SUITABILITY AND FEASIBILITY OF ALTERNATIVE FUELS AND TECHNOLOGIES FOR DECARBONIZATION OF ENERGY SYSTEMS

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ABSTRACT

In the global effort to combat climate change, international and regulatory bodies, such as the International Maritime Organization (IMO) and the European Union (EU), are advocating for net-zero greenhouse gas emission strategies (e,g, "Fit for 55"), which vessels will need to adhere to avoid financial penalties. For instance, from January 2024, shipping companies will be required to purchase a European Union Allowance (EUA) per ton of CO2 emitted and submit it to the EU each year, considering that no carbon leakage occurs [1].

Thus far, no specific solution has emerged as predominant and shipping companies are faced with a plethora of technologies to consider for implementation, both on their newbuilding vessels and through retrofitting existing ones. Such solutions range from alternate fuels like LNG, Methanol, Ethanol, Ammonia and Hydrogen, to electric propulsion through Fuel Cells and other non-traditional technologies like On-Board Carbon Capture Systems, Wind-Assisted Propulsion and Nuclear Propulsion. For commercial ships, the selection process of these options is always case-specific and is made arbitrarily since there is still a need for literature which compares the different green propulsion technologies.

This paper will investigate the potential and limitations of each solution from feasibility, techno-economic, logistical, and regulatory standpoints to aid in informed decision-making within the maritime industry. In addition to comparing CO2 emissions for each technology with those of Heavy Fuel Oil (HFO), a comprehensive evaluation entails assessing factors such as cost implications, potential loss of carrying capacity, adherence to existing rules, regulations and guidelines (IMO, IACS classes), and the inherent challenges in implementing these technologies within existing ship infrastructure. Only systems directly affecting propulsion and emissions are examined here. Solutions such as route planning, electrification, hull optimisation, air lubrication and others which facilitate carbon emission reduction indirectly are not examined here as while they can be implemented in parallel with the above technologies, they cannot replace them.

References

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