



Sustainable Ship Operation – The Potential for Energy

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– Marine Transportation of Energy
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**Lloyd's
Register**

Objectives

1. Provide an appreciation of how the shipping industry, in terms of energy provision, can move towards a more sustainable future
2. Provide an overview of what Lloyd's Register is doing to facilitate such a move towards a more sustainable future

Sustainable shipping and sustainable energy

Moving towards a sustainable future...

Sustainability means different things to different people

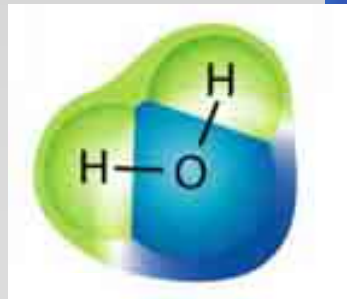
According to Renewable Energy & Energy Efficiency Partnership (REEP), *sustainable energy* has two key components...

- energy efficiency
- renewable energy



Sustainable shipping and sustainable energy

In the longer term high speed, ultra efficient ships powered by revolutionary sources of energy may make the provision of shipboard energy sustainable



Sustainable shipping and sustainable energy

In the near term however we need to be realistic about what is achievable

With respect to the provision of shipboard energy, near term sustainability is primarily about achieving two objectives...

- dramatically reducing fossil fuel oil consumption
- dramatically reducing airborne emissions, particularly CO₂

Sustainable shipping and sustainable energy

What is increasingly acknowledged however is that significant reductions in both fuel oil consumption and CO2 emissions can be achieved using a number of current or relatively near term operational and technical measures

Such measures are focused on...

- reducing energy demand
- using alternative sources of energy

Reducing energy demand - Operational measures

Figures suggest significant reductions in energy demand are possible through a range of operation measures including...

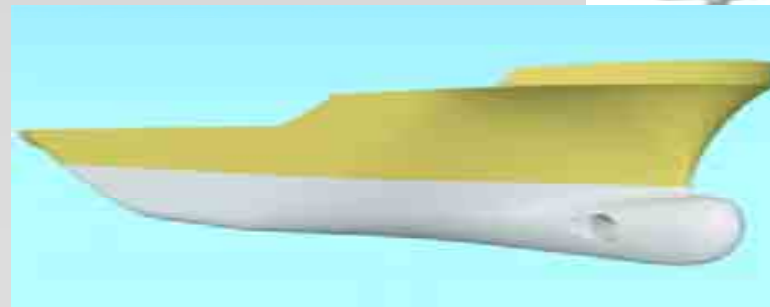
- voyage management (speed reduction, scheduling)
- passage planning (weather, currents)
- hull, propeller & rudder management
- engine & machinery management
- trim & ballasting



Reducing energy demand - Technical measures

Figures suggest equally significant reductions in energy demand are possible through a range of existing technical measures relating to the ships structure including...

- hull form
- hull coating
- hull lubrication
- lightweight material
- bulbous bow
- stern flap



Reducing energy demand - Technical measures

And through a range of existing technical measures relating to the ships engineering systems including...

- electric propulsion
- advanced and superconducting propulsion motors
- variable speed drives
- waste heat recovery
- propeller design



Alternative sources of energy

Significantly reducing the enormous energy demand associated with modern ship operation means that alternative and renewable energy sources can begin to make a meaningful contribution. Such sources include...

- gas-fuelled engines
- on-shore power supplies
- wind engines, sails and kites
- bio-fuelled engines
- photovoltaic arrays
- nuclear reactors
- fuel cell generators

The installation of such technologies onboard ships may require Rules and standards to facilitate their introduction

Gas-fuelled engines

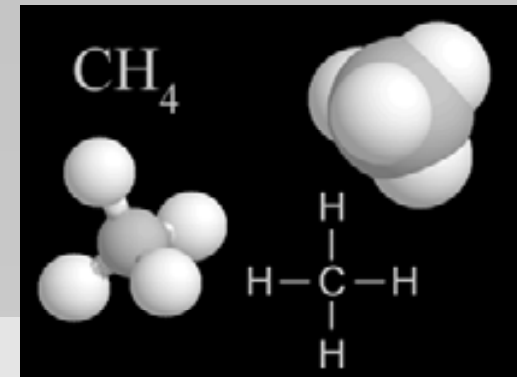
Potential for significant reduction in emissions marine fuel oils

- 30% lower CO₂ (low Carbon fuel)
- 85% lower NO_x (high air/fuel ratio), very low SO_x and PM

However limited availability and even less as liquid (LNG) Storage volume even for LNG up to 4 x greater than for MDO

Lloyd's Register's Provisional Rules for Methane Gas Fuelled Ships for all types of gas-fuelled machinery including single and dual fuel engines, gas turbines and boilers already published

Lloyd's Register is contributing to the development of the IMO IGF Code



Onshore power supplies

Elimination of all shipboard emissions berthed using shore power

Maximum benefit where shore power provided from local renewable source such as wind turbines

Lloyd's Register's Rules for On-Shore Power Supplies already published

Lloyd's Register is contributing to the development of ISO/IEC standard

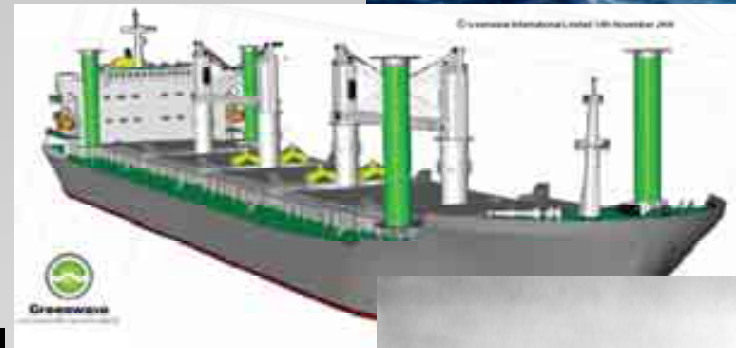
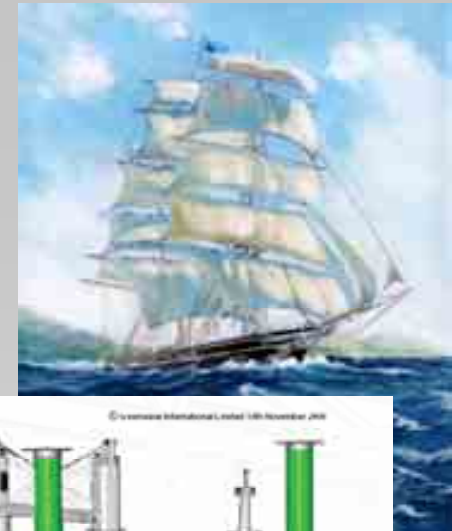


Wind engines, sails and kites

Conversion of renewable energy directly thrust with corresponding reduction consumption, CO2, NOx, SOx & PM

No doubt that sails, kites and wind engines have the potential for big reductions. But how practical with regard to modern ship operation

Lloyd's Register engaged with industry in wind engine demonstration project to examine the risks and, if necessary, publish guidance and/or Rules



Bio-fuelled engines

Second and third generation bio-fuels offer potential for carbon neutral shipping

Ethical issues aside, the use of bio-fuels introduces a number of technical issues which need to be addressed including engine fouling, corrosion and long term stability

Lloyd's Register engaged with industry in bio-fuel demonstration project to fully understand the risks and, if necessary, publish guidance and/or Rules



Photovoltaic arrays

Conversion of renewable energy using established technology

Reductions in both fuel consumption and emissions according to ship type corresponding to available surface area

Wide design potential with rigid and lightweight flexible technologies

Lloyd's Register engaged in studies looking at generation technology application to ship types



Nuclear reactors

While not a truly sustainable solution, fission offers the potential to reduce harmful emissions, using proven

Lloyd's Register's Rules for nuclear first published in 1966

Lloyd's Register engaged with industry in near and long term application and design studies



Fuel cell generators

Exhibit properties of batteries and generators.

Flexible and potentially have a low capital cost.

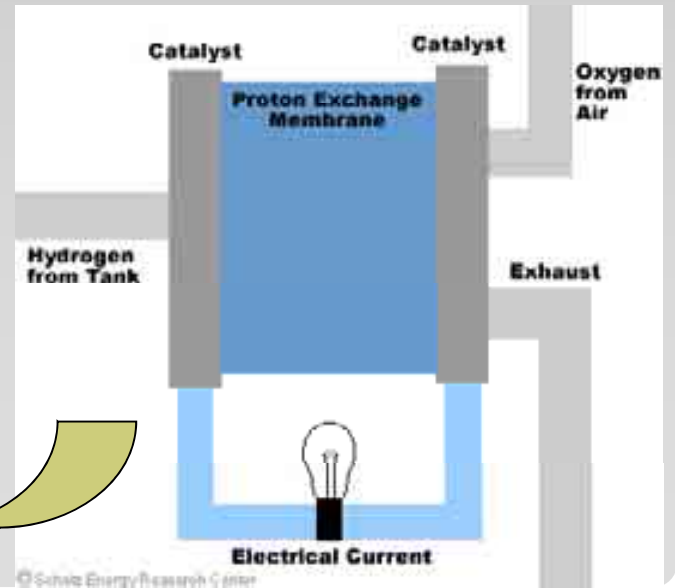
Potentially very efficient and benign



Fuel cell generators

Not heat engines – many types classed by electrolyte or operating temperatures (70 DegC to +1000 DegC)

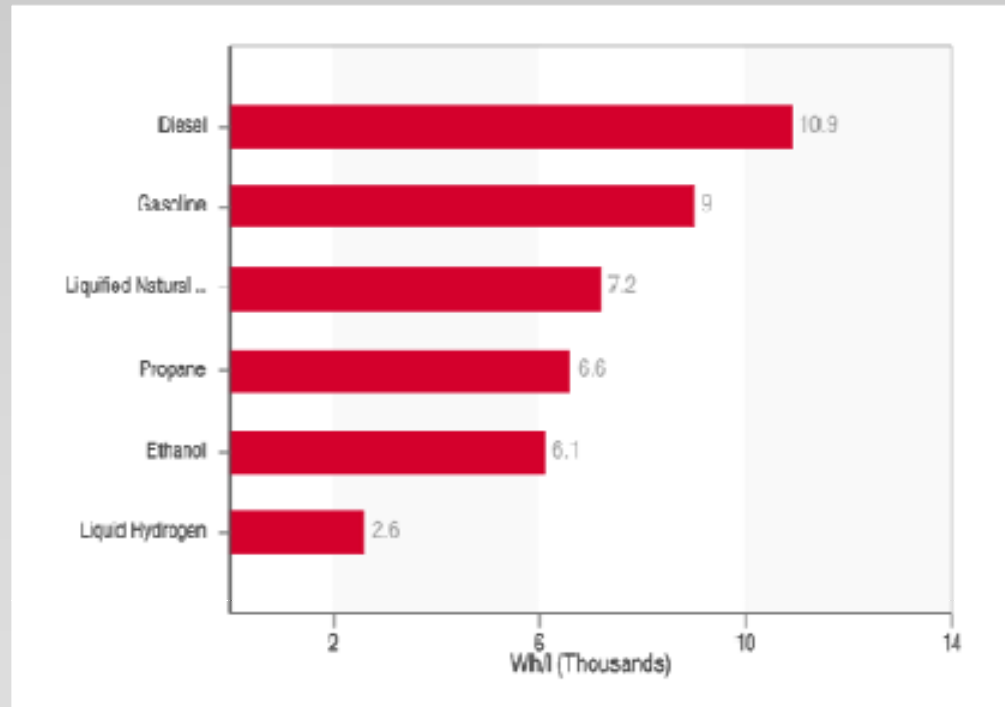
Lower temp tend to be hydrogen fuelled and higher temp generally natural gas fuelled.



Fuel cell generators

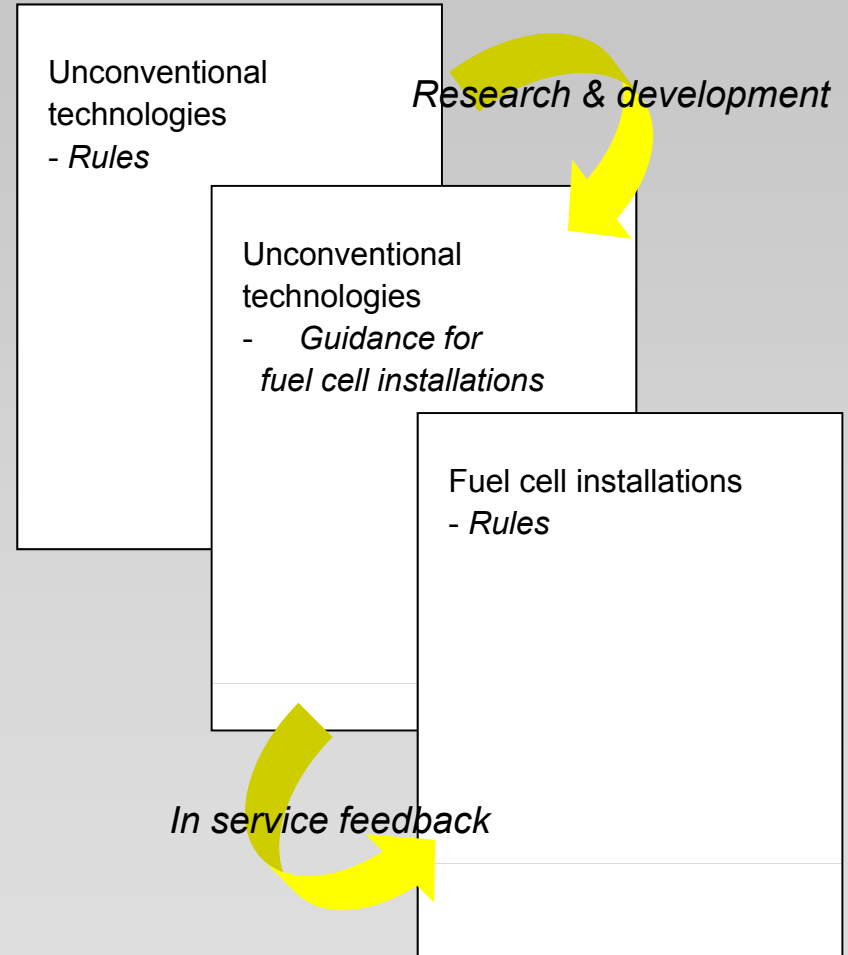
Key issues for marine applications...

- Fuel storage and availability
- Footprint
- Ship's lifecycle costs
- Sensitivity/reliability
- Safety

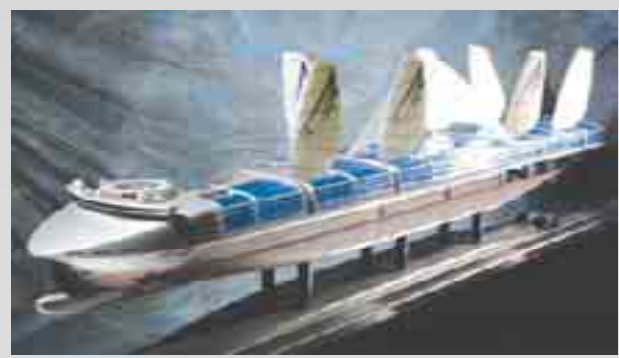
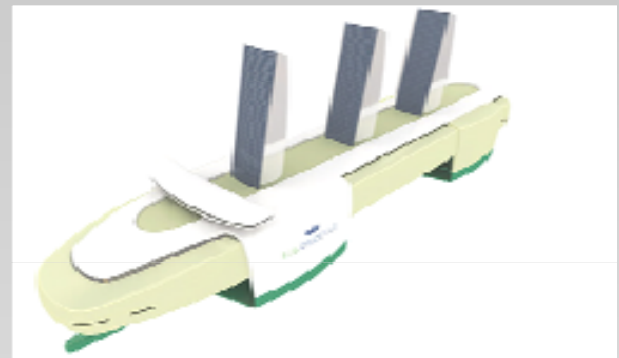
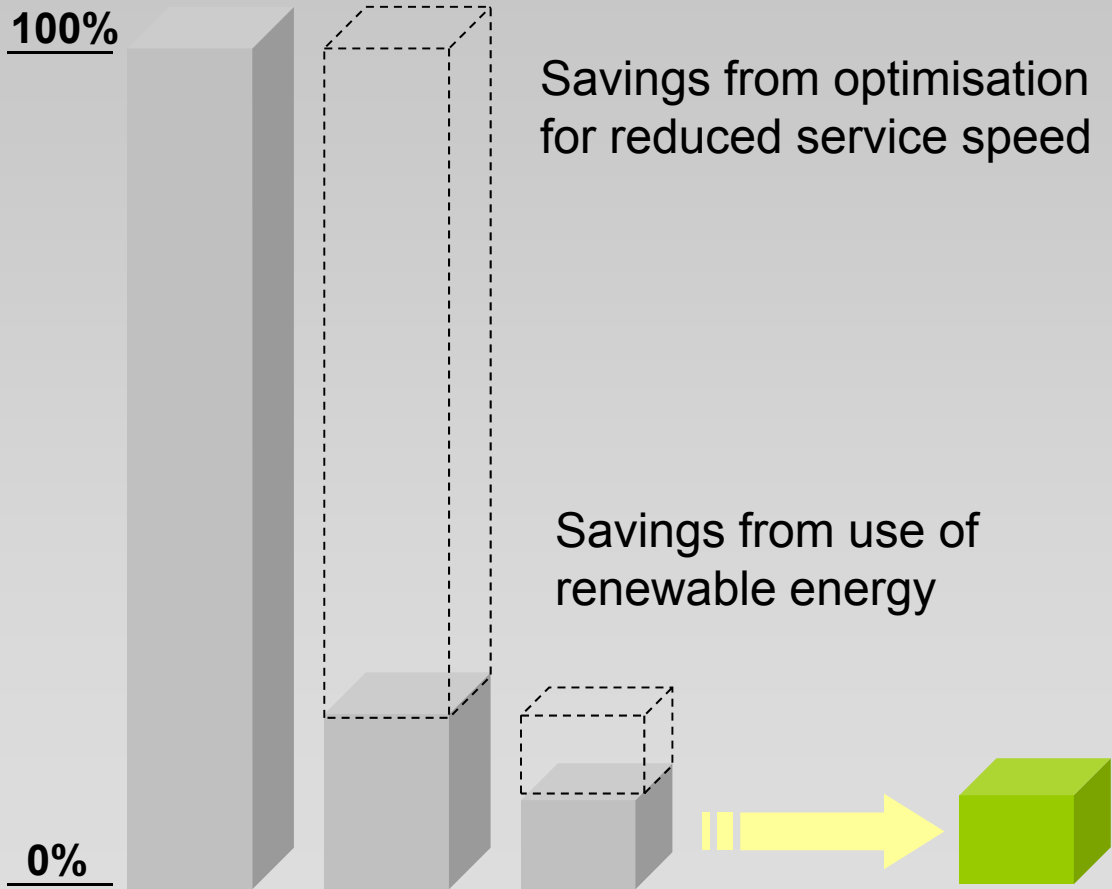


Fuel cell generators

Must use a risk-based approach
in the absence of data and
operational experience.



Near term sustainability



Conclusion

Sustainable ship operation within 30 years is feasible without the need for a breakthrough in technology

However, in order to achieve sustainability ships and shipping fleets will need to be optimised for efficiency rather than speed

Designing ships for optimum efficiency could reduce energy demand by up to 80% making renewable energy and sustainable fuels a viable alternative to fossil fuels

Ships could be operated at optimum efficiency if the imperative for sustainable shipping is recognised by all stakeholders in the industry



**Thank you for your
attention**

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