Commercial Green Initiatives

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Contents

- Ship emissions and regulatory developments
- Energy efficiency, CO2 reduction
- Air emissions and abatement – NOx and SOx
- Operational measures, logistics
- Alternative fuels

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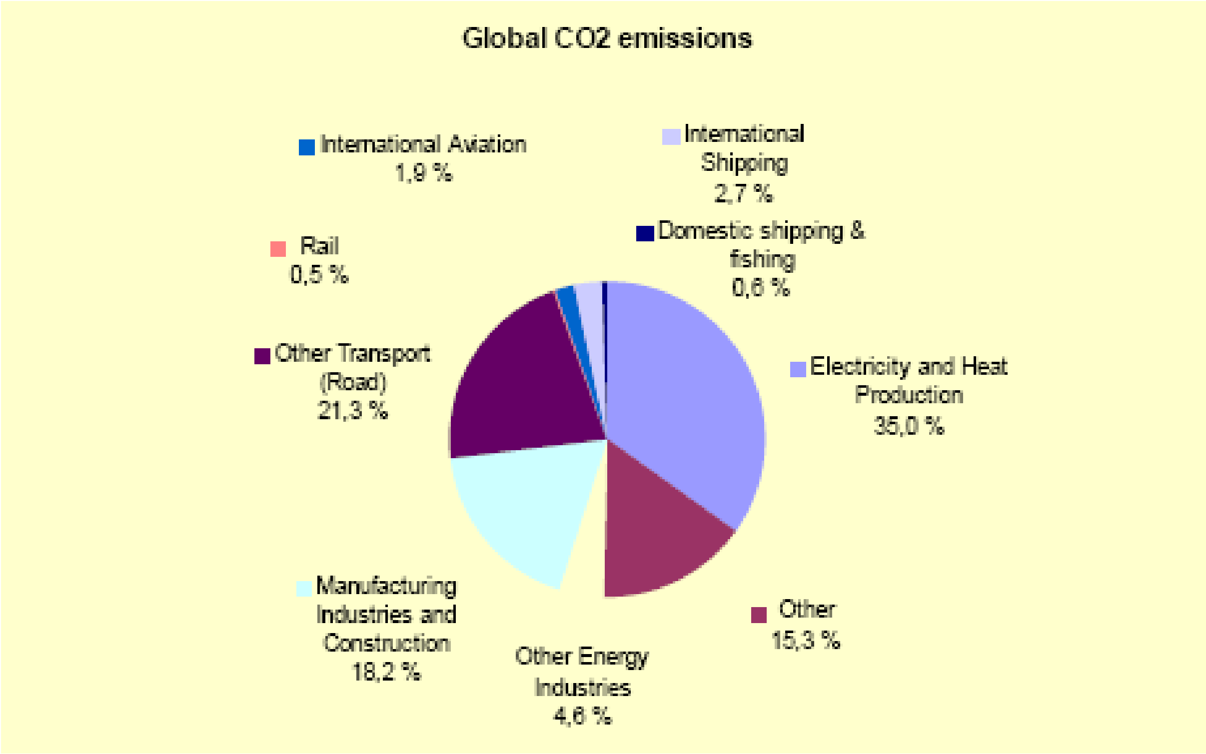
Second IMO GHG Study 2009
Global CO2 emissions

- International shipping: 2.7% of global emissions; domestic/coastal shipping: 0.6%
- CO_2: main GHG ships



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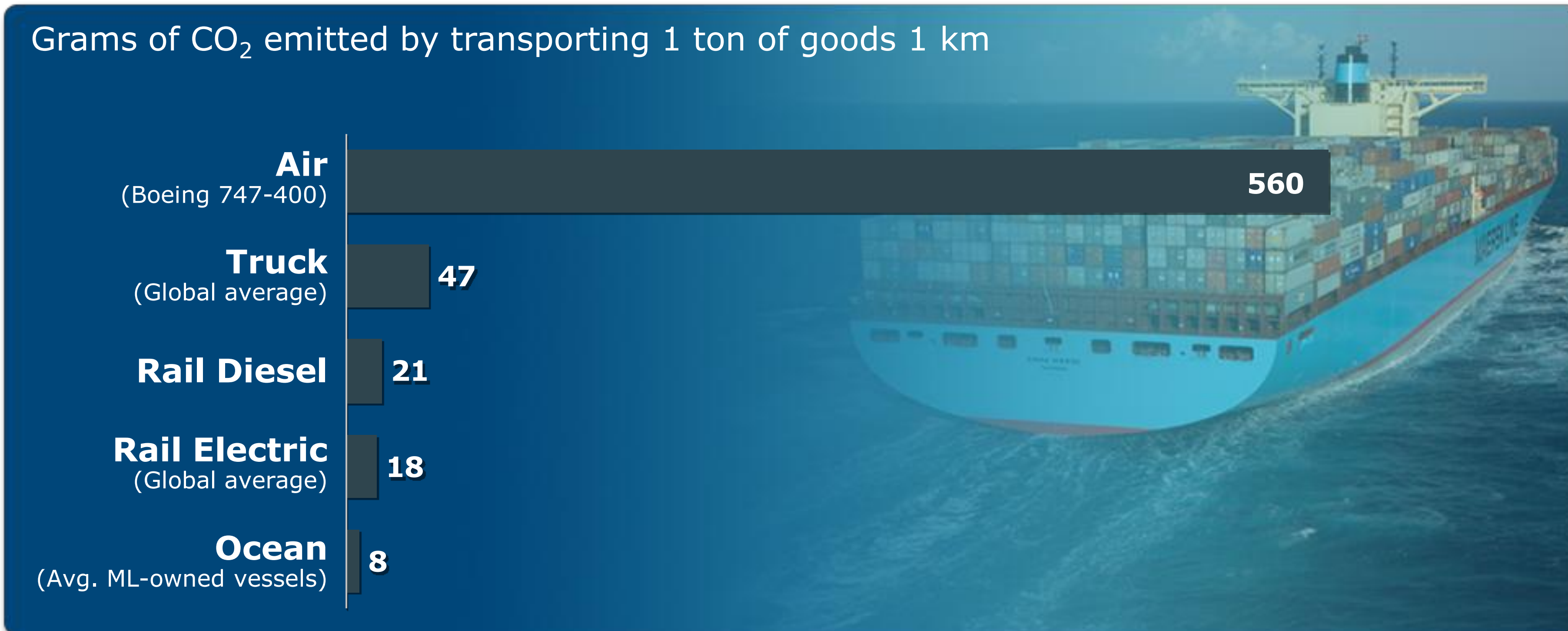
CARBON FOOTPRINT OF SHIPPING IS LESS THAN OTHER MODES OF TRANSPORT

80-90% of world’s goods transported by ship



Source: Based on data from the Network for Transport and Environment, Sweden

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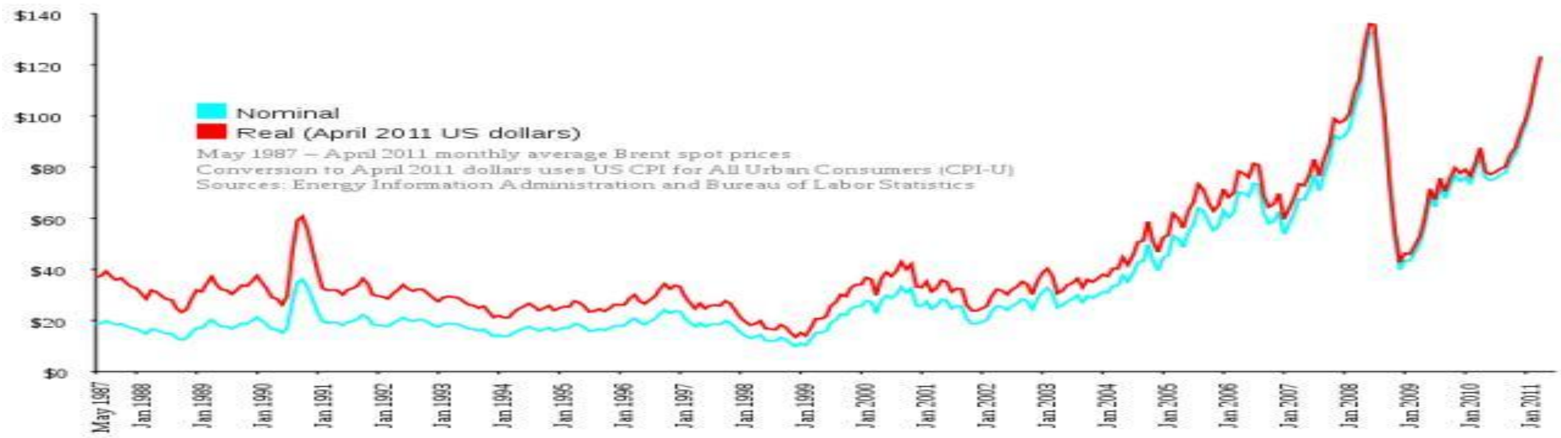
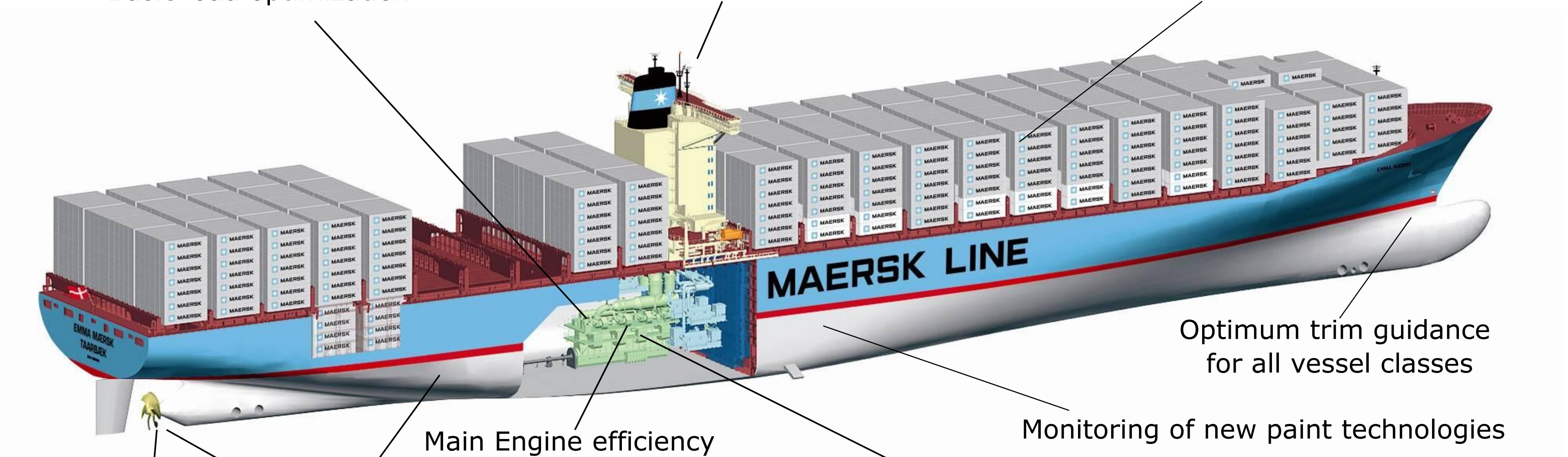
- 1987
  - Tracking DRC, Fuel consumption and Cylinder L/O consumption as independent metrics
  - Safety tracked by claims
- 1998
  - ISM drives process driven operations
- 2000 – 2001
  - Bunkers and L/O costs mandate renewed emphasis on energy consumption; beginning of voyage optimization; focus on coatings, scamping
- 2004 - current
  - Shipping KPI project
    - Little focus on energy costs
  - Benchmarking between competitors
- 2008 – Weak economy, over capacity, high energy costs, increased emissions focus (ECAs)
- 2012 – Lean operations, optimization of capital, alternative energy sources



Five elements essential for sustainability

Marine Engineering **Innovation** **Vessel Performance** **Regulatory** **Business Case**



- *Waste heat recovery system*
- *Slow steaming and super-slow steaming*

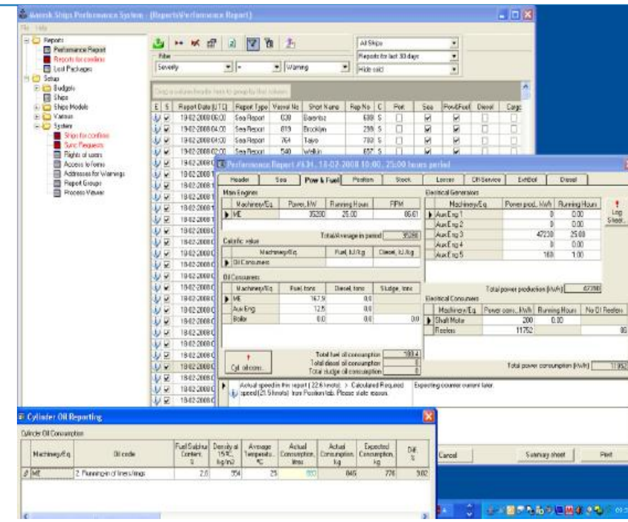
Other Initiatives

- *Alternative fuel tests*
- *New propulsion technologies*
- *ISO 14001 certified*
- *Crew awareness/engagement*
- *SOx scrubber studies*
- *QUEST: Low energy chilled containers*
- *Modified bulbous bow*
- *Ballast water optimization and treatment systems*

Vessel Performance Management

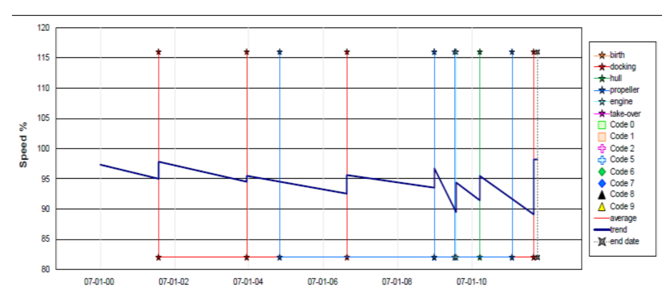
Performance tool

- Vessel Performance Management Service (VPMS) provides
  - Key vessel performance monitoring
  - Decision support on vessel operation
- VPMS reports provide guidance and decision-support on
  - Hull and propeller performance and efficiency
  - Improving main and auxiliary engine performance
  - Optimal cylinder oil consumption
  - Drydocking, hull cleaning and propeller polishing intervals
  - Evaluation of anti-fouling paint type



Value Proposition

- Believe in the credo – “You can only improve what you measure”
- Promoting and reinforcing green image in the business
- This service has direct impact on optimising daily running cost
- Direct impact on improving fuel performance
- Provides continuous and close performance monitoring
- Ensures drydocking costs and off-hire are kept at minimum level



Innovation projects on the Maersk fleet

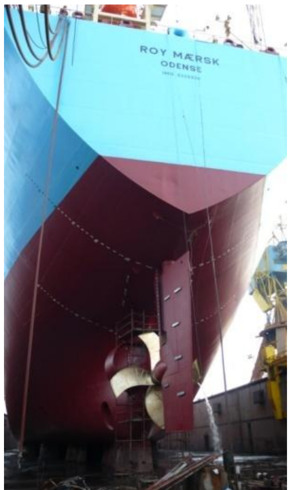
Maersk Attender
Crane pendulation

Thurø Maersk
BWTS testing

Maersk Kendal
Ventilation optimization

Jeppesen Maersk
Auto-tuning of main engine

Emma Maersk
Aux. engine waste heat



Roy Maersk
CLT Propeller

Maersk Kalmar
Biofuel

Olivia Maersk
Air lubrication

Alexander Maersk
Exhaust gas recirculation

Gudrun Maersk
Main eng. cooling systems

Clementine Maersk
CRS autologging and performance prediction

Laura Maersk
HT Pump optimization

Maersk Ohio
Propeller boss cap fin

Maersk Belfast
Water based hydraulics

Arthur Maersk
Cylinder lube oil reduction

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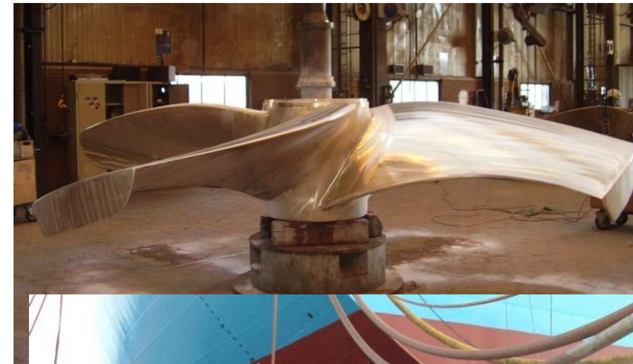
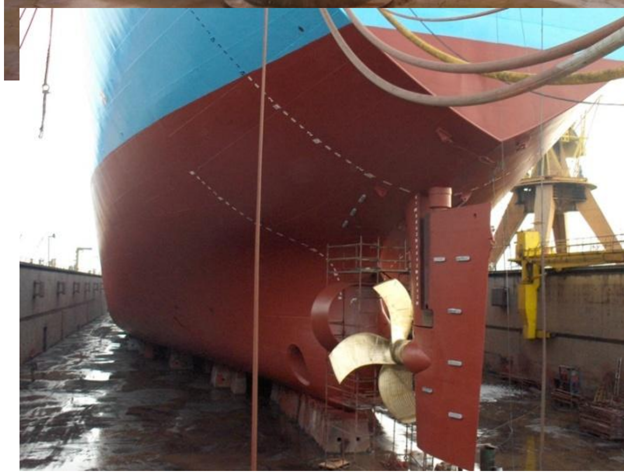
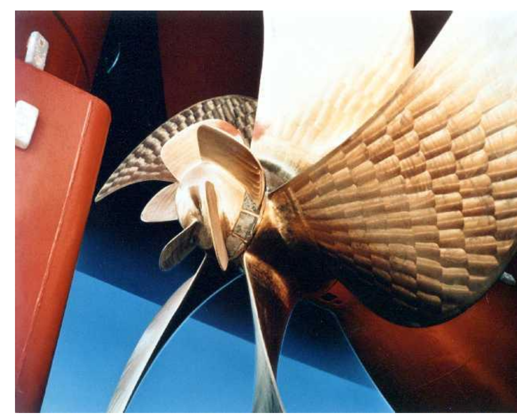
MARITIME TECHNOLOGY

Example: CLT Propeller and Propeller Boss Cap Fin Projects

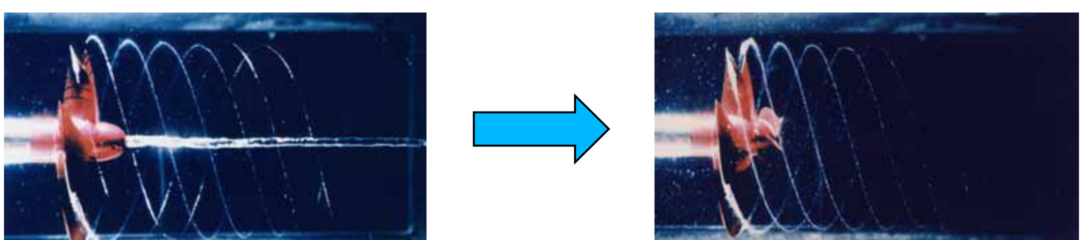




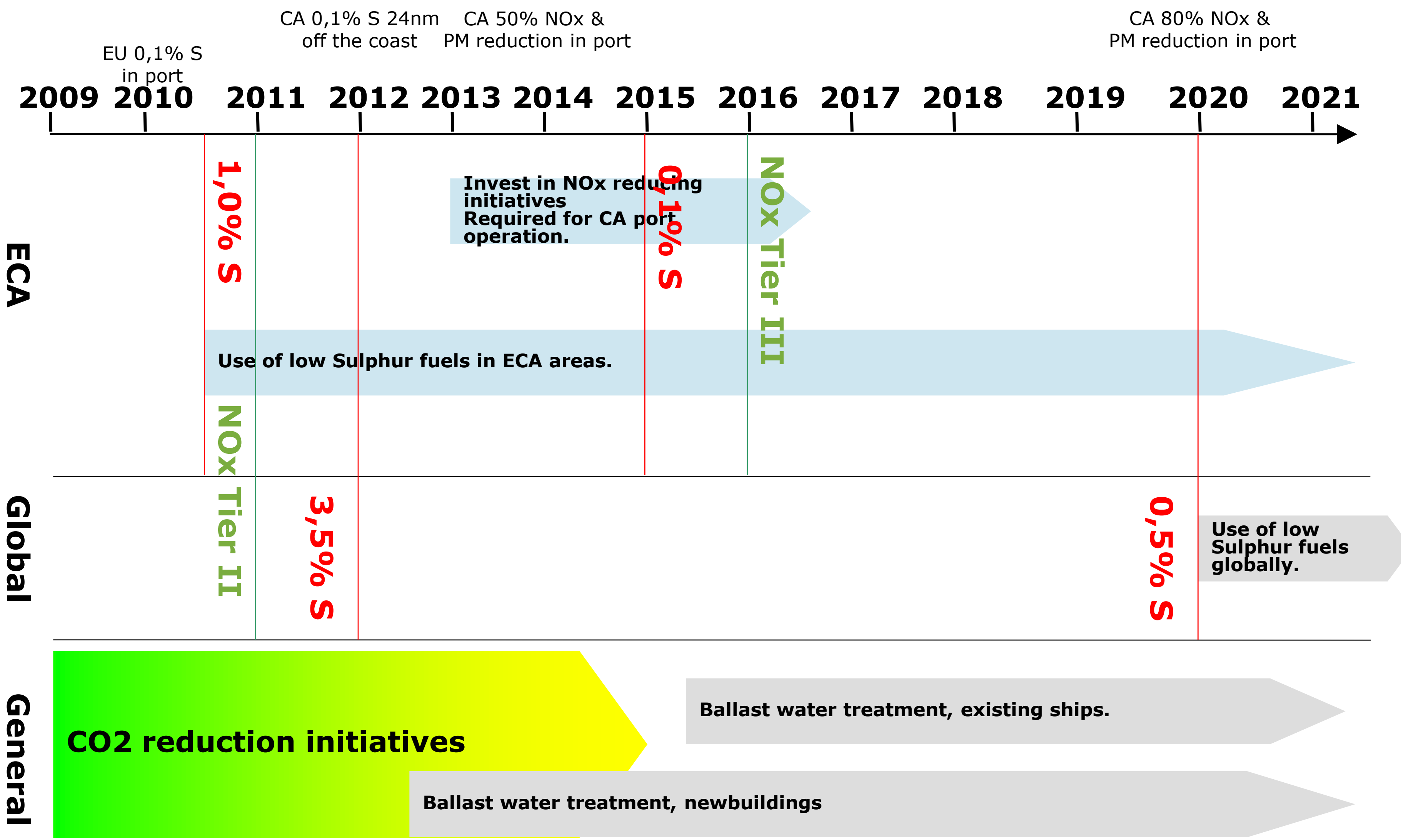
- CLT propulsion principle
  - Endplates fitted with minimum resistance
  - Higher efficiency (perhaps up to 5% fuel savings)
  - Lower vibration & noise level
- Main objective:
  - To confirm performance in full scale on a tanker



- PBCF principle
  - Fins to break up hub vortex, 1-5% fuel saving
  - Fit to series of tankers and container vessels



Regulatory scene



Sulphur challenge: feasible solutions for 2015 and beyond

- Existing fleet:
  - Burn low sulphur fuel
    - ✓ *Availability from refineries?*
    - ✓ *Increase overall CO_2*
    - ✓ *High cost*
  - Retrofit SOx scrubbers
  - Use Biofuel on certain trades as supplement or alternative to low sulphur fuel

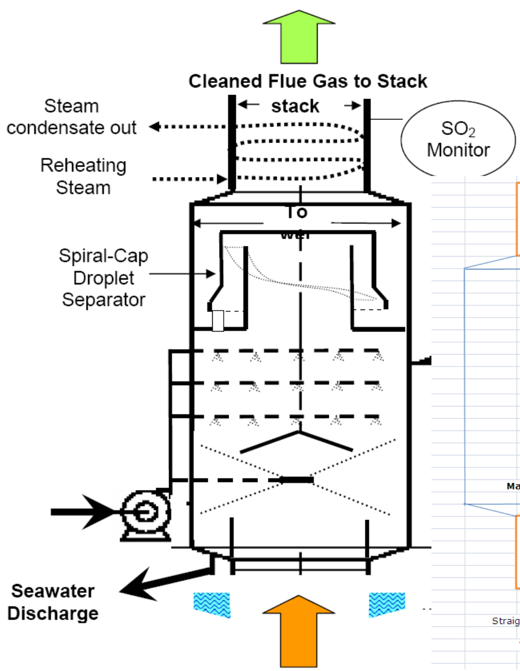
- Newbuildings:
  - Burn low sulphur fuel
  - Install SOx scubbers

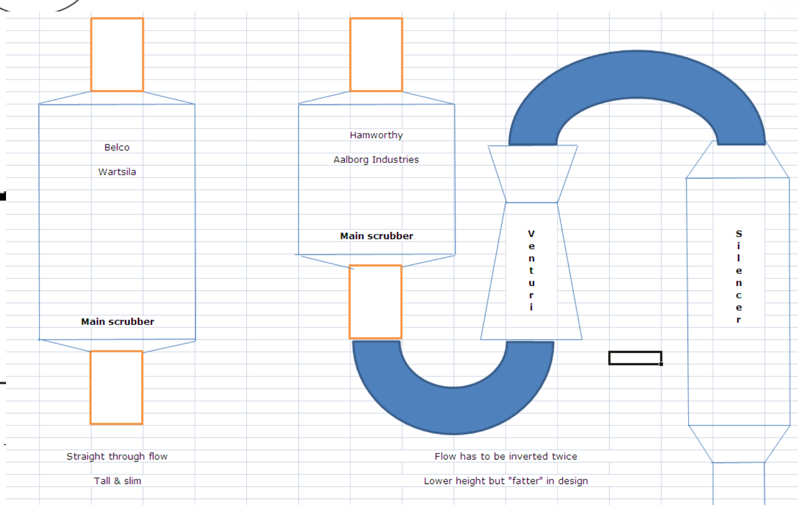
- Longer term possibilities
  - Switch to LNG
  - Biofuel in large quantities
  - Nuclear power

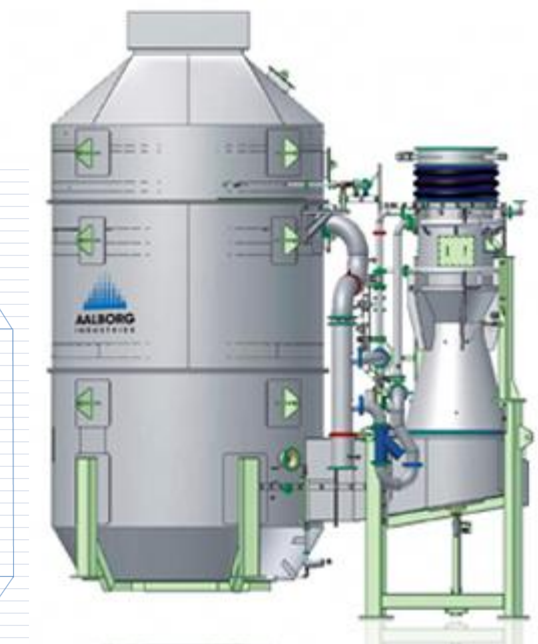
Examples of Scrubber Designs

More than 90% reduction of Sulphur and Particulate matter

Two most common scrubber types (both open and closed loop):
- Straight through flow
- Venturi type







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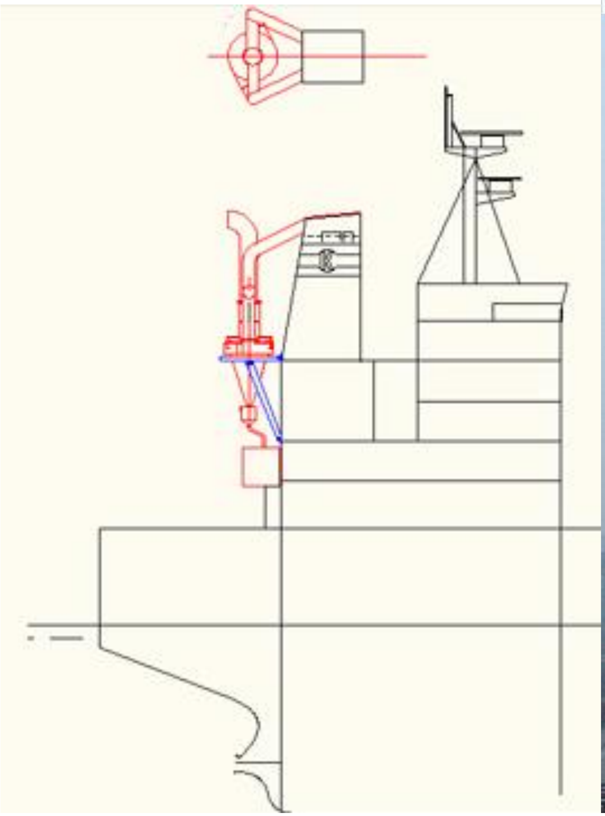
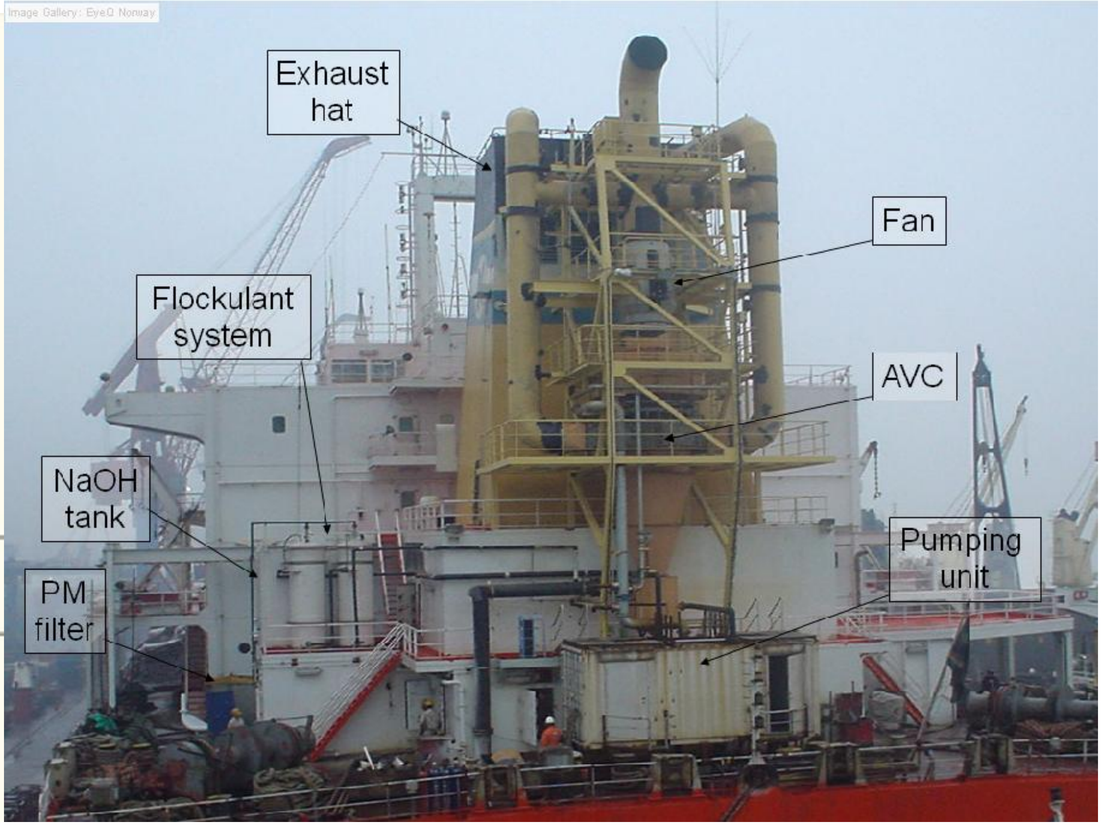
Example of full installation on a bulk carrier 10MW (Clean Marine scrubber system)





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Example of Main Engine scrubber installation on Ro-Ro TOR FICARIA

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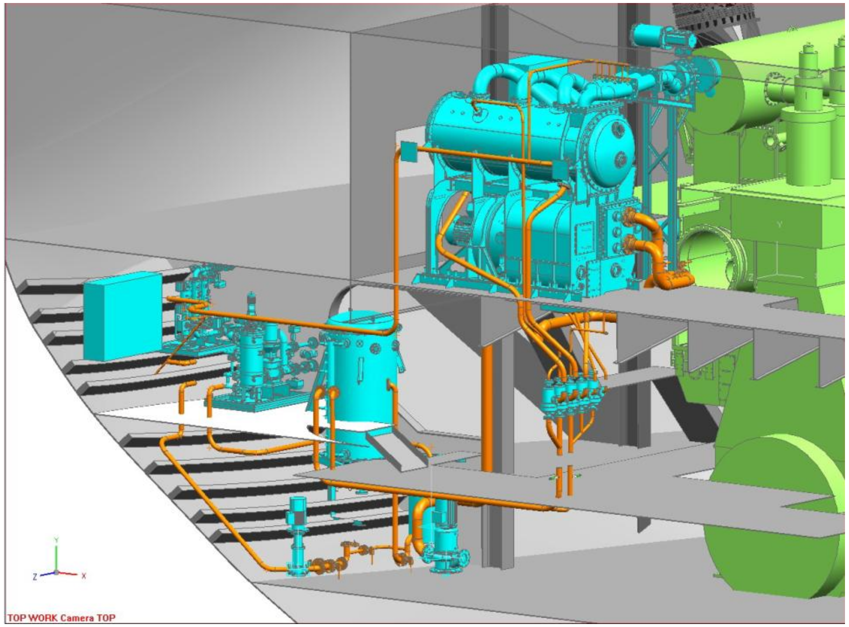
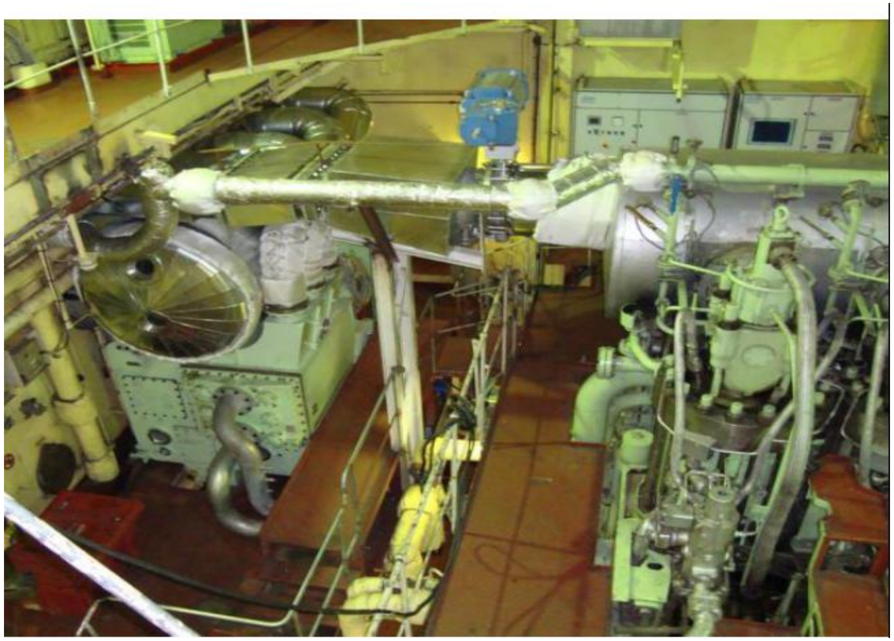
Exhaust Gas Recirculation project





Source : MAN Diesel

Objective:

- Reduce NOx emissions by at least 50%

Status:

- System has been installed on board Alexander Maersk (1000 TEU, 10 MW)
- Cooperation with MAN Diesel and ABB, *EU FP7 project HERCULES B*
- Tests and evaluation of the concept to be documented throughout 2011.

MAN Diesel

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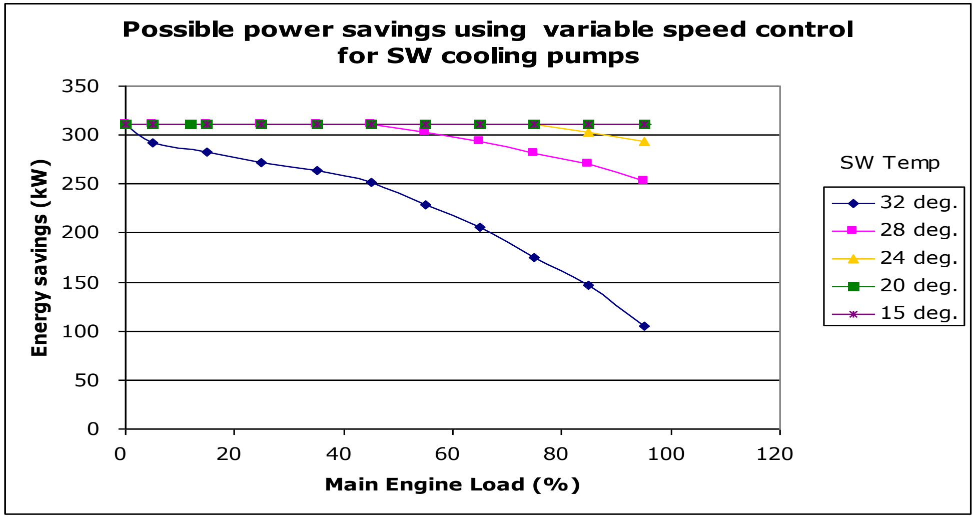
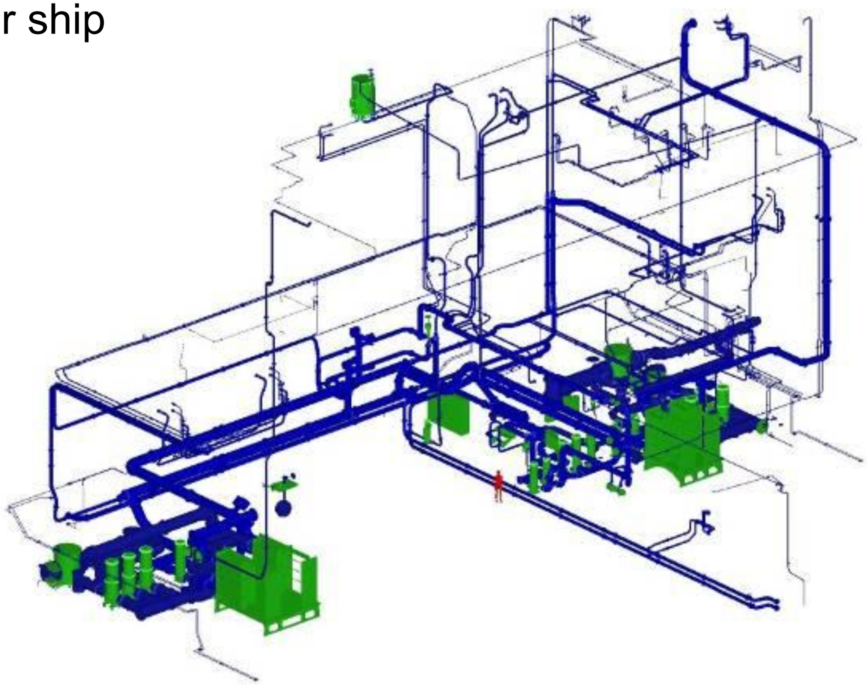
Machinery optimization for energy efficiency

Cooling and ventilation systems

- Retrofit of systems aimed at minimizing energy consumption
- Ventilation; SW and LT cooling systems
- Potential: 1% CO_2 global reduction for a container ship





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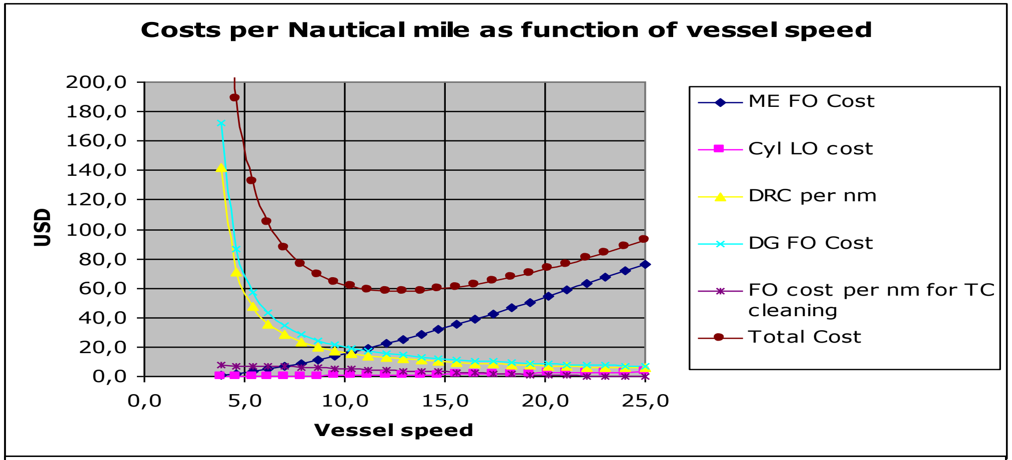
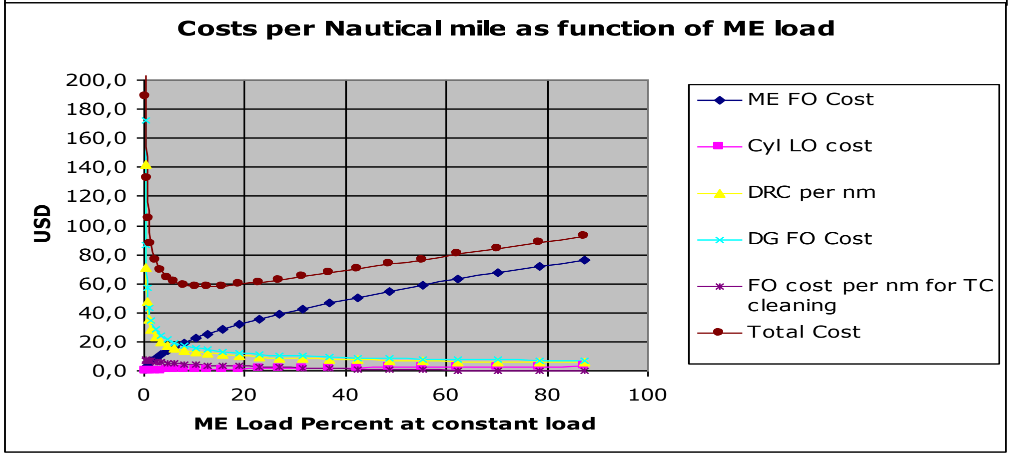
Slow steaming: extensive investigations have led to new industry standard on super slow steaming: BIG savings, less CO_2

Container vessel

Optimum ship speed



Optimum engine load



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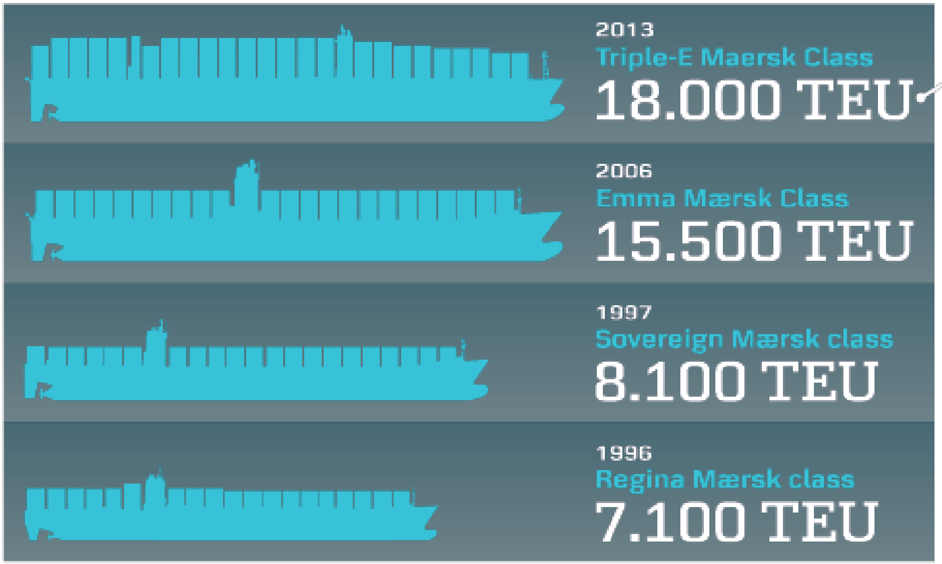
EEE Dimensions

- Length: 400 m
- Beam: 59 m
- Height: 73 m
- Capacity: 18,000 TEU



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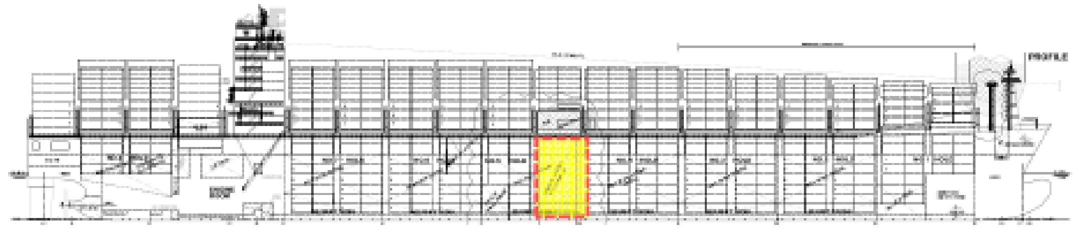
LNG for Fuel

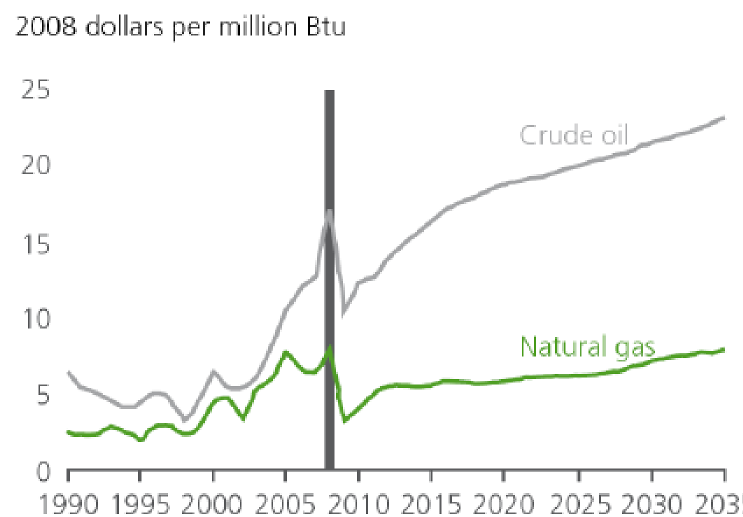


LNG: reduce impact on environment

- 20% less CO_2
- 100% reductions of SOx and PM
- NOx reductions

Key challenges for shipping are

- Substantial investments for Shipowners, Oil Majors and key suppliers
- Issues related to Bunkering (terminals, bunker boats, procedures, etc.)
- Uncertainty regarding the future LNG bunker price



Ref. U.S. Energy Information Administration (EIA)

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Small scale LNG in Norway is a reality



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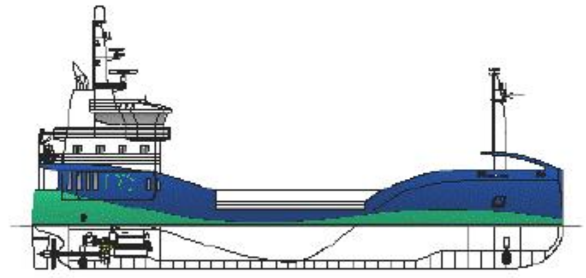
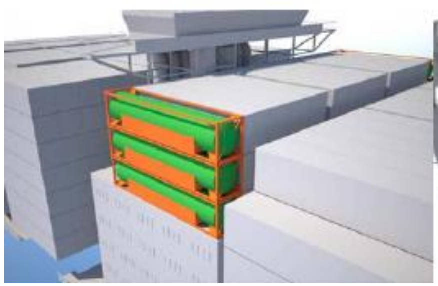
Many LNG shipping projects in the pipeline



DNV's Quantum Project:



Biofuels

- 1st generation: fuel derived directly from plant seed or animal fat.
- 2nd generation: derived from non-food crops or from agricultural waste products , i.e. not competing with food. Sources can be straw, jathropha, lignin, waste from paper mills, etc.
- 3rd generation: new technologies such as algae -- not considered cost-competitive in the short to medium term.

➢ Large-scale biofuel is expected to be derived from sustainable 2nd generation biofuel in the medium to long term

➢ Reduce carbon footprint / approx. CO2 neutral

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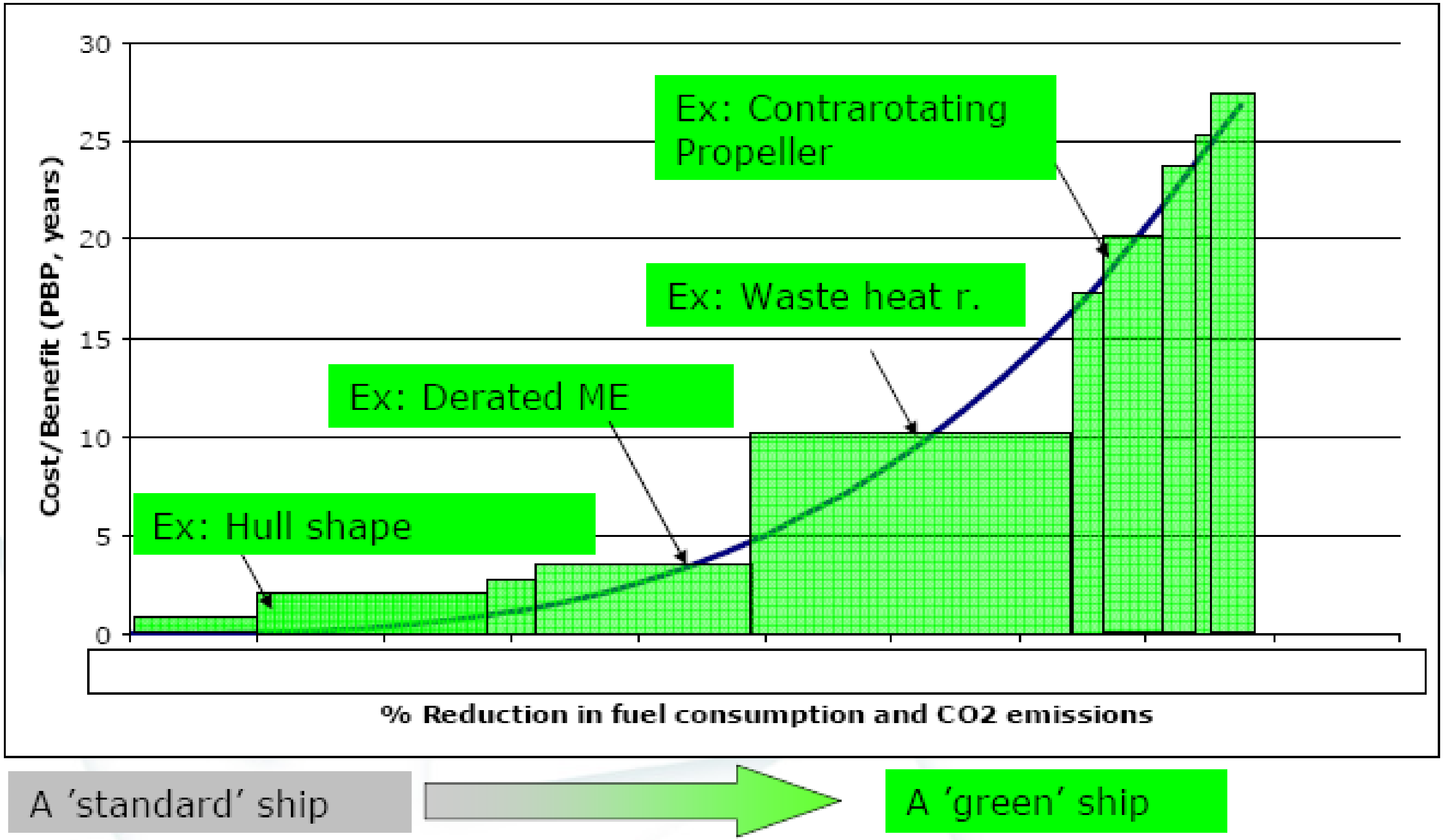
Eco-efficient ships: consider all relevant technologies.
Maximum benefit for business and environment

Example



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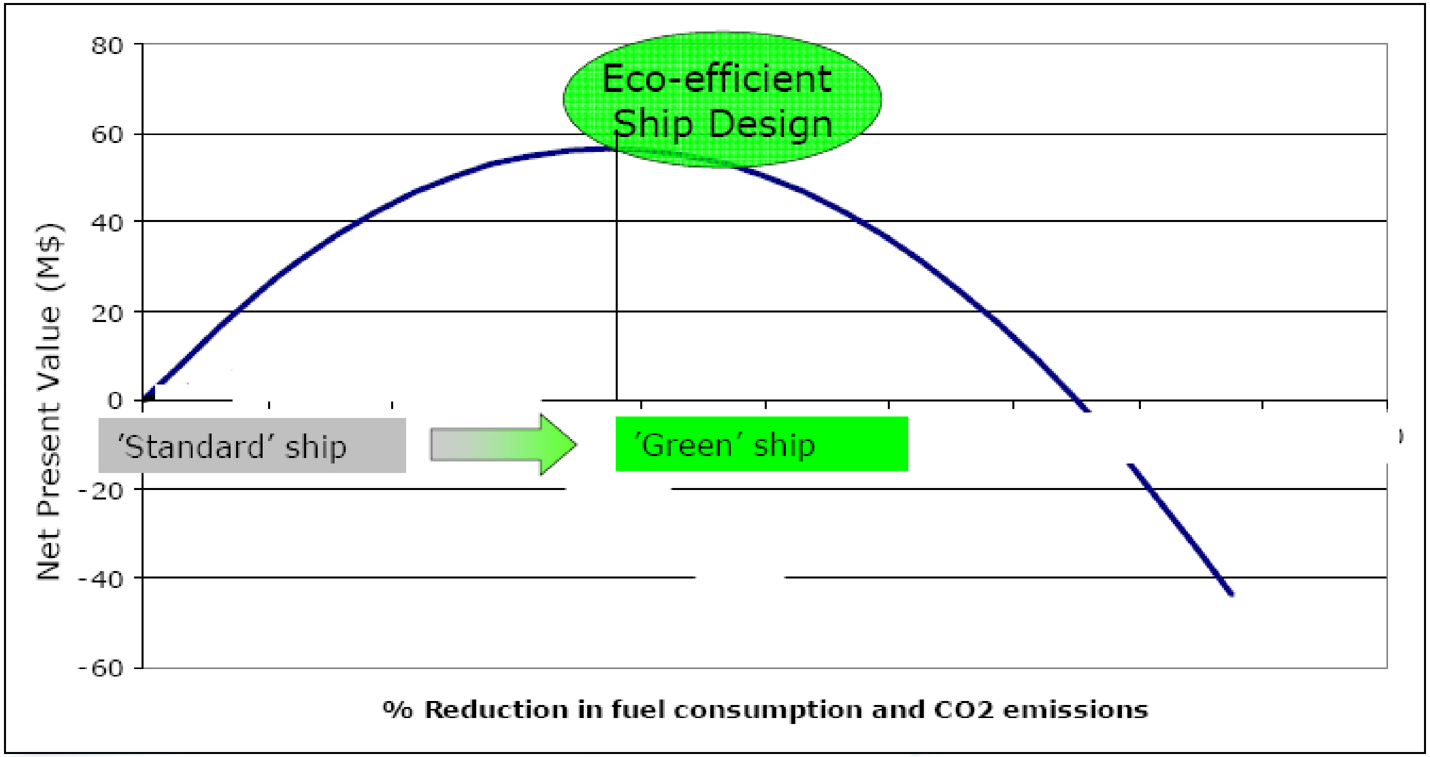
Eco-efficient ship: choose level of fuel efficiency for max business value subject to limits of investment

Example



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Conclusions

- Shipping is a very efficient mode of transportation
- Shipping industry can achieve ambitious emission reduction goals
- Solutions exist or will be available to reduce emissions and comply with future regulations
  - Technologies are of a complex nature and typically not mature yet
- Long time horizon is needed for R&D, testing and implementation
  - Technical, operational and commercial challenges
- Life cycle approach required for making investment decisions
- Emission regulations: must be goal based, encourage innovative solutions with level playing field

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Impact on fuel consumption and CO_2 when installing BWTS

- Impact on daily fuel consumption when installing BWTS, 500 USD/T HFO assumed:

	Daily fuel consumption, USD	BWTS daily fuel consumption, USD	Percentage
7500 TEU	33,600	150	0.5
4500 TEU	15,600	70	0.5
VLCC	24,600	300	1.2

➔ Total impact on Maersk Line CO_2 emission:

- ➔ 2009 fuel consumption: ~10 MTONS -> 0.5% increase due to BWTS: 50,000 tonnes fuel
- ➔ **For Maersk Line alone the introduction of fleetwide ballast water treatment will lead to an increase in CO_2 emissions of ~160,000 tonnes per year.**
- ➔ **This corresponds to the CO_2 emission from ~25,000 average UK households in one year**

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Questions & Answers

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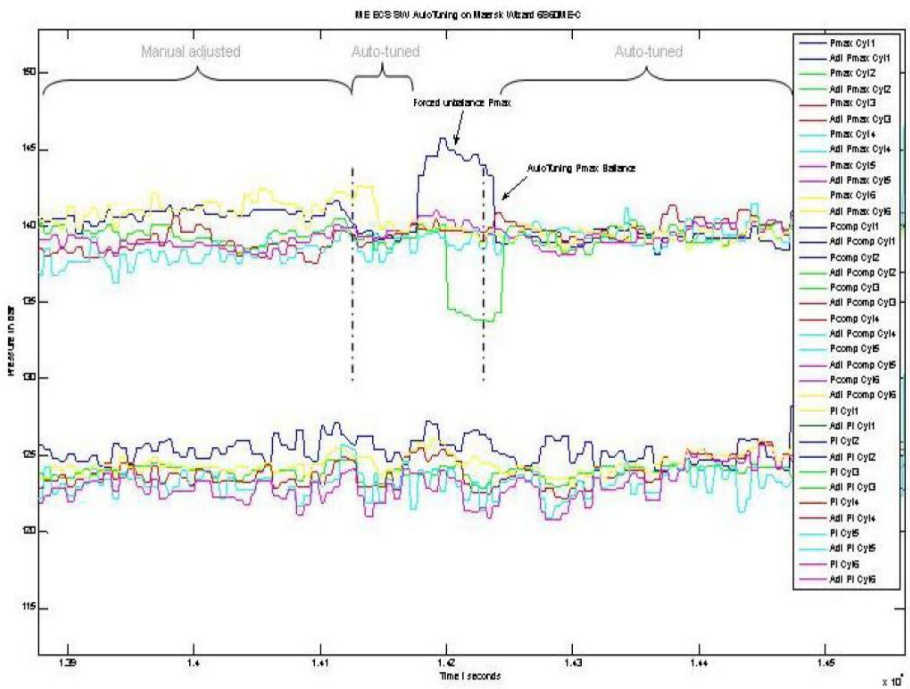
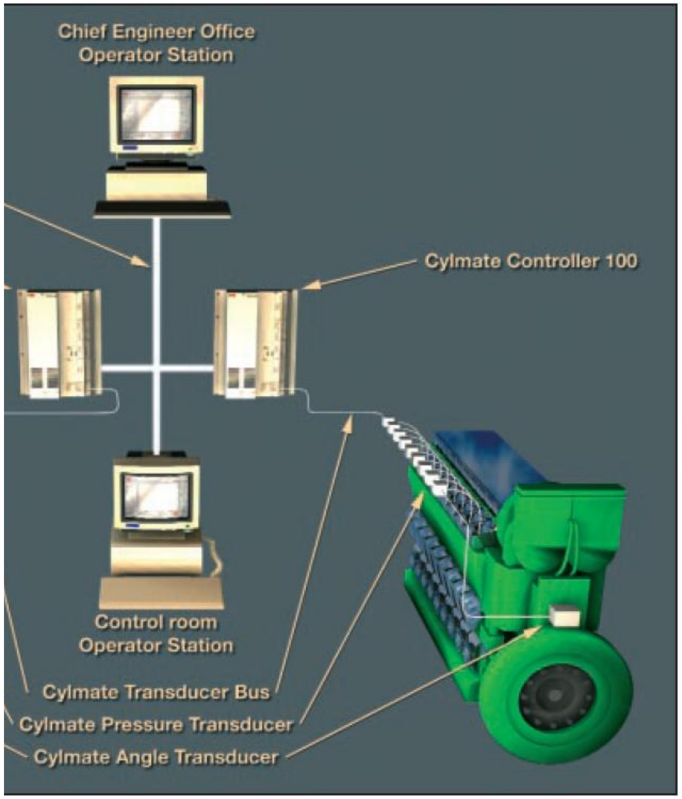
Efficiency: engine auto-tuning

- Automatic adjustment of engine settings
  to obtain optimum maximum combustion pressure
- Retrofit/upgrade potential for larger MAN B&W ME engines
- Field test proved concept on vessel in service
- Fuel/CO_2 savings: approx. 0.3 - 2%
- Retrofit and newbuilding applications





Can we make the overall supply chain greener?

- Can consumer drive major changes?
- Structural changes: For instance Carbon War Room
- Benchmarking: For instance BSR: Clean Cargo Working Group