

CO₂ Emission Reduction Technologies for Shipping

In recent years maritime shipping has emitted approx. one gigatonne of carbon dioxide (CO₂) per annum. Based on current trends this is projected to increase 150-250% by 2050, but the International Maritime Organisation has set targets of 30% reduction by 2030 and net-zero by 2050. This work reviewed the potential for different emission reduction technologies to reach those targets.

Key findings:

- Fuel switching (to nuclear, hydrogen, ammonia or biofuels) offer the highest emission reduction potentials, but may require significant green electricity inputs
- The reported reduction range for methanol is very wide depending mainly on production pathway and other factors
- Operational measures, voyage and speed optimisation offer moderate carbon reduction potential and can be deployed in the near term
- Structural changes to vessels (including hull design, coating and material choices) would take longer to implement and have relatively small reduction potential
- Cold ironing and onshore power can play a significant role but is constrained by grid capacity

Overall combining measures, rather than relying on a single solution, is the most practical and realistic approach for emission reductions in the sector.

POLICY RECOMMENDATIONS

- Mandating low-carbon fuels or similar measures to accelerate adoption can reduce emissions in the short term, alongside additional strategies to promote operational efficiency
- In the medium-term fuel switching, nuclear and shore-side electricity should be developed along with appropriate infrastructure
- Vessel design measures and supply chains can provide reductions, but these are unlikely to be sufficient to justify early vessel replacement
- Reaching emission targets will require a mix of measures including design, operational and fuel switching

Forthcoming research will explore scale-up limits on low carbon fuels by focusing on what constrains each decarbonization option in delivering its maximum emissions reduction potential.

RESEARCH PUBLICATION

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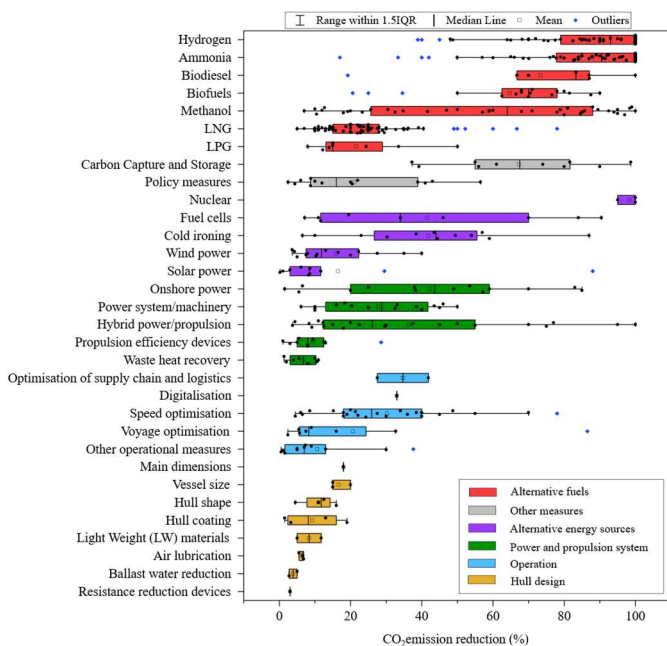


Figure. CO₂ emission reduction measures
Box & Whiskers Plot: Coloured boxes indicate the middle range (25%-75%) of reduction potential values, while the black lines on either side show the variability of the remaining data.

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