP part III?

SEEMP part III is a **mandatory**, ship specific document that lays out the plan to **improve the CII**, therefore vessel's **operational energy efficiency**.

Comes into addition to **SEEMP I** and **SEEMP II** – handled as a separate document.

Includes:

- **Required CII** for the next three years
- **Target CII** for the next three years
- Implementation plan on how required CII will be achieved
- Procedures for self-evaluation and improvement
- Possibly corrective action plan



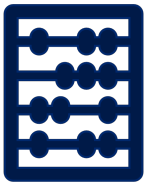
1st January 2023

Why do we need SEEMP part III?

SEEMP part III is intented to help the companies to achieve the **required CII** and **environmental rating**.

It is a dynamic document subject to regular updates reflecting changing performance of the vessel.

SEEMP Part III goal is to plan, self-evaluate and adjust vessel performance throughout the 3 year sailing period based on experience.



Environmental ratings and Corrective Actions Plans

Vessels, are required to fulfill **Required CII** threshold.

Based on their performance, receive **an Environmental Rating**: **A, B, C, D or E.**

The rating thresholds will become increasingly stringent towards 2030.

Corrective Actions Plans are applicable for two scenarios:

A-C ✓

3 x D ✗

E ✗

DNV

CII Correction factors

Dynamic

Based on Operational Vessel Data

Voyage adjustments - FCvoyage,j:

- Securing the safety of a ship or saving life at sea – all vessels
- Sailing in ice conditions – ice-classed vessels

Correction factors:

- **AFTankerSTS** – oil tankers engaged in STS voyages
- **FCelectrical** – ships carrying refrigerated containers/gas carriers/LNG carriers/tankers
- **FCboiler** – tankers
- **FCothers** – tankers

Static

Based on static parameters

EEXI/EEDI Technical Files:

- fi - ice-classed ships
- fm - ships having ice classes IA Super and IA
- fc - chemical tankers
- fi,VSE - ship-specific voluntary structural enhancement

Based on vessel's DWT:

- **AFTankerShuttle** – shuttle tankers equipped with dynamic positioning

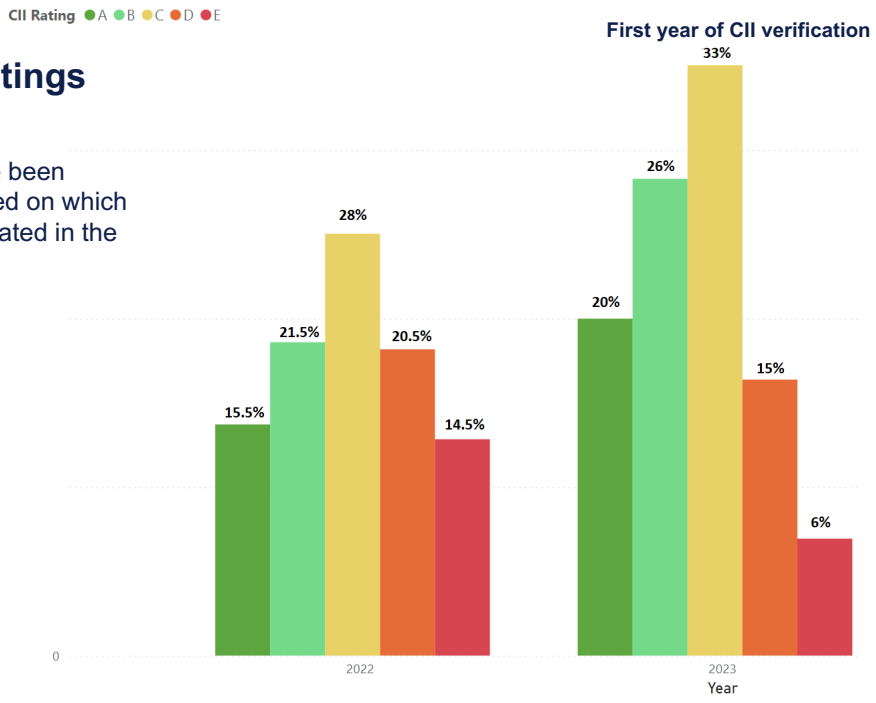
DNV

Reflections from CII verification

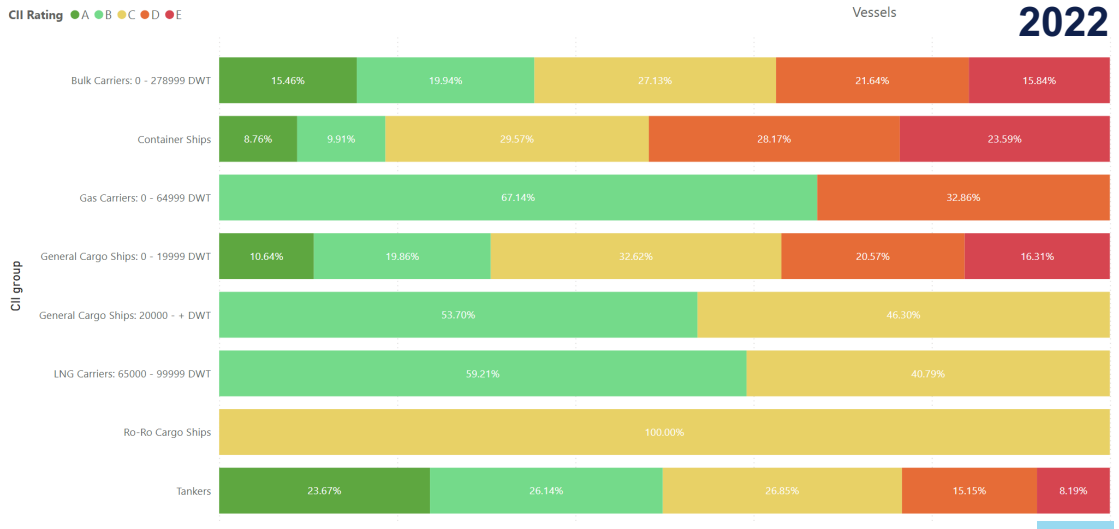
DNV

Environmental ratings

Shipping companies have been submitting DCS data based on which preliminary CII was calculated in the last few years



CII ratings distribution for different ship types and sizes



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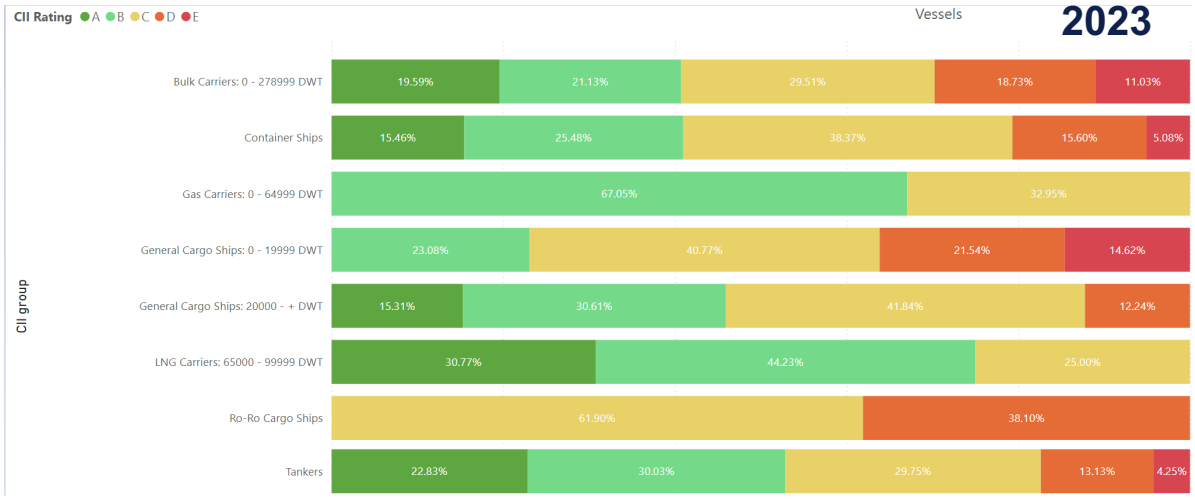
CII ratings distribution for different ship types and sizes



DNV

What have caused these changes?

1. Fear of penalties related to inferior CII ratings
2. Contracts between the parties were adjusted to include the requirement of positive CII rating
3. Improved DCS data quality
4. Implementation of CII correction factors enabling the vessels to improve their CII ratings

DNV

CII correction factors – last hope

For some vessels, it was impossible to achieve a rating higher than E without reporting the CII correction factors. At DNV, it was enabled by reporting additional figures in DCS noon reports:

e.g. FC_ELECTRICAL_REEFER – applicable for **ships carrying refrigerated containers**

New requirements:

• Reefer_Work

• Reefer_SFOC

• Reefer_Fuel_Type

More than 70% of applicable vessels used this correction factors to deduct fuel consumption.

DNV

CII correction factors influence

Vessels whose 2023 DCS and CII reports were verified by DNV:

- Deducted 290,964 tonnes of fuel – using correction factors
- Deducted 31,658 nm of distance – using voyage adjustments

DNV

What generated problems?

1. Foreseeing which correction factors will be used by the vessel at the moment of SEEMP Part III preparation
2. Getting used to the new DCS CII reporting/documentation requirements
3. DCS data transfer between companies after a change of management

- Previous company has to provide the verified DCS data for their period in a structurized way together with a document of compliance
- Based on data from two separate DCS periods, DNV verified full-year CII

DNV

What generated problems?

1. Foreseeing which correction factors will be used by the vessel at the moment of SEEMP Part III preparation
2. Getting used to the new DCS CII reporting/documentation requirements
3. DCS data transfer between companies after a change of management
4. SEEMP Part III Corrective Actions Plan after getting an E-rating

- Some vessels had their SIII verified by a different RO than DCS verifier which later led to delays/ changes of RO for CAPs

5. Changes of Deadweight/Gross Tonnage

- For non-DNV classed vessels, often not reported to the verifier, generated problems at the end of the year

DNV

Conclusions

1. CII/SEEMP3 was well implemented within the maritime industry

- Comparing to EU ETS/FuelEU Maritime
- Left time for preparations on both Verifier/Company side

2. CII might have been deemed less relevant due to no repercussions of poor performance of the vessel
3. IMO should collaborate with the industry to make CII more useful and relevant indicator for all the stakeholder

- Include more correction factors? Separate CII for sea and port ratings? Book and claim system?

DNV

WHEN TRUST MATTERS

www.dnv.com

45. ISF-Tagung 24.Mai 2024

Vortragsgruppe 1: "Energieeffizienz und Emissionsminderung“

ENERGY EFFICIENCY REGULATIONS - the challenge of measurement, management, treatment and monitoring of fuels - online process optimization in ship operations on board

Dr.-Ing. Ralf Moeck

Technical Director - Aquametro Oil & Marine GmbH

OWN THE FLOW AQUAMETRO

Who we are

Innovation

25% of the whole merchant fleet is equipped with Aquametro fuel meters

20% of all industrial oil boilers use CONTOIL® meter

» Mission

We navigate maritime and industrial sectors to become greener by providing intelligent and reliable measurement and performance systems.

Smart Fuel Meters

Seamless, professional and solution-driven support

Fuel Performance Optimization

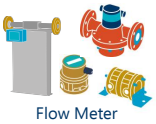
Global service network and numerous sales partners around the world

Where we are / What we do

Where we are

- Head Offices
- Sales Organizations
- Representative Offices
- Production sites

Measurement



Flow Meter

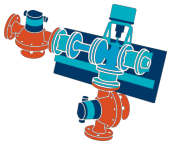
Viscosity system

Shaft Power Meter

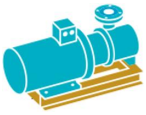
Fuel Performance

ONBOARD
ONSHORE

Fuel Treatment



GreenBLEND

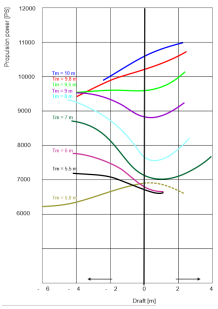


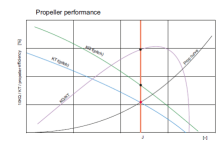
Homogenizer

Aquametro Competence

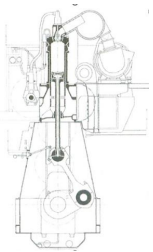
Safe, efficient & environmentally-friendly ship operation

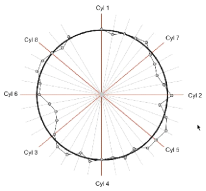
Hull / Propeller performance



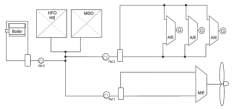


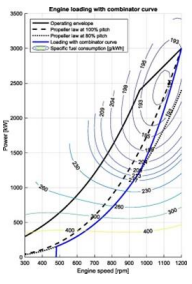
Engine Performance





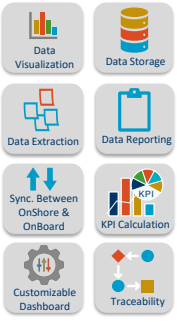
Ship Operation





Vessel Performance

DASHBOARD
ONBOARD / ONSHORE



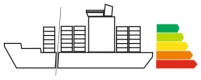
Ship Performance Challenges

Energy Efficiency Regulations

Ship Energy Efficiency Management Plan

SEEMP

Plan



Energy Efficiency Design Index

EEDI

Design

Construction Index

New building vessel

Energy Efficiency Design Index

EEXI

Design Reporting

Construction Index

Vessel in operation

- **SHaPoLi**
  Shaft Power Limitation

Ship Monitoring / Reporting

EEOI / MRV / CII / ETS ...

Operate Monitor Reporting

Operation Index

- **EEOI** Vessel in operation
- **Transport efficiency** Vessel in operation
- **CII** Vessel in operation
- **MRV/ DCS/ MSA** CO_2 reporting
- **ETS** Emission trading

Aquametro Ship Performance Solution

KPI

Fuel Efficiency Transport Efficiency

Fuel Efficiency Operate Monitor

Value measured
- Fuel consumption kg/h
- Shaft/electrical power kW

Parameter
- Calorific value of fuel

ONLINE Process Optimization
- Fuel efficiency M/E; A/E's
- Specific fuel oil consumption
  SFOC Propulsion g / kWh
  Ship g / NM

Energy Efficiency Operational index

EEOI Operate Monitor

Value measured
- Fuel consumption kg/h
- Transport work done
  - Distance traveled (GPS/SOG)
  - Cargo carried (DWT & DT)

Parameter
- CO_2 emission factor fuel

Reporting
- Voyage index reporting

CO_2 Emission

MRV DSC MSA Monitor Reporting

Value measured
- Fuel consumption kg/h
- Transport work done
  - Distance traveled (GPS/SOG)
  - Cargo carried (DWT & DT)

Parameter
- CO_2 emission factor fuel

Reporting
- Voyage emission reporting on sea / in port / at anchorage

Carbon Indicator Index

CII Monitor Reporting

Value measured
- Fuel consumption kg/h
- Transport work done
  - Distance traveled (GPS/SOG)
  - Cargo carried (DWT & DT)

Parameter
- CO_2 emission factor fuel
- Ship rating

Reporting
- Yearly ship index rating

Emission Trading System

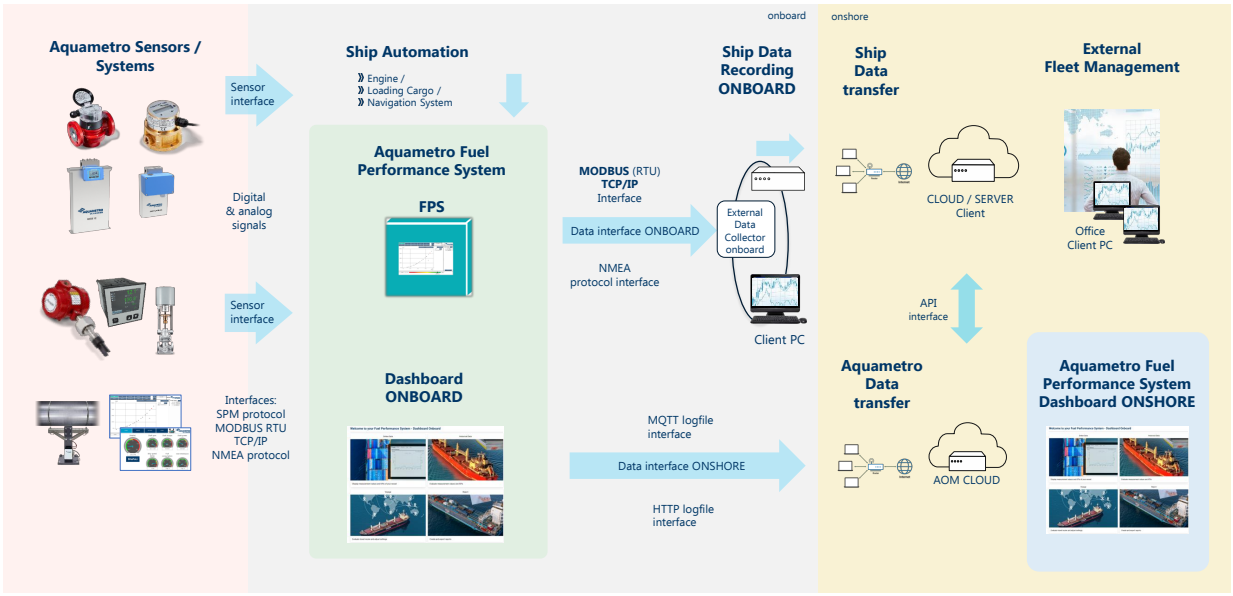
ETS Monitor Reporting

Value measured
- Fuel consumption kg/h

Parameter
- CO_2 emission factor fuel
- Yearly ship emission allowances
  CO_2; (CH_4) / (N_2O) (2026)

Reporting
- Yearly emissions reporting

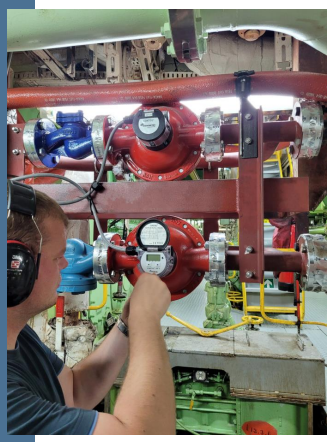
Aquametro Ship Performance Solution



OWN THE FLOW AQUAMETRO

Fuel Consumption Measurement

Volume flow meter - CONTOIL®



CONTOIL® Features

- Volume flow measurement
- **Mass flow calculation**
- **Integrated temperature sensor**
- Temperature compensated norm volume
- Easy installation, plug & play
- Accurate measurement
- Multiple pulse / analogous signal output

DN 4 - 8 (12)
Flow range: 1 l/h to 400 l/h
Accuracy: 1 %
Threaded ends

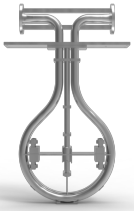
DN 15 - 50
Flow range: 20 l/h to 30.000 l/h
Accuracy: 0.1 % to 1 %
Flange (DIN, ANSI, JIS), threaded ends

Fuel Consumption Measurement

Coriolis - Mass flow meter - AOM-CM

AMO-CM Features

- Torsion oscillator design assures **a stable and drift free measurement** with excellent signal to noise ratio
- **Resilient to external noise** and vibration
- **No moving parts** to wear or fail
- Accurate measurement
- Multiple pulse, analogous signal / Modbus outputs

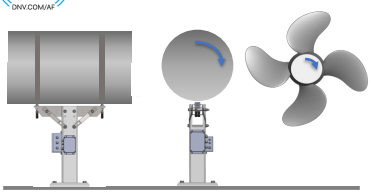


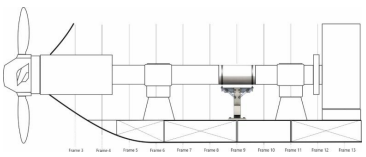
DN 015 - 100
Flow range: 2 kg/h to 540.000 kg/h
Flange DN15 up to DN200
Accuracy: 0.2 %
Flange (DIN, ANSI, JIS), threaded ends

AOM Shaft Power Measurement

Shaft Power Meter - SPM

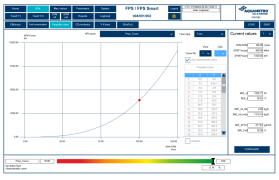
Working principle





SPM Features

- Easy, self installation / calibration - plug & play
- No electrical part on shaft
- RPM, Torque and Power measurement
- Thrust calculation
- Fuel / Propulsion efficiency



Shaft Power Measurement

Shaft Power Limitation – SHaPoLi

Shaft / engine **power limitation – SHaPoLi**

SHaPoLi - Shaft power limitation violations have to be documented

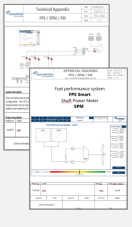
SHaPoLi Display - Features

- SHaPoLi display **monitors** whether the operating point approaches the characteristic curve **(Shaft Limitation)**
- **Warning and Alarm** (Limit) and whether the characteristic curve is exceeded – Digital output of alarm created
- The characteristic curve can be generated manually with support points by authorized engineer only
- Overriding SHaPoLi function – activation by ship's master or OICNW only – digital output created for external limit control device

Fuel Performance Monitoring

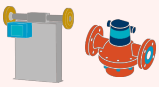
FPS / Dashboard

Engineering
Aquametro
Technical support



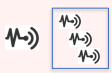
Technical Appendix,
Approval drawing

Sensors / Systems



Aquametro Flow Meter

Aquametro Shaft Power Meter



NMEA GPS protocol RMC

Hard- & Software ONBOARD **FPS**

Features

- System configuration
- System settings
- Vessel tracing
- Data reporting
- Data analysing KPI
- Data visualisation
- Data logging

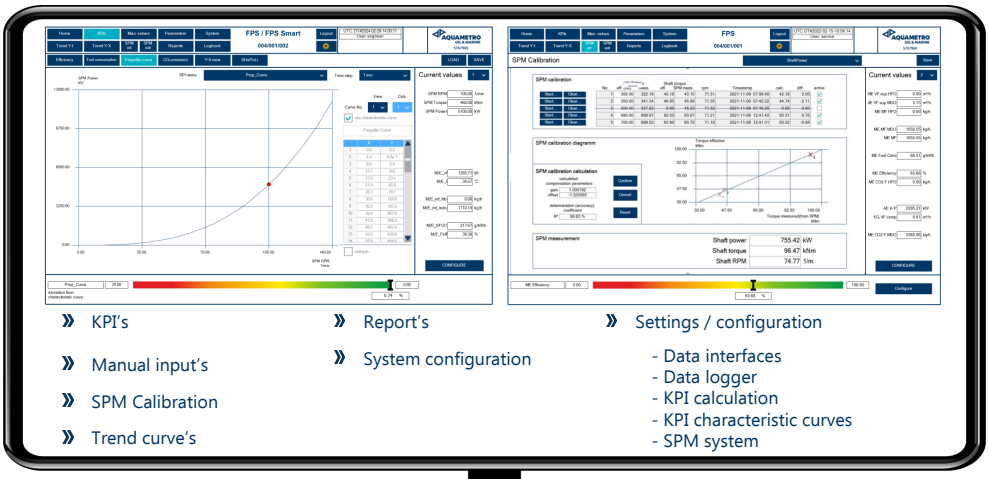
Hard- & Software ONBOARD / ONSHORE **DASHBOARD**

Features

- Data storage
- Database & Cloud
- Vessel tracing
- Data reporting
- Data analysing KPI
- Data visualisation

Fuel Performance System

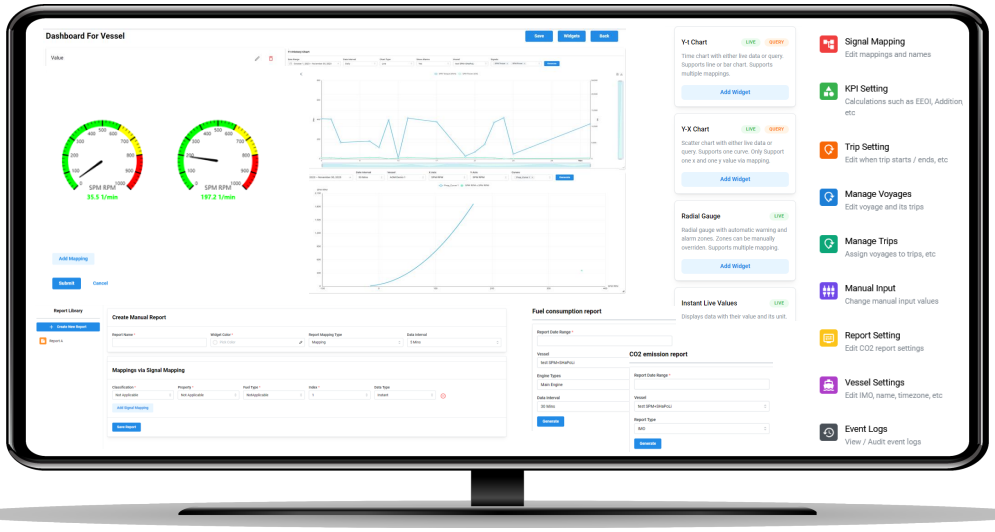
FPS settings / configuration



- KPI's
- Manual input's
- SPM Calibration
- Trend curve's
- Report's
- System configuration
- Settings / configuration
  - Data interfaces
  - Data logger
  - KPI calculation
  - KPI characteristic curves
  - SPM system

Fuel Performance Monitoring

Dashboard



AOM Project Engineering

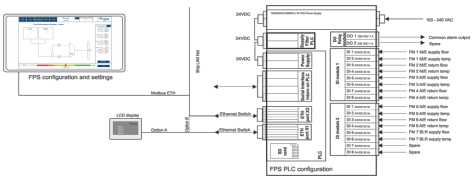
Project process

- **Project INFORMATION**
- **Project SPECIFICATION**
- **Project CLARIFICATION**
- **Project DETAILS**
- **Production**
- **Installation on board**
- **Commissioning / Service**

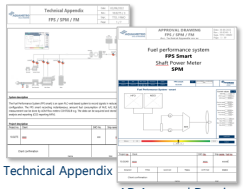
Engineering support

- Questionnaire
- Technical Appendix TA
- Approval drawings AD
- Workshop Certificate

Project documents



PLC HW / SW configuration



TA Technical Appendix

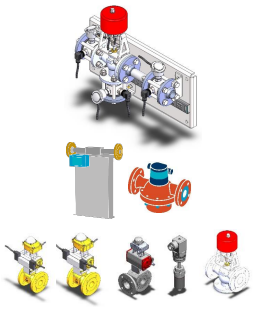
AD Approval Drawing

AOM Fuel Treatment

GreenBLEND / Diesel Switch

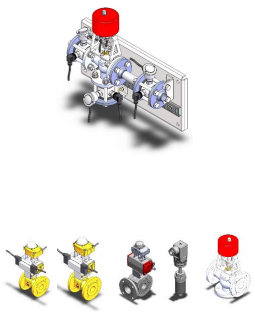
Fuel Blending of different types of fuels (e.g. alternative fuels)

GreenBLEND



Fuel change-over of different types of fuels

Diesel Switch



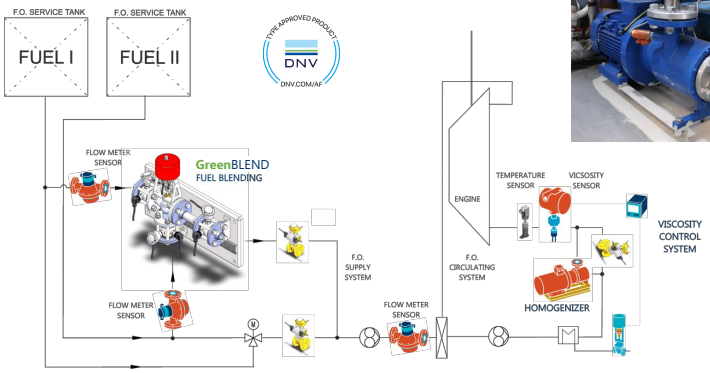
GreenBLEND Features

- **Simplest** and universal **design** / turnkey product
- Automatic fuel change-over or **permanently controlled fuel blending** of different types of fuels
- Full DNV type approval certificate
- **Saving fuel costs**
- **Improves CII-rating** thanks to Operator defined blending-in ratio of certified Biofuel to fossil fuel
- **Reduces cost for EU-ETS allowances** when used for blending-in certified Biofuel to fossil fuel
- Control of rise of fuel temperature on engine inlet
- **Full data visualization** and storage
- Additional **GPS-position and logging** available

AOM Fuel Treatment

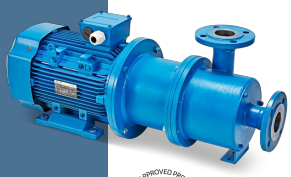
GreenBLEND / Diesel Switch

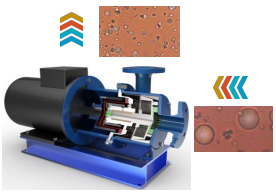
Application example GreenBLEND - fuel blending process

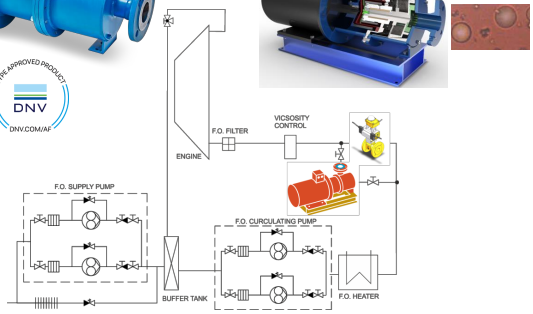


AOM Fuel Treatment

HOMOGENIZER







HOMOGENIZER SIZES
HG 100 up to 3 m^3/h | HG 130 up to 8 m^3/h | HG 150 up to 12 m^3/h | HG 220 up to 25 m^3/h
at fuel viscosity 14-20 cSt / 1 bar up to 15 bar / up to 150 °C

HOMOGENIZER Features

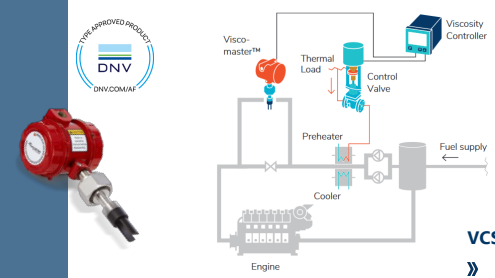
- **Prevents sludge, clogged filters, deposits** on engine parts & turbo charger
- Reduces fuel droplet size down to 5µm for a uniform & fine spray pattern at injection -> improves combustion -> **less emissions & visible soot**
- **Improves fuel stability** when switching between fossil fuels and ensures a stable resulting fuel when blending-in Biofuel
- **Extended lifetime** of filters & injection parts
- **Breakdown** of carbon chains & **particles & cat fines** sizes
- Prevent the adhesion of asphaltene
- **Emulsify blend fuels** and water in fuel

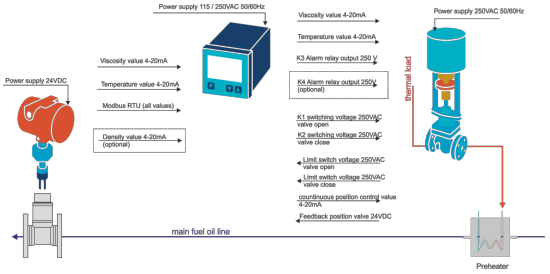
Saving effects

- Fuel & fuel cost savings up to **2 - 3 %**
- Operating & spare part costs saving **up to 3 %**

AOM Fuel Treatment

Viscosity Control System - VCS



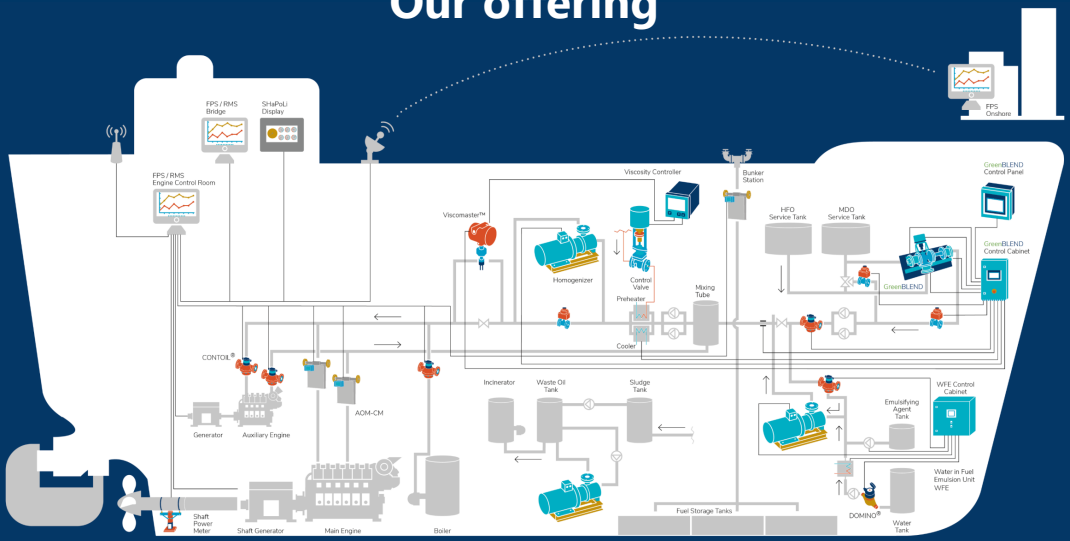


VCS FEATURES

- Measurement
  - viscosity / temperature (density)
- Controller
  - Controlled valve position based on viscosity or temperature set point
  - step control or continuous control of valve position
- Control valve (steam valve)
  - Control thermal load of preheater to reduce or increase viscosity

Own the flow

Our offering



MEASUREMENT MANAGEMENT & TREATMENT PERFORMANCE MONITORING

Contact us

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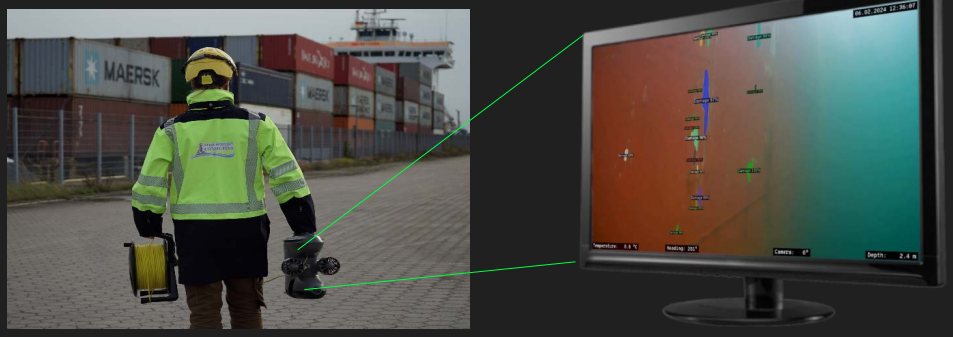
45. ISF-Tagung 24.Mai 2024

Vortragsgruppe 1: "Energieeffizienz und Emissionsminderung“

Unterwasserdrohnen und KI in der Schifffahrt - Ein Praxisbericht zur ertsen unbemannten Klasseinspektion und marine fouling Erkennung

Michael Stein

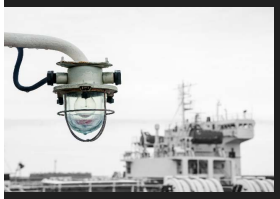
Vesselity



Optimizing Fuel Consuption With Data Science
A Story of Predictive Hull Maintenance using ROV Inspections and AI Analysis

2019	IDEA
2020/21	CODING
2022	VALIDATION
2023-09	FOUNDATION

VESSELITY
MARITIME
ANALYTICS



Predictive hull maintenance with data science

We **reduce emissions** of the maritime industry with a **data-driven** approach.

We **forecast CII** and measure marine fouling based on **ROV inspection** and **deep machine learning**.

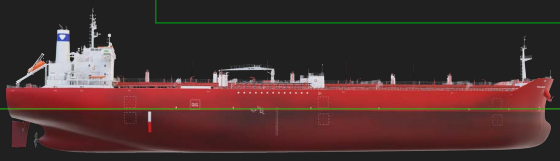
AIS analysis

machinery performance

weather factors

fuel consuption

There is knowledge about your ship in the market that is easily accessible...



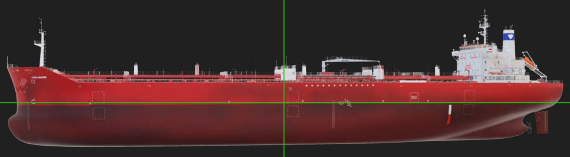
hull performance?

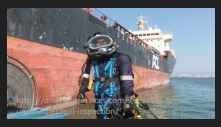
marine fouling?

... but how can you draw conclusions when you only know half of the equation?

Noon report

Real-time metrics

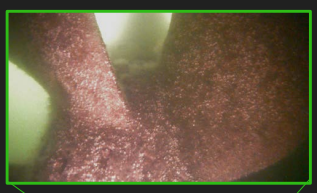




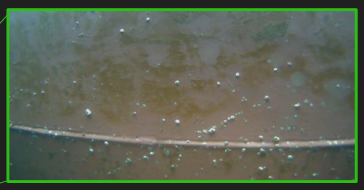
Intermediate class diving

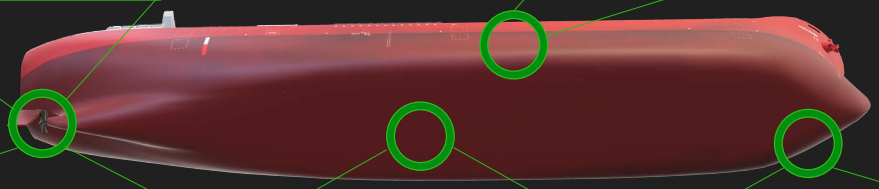
Proactive ROV inspection

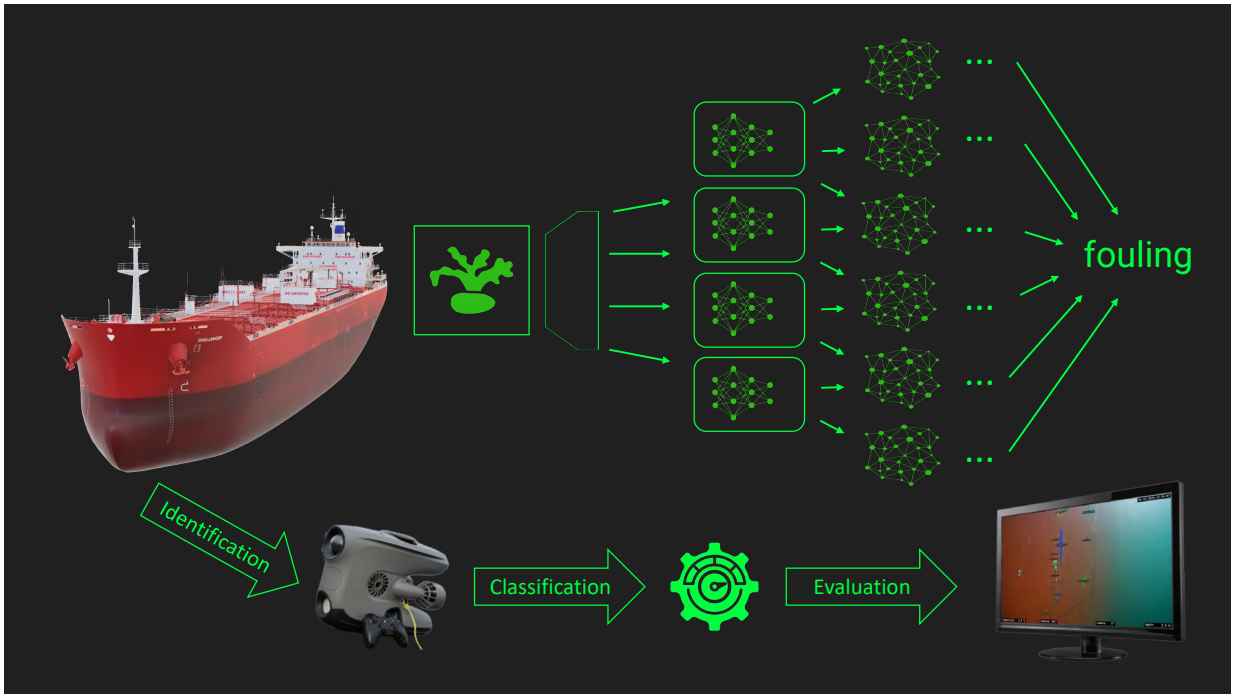
Data-driven evolution of vessel performance monitoring



Do you know what your fleet looks like...?

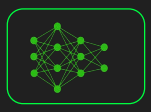






Custom Neural Network Architecture:

- developed for maritime environments
- our NN leverages convolutional layers to process and analyze complex video data
- capable of identifying even subtle signs of biofouling, damage, and rust



Curated Dataset Preparation:

- trained on meticulously assembled data, comprising thousands of annotated images
- dataset includes diverse examples of biofoulings, degrees of damage, and rust
- different lighting, turbidity and water conditions ensures robust detection capabilities

Quantitative Analysis:
- Measurable data enabling precise fouling condition assessment

Data-Driven Decisions:
- Supports maintenance and operational decisions with actionable insights

Predictive Maintenance:
- Leverages historical data and AI predictions to forecast potential problem areas

We started with area segementation..

2021

...and advanced to instance segementation.

2024

Simple vs. Instance Segmentation: Key Differences in AI Image Analysis

Simple (Semantic) Segmentation:

Definition: Classifies each pixel in an image into predefined categories, without differentiating between individual objects within the same category.

Application: Useful for broad categorization, such as distinguishing between water, ship hull, and biofouling in an image.

Limitation: Cannot identify or count individual instances if multiple objects of the same class are present.

Simple vs. Instance Segmentation: Key Differences in AI Image Analysis

Instance Segmentation:

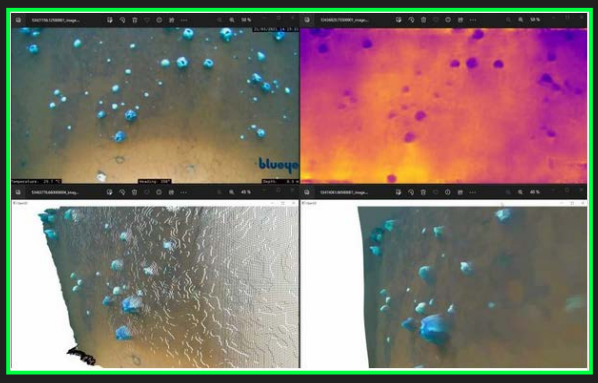
Definition: Goes a step further by not only classifying each pixel but also distinguishing between different instances of the same class in an image.

Application: Essential for detailed analysis, such as identifying and quantifying separate areas of damage or biofouling on a ship's hull.

Advantages: Enables precise measurements of each instance, critical for assessing the condition of the hull and planning maintenance.

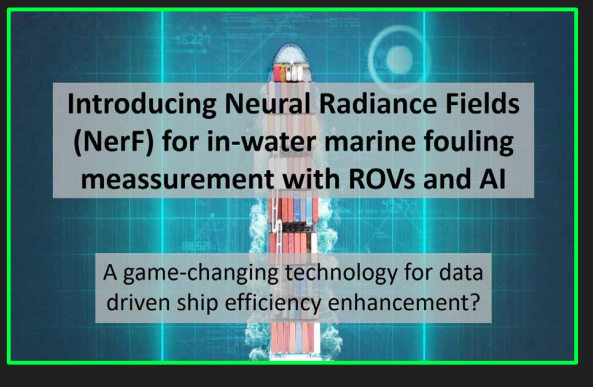
Importance for Hull Inspection:
Ability to provide detailed, instance-specific information makes it particularly valuable for the inspection of ship hulls. By accurately identifying each occurrence of biofouling, damage, or rust, it enables data harvesting of the ship hull's condition.

Let us take this to the next level...



A google algorythm published 06/2022 for photo manipolation and text to image generation.

Synthesising 3D outputs from a 2D input with a single viewpoint.
-> NeRF



Contextualizing data into decisions

Where are the benefit?

Early knowledge about fouling and excess fuel consumption

Preparation of drydock/ inspection after grounding

Remote Inspection **reduces surveillor costs**

Adding a whole new data layer to your decisions!

And by the way, we already changed class approval...

2023:

First official class certification by LR

done solely by ROV without any divers.

Let us keep in touch...

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18055 Rostock

+49 151 2017 8111

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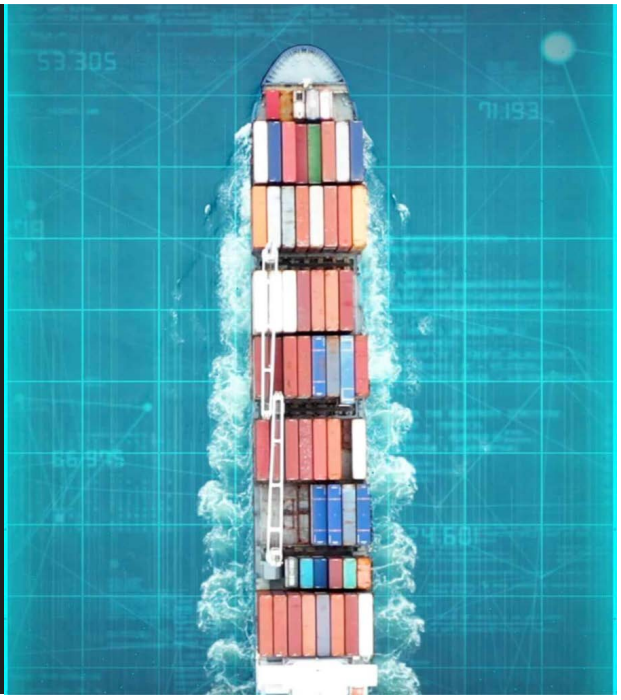
kaiser@vesselity.de

www.vesselity.de

LinkedIn



45. ISF-Tagung 24.Mai 2024

Vortragsgruppe 2: "Weiterentwicklungen in der Schiffstechnik"

The latest updates to maritime WHR technologies from Alfa Laval

David Jung

Business Development Manager, Alfa Laval

Latest updates to maritime WHR technologies

ISF Conference, 24th May 2024

David Jung

Alfa Laval – Key figures 2023

– MEUR

INVOICING 5,559	6,184 ORDER INTAKE	ROCE 21.0%	21,321 NO OF EMPLOYEES
16.1% ADJUSTED EBITA AS % OF SALES		893 ADJUSTED EBITA	

A global company

- 37 major production units*
- More than 100 service centres
- Sales companies in 55 countries
- Other sales representation in 45 countries

* Plus a number of minor production and assembling units

Alfa Laval milestones

1883
Swedish engineer and inventor Gustaf de Laval and his business partner Oscar Lamm establish the company AB Separator to manufacture and sell their centrifugal separator, which separates milk from cream.

1901
AB Separator becomes a listed company on the Stockholm Stock Exchange.

1913
Gustaf de Laval dies, aged 67, with 92 Swedish patents to his name. "The man of high speed" is engraved on his memorial.

1930s
The first heat exchanger is introduced. Development and production of heat exchangers is moved to Lund, where the company is head-quartered today.

1963
The name of the company is changed from AB Separator to Alfa Laval. Alfa comes from the alfa discs which increase the separator's capacity.

1971
Alfa Laval enters the fluid handling business when it acquires a majority interest in the Danish company Lavrids Knudsens Maskinfabrik (LKM).

1991
Alfa Laval is acquired by Tetra Pak, which owns the company until 2000, when it is sold to Industrikapital and then relisted on the stock exchange in 2002.

2011 - 2020
Alfa Laval acquires Aalborg Industries and two years later the Norwegian company Frank Mohn, which further strengthens Alfa Laval's presence within the marine and offshore markets.

2021→
In 2021, Alfa Laval acquires StormGeo, a global leader in weather intelligence and advanced data science solutions. The year after, Desmet is acquired, a world leader in edible oil and biofuel processing.

Three business divisions

Energy

This area covers a wide range of industries such as HVAC, oil & gas, chemicals, biofuels – with a special focus on energy efficiency.

Food & Water

Offers products, solutions and systems in the areas of food processing and water treatment.

Marine

The company has supplied the marine industry since 1917 and has today a broad offering incl. environmental marine products.

Key technologies

Our key technologies are adapted to each business unit and offered separately or combined into optimized solutions.

HEAT TRANSFER

ENERGY DIVISION
- Brazed & Fusion Bonded Heat Exchangers
- Gasketed Plate Heat Exchangers
- Welded Heat Exchangers
- Electrolyzer & Fuel Cell Technologies

FOOD & WATER DIVISION
- Food Heat Transfer
- Food Systems

MARINE DIVISION
- Marine Separation & Heat Transfer Equipment
- Boiler Systems
- Gas Systems

SEPARATION

ENERGY DIVISION
- Energy Separation

FOOD & WATER DIVISION
- High Speed Separators
- Decanters
- Food Systems

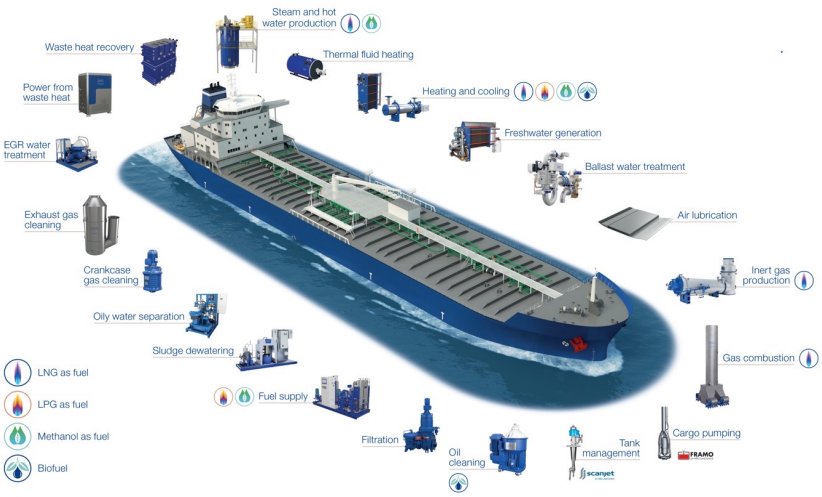
MARINE DIVISION
- Marine Separation & Heat Transfer Equipment

FLUID HANDLING

FOOD & WATER DIVISION
- Food Systems
- Hygienic Fluid Handling

MARINE DIVISION
- Pumping Systems

Solutions from bow to stern



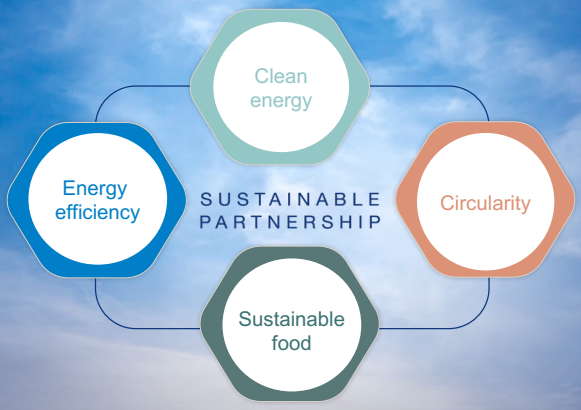
Enabling the future today

Wind propulsion
Through Oceanbird, a joint venture with Wallenius, Alfa Laval is enabling wind-assisted and wind propulsion.

Voyage optimization
Part of Alfa Laval, StormGeo is reducing fuel use and carbon emissions through digital services for optimized routing.

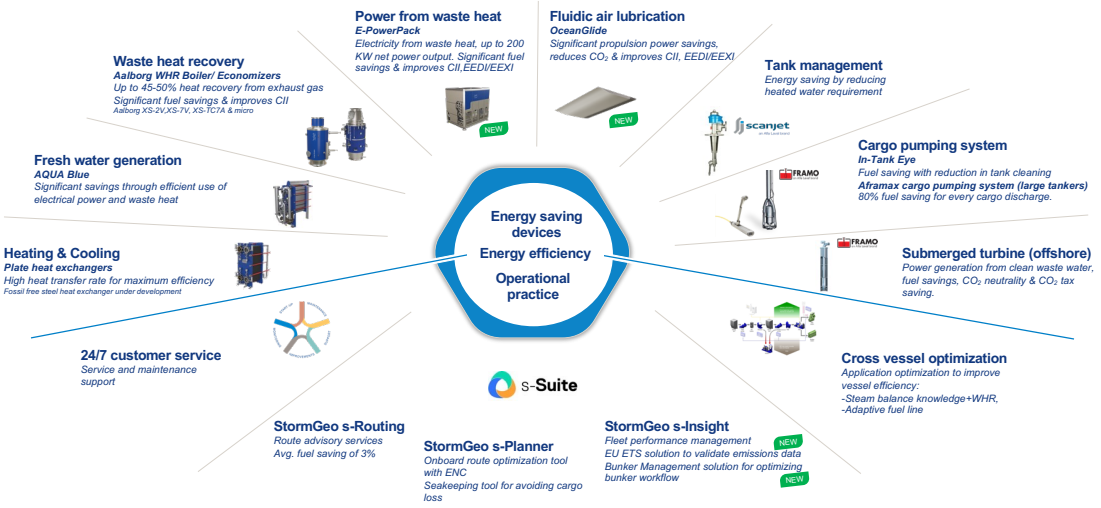
Sustainability focus areas in Alfa Laval

with customers

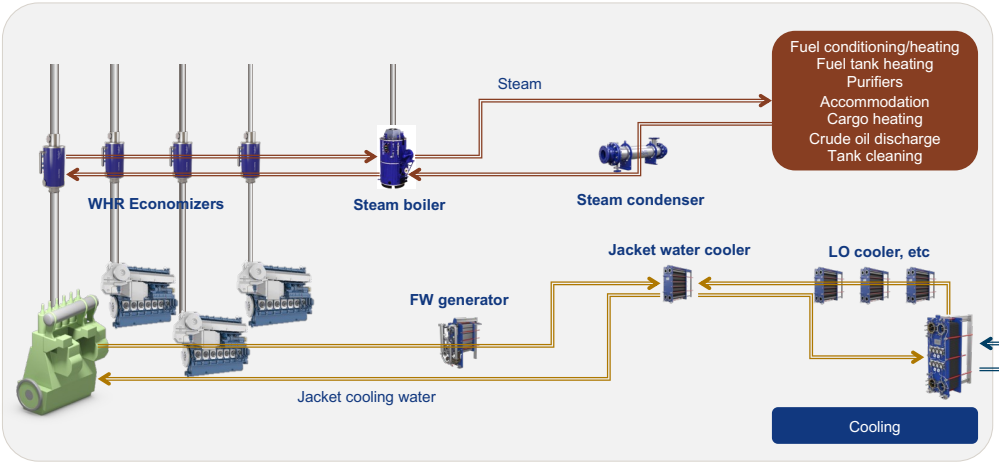


Energy efficiency

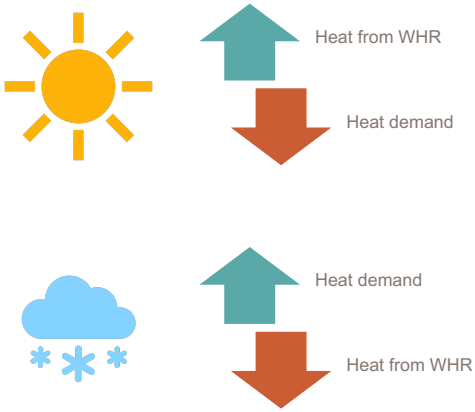
– Advancing towards fuel savings and efficient operations



Heating and cooling onboard



Traditional dilema in steam system design

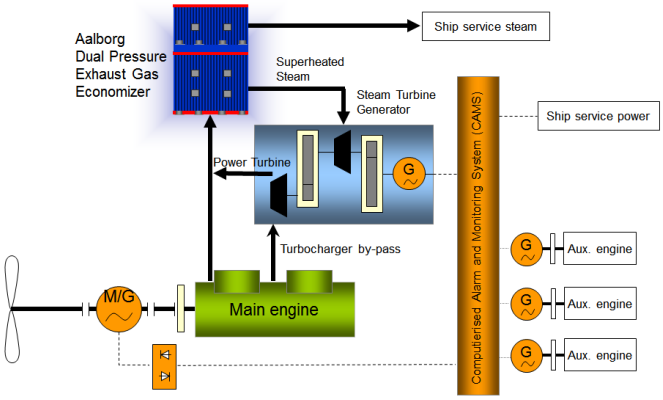


Catch is...

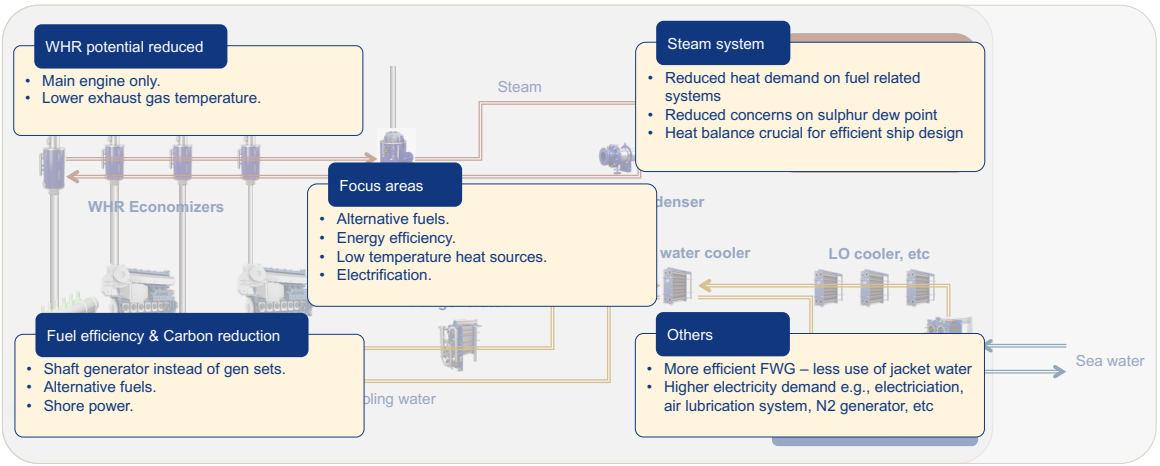
- When designing the WHR/heating system for average condition, heat generation via WHR does not meet heat demand in cold condition thereby fuels are consumed for heating.
  - Carbon emission & CII.
  - Alternative fuels = high fuel costs
- When optimizing heating system, fuel consumption in cold condition is minimized, but it also leads to larger heat generation in hot condition thereby extra capacities / equipment

Rankine cycle using steam turbine

– Applied to ~150 ships

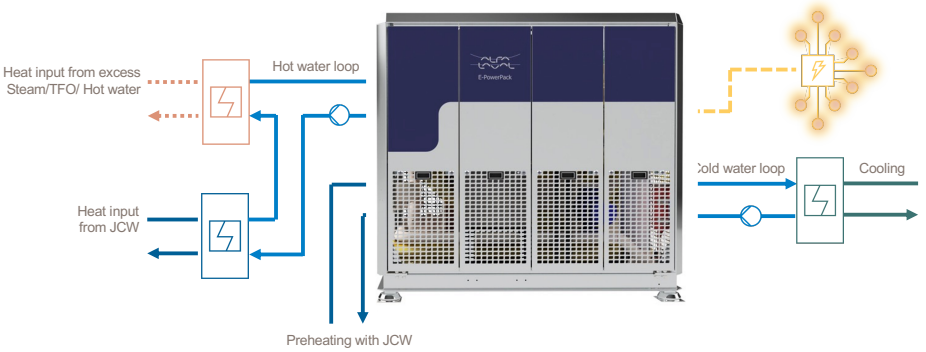


Changes to heating system



Organic Rankine Cycle

WHR utilizing low temperature heat sources



Alfa Laval E-PowerPack 200

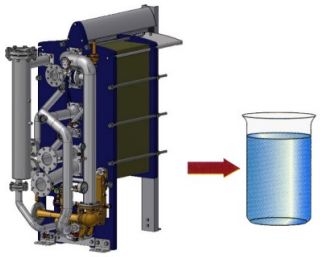
Technical highlights

Highlights for E-PowerPack 200

- Extended operational range (80 – 145 deg. C) allows the system to be operated with HT jacket cooling water when no excess steam/ TFO/ hot water is available.
- Hot water inlet temperature can be boosted with high temperature heat source (i.e. steam, TFO, hot water).
- Any high temperature heat can be utilized to increase the performance and net power output of the system

2-stage FW generator

– Opportunity for further heat recovery



The 2-Stage FWG utilizes 50% less heat consumption

The excess heat is converted to electricity through the E-PowerPack

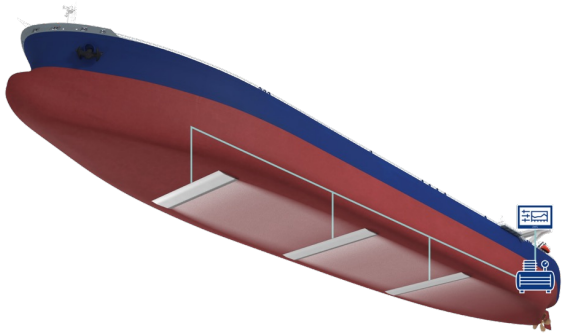
Energy saving by air lubrication

– Further improved with free electricity from EPP

When applying air lubrication system

Electricity demand

Fuel consumption

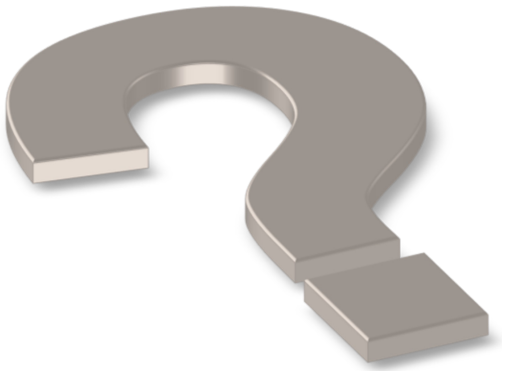


Free of charge electricity

Concluding remarks

- WHR has been an essential part of ship design & operation.
  - A large number of ships are equipped with WHR economizers for fuel saving in heating system.
  - Abundant excessive steam in hot condition is used for power generation via steam turbine.
- WHR technologies will be re-shaped by mega trends in shipping industry.
  - Regulatory requirements for carbon reduction and commercial drives on reduced fuel consumption.
  - Adoption of alternative fuels and changes to available thermal energy and heating system design philosophy.
- More changes are expected.
  - Beginning of applying bio/e-fuels. Current focus is on core functions, thereafter optimization.
  - New technologies will evolve as the environments get clearer.

Questions?



David Jung
Business Development Manager
BU Heat & Gas Systems, Marine Division
E-mail: david.jung@alfalaval.com

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45. ISF-Tagung 24.Mai 2024

Vortragsgruppe 2: "Weiterentwicklungen in der Schiffstechnik"

Innovative Lub Oil Filtration Concept for combustion engines

David Jüssen

Boll & Kirch

INTO THE FUTURE.

Presentation

Innovative Lube Oil Filtration Concept for Combustion Engines

Presented by: David Jüssen
24.05.2024

Maritimes Zentrum Hochschule Flensburg
BOLLFILTER Protection Systems

Agenda

Innovative lube oil filtration concept for combustion engines

David Jüssen, 24.05.2024

- Motivation
- State of the Art
- Future Concept
- Studies and Final Solution
- Field Experience
- Look into the Future
- Conclusions

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Motivation

Benefits of efficient lube oil filtration

- Extension of service lifetime
- Reduction of maintenance costs

Challenges

- Reducing the oil contamination for higher hydraulic standards
- Improving the user-friendliness of systems for oil treatment

Increasing the operational safety, availability, cost efficiency and sustainability during the operation of an engine!

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BOLLFILTER Protection Systems

State of the art

Lube oil filtration

Automaticfilter type 6.48 using filter candles

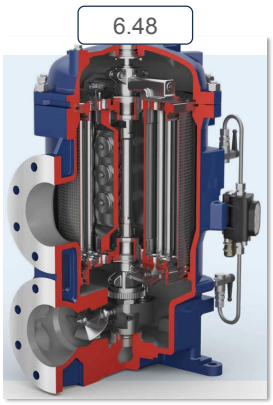
- Low operating and maintenance costs
- Max. particle size is limited to 25µm

Filter cartridge

- Finer filtration possible < 25µm
- Frequent replacement leads to increasing OPEX

Development goals

- Combination of the filtration performance of filter cartridges with low OPEX of an automatic filter



State of the art

Oil treatment

Separators or centrifuges

- Large amounts of external energy or installation of additional equipment (pump)
- Density difference between dirt and oil
- Efficient only at certain operation parameters
- Operator know-how mandatory for efficient operation

Development goals

- Filter system should also take care of oil treatment

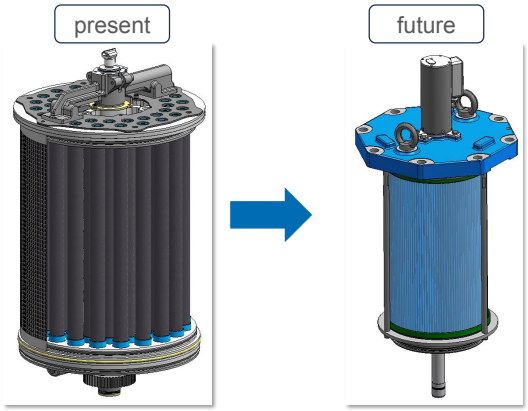
Source: https://m.gobizkorea.com/mobile/mobileGoodsDetail.do?goods_no=GS2019103076221

Future concept

Lube oil filtration

Pleated element concept (PEC)

- Filter candles are replaced by one PEC element
- Filtration efficiency of 10 µm abs. mesh (β10=2)
- Reduction of flushing volume
- Reduction of footprint
- Lower number of parts
- Easier maintenance
- Emergency operation ensured by redundancy



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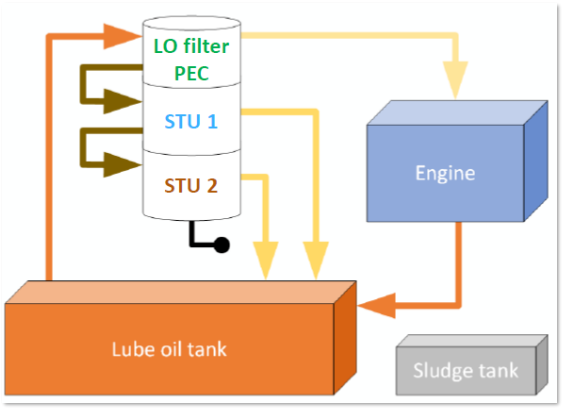
Future concept

Oil treatment

Flushing oil treatment (FOT)

- System consists of:
  - LO filter (PEC)
  - sludge oil treatment unit 1 (STU 1) with small size PEC
  - sludge oil treatment unit 2 (STU 2) with cartridge element
- No additional system for oil treatment necessary
- FOT system uses LO pump pressure and electrical power
- System works independently without crew intervention



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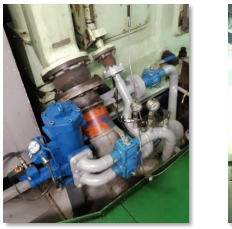
Studies and Final Solution

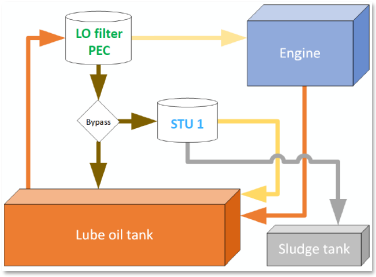
Validation Study 1

Performance test on a vessel in 2019

- Duration: 2000 h
- Replacement of filter candles with PEC element
- Installation of STU1 in backwash line
- Control system for pressure- and time-dependent backflushing



Source: WÄRTSILÄ R&D ancillary systems, 2023, Oscar Sunngren, Mathias Björklund, Ilary Hyöty, Mortti Pihlajamäki



Studies and Final Solution

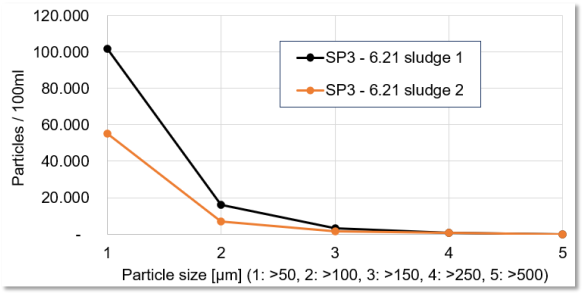
Results of Validation Study 1

Test series 1: flushing volume

- Function of PEC element was proved
- Reduction of flushing volume by -83%

Test series 2: performance of STU 1

- Function of STU 1 was proved
- Extension of flushing intervals of STU 1 (from < 10 sec to > 2-3 min)
  → Reduction of particle amount by 40-50%



Source: WÄRTSILÄ R&D ancillary systems, 2023, Oscar Sunngren, Mathias Björklund, Ilary Hyöty, Mortti Pihlajamäki

Studies and Final Solution

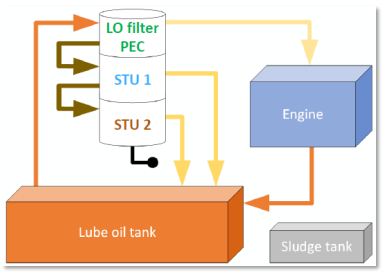
Validation Study 2

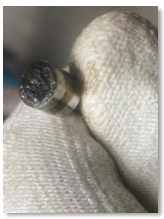
Performance test on an engine test bed in 2022

- Duration: 400 h
- LO filter with PEC element and STU 1
- Installation of a STU 2
- Engine operation with LFO and HFO

Results:

- Function with STU 2 was proved
- Operation with LFO and HFO was proved
- Removal of metal particles from the system





Source: WÄRTSILÄ R&D ancillary systems, 2023, Oscar Sunngren, Mathias Björklund, Ilary Hyöty, Mortti Pihlajamäki

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Studies and Final Solution

Final Solution

- Electrical Drive for flushing the PEC element and STU 1

  → Lower pressure drop
  → Only electric energy necessary

- Valve for bypassing the STU 1 and STU 2

  → Maintenance without interruption of engine operation

6.49 FOT

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Field test

Customer test in Finland

- Start in November 2023
- Meanwhile more than 500 h, without trouble
- LO filter with10µ abs, STU 1 with 10µ, STU 2 with 10µ
- LO filter function (backflush performance) is not affected by STU 1 and STU 2
- STU`s controlled over time setting
- Test until end of summer 2024
- Oil samples show remarkable reduction of particles after installation of the FOT system

FOT-unit installed on the W25 test engine at Wärtsilä in Finland

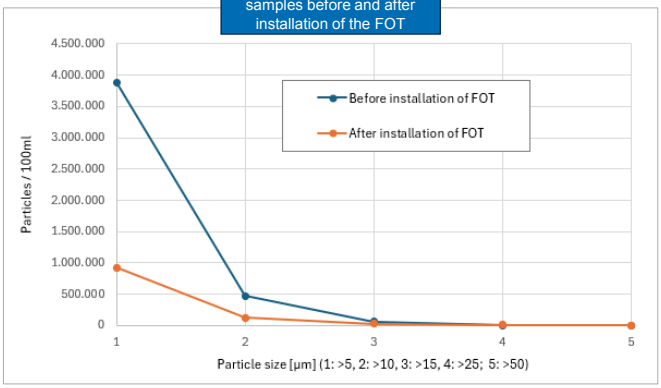
Source: WÄRTSILÄ R&D ancillary systems, 2024, Oscar Sunngren, Mathias Björklund, Ilary Hyöty, Mortti Pihlajamäki

Field test

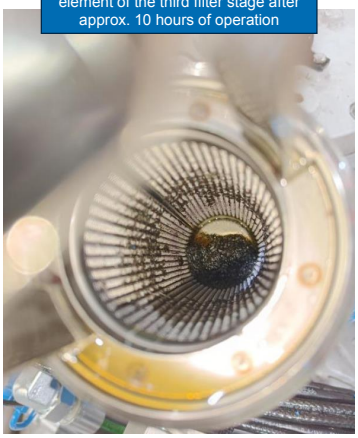
Customer test in Finland

Source: WÄRTSILÄ R&D ancillary systems, 2024, Oscar Sunngren, Mathias Björklund, Ilary Hyöty, Mortti Pihlajamäki

Comparison of the oil samples before and after installation of the FOT



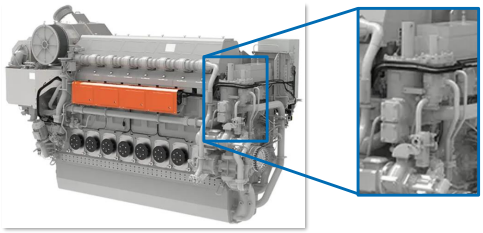
Collected dirt particles within the element of the third filter stage after approx. 10 hours of operation



Look into the Future

Next development steps

- Intelligent control system regulates electric motor and flushing valve
- Further reduction of flushing volume and extending the lifetime of STU 2 cartridge
- Artificial learning ready



Source: https://www.wartsila.com/marine/products/engines-and-generating-sets/dual-fuel-engines/wartsila-25

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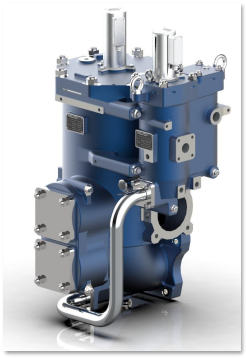
Conclusions

- Automatic filtration with 10 µm is proven standard with PEC
- Reduction of the necessary flushing oil volume at least by half
- Reduction of weight and footprint

- Further increase of oil quality due to flushing oil treatment with FOT system
- No need for additional separation



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BOLLFILTER Protection Systems

THANK YOU FOR YOUR ATTENTION.

David.Juessen@bollfilter.com

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45. ISF-Tagung 24.Mai 2024

Vortragsgruppe 3: "Alternative Energiequellen"

Operation experience with an innovative street-trailer based LNG-bunkering system and MaK 8M46 DF engines

Tony Johnson

SeaRoad Shipping Pty Ltd

Searoad Mersey II - experience operating on LNG

Introduction

Tony Johnson – Technical Marine Manager – Searoad Shipping

1984 to 1987 - Australian Maritime College –– Bachelor of Applied Science (Marine Engineering)

Engineer Class 1 – Motor - Issued by the Australian Maritime Safety Authority (AMSA)

1994 – completed - Master of Business Administration (Technology Management)

Dec 1987 to Oct 1998	Seagoing Engineer - ASP Shipmanagement Inc – Australia
Oct 1998 to May 2000	Technical Superintendent - Intership Navigation Co. Ltd – Limassol, Cyprus
July 2000 to June 2006	Technical Superintendent - LMS Shipmanagement Inc - New Orleans, USA
July 2006 to July 2011	ABS Surveyor & Senior Surveyor - New Orleans, USA
July 2011 to Nov 2011	ABS Principal Surveyor – Geoje, Korea (DSME & SHI – LNG New Building)
Nov 2011 to July 2013	ABS Principal Surveyor – Glasgow, UK
July 2013 to Jan 2016	ABS Principal Surveyor-in-Charge – Aberdeen, UK
Jan 2016 to May 2017	ABS Principal Surveyor-in-Charge – Sydney, Australia
May 2017 to Oct 2019	Technical Manager – TT Line Pty Ltd – Melbourne, Australia
Nov 2019 to Present	Technical Marine Manager - SeaRoad Shipping – Melbourne, Australia

Where we come from

We are an Australian family-owned business that is immensely proud of its local heritage.

Our origins date back to the late 1890s, when William Holyman and Sons established their Bass Strait shipping service.

Acquired in 2007 by the family of former Holymans' employee, Chas Kelly, in partnership with the Morris family, we are known today as SeaRoad—Tasmania's trusted shipping and transport logistics partner.

Board of Directors aboard LIEKUT

What we do

Bass Strait shipping is an essential domestic service, providing for the Tasmanian population, visitors and economy.

SeaRoad's sea freight services include the transportation of containers, trailers, refrigerated units, cars and other mobile equipment on our RoRo vessels, Searoad Mersey II and Liekut.

The vessels sail overnight from Monday to Saturday between Melbourne and Devonport.

Our diverse fleet enables us to handle freight in a range of sizes, including:

•Wharf-to-wharf, Devonport to Melbourne
•Overnight service sailing each way Monday-Saturday
•Dedicated fleet of two roll-on/roll-off vessels
•Carrying 20' and 40' containers, all road trailers, refrigerated units, oversized cargo and machinery, cars and other mobile equipment

What we do and how we do it

We move goods across Bass Strait through three principal service lines:

Shipping Logistics
• Wharf-to-wharf, Devonport to Melbourne
• Overnight service sailing each way Monday-Saturday
• Dedicated fleet of two roll-on/roll-off vessels
• Carrying 20' and 40' containers, all road trailers, refrigerated units, oversized cargo and machinery, cars and other mobile equipment

Transport Logistics
• Depot-to-depot, depot-to-door, door-to-depot or door-to-door
• Seamless, fully integrated blue water and road transport service
• Guaranteed cargo space on SeaRoad vessels
• Flexible add on services, including third party logistics/warehousing within Tasmania.
• Network pickup/last mile capability within Tasmania and Metropolitan Melbourne
• Intermodal pickup/last mile capability across mainland Australia via rail and/or preferred third party suppliers
• Carrying goods of varying size, including palletised freight, cartons, skids, rolls, FCL and LCL

Container Logistics
• Seamless, fully integrated blue water, road transport and container supply service
• Range of 20' and 40' containers including Bulkers, Side Doors, High Cube, Refrigerated & Cargo Bases Guaranteed cargo space on SeaRoad vessels
• Network pickup/last mile capability within Tasmania and Metropolitan Melbourne
• Intermodal pickup/last mile capability across mainland Australia via rail and/or preferred third party suppliers

Where we operate

SEAROAD

Where we operate

SEAROAD

Where we operate

Original Searoad Mersey

Build year: 1991

Builder: Keppel Singmarine - Singapore

Gross tonnage: 7,928 tons

Summer DWT: 4,824 tons

Length: 118 m

Beam: 19 m

Draught: 5.3 m

Searoad Tamar

Build year: 1991

Builder:

Carrington Slipways - Newcastle, Australia

Gross tonnage: 13,965 tons

Summer DWT: 9,958 tons

Length: 150 m

Beam: 23 m

Draught: 5.3 m

Voyage Profile

20,0 Knots	Distance	Speed	time fraction	Elapsed Time hh:mm	Time	Main Engines Running	Main Engines Hours	Generators Running	Generators Hours
Depart Webb Dock					17:00 hrs				
Manoeuvring Melbourne port	0,5	0	0,33	00 hrs : 20 min	17:20 hrs	2	0,67 hrs	2	0,67 hrs
Melbourne harbour channel transit	1	7	0,17	00 hrs : 10 min	17:30 hrs	2	0,33 hrs	2	0,33 hrs
Port Melbourne channel	6,5	13	0,50	00 hrs : 30 min	18:00 hrs	2	1,00 hrs	0	0,00 hrs
Port Philip bay transit	21	18	1,17	01 hrs : 10 min	19:10 hrs	2	2,33 hrs	0	0,00 hrs
South channel speed limit zone	15	18	0,83	00 hrs : 50 min	20:00 hrs	2	1,67 hrs	0	0,00 hrs
Bass Strait transit	190	20,0	9,50	09 hrs : 30 min	05:30 hrs	2	19,00 hrs	2	19,00 hrs
Devonport transit	3	6	0,50	00 hrs : 30 min	06:00 hrs	2	1,00 hrs	2	1,00 hrs
Manoeuvring Devonport	0	0	0,25	00 hrs : 15 min		2	0,50 hrs	2	0,50 hrs
Arrive Devonport					06:15 hrs				
Port Time Devonport			10,75	10 hrs : 45 min		0	0,00 hrs	1	10,75 hrs
Depart Devonport					17:00 hrs				
	237 N miles		24 hrs 00 min	24 hrs 00 min					
Voyage Time 13 hrs 15 min						Total Hrs	26,50 hrs		32,25 hrs
Port Time 10 hrs 45 min						Average / ME	13,25 hrs	Average / Aux	16,13 hrs

Cargo Profile

CASSETTES

Cargo Profile

CASSETTES

SEAROAD

Cargo Profile

Road Trailers

SEAROAD

Cargo Profile

Road Trailers

Cargo Profile

Livestock Trailers

Commercial Competition

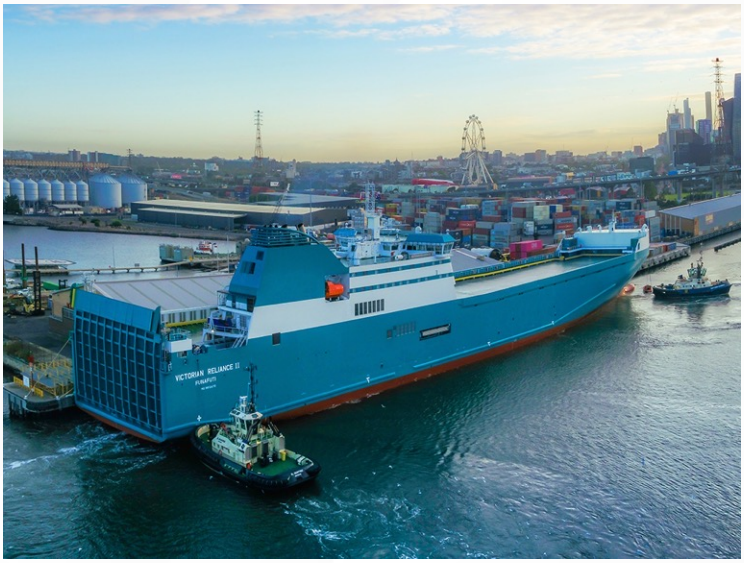
SEAROAD

Commercial Competition

SEAROAD

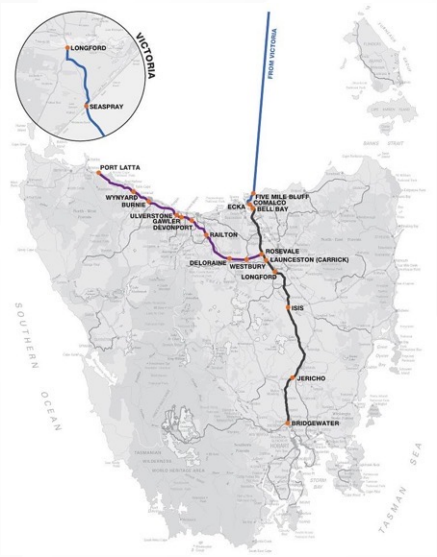
Commercial Competition

Commercial Competition



Natural Gas

Natural Gas is Delivered to Tasmania via the subsea “Tasmania Gas Pipeline”



SEAROAD

Westbury Micro LNG Plant

Construction of the micro-liquefied natural gas (LNG) plant in Westbury in Tasmania, Australia, started on 6 August 2009 and was completed in February 2011.

The plant produces 50t of LNG per day, which is equal to 70,000l of diesel.

The plant was built to supply LNG for Tasmania's heavy transport sector.

Initially, the entire production output from the plant for 15 years would be supplied to ***LNG Refuellers***, which comprises seven transport operators in Tasmania. The project required an investment of $A150m.

The consortium consisted of **Chas Kelly Transport**, KJ Padgett, Aprin Transport, Les Walkden Enterprises, Exeter Sawmill, Country Roadways and Kevin Morgan.
Together, they operated 125 natural gas-powered heavy-duty trucks in Tasmania.

Six cryostar LNG fuelling stations were supplied in Tasmania to establish a pipeline-to-truck fuel supply. The fuelling stations featured state-of-the-art filling system enabling vehicle filling with minimal gas losses.

SEAROAD

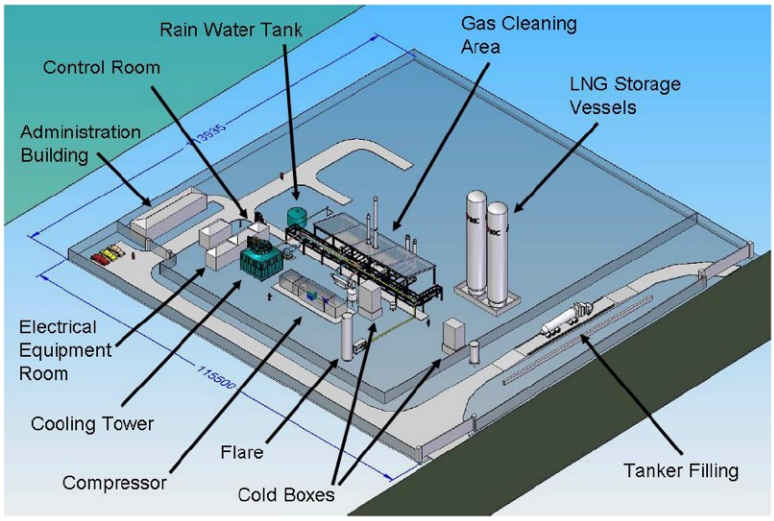
Westbury Micro LNG Plant

SEAROAD

Westbury Micro LNG Plant

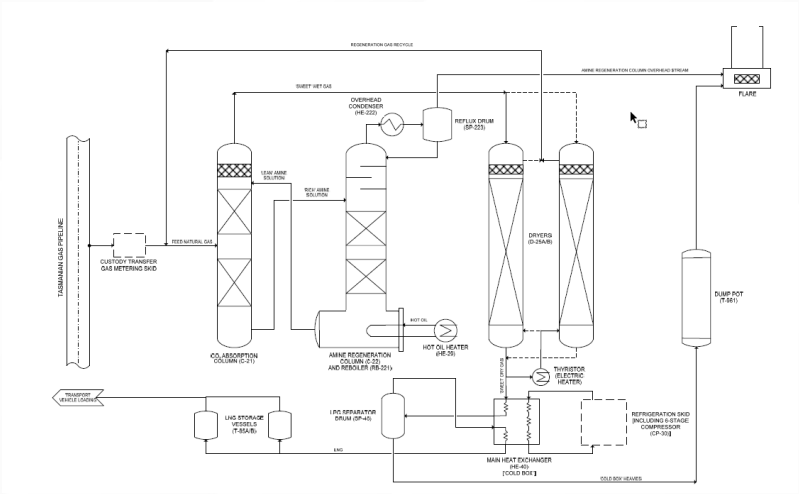
SEAROAD

Westbury Micro LNG Plant



SEAROAD

Westbury Micro LNG Plant



SEAROAD

Searoad Mersey II & LNG

Over time, the LNG concept for fuelling the Transport fleets was not successful.

In May 2014 – a Shipbuilding Contract was signed between SeaRoad and FSG for the construction of Hull 768

With Chas Kelly's role in the original consortium, the availability of the LNG supply presented an opportunity for fuelling the Searoad Mersey II.

The concept involved the use of Road Trailers and an LNG Garage onboard the vessel. The Garage can accommodate 3 Trailers, providing sufficient LNG to complete a round trip from Devonport to Melbourne.

Searoad Mersey II

Build Date	2016-11-01
Length, overall	181.52 m
Length, bp	171.31 m
Breadth, moulded	26.60 m
Depth, to main deck	8.90 m
Depth, to upper deck	17.60 m
Draught, design	5.90 m
Draught, scantling	6.30 m
Deadweight @ 6.30m draught	8,269 t
Gross Tonnage	25,409 t
Freight Decks	3
Ro-Ro Freight Capacity	1,919 lane-m
Number of Stern Doors	2
Stern Door Clearance	7.50 m
Main Deck Clearance	7.50 m
Weather Deck Clearance	4.75m
Main Engine Power	2 x 7,200 kW (MAK 8M46DF)
Auxiliary Engines	2 x 3000 kW (MAK 6M34DF)
Service Speed	20.5 kts
Bow Thrusters	2 x 1,000 kW (Brunvoll)
Rudders	2 x Twist Flow type with Costa bulbs
EEDI	11.0
EDD Approved	As per IACS Rec. 133

Searoad Mersey II

Weather Deck	65 Road Trailers - on SAT's
Main Deck	70 Cassettes + 3 Road Trailers or 56 Road Trailers
Lower Hold	111 Cars
Ballast/Flume Capacity – (Fresh Water)	2248m^3
Heeling Water (Fresh Water)	1103 m^3
MGO	739m^3
LNG (connected)	3 x 51m^3

Searoad Mersey II

Fuel Gas System

Novel Fuel Gas System design by MAN Energy Systems (Cryo AB)

Portable IMO Type C vacuum insulated tanks connected to the ships fixed system in 3 bays via flexible hoses/couplings.

7 x Type C tanks allow for rotation of tanks in service
Portable LNG Tanks loaded/discharges using terminal tractors and SAT lashing system.

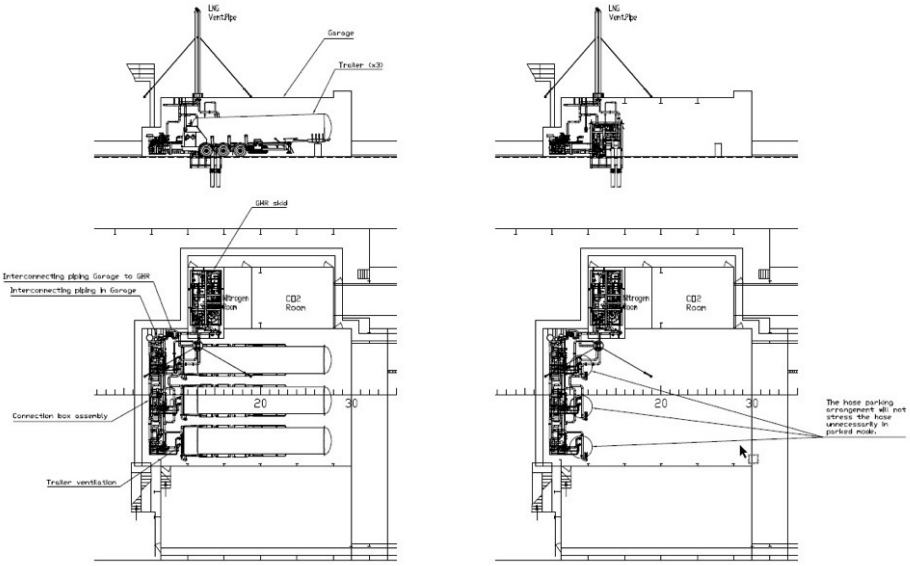
Pressure regulated supply of NG to Main and Auxiliary engines via centrifugal pump and vaporising system.

Searoad Mersey II – Type C Trailers

Searoad Mersey II – Type C Trailers

Searoad Mersey II – Type C Trailers

Searoad Mersey II – GA of Trailer Garage



Searoad Mersey II – LNG Garage

Searoad Mersey II – LNG Garage

Searoad Mersey II – LNG Garage

Searoad Mersey II – LNG Garage

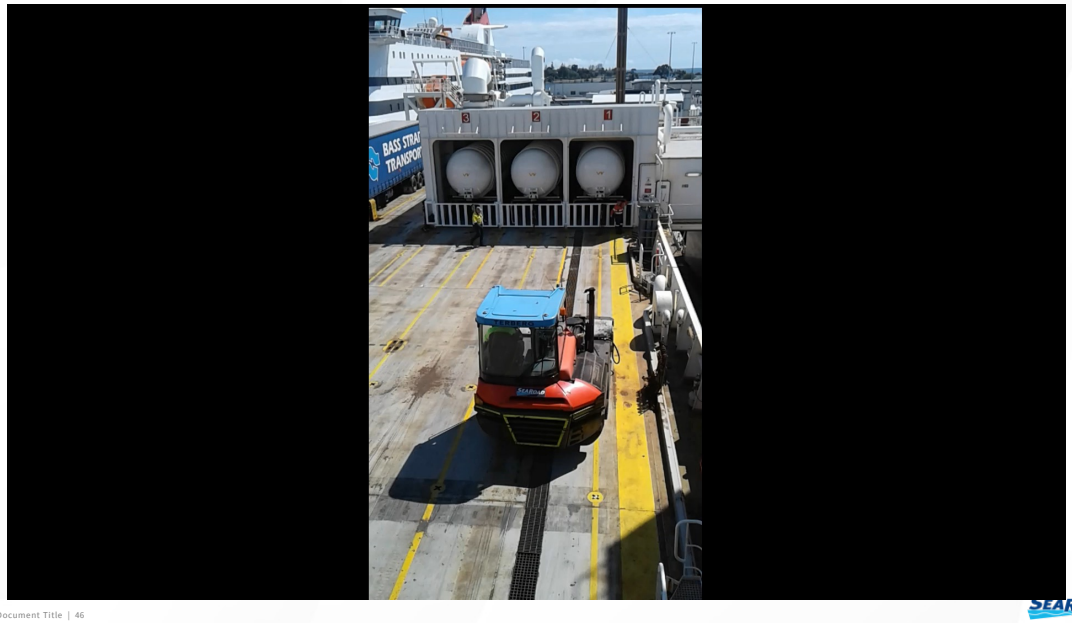
Searoad Mersey II – LNG Garage

Searoad Mersey II – LNG Garage

Searoad Mersey II – LNG Trailer Exchange

The following video shows the exchange of one trailer and has been edited and sped up - originally about 26 minutes in real time.

The exchange process for 3 trailers takes approximately 45 minutes to 1 hour.



Searoad Mersey II – LNG Trailer Exchange

SeaRoad owns 7 LNG trailers

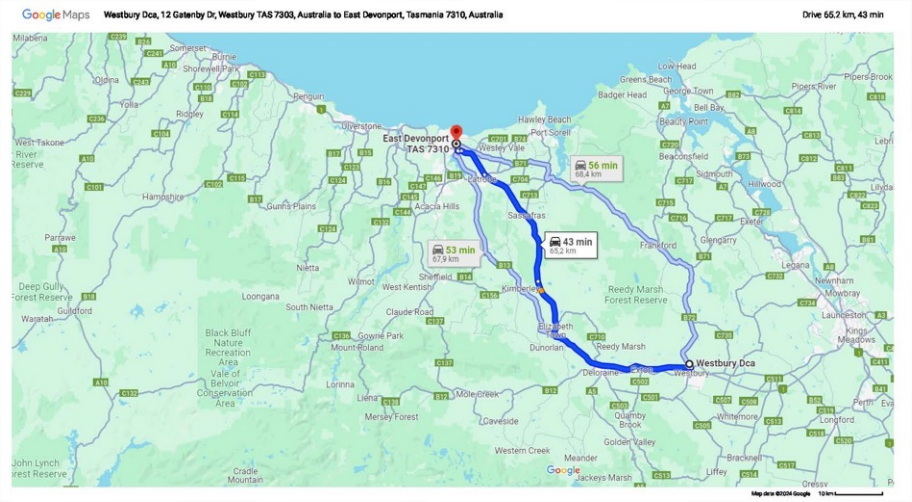
3 in use – 3 ready to be exchanged and one spare.

The empty trailers are taken to Westbury for filling and returned to the dockside and await transfer onboard.

The transport and filling process takes around 3 hours.

Prior to being taken aboard the vessel – ship staff conduct pre-load inspections of the trailers, checking that tank pressure is below 5 bar and a visual check of the trailer condition.

Searoad Mersey II – LNG Trailer Exchange

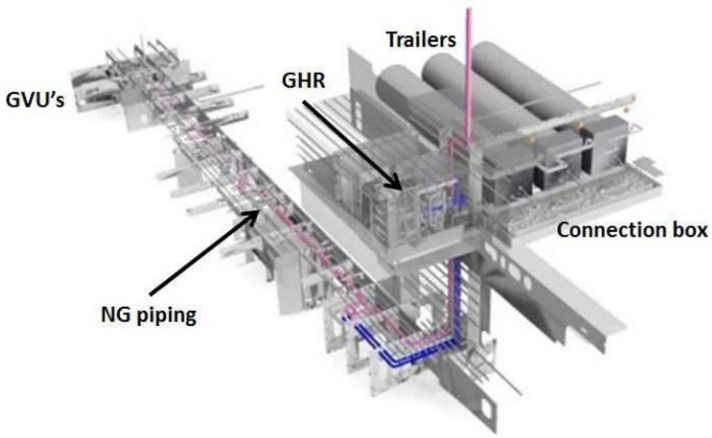


Searoad Mersey II – LNG Trailer Exchange - data

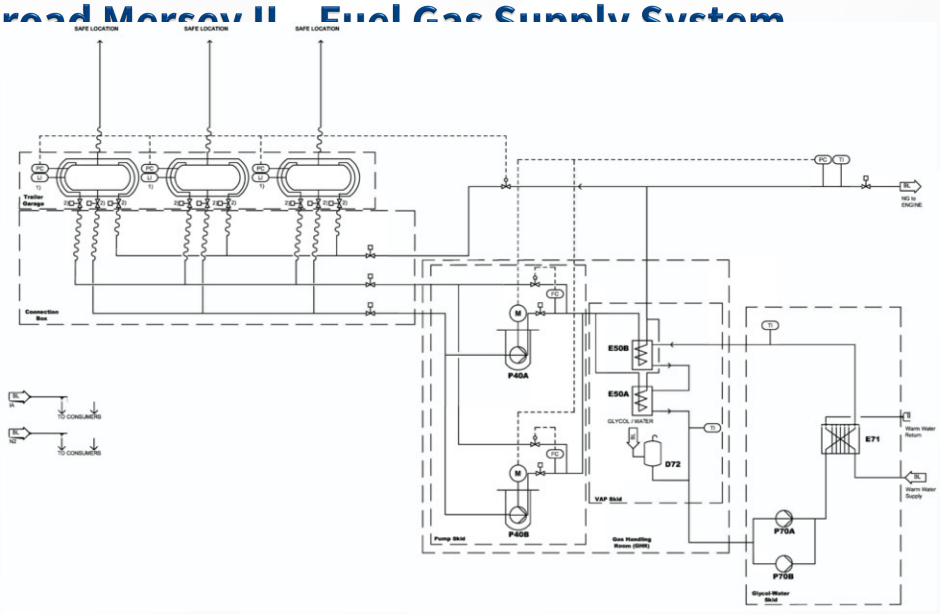
Data collected over several years reveals the following

	Tare Prime Mover + Trailer 9000 + 17500	Start Weight	Remaining LNG (Start Weight minus Tare)	Finish Weight	Vent Loss	Loaded Weight
Min	26.500 kg	26.380 kg	-120 kg	32.420 kg	0 kg	5.320 kg
Max	26.500 kg	39.760 kg	13.260 kg	45.460 kg	380 kg	18.660 kg
AVERAGES		30.303 kg	3.803 kg	45.040 kg	69 kg	14.668 kg

Searoad Mersey II – Fuel Gas Supply System



Searoad Mersey II – Fuel Gas Supply System



Searoad Mersey II – Fuel Gas Supply System

The system consists of three (3) trailers with connections to the fuel gas system via the connection box. Each trailer has four (4) connections;

1. Safety valve vent line, DN100
2. Gas return line, DN50
3. Minimum flow line, DN25
4. LNG line, DN80

The gas return line, minimum flow line and LNG line are all fitted with trailer on-board ESD-valves, which are operated by the safety and control system.

The safety valve vent line from each trailer has a separate connection on the ship and is connected to a separate vent mast, outside the garage, to avoid release of natural gas inside the garage at upset conditions.

Searoad Mersey II – Fuel Gas Supply System

The trailers and connection box are in the Garage.

The LNG line is the suction line of the two (2) LNG pumps, installed in parallel. The LNG pumps transfers LNG from the trailers and increase the pressure to correct operational pressure. LNG is routed to the two (2) vaporizers, installed in parallel, where the natural gas is vaporized and superheated to correct operational temperature.
During start-up of the pump and at low gas consumption in the engines, the minimum flow line is used to reroute LNG back to the trailers.

The energy needed to vaporize and superheat the natural gas is supplied by circulating glycol water in the vaporizers. The glycol water flows in series through the vaporizers, and the circulation is needed to maintain high capacity in the vaporizers. The glycol water is heat exchanged with warm cooling water from the ship's engines, to utilize the waste heat contained in the cooling water. Two (2) glycol water circulating pumps generate the flow in the glycol water circuit.

Searoad Mersey II – Fuel Gas Supply System

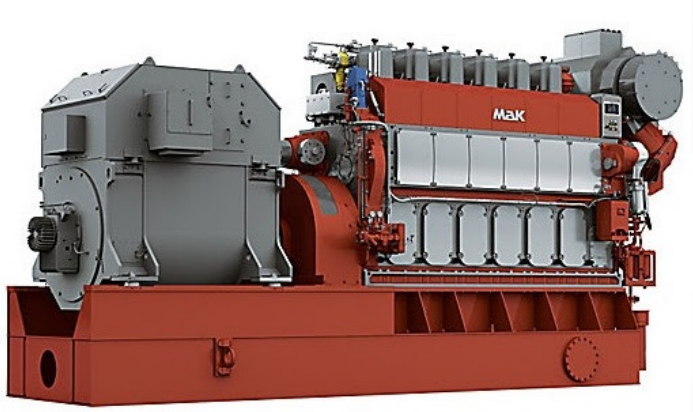
If necessary, and to maintain the pressure in the trailers, or to increase it, the gas return line facilitates the possibility to route warm natural gas at higher pressure back to the trailers.
The LNG pumps and vaporizers are located in the Gas Handling Room (GHR) and the glycol water circulations pumps and heat exchanger are located on the GWA skid, in the engine room.
After the vaporizers, the natural gas flows to the Gas Valve Units (GVU's) where it is reduced to correct engine inlet pressure. The GVU's are located in the Gas Valve Unit Room (GVR).

In order to vent trapped gas, the GVU's and engines are equipped with venting connections which are connected to the vent system. Two (2) On/Off valves (HV-610 and HV-621) in the gas line piping in the GHR and piping to GVR are also connected to the vent system, in order to be able to vent the gas lines remotely. All safety valve outlets and safety valve bypass valves in the fuel gas system are connected to the vent system.
Nitrogen purging of all piping segments are possible via fixed installed nitrogen purging valves. During purging the safety valve bypass valves shall be opened to lead the purge gas to the vent mast. This is manual operation

MaK – 8 M46 DF – Port Main Engine

MaK – 8 M46 DF – Stbd Main Engine

MaK – 6 M34 DF – Auxiliary Engine



Searoad Mersey II

Operational Challenges with LNG Operation

1. Novel Fuel Gas System
2. Physical arrangement of Garage and Gas Handling Room on same deck
3. Limited operational experience with Main & Auxiliary Engines
4. Trailer Logistics & maintenance
5. Weather
6. Geographic isolation

Searoad Mersey II

Operational Challenges with LNG Operation

1. Novel Fuel Gas System

- Bespoke design
- Limited global operational experience to rely upon
- Integration challenges with different OEM's
- Limited regional support

Searoad Mersey II

Operational Challenges with LNG Operation

2. Physical arrangement of Garage and Gas Handling Room on same deck

- Design may lead to vapour entrapment as no positive head between Trailer and Gas Handling Room
- Gas Handling Room has limited area to access components.

Searoad Mersey II

Operational Challenges with LNG Operation

3. Limited operational experience with Main & Auxiliary Engines

- Limited number of Dual Fuel Engines produced
- Limited global operational experience to rely upon
- Integration challenges with different OEM's
- Parent company have ceased production of large bore engines under the brand
- Limited regional support

Searoad Mersey II

Operational Challenges with LNG Operation

4. Trailer Logistics & maintenance

- Trailers required modification to suspension system to meet local requirements
- Limited global operational experience to rely upon
- Limited local support
- Trailers are at risk of damage whilst in transit and during loading / unloading operation
- Time burden on Ships' Engineers during the pre-load checks and the disconnect/connect operations in the garage.
- Product remaining in the trailers prior to re-filling reduces the effect fuel lift.

Searoad Mersey II

Operational Challenges with LNG Operation

5. Weather

- Vessel has experienced fluctuations in gas pressure when entering Port Phillip Bay
- Theorised that sloshing / rollover in the LNG Trailers may have contributed to vapour entrapment.
- Vessel changes to MGO before entering the area known as the rip.
- Extreme weather in Bass Strait has also had effects on continued LNG operation.

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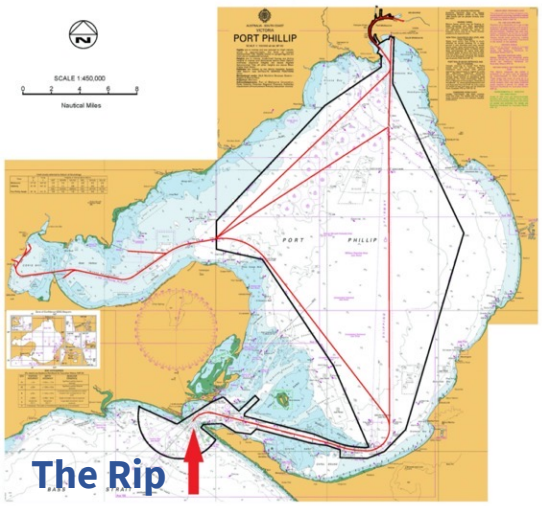
Searoad Mersey II

Operational Challenges with LNG Operation

5. Weather



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Searoad Mersey II

Operational Challenges with LNG Operation

5. Weather – Heading south - out of The Rip.

Searoad Mersey II

Operational Challenges with LNG Operation

6. Geographic isolation

Searoad Mersey II

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Thank You

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45. ISF-Tagung 24.Mai 2024

Vortragsgruppe 3: "Alternative Energiequellen"

First experiences with ammonia combustion in two stroke engines

Kristian Mogensen

MAN ES

A new chapter - ammonia two-stroke engines

MAN Energy Solutions
Future in the making

Powering the maritime energy transition

Kristian Mogensen
Promotion, Newbuilding
24. May 2024

Agenda

1 Market outlook

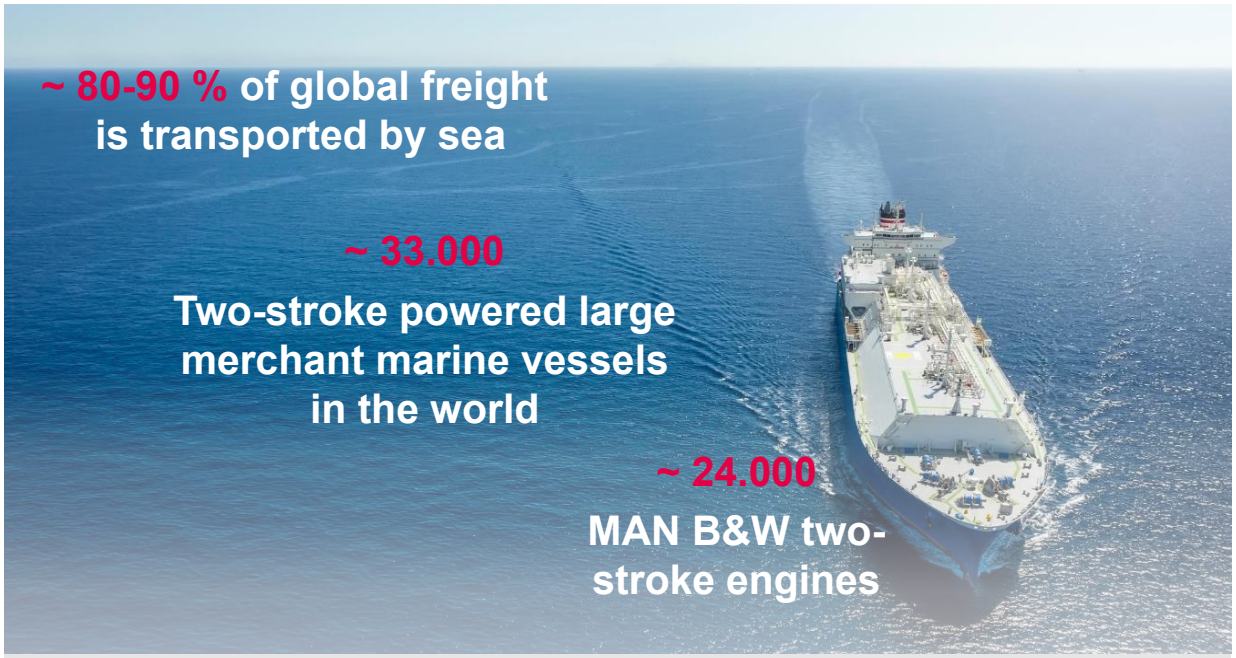
2 Ammonia engine development

3 Ammonia engine auxiliary systems

4 Market introduction strategy

5 Summary

1 Market outlook



~ 80-90 % of global freight is transported by sea

~ 33.000

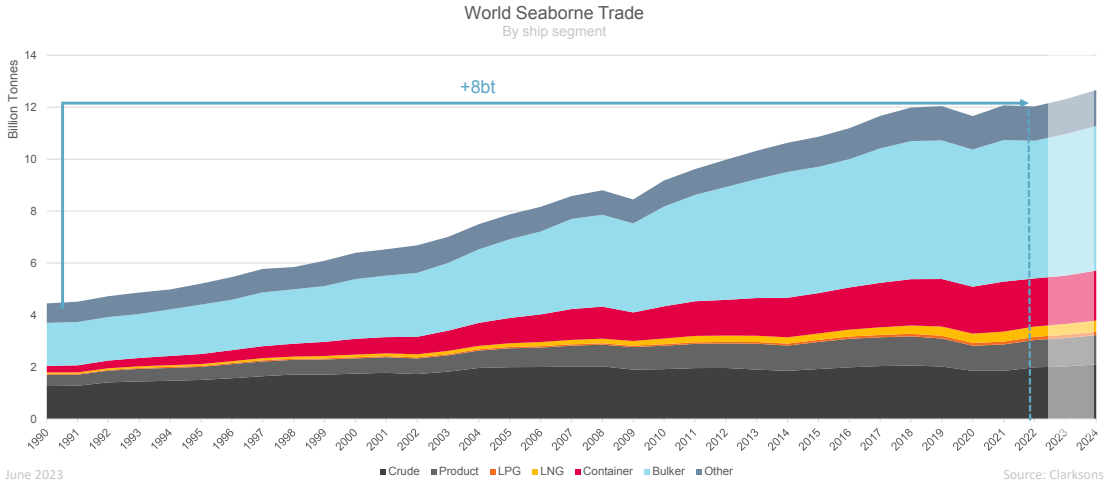
Two-stroke powered large merchant marine vessels in the world

~ 24.000

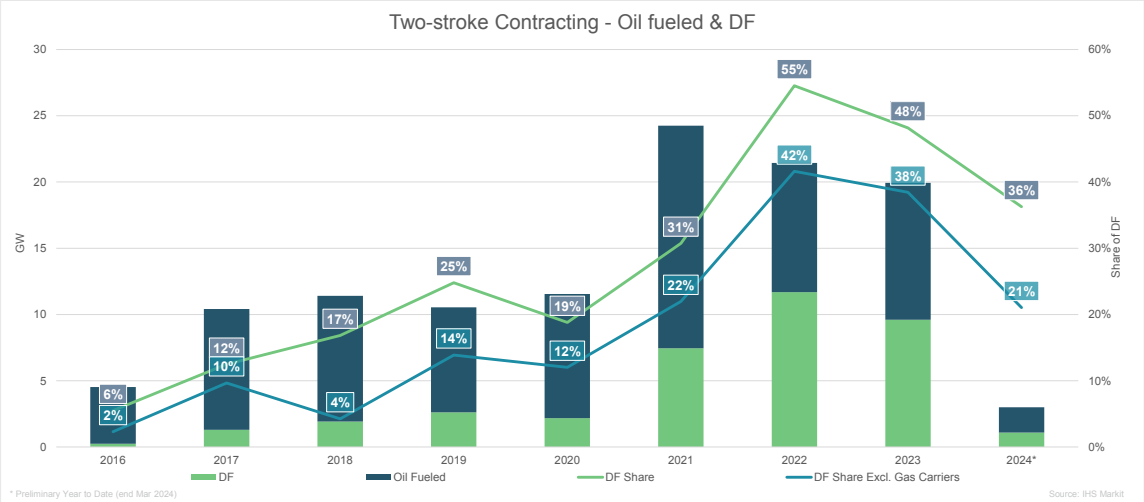
MAN B&W two-stroke engines

World Seaborne Trade

Since 1990 world seaborne trade has increased by 8 billion tons and is expected to grow around 60% over the next 30 years



The maritime energy transition is picking up with two-stroke dual-fuel contracting



Clear message from IMO GHG legislation

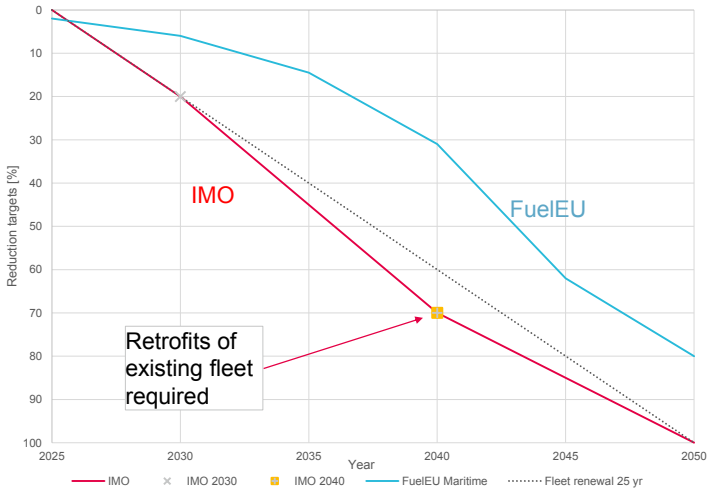
Baseline and compliance levels

IMO Targets are for absolute reductions in the sector

– Maritime trade growth is expected to level out efficiency improvement.

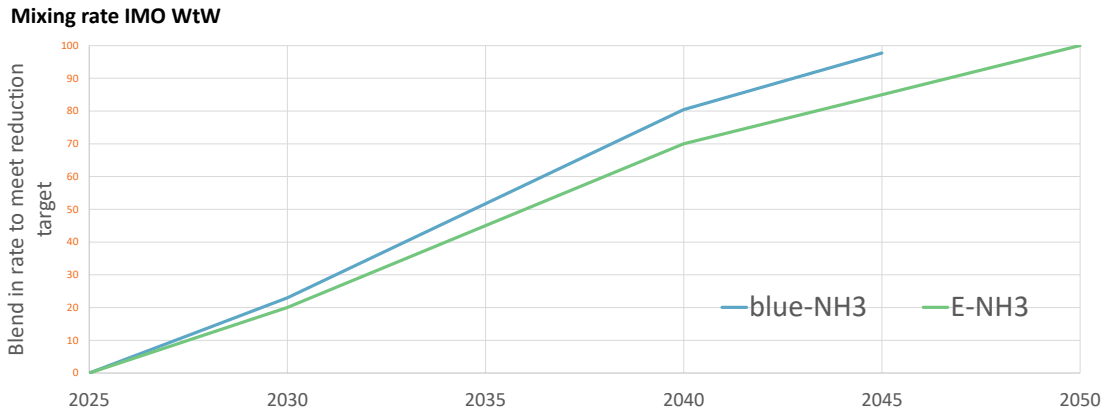
– With an estimated lifetime of 25 years, one can assume a complete fleet renewal until 2050.

– Even if 100% of new ships going into service from now on are carbon neutral, meeting IMO 2040 target reduction of 70% will require significant retrofit of the existing fleet, if we estimate a linear propulsion power of newbuilds.

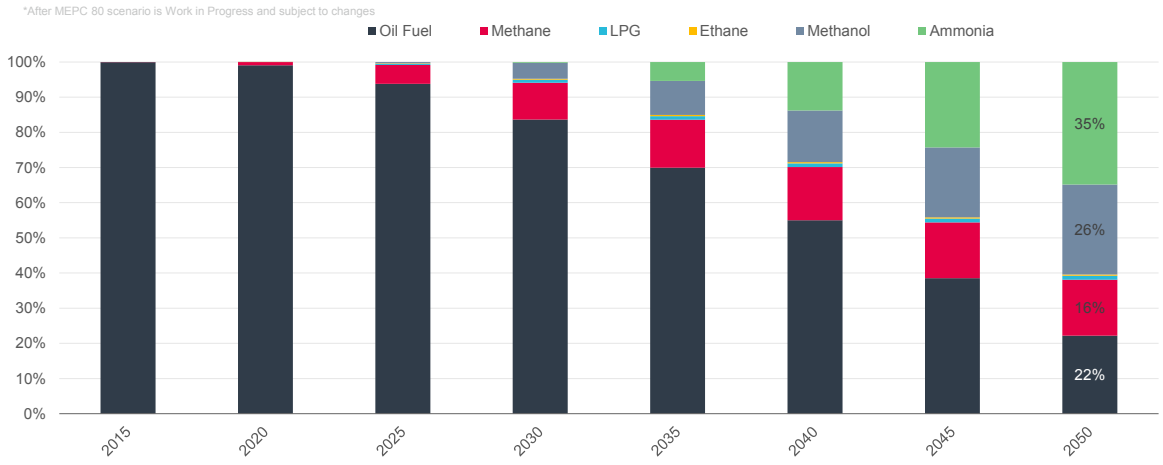


Both Blue and Green ammonia has a huge potential

Blue ammonia can be used until around 2045
e-Fuels are the only fuels that are truly scalable and can be used throughout and entirely from 2045 onwards



Demand for e-Fuels from shipping will be high

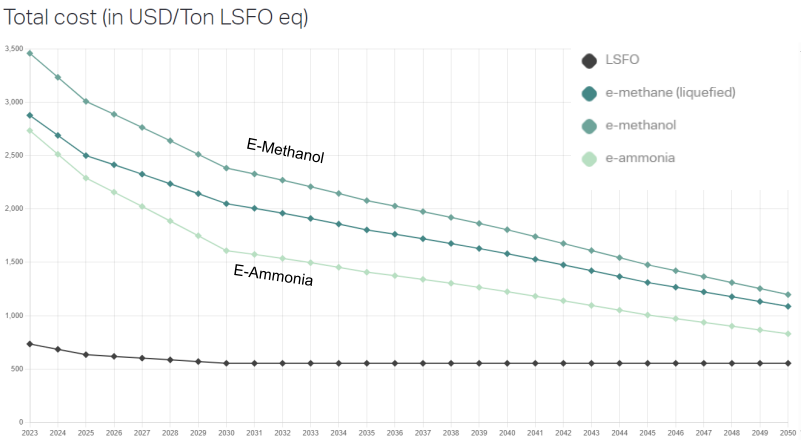


Price of e-Fuels?

It is not possible to foresee the market based prices of e-fuels, however looking into the production cost provides certain indicators.

E-ammonia is expected to be the least costly energy dense e-fuel to produce compared to e-methanol and e-methane.

E-ammonia is made from green Hydrogen and N_2, which is available in the atmosphere and cheaper to obtain than the biogenic CO_2 needed for carbon based e-Fuels.



Source: Maersk Mc-Kinney Møller Center for Zero Carbon Shipping https://www.zerocarbonshipping.com/cost-calculator/

2 Ammonia engine development

R&D timeline

2024 – a full year planned with R&D activities

Full engine test in Research Centre Copenhagen

- Installation of engine components.
- Expected full engine testing by end of August or beginning of September.
- R&D engine testing including:
  - Performance.
  - Emissions.
  - Control concept.

7S60 R&D test

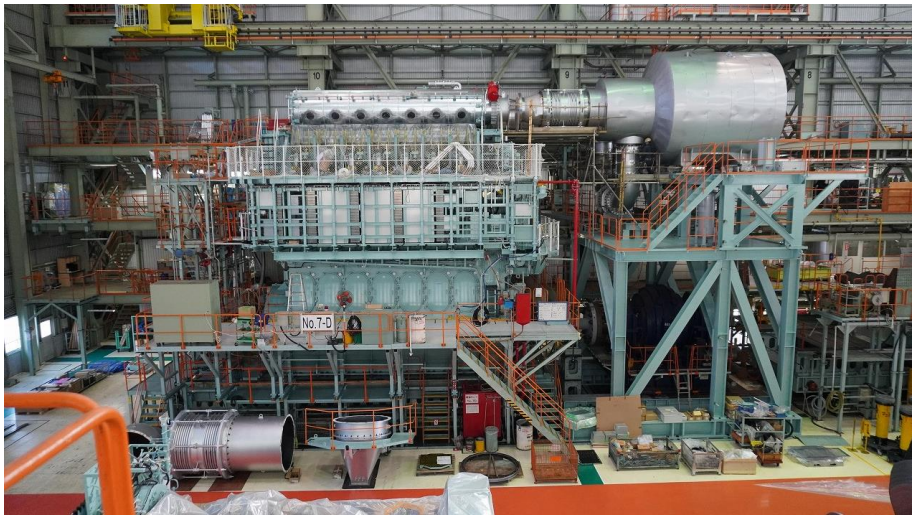
- Test of commercial engine design. Ammonia running scheduled to start in July.
- Test of engine concept.
- Performance and emission analysis.
- Commercial auxiliary systems testing.

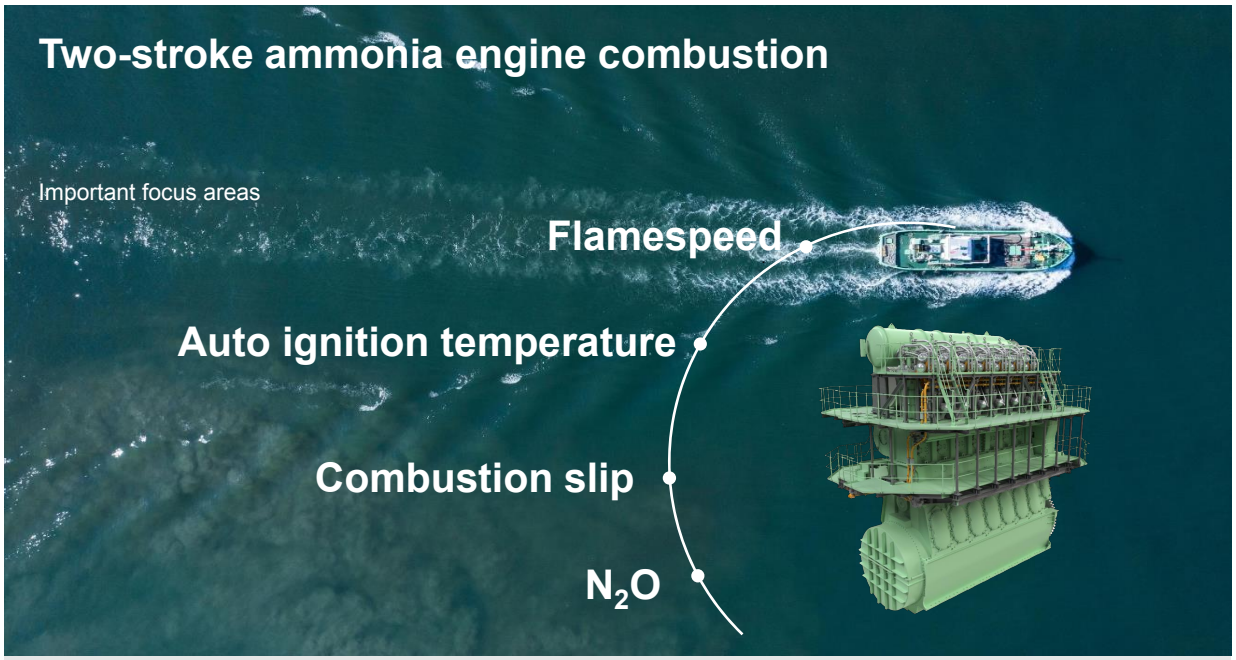
First commercial engine ready for delivery

- Full scale engine test evaluated for 1st commercial design.
- Test of engine and software.
- Planned factory acceptance test.

7S60ME-C10.5-LGIA at Mitsui E&S Co., Ltd.

Assembly well underway. Currently some components remain to be mounted. Start on diesel in May with Ammonia running scheduled by July.



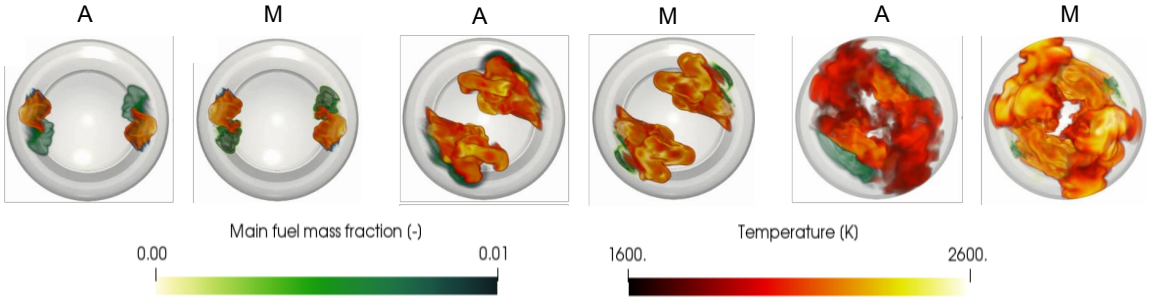


Computational Fluid Dynamics (CFD) Simulations

Comparison between ammonia and methanol combustion

Evaluation and design by CFD analysis

- Flamespeed is 6 times lower for ammonia (cm/s).
- Autoignition temperature is 33% higher for ammonia.
- Two-stroke slow speed engines however manages these properties very well.



A = Ammonia M = Methanol

Engine emissions

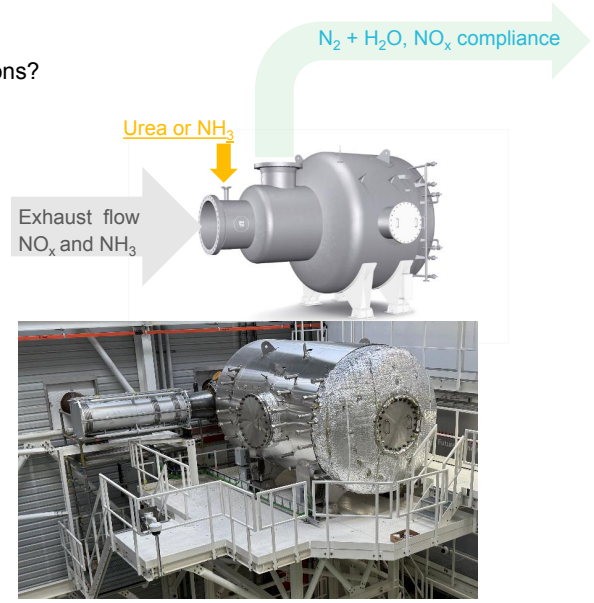
How do we handle potential Nitrous Oxide (N_2O) emissions?

N_2O is a very potent GHG with GWP of 298 and will be accounted in on-going adopted regulations

- N_2O will be removed by engine tuning alone, and emission levels are extremely low.
- Exact levels will be published to market after four-cylinder testing.

Ammonia slip and NOx emissions

- Unburned NH_3 and NO_x is removed in the SCR reactor
- Dosing of additional ammonia to SCR reaction if needed.
- Four cylinder testing will be used to find balance between NH_3 slip and NO_x



Two-stroke ammonia engine combustion

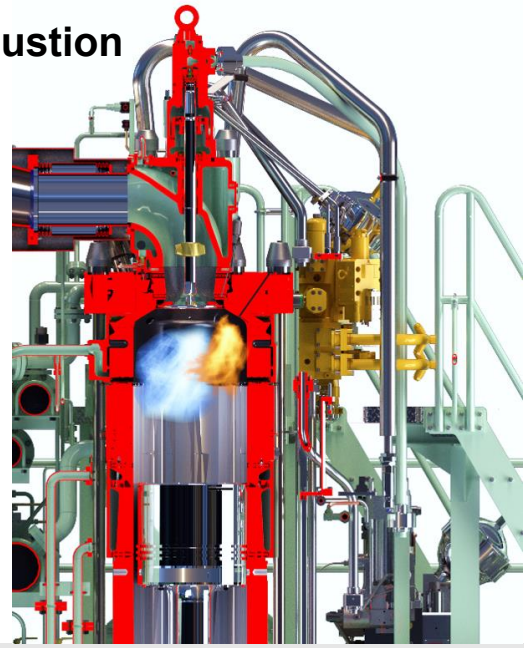
The MAN B&W ME-LGIA design philosophy

"Ammonia mode":

- Small pilot flame needed.
- Target of 5% **S**pecific **P**ilot **O**il **C**onsumption at 100% load for L1-rated engines has been reached.
- Potential for further reductions, however 4-cylinder testing will showcase the full potential. The initial ME-LGIA engines will have 5% SPOC.
- We target to obtain same heat rate as "fuel oil mode".

"Fuel oil mode":

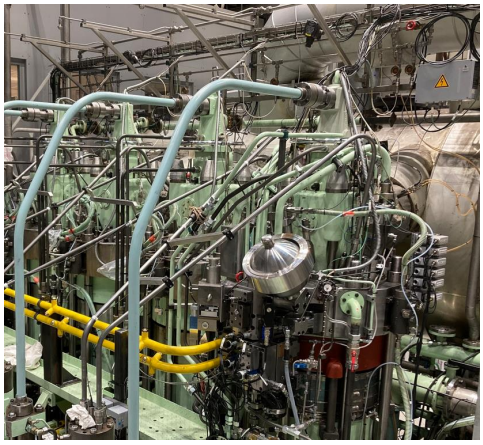
- We target identical performance as a conventionally fueled Diesel engine.



Two-stroke ammonia engine combustion

Status on the ammonia engine testing

- 3rd of July 2023: First two-stroke ammonia combustion
- Over 300 tests and 175,000 R&D man hours clocked
- Engine testing includes both performance and emissions tests in load points from 10-100% load
- Pilot oil energy fractions similar to other LGI engines
- N_2O emissions are extremely low and are handled by engine tuning alone
- NOx emissions approximately 40% lower than conventional fuel oil. Can be adjusted according to final engine tuning
- Ammonia slip is minimized by design and performance modifications

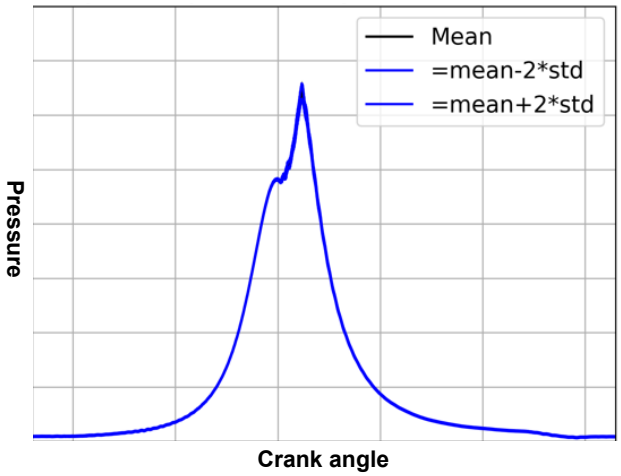


Ammonia combustion

Diesel cycle ammonia combustion

Cylinder pressure is following the Diesel principle

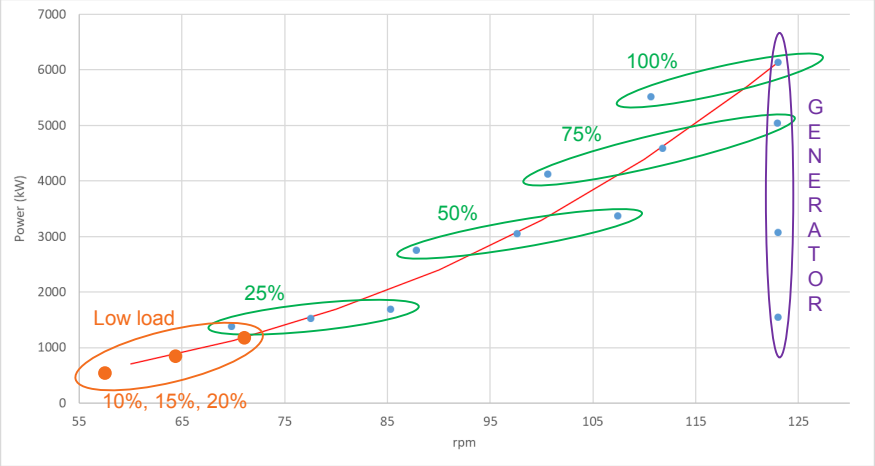
- Combustion has good stability behavior and acts like other fuels of hydrocarbon origin.
- Robust compression and expansion curves.
- Mean statistical analysis indicate very good combustion stability on a cycle-to-cycle pressure variation as measured during engine testing operation.



Engine testing at both light & heavy running and generator curve

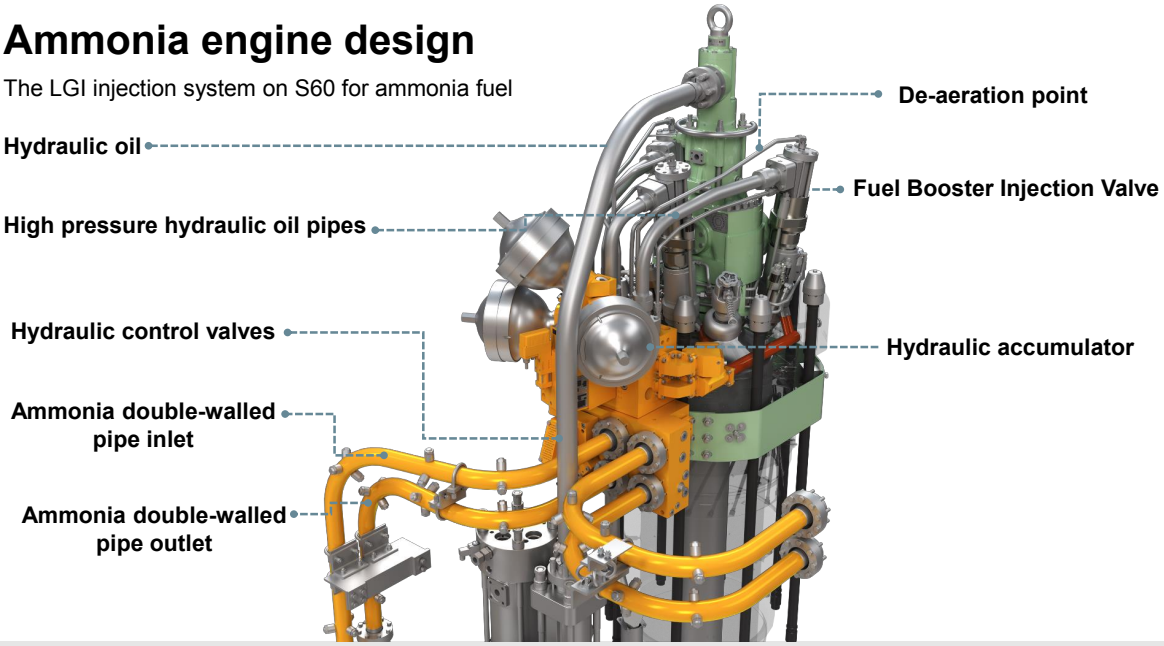
Engine testing includes not only the propeller curve but both light and heavy running points for each given load.

- In additional a PTO effect is simulated and tested.
- The tests are including operational screening.
- Combustion is confirmed stable on all test points.



Ammonia engine design

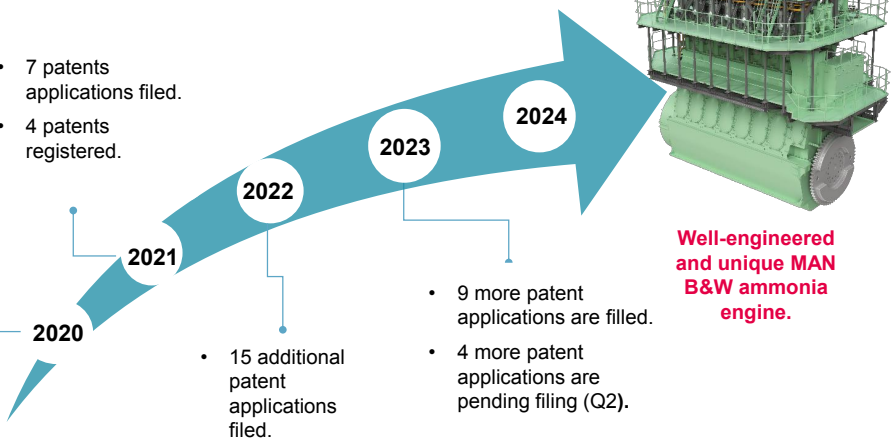
The LGI injection system on S60 for ammonia fuel



Unique and breakthrough R&D progress

175,000 man hours completed

- 37 patent applications filed around ammonia engine development.
- 4 additional applications in the filing process.
- 6 patents granted.



- First 2 patent applications for ammonia engine filed.
- 2 patents registered.

- 7 patents applications filed.
- 4 patents registered.

- 15 additional patent applications filed.

- 9 more patent applications are filled.
- 4 more patent applications are pending filing (Q2).

Well-engineered and unique MAN B&W ammonia engine.

Upcoming test campaign steps in Research Centre Copenhagen

1-cylinder testing

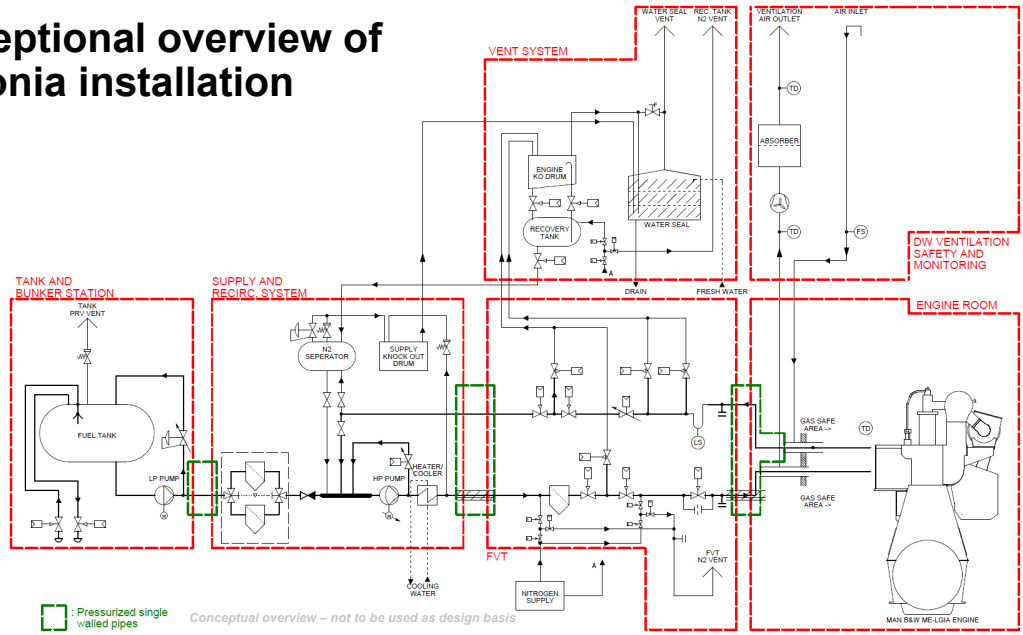
- Reducing NH3 slip further
- Balancing NOx/NH3: exploring performance handles
- Diesel atomizer optimization and pilot oil testing
- FBIV-A injector type testing
- Process response to changes in performance handles

4-cylinder testing

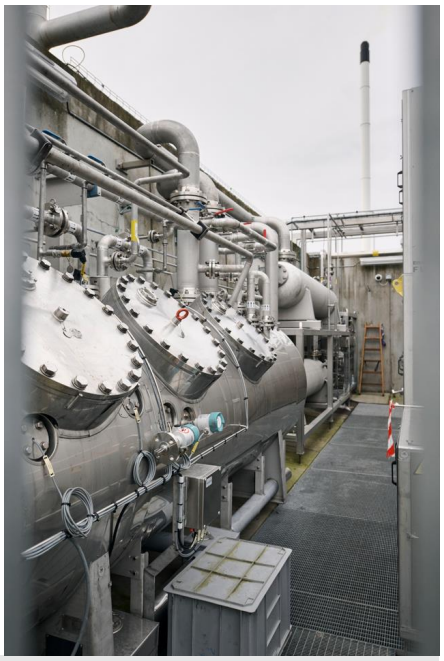
- Full engine performance testing with optimization of turbo charging incl. CBV, EGB etc.
- Testing of SCR and emission control strategies
- SW type approval test for class societies in due time before the first sea trial

3 Ammonia engine auxiliary systems and safety

Conceptional overview of ammonia installation



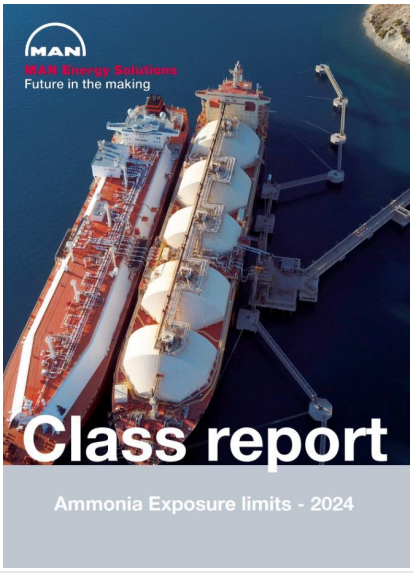
Ammonia Catch System



Basic principles

- Designed to avoid direct ammonia vapours to atmosphere when purging.
- Is designed to only release vapours of ammonia up to 20 ppm.
- We have been able to test the system with blow down equivalent to a full engine shutdown due to a test rig set up.
- Approx. skid size: Length: 7m - Width: 2,5m - Height: 3,5m.
- Accumulated water/ammonia mixture to be discharged as chemical waste based on existing regulations.

Regulative clarity is needed

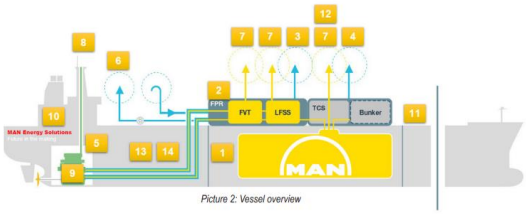


On board locations

The majority of the Classification Guidelines are based on the IGF Codes framework and in some cases, additional experience from Risk Assessments have been considered. For limits that have not been official published, the report have not directly included that data.

In total, 14 different areas with exposure limits have been identified, see below Picture 2:

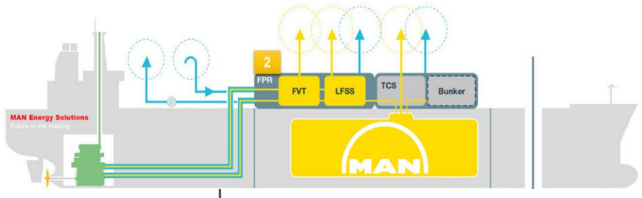
1. Fuel storage holding space
2. Fuel preparation room (inside)
3. Fuel preparation room ventilation exit
4. Tank connection space ventilation exit
5. Machinery space
6. Fuel supply pipe ducting or secondary enclosure
7. Vent mast exit
8. Engine exhaust exit
9. Crankcase or under piston
10. Gas at ventilation inlet to accommodation spaces, service spaces and control stations
11. Bunker station
12. Vent pipes from bilge water holding tanks
13. Other spaces (Airlock, etc.)
14. Leaks to auxiliary system

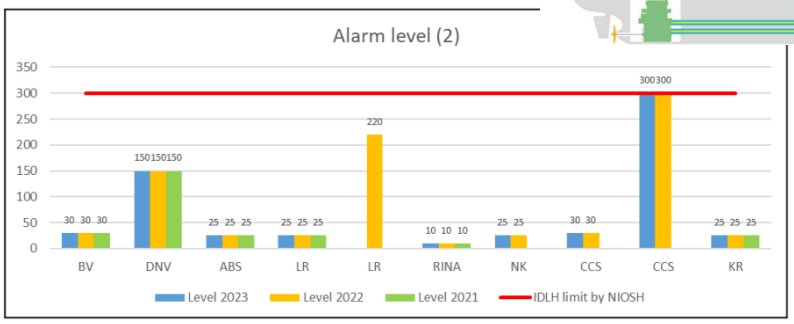


Picture 2: Vessel overview

For each classification society, the stated ammonia exposure limits were collected for the corresponding identified locations defined in chapter - *Exposure Vessel Map.*

Example of current different alarm level class requirements for fuel preparation room

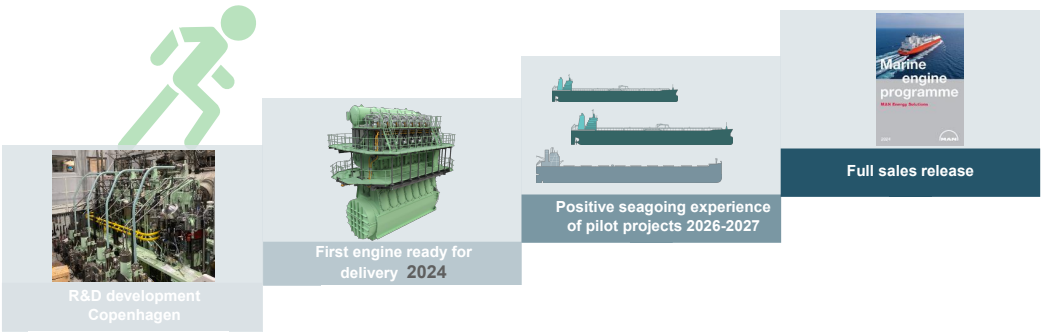


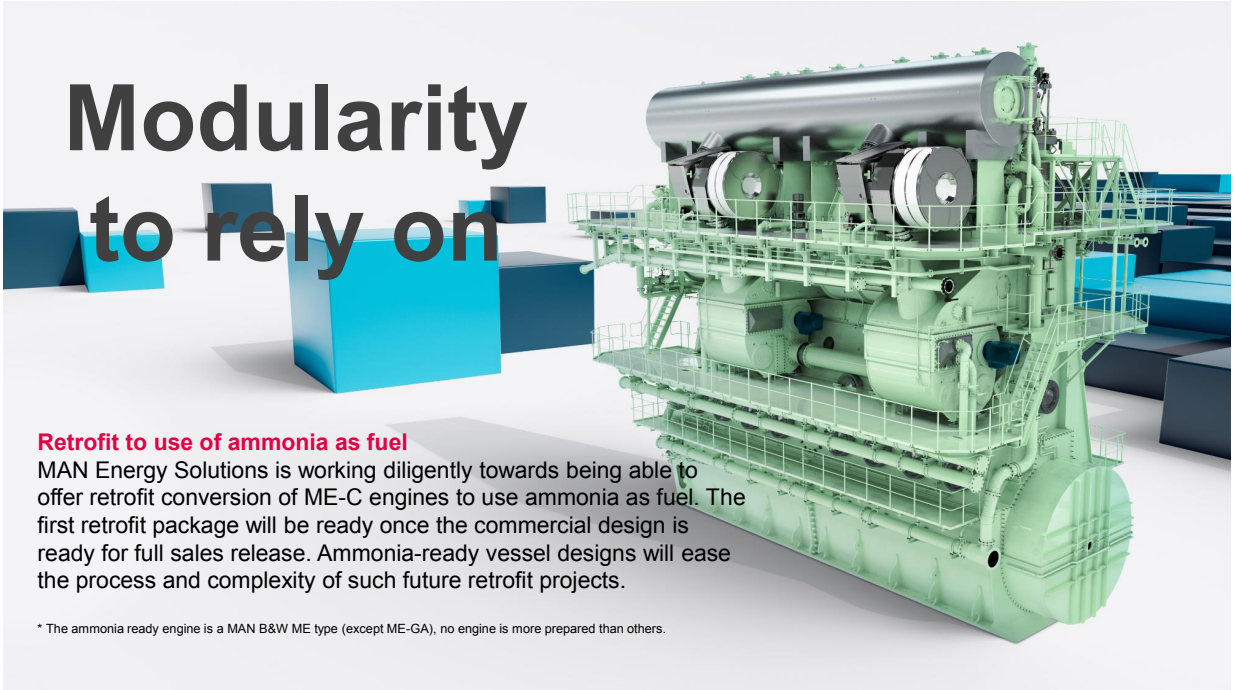


Two-stroke ammonia engine main development timeline

Pilot projects in Korea, Japan and China.

Release of G50, S60, G60, G70 and G80 ME-LGIA to the market as soon as the first vessel or vessels have demonstrated positive seagoing service experience operating on Ammonia. As such the actual time schedule will be pending shipyard delivery schedule. A best guess time estimate for sales release is end of 2026





Retrofit to use of ammonia as fuel

MAN Energy Solutions is working diligently towards being able to offer retrofit conversion of ME-C engines to use ammonia as fuel. The first retrofit package will be ready once the commercial design is ready for full sales release. Ammonia-ready vessel designs will ease the process and complexity of such future retrofit projects.

* The ammonia ready engine is a MAN B&W ME type (except ME-GA), no engine is more prepared than others.

5 Summary

Summary

Ammonia engine development

- ✓ More than 175,000 R&D man hours completed for the MAN B&W ammonia engine development.
- ✓ More than 5,000 hours alone for identification of hazards and risks on our engine and auxiliary system designs.
- ✓ Very promising results from engine combustion testing.
- ✓ High expectations to ammonia as a marine fuel due to high PtX efficiency and thereby lower production cost compared ot other e-fuels.
- ✓ Pilot projects with G50, S60, G60, G70 and G80 on-going in Korea, Japan and China.
- ✓ Seagoing experience before full sales release in order to safeguard the use of ammonia as a marine fuel. As such the actual time schedule will be pending shipyard delivery schedule. A best guess time estimate for sales release is end of 2026.

MAN Energy Solutions
Future in the making

Thank you very much!

Disclaimer

All data provided in this document is non-binding.
This data serves informational purposes only and is especially not guaranteed in any way.
Depending on the subsequent specific individual projects, the relevant data may be subject to changes and will be assessed and determined individually for each project. This will depend on the particular characteristics of each individual project, especially specific site and operational conditions.

45. ISF-Tagung 24.Mai 2024

Vortragsgruppe 3: "Alternative Energiequellen"

Operational experiences with battery hybrid systems and flettner rotors

Rasmus Nielsen

Naval Architect, Scandlines

Operational experiences with battery hybrid systems and Flettner rotors

ISF Conference
24 May 2024

Scandlines

Rasmus Nielsen

- Employed at Scandlines since 2003
- Employed in Project Department / Operations
- Project Manager for Scandlines newbuilding in Turkey
- Master Mariner 1996
- Naval Architect 2002

Scandlines

Agenda

- Scandlines
- Flettner rotor
- Hybrid operation
- Zero direct emissions

Scandlines

Scandlines' Traffic Machines

Two ferry routes between Germany and Denmark

High frequency and large capacity, crossing times up to 2 hours

Reliable transportation services for passengers and freight customers

Catering services and retail sales of goods on board and ashore

Scandlines' green agenda – a central part of our strategy

Our goal are **zero direct emissions ferries** – we take 'one nautical mile at a time'.

We invest in tomorrow's technology leading towards a greener future.

Past 1997-2013

Diesel/electric propulsion

Present Since 2013

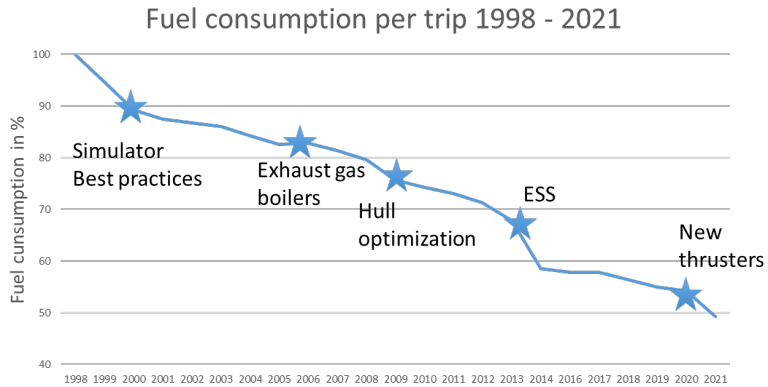
Diesel/Battery/ electric-hybrid

Future In a few years

Zero direct emissions
- 100% battery
- Battery-hybrid

Scandlines

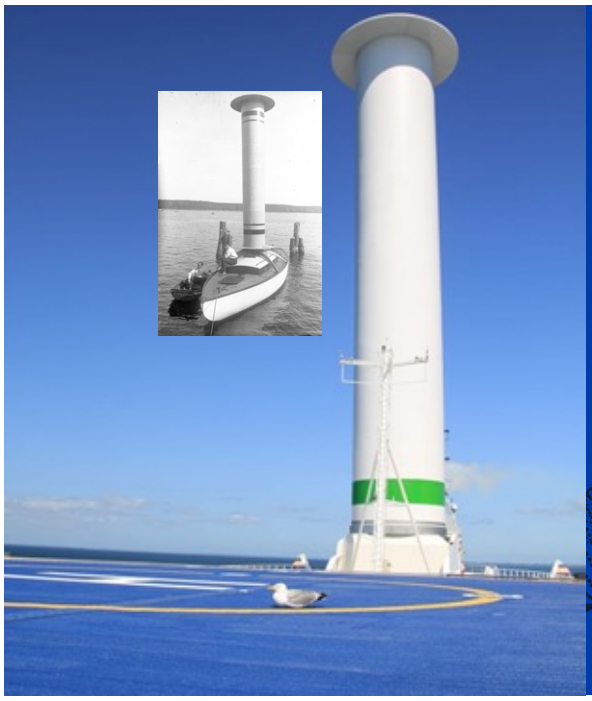
Energy focus



Scandlines

Rotor sail

Scandlines



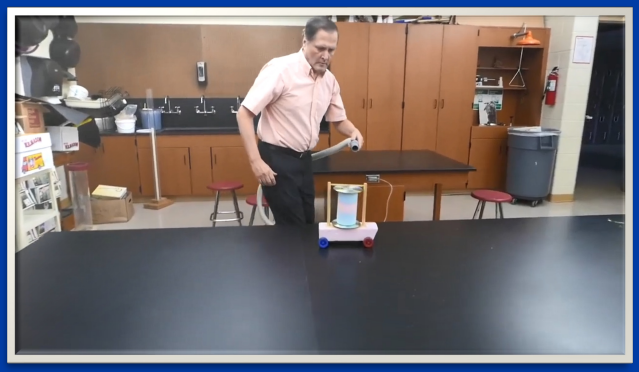
Why install a rotor sail?

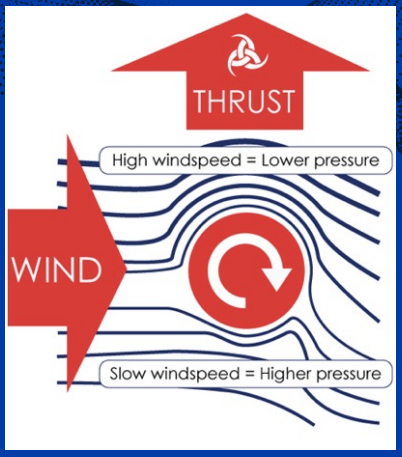
- Scandlines is a frontrunner in green ferry operation
- Scandlines turns down the diesel motors once again and reduces CO_2 emissions even more
- Scandlines continues the journey towards zero direct emissions

Scandlines

How does it work?

Magnus effect

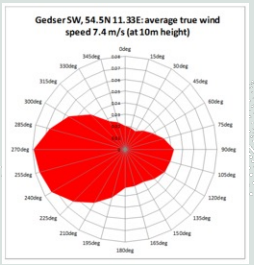


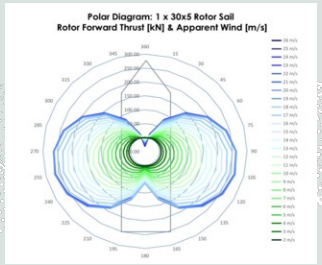


Scandlines

Wind conditions

- Wind conditions of the route area are good
- Prevailing wind direction is favourable for rotor sails

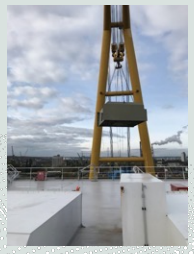




Scandlines

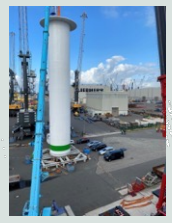
Preparation

- Risk assessment
- Lloyd's Register
- DMA
- Stability
- Position of top lights
- Foundation
- Cabling
- Interface to IMAC
- Fire detection system



Scandlines

Installation in Rostock – 25 May 2020



Scandlines

Issues after installation

- Vibration at high RPM
- Stiffness of foundation
- Mass dampers installed
- Incorrect information from wind sensor
- Correction with LIDAR
- New position of wind sensor
- Ice on top of rotor sail during operation
- Noise issues in accommodation

Scandlines

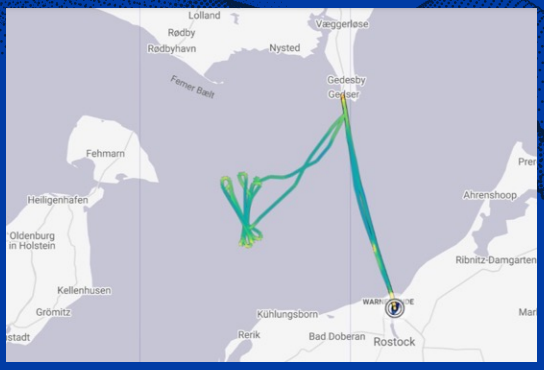
Operation

- No significant impact on manoeuvrability
- Auto start and stop function
- No action needed from crew in daily operation

Scandlines

Performance

- Speed test carried out 6-7 March 2021
- Results confirmed estimated energy savings
- The rotor sail reduce fuel consumption 4–5%



Scandlines

M/V Prinsesse Benedikte
Scandlines' first hybrid ferry

- Built in 1997, hybrid since 2013
- Hybrid system corresponds to approx 182 "Toyota Prius" hybrid cars
- Reduces its CO_2 emissions by up to 15% (approx 15.000 t CO_2 per year)

13 CLIMATE ACTION

Co-financed by the European Union
Trans-European Transport Network (TEN-T)

Hybrid operations

1. In 2013 Corvus batteries were installed in all 4 Puttgarden-Rødby ferries
2. 2.6 MWh ESS installed
3. New genset installed and ESS reduced to 1.6 MWh
4. Reduced number of engines running
5. Make sure that engines run on optimal load
6. ESS charged in port and discharge at sea
7. Fuel consumption reduced 10 – 15 %

Scandlines

Zero direct emissions freight ferry for Puttgarden-Rødby

- To be inserted in 2024
- Operated as emission free or hybrid ferry

- Freight capacity: 66 freight units
- Lane metres: 1,200 m
- Max. number of passengers: 140
- Length: 147.4 m
- Breadth: 25.4 m
- Design draft: 5.3 m
- Service speed: 16/10 knots
- Battery system: 10 MWh
- Charging time in port: 12 minutes

LMG MARIN

CEMRE SHIPYARD

NORDWES

Zero Direct Emissions

1. Electrical operations – Ferries charged with shore power
2. Preferred green solution on Puttgarden-Rødby
3. High CAPEX, both in ports and on board vessels
4. More than 10 years experience with battery operations
5. Low OPEX compared to alternative green fuels

Scandlines

E/V Futura

Futura is being built at the Cemre Shipyard in Turkey and was launched in November 2023.

The ferry will be equipped with a 10 MWh advanced battery system from Corvus. The battery can be charged in just 12 minutes in each port, and allows the ferry to cover the 18.5 km between Puttgarden and Rødby in 45 minutes with zero direct emissions which supports our goal to operate the route without direct emissions by 2030.

Scandlines

ZE80 Project

1. Installation of large battery capacity on board our two existing ferries Deutschland and Schleswig-Holstein
2. 80 % of the energy consumption will be charged in port
3. The remaining 20 % energy demand will be delivered form the diesels engines of the vessel
4. In operation end of 2025

Scandlines

Thank you for your attention