WÄRTSILÄ VISION ON SUSTAINABLE SHIPPING

VESA-PEKKA VIRKKI

DIRECTOR, STRATEGY & BUSINESS DEVELOPMENT

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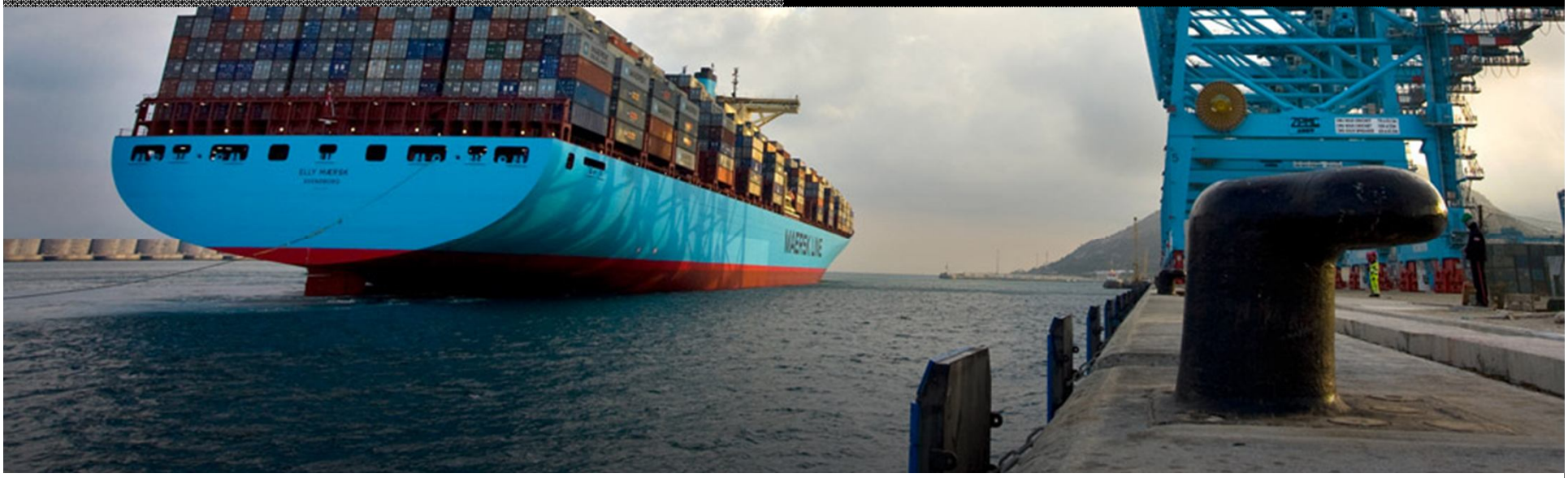
Sustainable Shipping - Vision

Optimizing total value chain and developing safe mode of transportation.

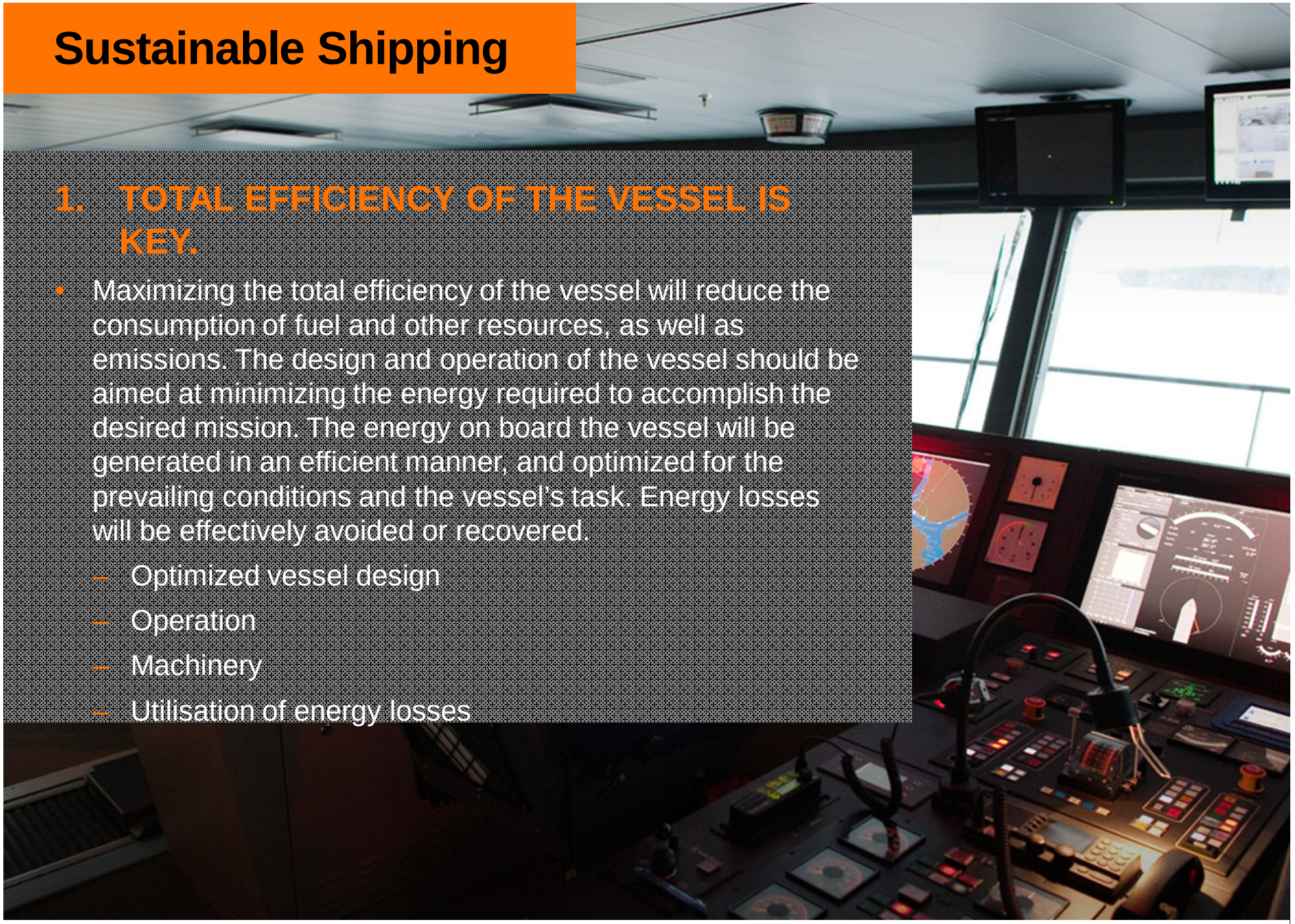
Adding value to society through efficient performance and ecological operations.



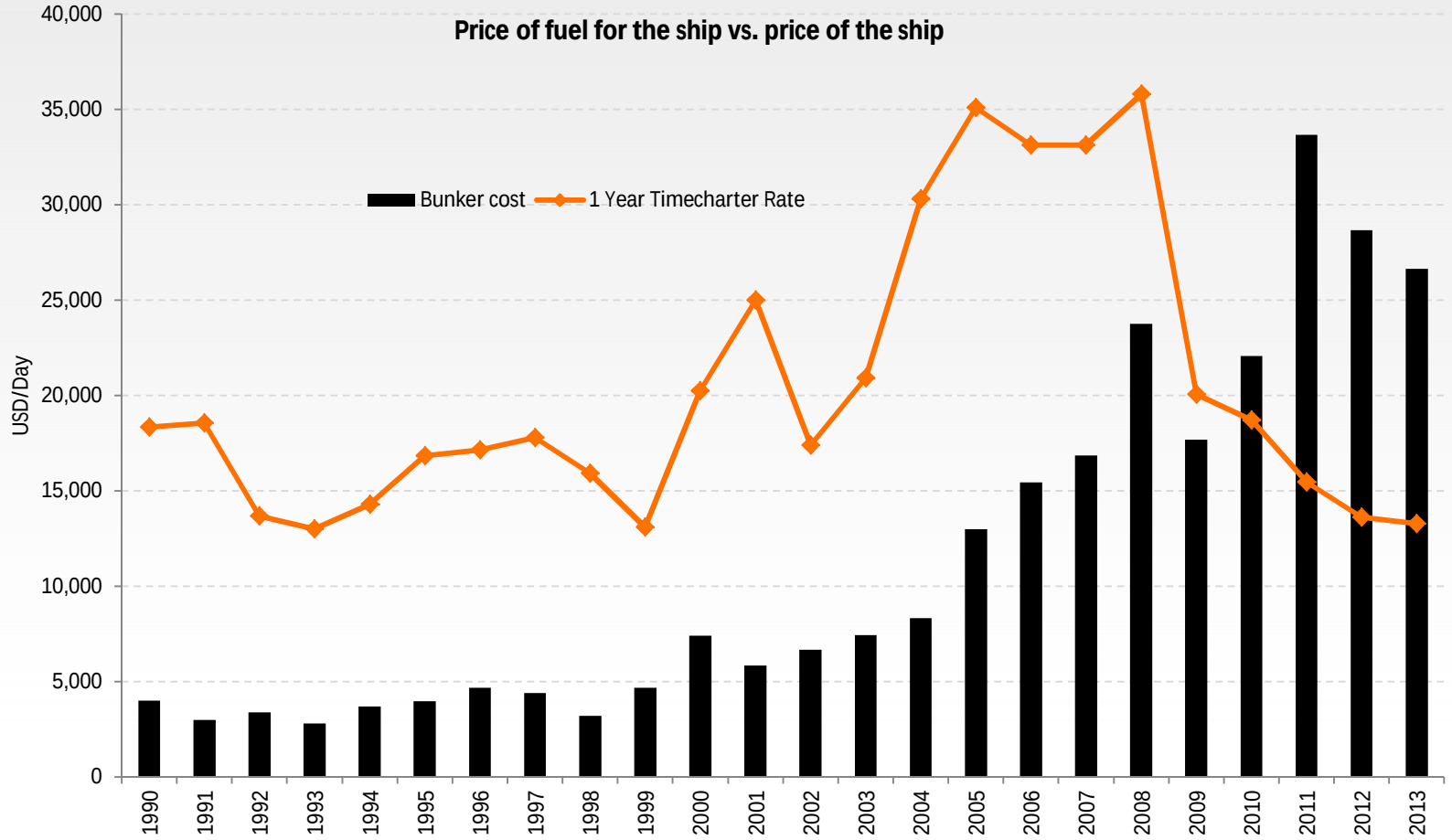
Sustainable Shipping

1. TOTAL EFFICIENCY OF THE VESSEL IS KEY.

- Maximizing the total efficiency of the vessel will reduce the consumption of fuel and other resources, as well as emissions. The design and operation of the vessel should be aimed at minimizing the energy required to accomplish the desired mission. The energy on board the vessel will be generated in an efficient manner, and optimized for the prevailing conditions and the vessel's task. Energy losses will be effectively avoided or recovered.
  - Optimized vessel design
  - Operation
  - Machinery
  - Utilisation of energy losses



Bunker fuels – Focus on fuel efficiency, regulatory issues



Source: Clarkson Research Services, Consensus Economics Inc.

Based on modern aframax tanker, Rotterdam 380 cst price, 2013 calculated on a 2012 average consumption

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Efficiency improvement measures

ENERGY SAVING OPERATION AWARENESS

ENERGY SAVING LIGHTNING

EFFICIENCY OF SCALE

VOYAGER PLANNING – WEATHER ROUTING

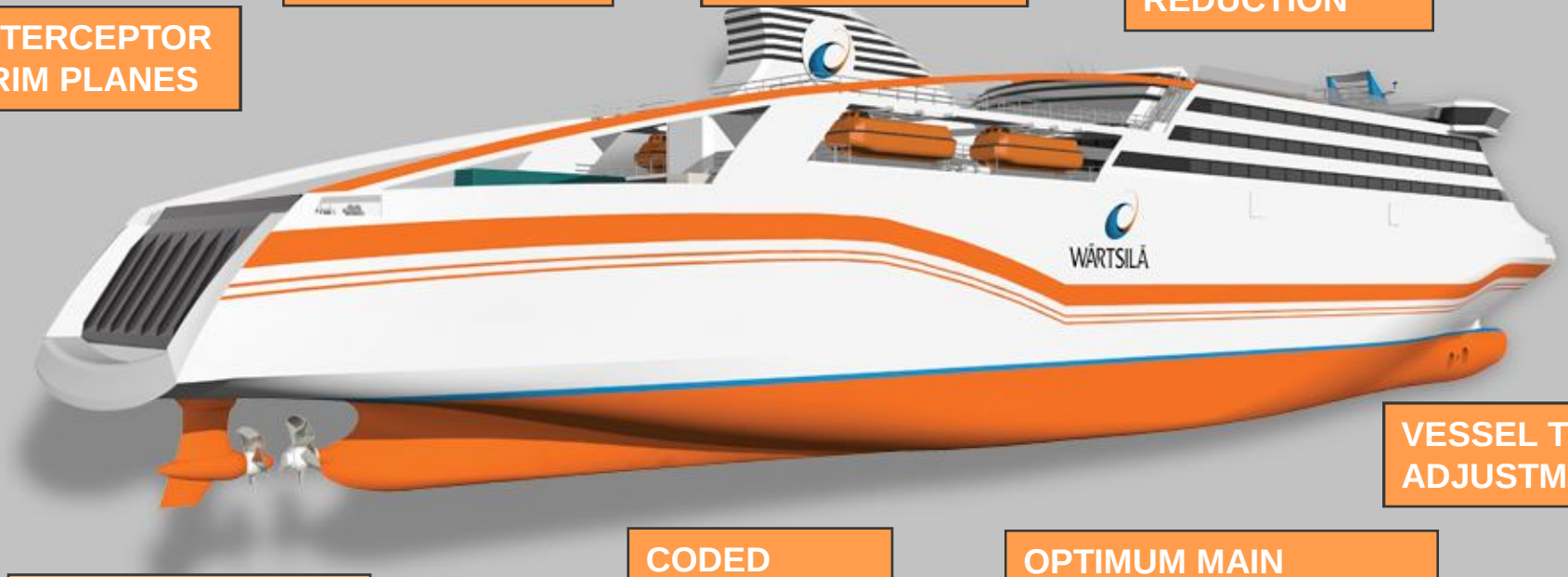
WIND POWER

TURNAROUND TIME IN PORT

LIGHTWEIGHT CONSTRUCTION

SHIP SPEED REDUCTION

INTERCEPTOR TRIM PLANES



VESSEL TRIM ADJUSTMENT

PROPULSION CONCEPTS

CODED MACHINERY

OPTIMUM MAIN DIMENSIONS

FUEL TYPE – LNG

HULL CLEANING

COOLING WATER PUMPS, SPEED CONTROL

WASTE HEAT RECOVERY

HULL SURFACE – HULL COATING

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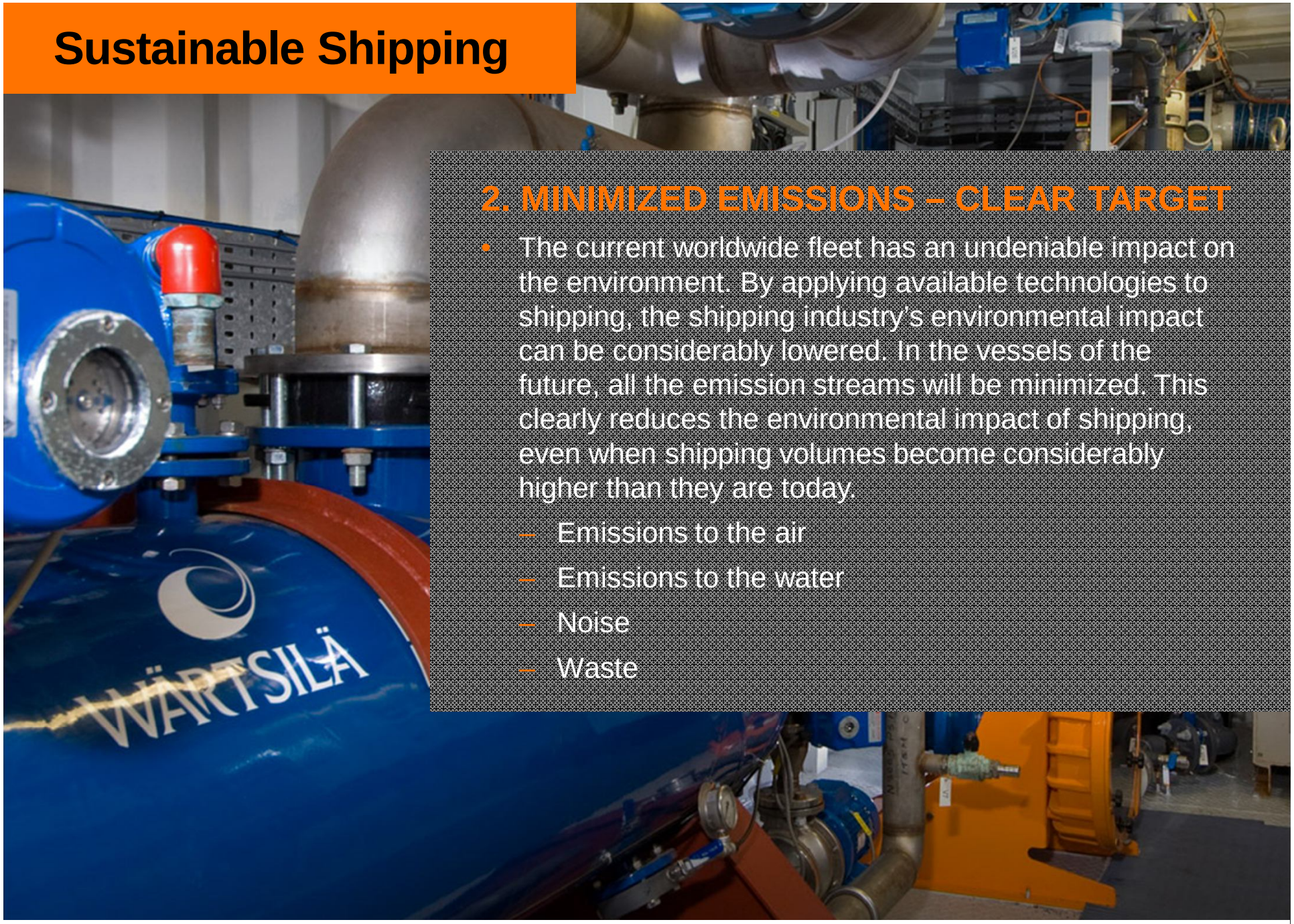
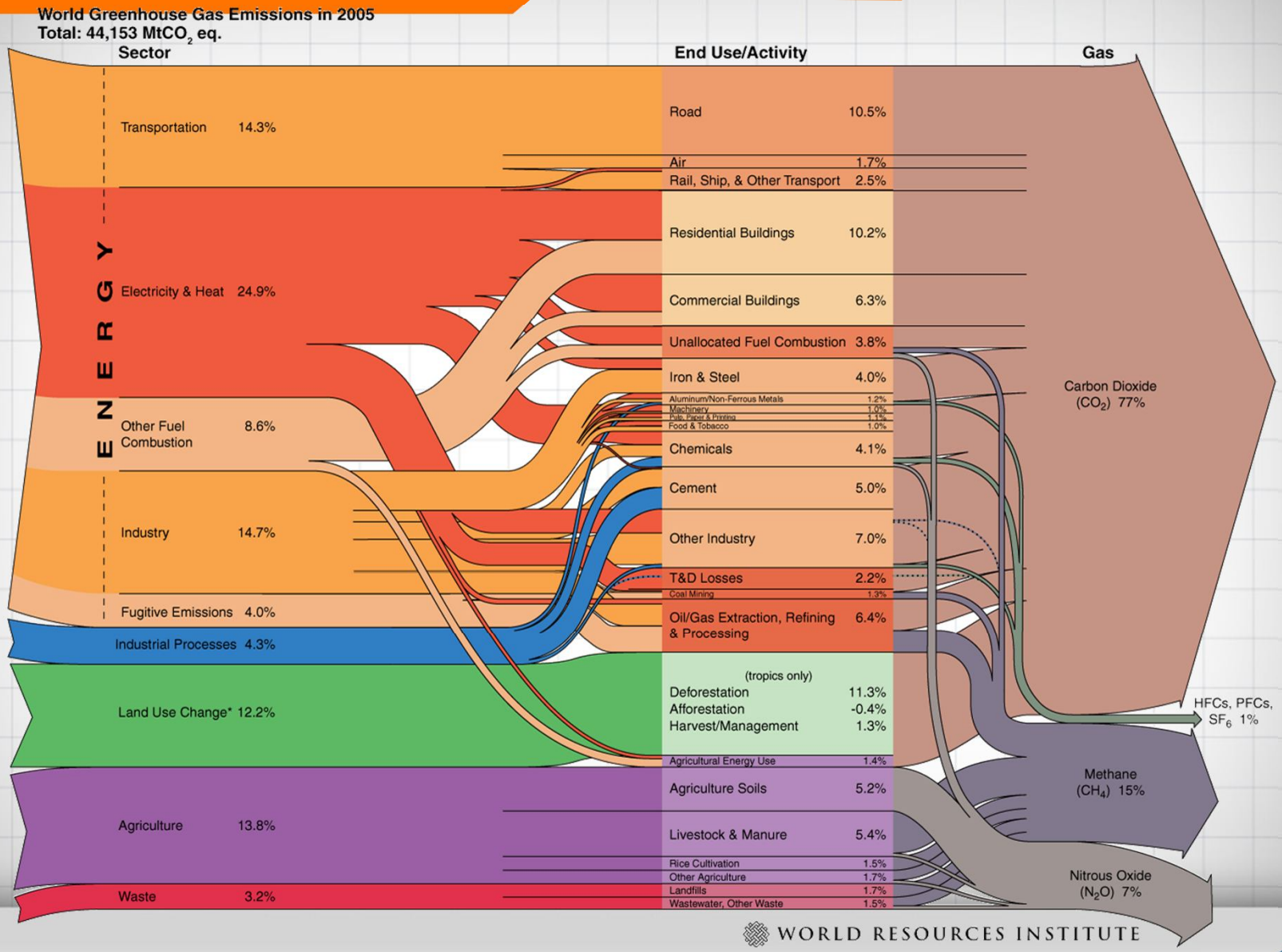


2. MINIMIZED EMISSIONS – CLEAR TARGET

- The current worldwide fleet has an undeniable impact on the environment. By applying available technologies to shipping, the shipping industry's environmental impact can be considerably lowered. In the vessels of the future, all the emission streams will be minimized. This clearly reduces the environmental impact of shipping, even when shipping volumes become considerably higher than they are today.
  - Emissions to the air
  - Emissions to the water
  - Noise
  - Waste

Focusing on GHG emissions linked to shipping



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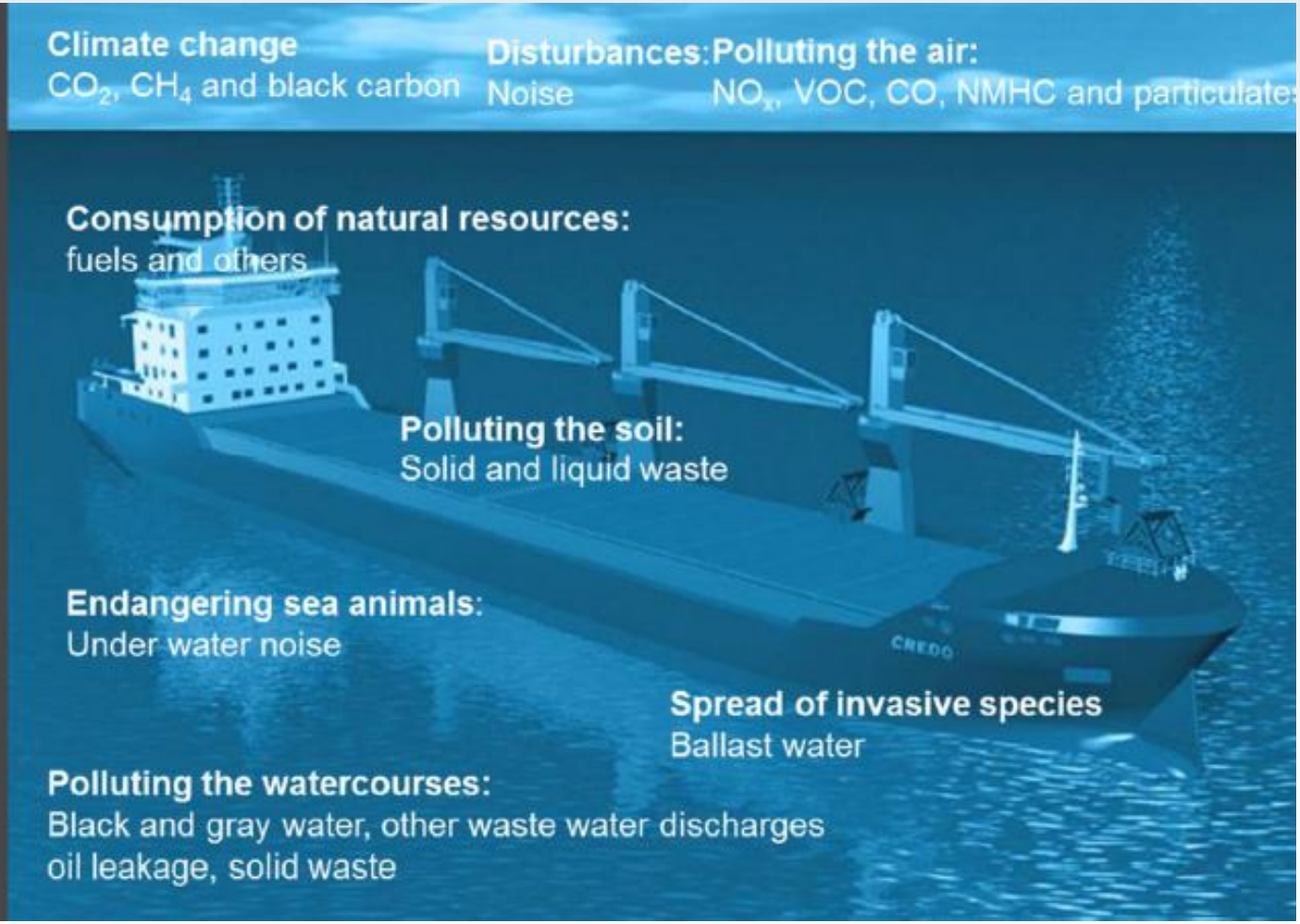
Vessel emissions overview

Technical features, which have impact on emissions

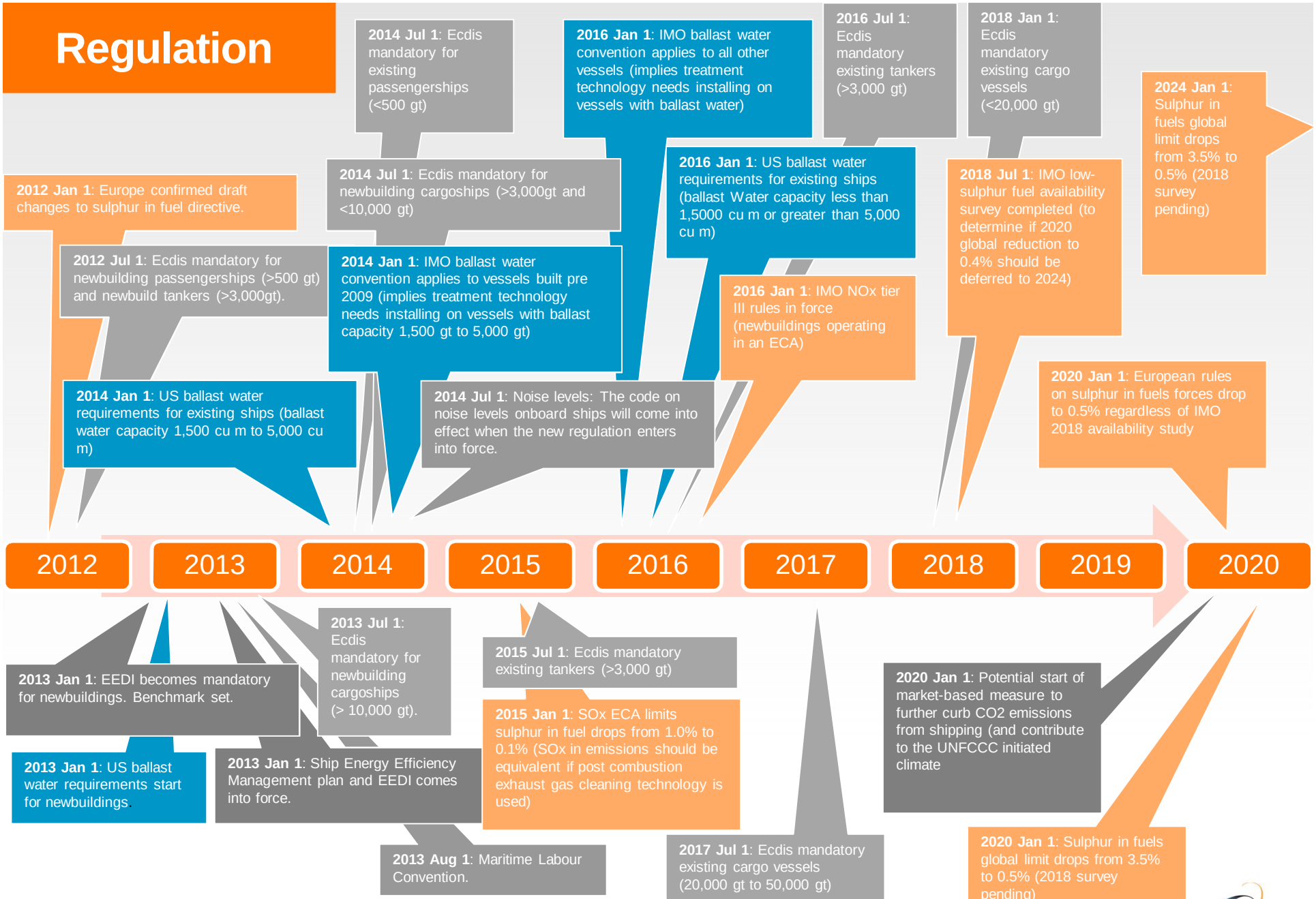
- Vessel design
- Vessel type and size
- Technology in use
- Fuels in use

Operational features, which have impact on emissions

- Speed
- Sea conditions/ route optimization
- Maintenance
- Fuels
- Loading



Regulation



Source: Lloyd's List.
ECDIS=Electronic chart Display and Information system, EEDI=Energy Efficiency Design index

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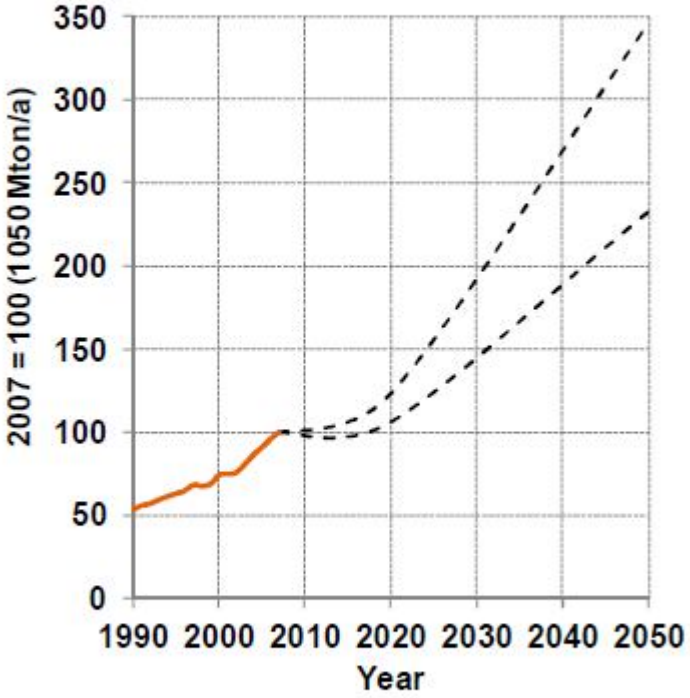
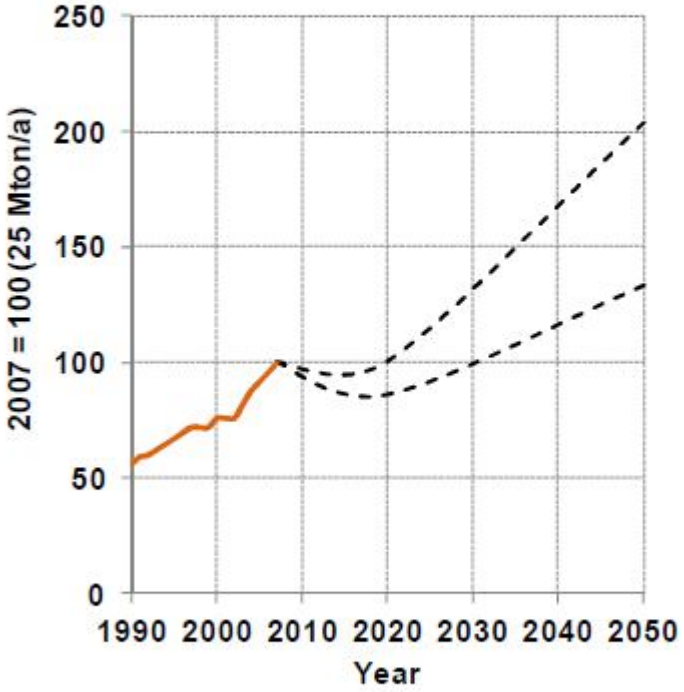
IMO emissions forecast

The shipping sector's share of the total emissions from various sources would inevitably increase. One indication of the shipping sector's increasing environmental impact was presented in the EU assessment, which forecasted that by 2020 the NO_x and SO_x emissions from vessels will exceed those from land-based sources in the EU. [8]



GHG emissions of shipping (IMO 2009)



NO_x emissions of shipping (IMO 2009)

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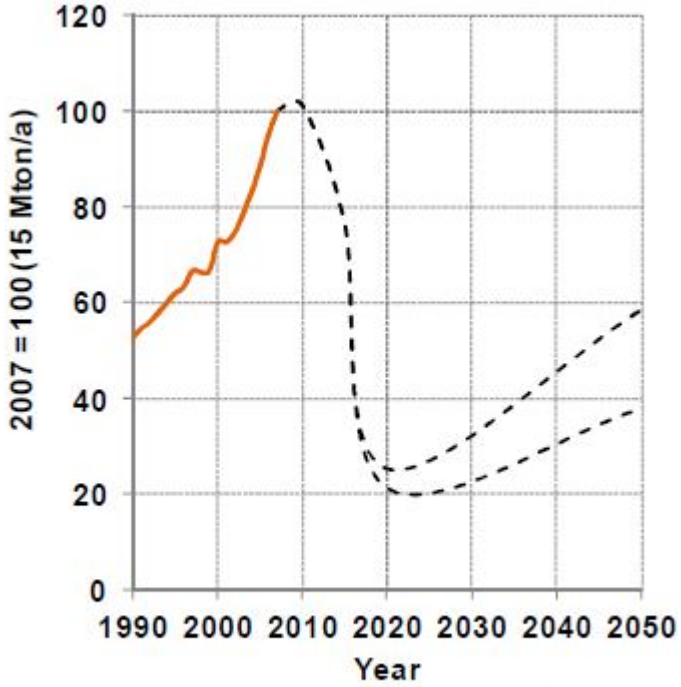
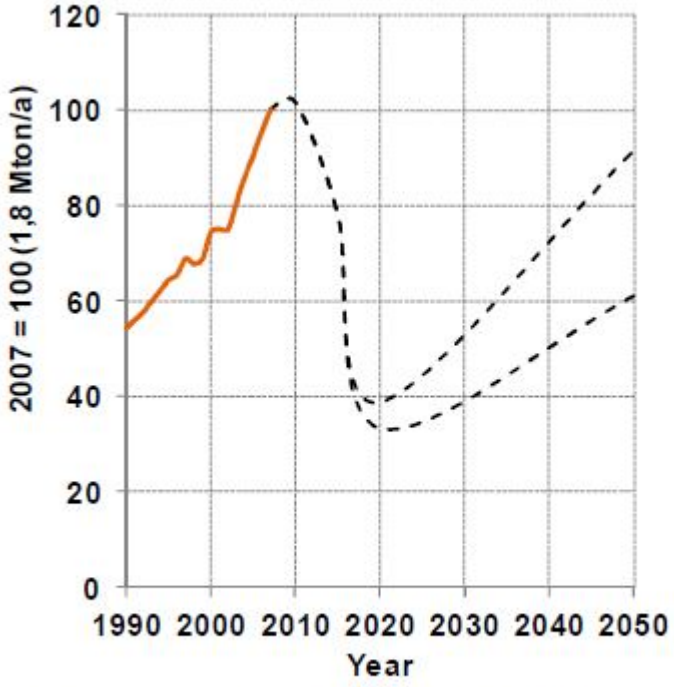
IMO emissions forecast



SO_x emissions of shipping (IMO 2009)



PM emissions of shipping (IMO 2009)

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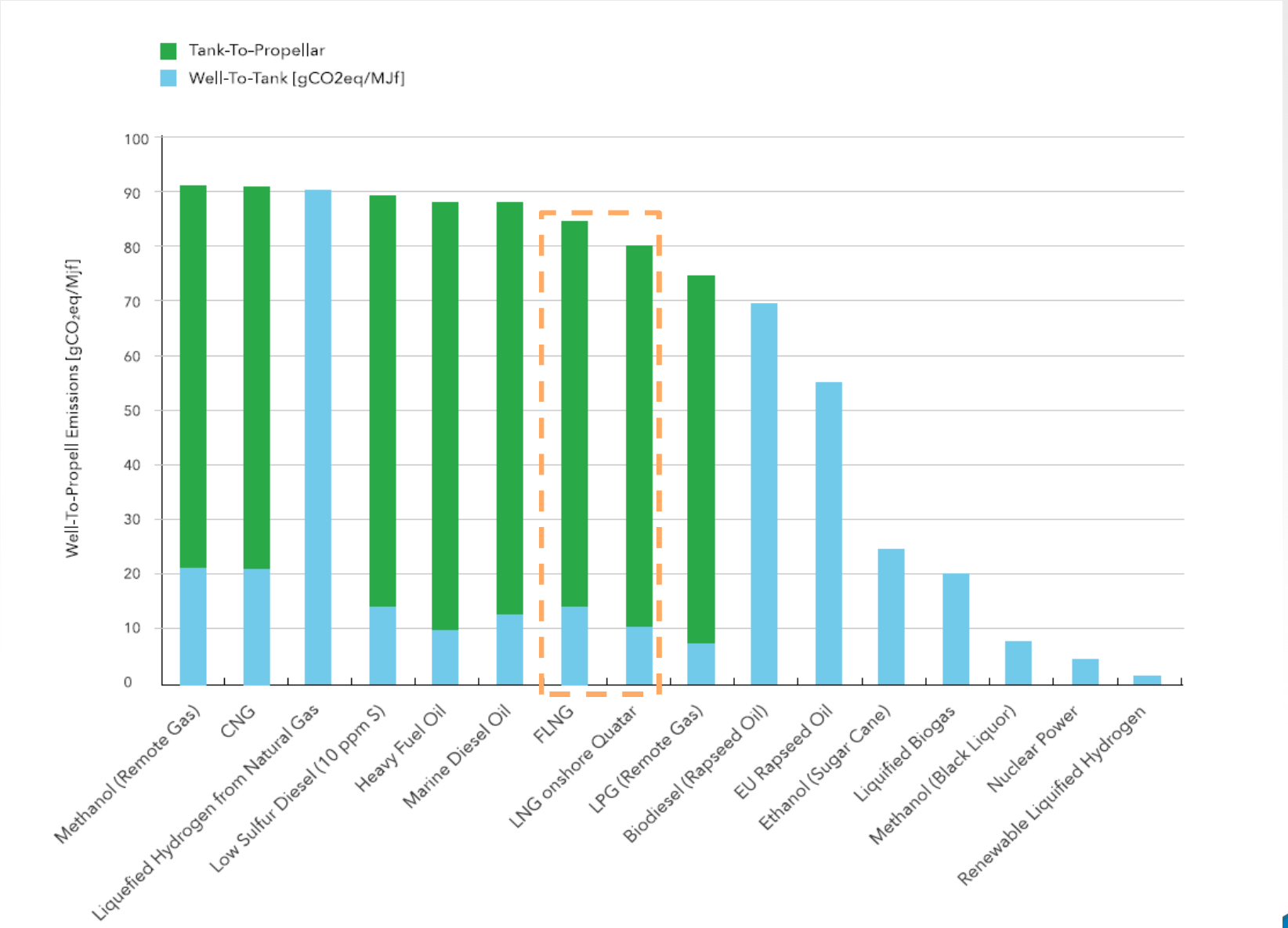
3. TOWARDS MORE SUSTAINABLE FUELS - FUEL FLEXIBILITY IS NEEDED.

- The industry needs to move towards less polluting fuels. This increases the available fuel options and gives a more balanced use of resources. Fuel flexibility is a crucial enabler for this development.
  - Gas
  - Biofuels
  - Others

Choice of fuel towards new regulations

GHG Emissions “well-to-propeller”



Source : DNV-GL, Alternative fuels for shipping 1/2014

EMISSIONS

Emission	Unit	HFO	LFO	CRO	Palm Oil
CO_2	vol %	5.5	5.3	5.5	0.0
SO_2	ppm, dry 15 % O_2	463	118	460	< 2
NOx	ppm, dry 15 % O_2	970	860	970	1050
CO	ppm, dry 15 % O_2	40	40	40	30
THC (as CH_4)	ppm, dry 15 % O_2	80	170	80	30
Particulates	mg/Nm^3, dry 15% O_2	40-60	<25	40-60	<10

ALMOST ZERO

ALMOST ZERO

SLIGHTLY HIGHER

SMALL DIFFERENCES, VERY LOW LEVELS ANYWAY

-80%

However ....You need to harvest 29 km² to produce 10MW

Lufussa “Pavana III” plant (Honduras): the plant accommodates 16 Wärtsilä 18V46 engines in two separate engine halls joined together by the control room.

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Stena Germanica - Methanol Conversion Project General

- The four main engine at Stena Germanica will be converted to enable running on methanol
- Project time frame is 2013.1.1 → 2015.12.31.

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Fuels and Regulation

2020 Jan 1:
Potential start of market-based measure to further curb CO2 emissions from shipping (and contribute to the UNFCCC initiated climate

2015 Jan 1:
SOx ECA limits drops from 1.0% to 0.1%

2016 Jan 1:
IMO NOx tier III rules in force (newbuildings operating in an ECA)

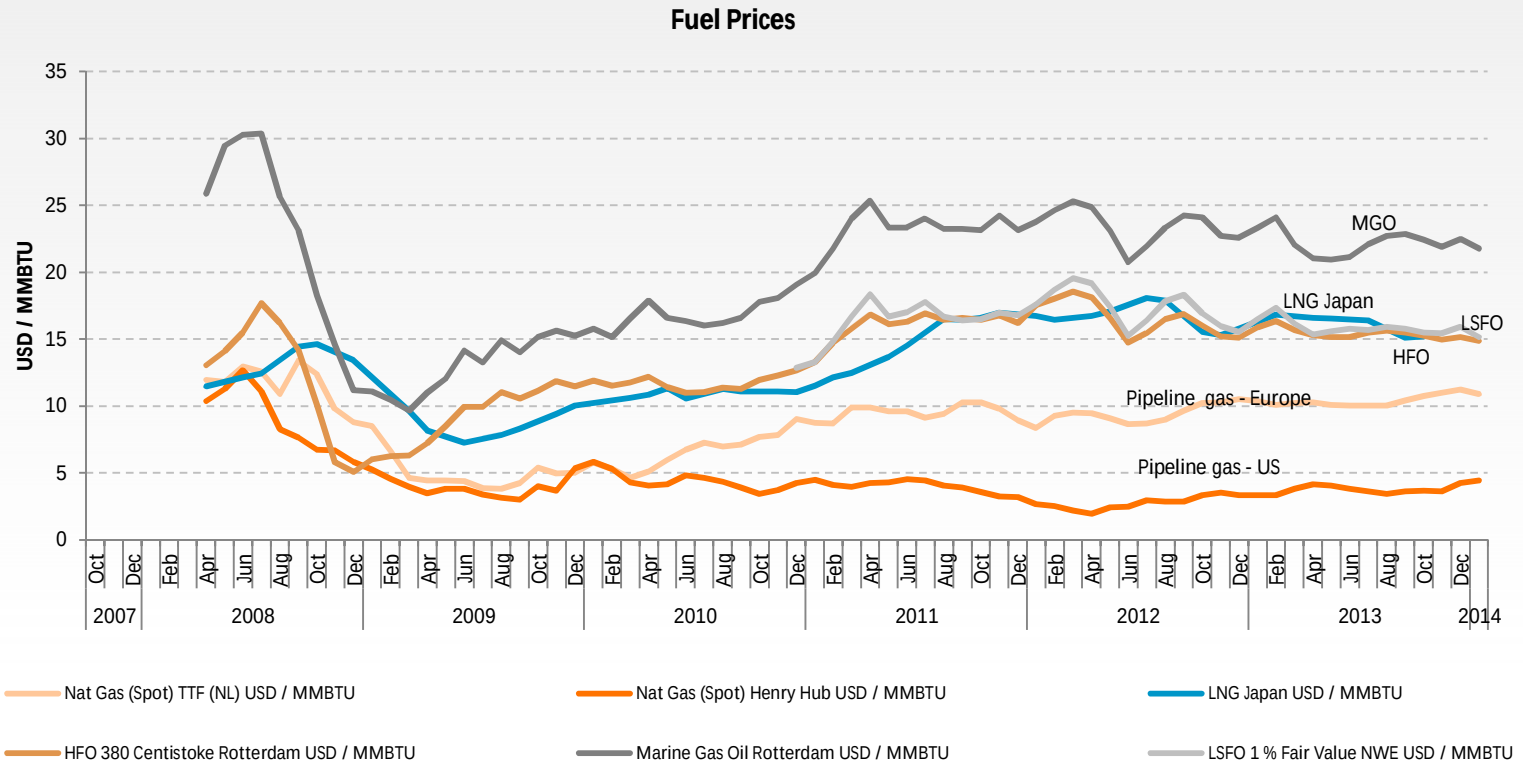
2018 Jul 1:
IMO low-sulphur fuel availability survey completed

2020 Jan 1:
European rules on sulphur in fuels forces drop to 0.5%

2020 Jan 1:
Sulphur in fuels global limit drops from 3.5% to 0.5% (2018 survey pending)

2024 Jan 1:
Sulphur in fuels global limit drops from 3.5% to 0.5% (2018 survey pending)

2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025



Growing number of regulations controlling shipboard emissions and discharges have been agreed within the committees of the IMO, some already in force, some yet to come into force.

Other regulations are being written and agreed, including regional rules from the US and European Union.

Source: Lloyd's List, Bloomberg

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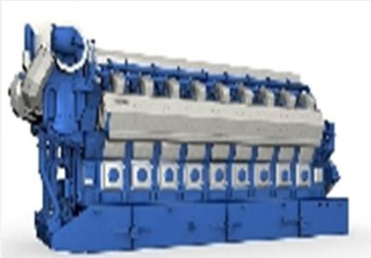
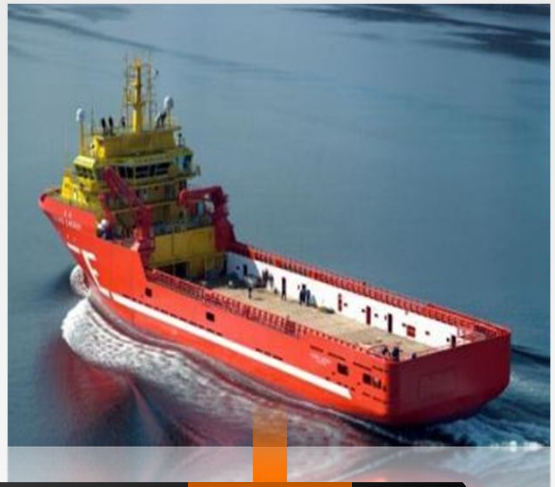
The gas engine evolution

1987

SPARK-IGNITION GAS (SG)



1992



1995

GAS-DIESEL (GD)

DUAL-FUEL (DF)

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4. VESSEL SAFETY REDUCES HEALTH AND ENVIRONMENTAL RISKS

Zero casualty policies will be widely used and applied throughout the lifecycle of the vessel.

- Remote monitoring and interactive systems
- State of the art systems for
  - Navigation
  - Route optimisation
  - Traffic monitoring and control
- Improved operations, maintenance and service
- Shorter operational lifetimes of vessels
- Recycling and sustainable scrapping

Sustainable Shipping

5. FLEET OPTIMIZATION REWARDS THE TOTAL VALUE CHAIN.

- Fleet optimization guides the vessel design and the effective use of the operators' fleet. This ensures competitiveness, efficient operations, and excellent environmental performance.
  - Optimized trade points, location and infrastructure of the harbours
  - Optimal combination of fleet size, vessel size and speed

Sustainable Shipping

KEY ELEMENTS IN DECISION MAKING TO ACCELERATE THIS DEVELOPMENT ARE AS FOLLOWS:

A. Developing a LNG fuel based maritime industry
B. Global harmonisation of the regulatory framework and its implementation
C. Incentives for improving vessel performance
D. R&D development programmes to include demonstrators of novel vessels and technologies
E. Expertise of the crew needs to be secured
F. The role of scrapping in sustainable shipping

> Globally harmonized regulatory frameworks and investments in development of maritime industry capability are required for the shipping industry in order to ensure a sustainable future for shipping.