21 December 2023

IUMI Policy Agenda

10. Safe decarbonisation and alternative fuels

Brief description

Climate change is considered one of the most pressing issues of our time. It has also been identified by IUMI as a major concern to marine insurers. The effects of global warming are already evident and are changing the nature of the insured assets. The frequency of weather-related catastrophes has increased significantly which drives up losses and leaves some assets uninsurable. The potential impact of climate change is therefore a fundamental issue for regulators.
The shipping sector accounts for approx. 3% of global CO_2 emissions. International agreements on the need to combat climate change require the reduction of greenhouse gas emissions from shipping. In addition to regulatory pressures from the IMO, other stakeholders such as banks, charterers and the broader public are setting requirements for the environmental performance of vessels, for instance in connection with the financing of new ships and new chartering agreements. Therefore, the industry must examine low and zero carbon ship propulsion systems taking into account the entire value chain, not just the combustion cycle.

There is currently no agreement on which fuel or fuels will be favoured and there can be very little progress without political support for the necessary infrastructure which is internationally absent. Notwithstanding the imperative of the green energy transition, it is crucial for carriers to assess potential safety concerns associated with measures to reduce the carbon footprint. Proper risk management is critical and safety must not be an afterthought.

In April 2018, the IMO adopted the Initial IMO Strategy on the reduction of GHG emissions from vessels. A revised Strategy was adopted by MEPC 80 in July 2023, setting a well-to-wake target of net-zero GHG emissions by 2050. Interim goals were agreed with a 20% reduction by 2030 (compared with 2008), including a 40% carbon intensity reduction target and 5% uptake of net-zero technologies, fuel and/or energy savings, and 70% reduction by 2040. There was also an agreement in principle on a new GHG intensity fuel standard and possible price on GHG emissions. These new GHG measures should be developed in view of adoption in 2025 and entry into force from 2027.

The Fourth IMO GHG Study 2020 is the first IMO greenhouse gas study published since the adoption of the Initial IMO Strategy on reduction of GHG emissions from ships. It demonstrates that whilst further improvement of the carbon intensity of shipping can be achieved, it will be difficult to reach IMO's 2050 GHG reduction ambitions through energy-saving technologies and speed reduction of ships. Therefore, under all projected scenarios, in 2050, a large share of the total amount of CO_2 reduction will have to come from the use of low-carbon alternative fuels.

In February 2023, IUMI co-sponsored a proposal for a new output at the IMO to undertake a regulatory assessment of safety aspects associated with reducing GHG emissions from vessels in line with the Organization's strategy and to develop a road map to support the safe delivery of IMO's strategy. The proposal was agreed by the Maritime Safety Committee in June 2023, and work will continue in a Correspondence Group coordinated by the United States in which IUMI participates.

The Marine Environment Protection Committee (MEPC) adopted in June 2021 a measure demanding energy efficiency requirements on existing vessels starting from 2023, and the introduction of carbon intensity targets for vessels with a first reporting deadline in March 2024.

IMO's Sub-Committee on Carriage of Cargoes and Containers (CCC) initiated in September 2021 the development of guidelines on the safety of vessels using hydrogen as fuel under the International Code for Ships using Gases or Other Low-flashpoint Fuels (IGF Code). The guidelines will address both liquefied and compressed fuel, and will be developed by a Correspondence Group. In April 2022, the Maritime Safety Committee agreed to develop guidelines for safety of ships using ammonia as fuel as an interim measure for newly built vessels. In September 2022, CCC 8 agreed on a holistic approach to the development of the guidelines for ammonia, tackling both safety and environmental considerations simultaneously. The work will continue in a Correspondence Group and is scheduled to be finalized in 2024.

The European Union is implementing its own legislation through their Fit for 55 package. In January 2024, the EU's Emissions Trading System (EU ETS) will be extended to cover CO_2 emissions from all large ships (of 5 000 gross tonnage and above) entering EU ports, regardless of the flag they fly. In addition, the package includes a requirement for owners to buy cleaner fuels and ports to ramp up supply of shore power and liquefied natural gas (LNG) as fuel.

A significant push for decarbonisation in the maritime industry is not only underway within regulatory authorities but also in form of various industry initiatives comprised of a diverse range of maritime stakeholders, e.g. the Poseidon Principles for Marine Insurance. These efforts are necessary as the existing fleet is going to be non-compliant with IMO requirements soon. Changes in vessel design, fuel and propulsion types, and infrastructure will affect the risk landscape for marine insurers going forward. Marine insurers must be prepared to assess new risks and potential safety concerns. Moreover, they are likely to play a role as facilitators for decarbonisation by providing guidance and advice to their insureds.

An important aspect of using alternative fuels safely is not only a comprehensive review of risks associated with the new fuels and propulsion methods, but also thorough consideration of how human performance may be influenced by new equipment, new ways of collaboration, and new procedures and processes for bunkering. At the same time, conventional fuel types will be in use for the foreseeable future and until the transition period is concluded.

Low/zero carbon fuels

Ammonia

Ammonia offers a potential long term solution for the maritime industry's transition towards a low carbon value chain. Green ammonia can be produced from renewable power by electrolysis of H_2O, making it a zero carbon fuel. However, due to the extreme toxicity of the fuel it is critical to assess the safety issues of ammonia in order to mitigate risks for people, assets and the environment. Risks such as toxicity and flammability must be addressed for both key equipment, spaces dedicated to ammonia storage and alternative vessel designs. Unless satisfactory safety systems and operations are implemented, the properties of ammonia may lead to an increased overall risk level associated with its use as fuel on vessels.

Battery-powered propulsion

~~Battery-powered propulsion is suitable for stop-and-go operating cycles such as ferries.~~ Ferry operators in Europe, North America and Asia have been testing and deploying hybrid propulsion systems for the last decade, and the technology has been adopted for passenger vessels of various sizes.

Thermal runaway constitutes the largest risk for batteries used in maritime operations. Thermal runaway occurs if the lithium-ion cells used in marine batteries are subjected to mechanical abuse, suffer from internal manufacturing defects, or operate over or under the correct voltage or internal temperature. In these situations, heat may be generated within the lithium-ion cells which may increase to a point whereby it melts the separators inside the cells. This reaction can result in the temperature increasing until the cell emits toxic and flammable gasses. If ignition occurs, these gasses can create a fire which can be difficult to extinguish. In large concentrations, these gasses are also capable of causing explosions. Preventing thermal runaway is therefore key, for instance through the use of active cooling systems and internal thermal barriers as part of an effective safety management system.

Biofuels

Biomass is a renewable fuel source. Its use for marine fuels can be considered a carbon neutral way of generating energy because the organic matter used to produce biofuels roughly absorb as much CO_2 during their lifetime as they release when burned. Biofuels are produced from organic matter that is largely unsuitable for food or feed. However, their potential to reduce the amount of arable land earmarked for normal food production is contentious.

For biodiesel, fuel lubricity, conductivity and corrosion are areas of concern. Due to oxidation, it tends to lose lubricity over long periods of time, which may cause wear on essential components. Because electrical conductivity can cause static charges, it is likely to need anti-static additives. Corrosion from the degradation of biodiesel can weaken steel holding tanks and pipelines over time, compromising storage and transportation. Biofuels with high acidity can cause increased wear on engine components, so the engine manufacturer should be consulted when considering the use of fatty acid methyl esters (FAME) in a conventional engine. In the latest specification, ISO 8217:2017 recommended limiting the proportion of FAME in distillate fuel oil blends to 7%, creating the first industry standard for fuel oil with a provision for biofuel. There may also be contamination risks.

Fuel cells

Fuel cells produce energy from an electro-chemical process. Two reactants, typically hydrogen and oxygen, merge within the fuel cell to produce water, releasing electrical energy and thermal energy in the process. Although hydrogen is the most commonly used fuel in fuel cells, methanol and ammonia are viable alternatives. The reactants consumed by the fuel cell are stored externally and are supplied to the fuel cell in a similar way as in conventional diesel engines. Hence, a fuel cell has the potential to produce power as long as it has a supply of reactants.

Hydrogen, methane and other gaseous fuels that are lighter than air need special ventilation arrangements to prevent the creation of hazardous areas. For many types of fuel cells, the non-hydrogen supply is externally reformed to hydrogen and other by-products prior to introduction into the fuel cell, so the hydrogen portion of the fuel system needs special consideration. Fuel management, identifying the risks to personnel and managing the hazardous areas associated with the ships' physical layouts, operations and maintenance are key safety challenges with fuel cell systems. Toxic exposure, asphyxiation and explosions are among the risks to crews and the vessel.

Hydrogen

Hydrogen is a potential alternative fuel for ship propulsion. It requires energy to produce hydrogen which could originate from conventional fuels or non-fossil sources such as wind, hydro-electric or nuclear to make it low/zero carbon. For hydrogen, challenges relate to extremely low temperatures (-253°C) if stored as a liquefied gas, and high pressure (250–700 bar) if stored as compressed gas. The hydrogen molecule is the smallest of all molecules, making it challenging to contain. It also has a wide flammability range and ignites easily. The properties of hydrogen may therefore lead to an increased overall risk level associated with its use as fuel on ships unless satisfactory safety systems and operations are implemented.

Asphyxiation and explosions are potential risks for the crew and the vessel. For the onshore and offshore personnel, an extensive assessment of the hazards associated with physical layout, operations, maintenance, transfer and carriage of the fuel are necessary to ensure safe operations. Onboard ventilation, alarm systems and fire-protection strategies and other measures to limit the likelihood and effects of leakage will need to be designed into hydrogen-dedicated assets.

Liquid natural gas (LNG)

Liquefied natural gas (LNG) is the cleanest-burning fossil fuel currently available at scale; its use as a marine fuel is supported by advanced engine technologies that have been proven in practice. As a fuel, it reduces nitrogen oxide (NOx) emissions, eliminates most sulfur oxides (SOx) and particulate matter, and contributes to carbon dioxide (CO_2) reduction. However, methane slip is a cause for concern because methane, when considered as a greenhouse gas, is much more potent than CO_2.

Familiarity with the properties and characteristics of methane is critical to understanding the safety hazards associated with the use of LNG as a marine fuel. It is not considered to be corrosive nor toxic. Instead, the hazards are related to its storage, transport and combustion, and they also include cryogenic temperatures, vapour flammability and asphyxiation. Due to heat leakage through the insulation into the LNG cryogenic tanks, some of their contents continuously evaporate and generate boil-off gas, which increases tank pressure, potentially raising the risk of LNG and methane vapour releases. Those vapours are flammable and have the potential to asphyxiate workers. If a vapour spill comes in contact with a ship's structure, it causes brittleness and fracturing.

In a liquid state, LNG is not considered flammable and cannot ignite. However, LNG vapours become flammable when the percentage of methane in air reaches 5-15% and it can ignite when introduced to an ignition source. The auto-ignition temperature of methane is relatively high (595ºC). When released from LNG, methane vapours will at first be heavier than air and then rapidly become lighter than air as it warms beyond -100ºC. It is therefore crucial that safeguards are in place to prevent a flammable mixture from occurring, and to ensure that any sources of ignition are nowhere near.

Nuclear

This source of power has been considered in the past and work was paused after Fukushima. Given the problems associated with other alternative fuels, research into the viability of nuclear propulsion for vessels is being actively undertaken with much hope focused on molten salt reactors.

Relevant authority / organisations and documents

- **IMO – MEPC & MSC**
    - ***MSC.1/Circ. 1622:*** Guidelines for the acceptance of alternative metallic materials for cryogenic service in ships carrying liquefied gases in bulk and ships using gases for low-flashpoint fuels, 2 December 2020.
    - ***MSC.1/Circ. 1599/Rev.1:*** Revised interim guidelines on the application of high manganese austenitic steel for cryogenic service, 4 December 2020.
    - ***MSC.1/Circ. 1621:*** Interim guidelines for the safety of ships using methyl/ethyl alcohol as fuel, 7 December 2020.

  - ***CCC7/3/9***: Comments on CCC7/3/Rev.1 and proposal for developing guidelines for the use of ammonia and hydrogen as fuels, 14 June 2021.
  - ***MSC104/15/9***: Development of non-mandatory guidelines for safety of ships using ammonia as fuel, submitted by Japan, Singapore, ICS and INTERCARGO, 2 July 2021.
  - ***MSC104/15/30:*** Necessity of deliberations on operational safety measures and fire safety measures, submitted by Japan, 30 July 2021.
  - ***A32/12/2:*** The development of safety requirements at the needed pace and detail to support the achievement of a decarbonization goal, submitted by IACS, 23 November 2021.
  - ***MSC105/2/2:*** The development of safety requirements at the needed pace and detail to support the achievement of a decarbonization goal, submitted by IACS, 15 February 2022.
  - ***CCC8/13:*** Report of the Correspondence Group – safety information for the use of ammonia, 17 June 2022.
  - ***CCC8/2/1:*** The development of safety requirements for alternate fuels and technologies at the needed pace and detail to support the achievement of the IMO's decarbonization goals, submitted by IACS, 14 July 2022.
  - ***CCC8/WP.3:*** Report of the working group (low-flashpoint fuels, ammonia & hydrogen), 22 September 2022.
  - ***SSE9/INF.8:*** Experimental study for basic considerations of characteristics of hydrogen dispersion and explosion in ships, submitted by the Republic of Korea, 23 December 2022.
  - ***MSC107/17/21:*** Proposal for a new output to facilitate a regulatory framework to support the safe delivery of IMO's strategy on reduction of GHG emissions from ships, submitted by Belgium, Cook Islands, Germany, Greece, Kingdom of the Netherlands, Panama, Republic of Korea, United Arab Emirates, United Kingdom, ICS, IUMI, BIMCO, IACS, OCIMF, INTERTANKO, SIGTTO, IBIA and SGMF, submitted 28 February 2023.
- **EU**
  - ***COM(2021)562:*** Proposal for a regulation on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC ('FuelEU'), 14 July 2021
  - EMSA: Guidance on the safety of battery energy storage systems on board ships, November 2023
- **U.S.**
  - ***Environmental Protection Agency (EPA):*** North American Emission Control Area: http://www.epa.gov/otaq/oceanvessels.htm#north-american
  - ***Coast Guard:*** Safety Alert 10-18: U.S. Gulf Coast bunker contamination, 8 June 2018.
- **ABS:** Advisory on decarbonization applications for power generation and propulsion systems, March 2022.

- **The Maritime Just Transition Task Force:** Position Paper - Mapping a maritime just transition for seafarers, 9 November 2022.
- **Mærsk Mc-Kinney Møller Center for Zero-carbon Shipping & Lloyd's Register:** Recommendations for design and operation of ammonia-fuelled vessel based on a multi-disciplinary risk analysis, 26 June 2023.
- **Poseidon Principles for Marine Insurance** launched in 2021

Timeline / important dates

- Adoption of initial IMO GHG Emission Reduction Strategy, 2018
- 2nd IMO symposium on low- and zero-carbon fuels for shipping: 21 October 2022.
- IMO Energy Efficiency Existing Ship Index (EEXI) enters into force 1 January 2023.
- Adoption of revised IMO GHG Emission Reduction Strategy, July 2023

IUMI will:

- Increase awareness for alternative low and zero carbon fuel types and propulsion methods, and contribute towards any necessary safety regulation amendments.