Opportunities and challenges of future ship propulsion

05.12.2013

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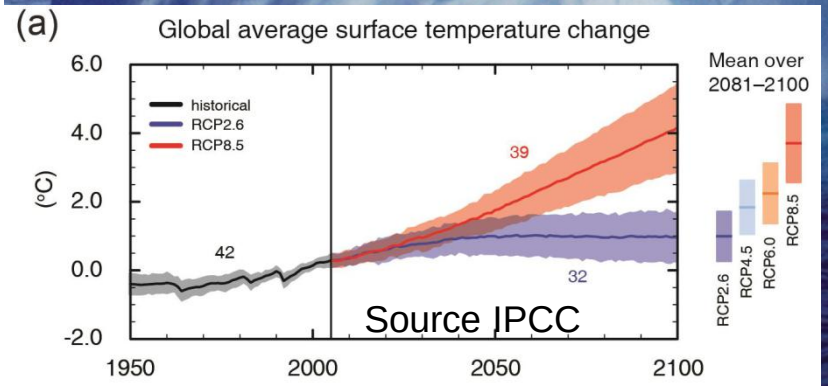
Serius environmental concerns around us

There are real reasons for concern for environment

The key question is:

How to meet the needs in a sustainable and economical way

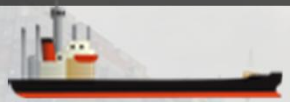


Is shipping sustainable ?

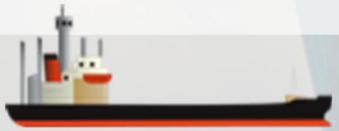
Optimizing total value chain and developing safe mode of transportation.

Today we are not the worst alternative of transportation

Heavy truck
with trailer
50 CO_2 /km



Cargo vessel
2,000-8,000 dwt
21 CO_2 /km



Cargo vessel
over 8,000 dwt
15 CO_2 /km

Air freight 747-400
1,200 km flight
540 CO_2 /km

What if…

..Other means of transportation become more sustainable or even carbon neutral ?

What kind of pressure will that leave for the marine industry.. Are we fast enough?

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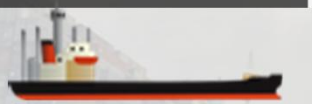
~~50~~ CO_2 /km



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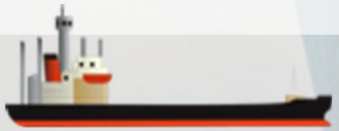

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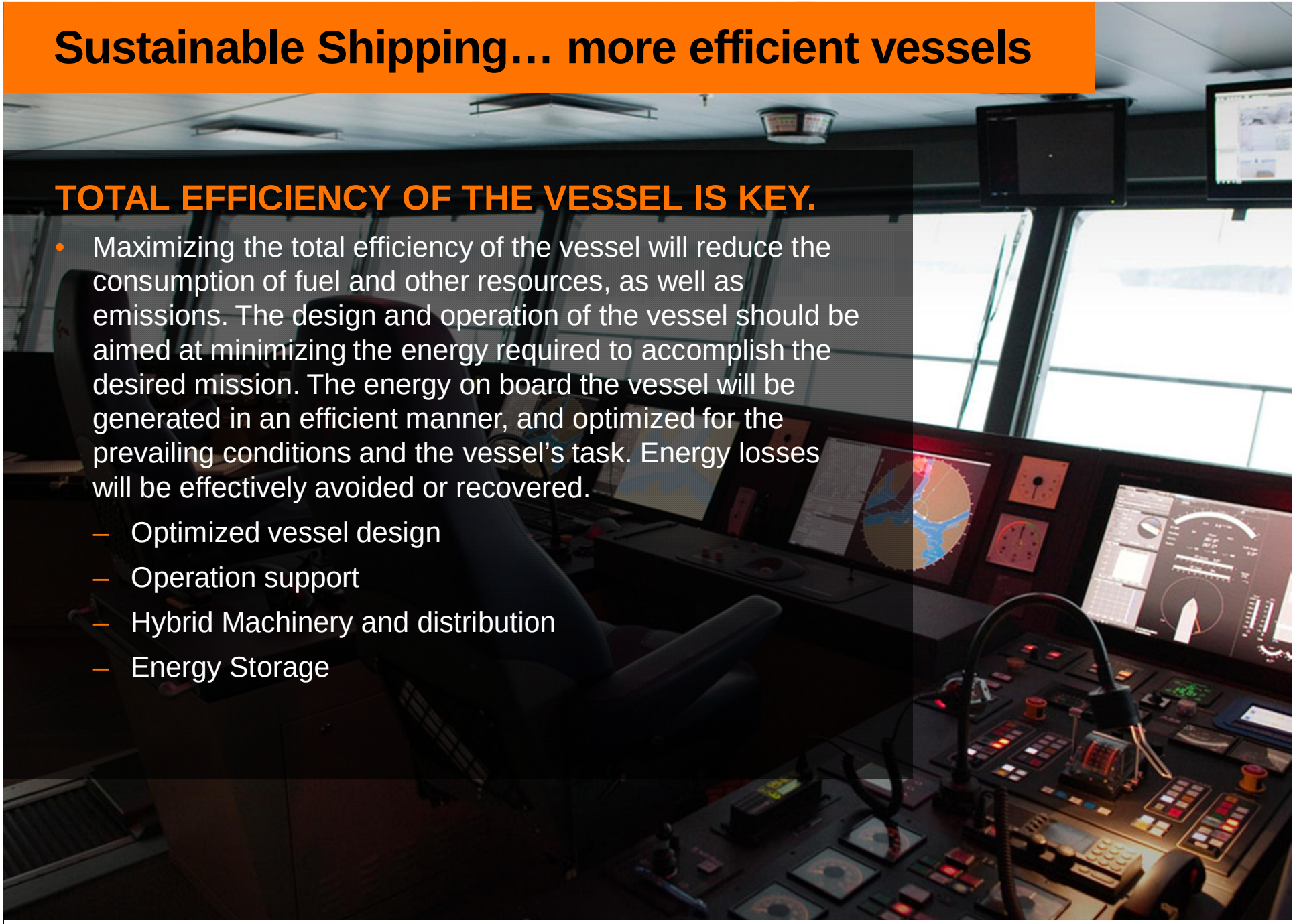
Sustainable Shipping what are the alternatives

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.
  - LNG / Gas
  - Biofuels
  - Hydrogen
  - Stored shore energy

Sustainable Shipping… more efficient vessels



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 support
  - Hybrid Machinery and distribution
  - Energy Storage

Sustainable energy sources

Future energy sources and technologies

- 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.
  - Wind and current assisted operation
  - Fuel Cells
  - Solar
  - Carbon Capture
  - Other energy carriers

Sustainable Shipping

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, route, location and infrastructure of the harbours
  - Optimal combination of fleet size, vessel size and speed

Sustainable Shipping

Tool box:

A. Flexibility in fuels (LNG, BIO, Hydrogen)
B. Flexebility in energy sources (Engine, energy storage, Fuel Cells, Wind assisted)
C. Flexibility in propuslsion train (Energy storage and hybrid systems)
D. Smarter equipment / Ships / Fleets
E. Efficient design
F. Vessel fit for purpose

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

The future needs sustainable shipping