Decarbonisation pathways within deep sea shipping: Outlook and options

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Agenda.

- Initial IMO GHG Strategy
- Zero carbon fuels:
  - Investment Readiness
  - Technology Readiness
  - Community Readiness
- Deep Sea vs IWW
- Q&A
Why are zero-carbon fuels needed for full decarbonisation?

To achieve an absolute reduction in GHG of at least 50% by 2050.

- Shipping emits around 2.3% of global CO₂ emissions
- Unchecked increase to 10% by mid-century
What is the required reduction in carbon intensity?

- By 2050 shipping emissions will need to decrease by **60-90%** in fleet average carbon intensity in order to accommodate a growing demand of transport.

- Efficiency and renewables are not enough to reach the goal.

- Zero-emission vessels need to be entering the fleet from 2030.

![Graph showing required EEOIs for different vessel types from 2010 to 2050.](image-url)
Delivering on the Initial IMO Strategy

• Consensus on goal-based approach to short-term measures to improve the carbon intensity of shipping
• Amendments to MARPOL Annex VI
• Foundation not solution

Goal-Based Operational & Technical Efficiency Measures (All Ship)

Goal-Based Technical Efficiency Measures (Existing Ships)

A Hybrid

Mid- and Long-Term Measures to transition shipping from reliance on fuel oils
• Novel Regulatory Approaches
• Industry Initiative and Ambition

Encouraging Uptake of Low- and Zero-Carbon Fuels

Lloyd's Register
### What do we mean by zero-carbon fuels?

Transition to zero emission vessels means phasing out fossil based fuels.

<table>
<thead>
<tr>
<th>Energy source</th>
<th>Methanol</th>
<th>Gas oil</th>
<th>Hydrogen</th>
<th>Ammonia</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas with CCS</td>
<td></td>
<td></td>
<td>NG-H₂</td>
<td>NG-NH₃</td>
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</tr>
<tr>
<td>Biomass</td>
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Our ‘Getting to Zero’ model.

Marine product readiness level = Technology readiness level + Investment readiness level + Community readiness level
Technology readiness.

Onboard technology systems ready in 2-3 years

- Safety risks can be mitigated
- Experience building phase
- Technology challenge is the supply infrastructure
Comparative energy equivalence.

**LNG**
Mass ~x0.8  
Volume ~x2

**Methanol**
Mass ~x1.8  
Volume ~x2.4

**Ammonia**
Mass ~x1.8  
Volume ~x2.9

**Hydrogen 350 bar**
Mass ~x0.3  
Volume ~x15.5

**Hydrogen 900 bar**
Mass ~x0.3  
Volume ~x6.7

**Hydrogen -253 °C**
Mass ~x0.3  
Volume ~x3.3

Lloyd's Register
Investment readiness.

The cheapest option is still likely to be 2-3 times the total cost of ownership.

- The main cost driver is fuel price
- Need to reduce the cost of fuel production technologies
- Applying a carbon price makes the investment case more attractive ~ $200-300 / tonne of CO₂

- Uncertainty in future production costs: Direct Air Capture
Community Readiness.

Policy intervention and a fundamental shift to the incentives scheme is needed

- Fossil fuels need to be least attractive and zero-carbon fuels more attractive
- Closely related to how the wider energy system decarbonises
- Competition with other sectors
- Market incentive schemes
IWW and Coastal Shipping
Differences between Deep Sea and IWW?

Range and Size drive differences in onboard technology feasibility

Feedstock and production availability/cost still key drivers

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Zero-carbon fuels

Compressed vs Liquid storage

Fuel Cells: size
Technology readiness: Deep Sea vs IWW

- Safety risks can be mitigated
- Experience building phase
- Primary technology challenge is the supply infrastructure
  - IWW advantages
Conclusions.

- Certain pathways appear more resilient than others from the perspective of asset longevity
- Fuel price is the predominant factor
- Competitive options in the short-term may become uncompetitive in the long-term
- Many unknowns and uncertainties still exist
  
  I. Market price development
  II. Competing demand
  III. Technology development for fuel production
  IV. On-board safety
- Much overlap, but some material differences Deep Sea to IWW: IWW to lead Deep Sea?
Thank you.

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