

The Prospect of Ammonia-fueled Ships and Challenges for Commercialization

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Rather than doubting the feasibility of ammonia-fueled ships, the aim is to lift the barriers to the commercialization of the vessels.

The Prospect of Ammonia-fueled Ships

When I first encountered ammonia as a zero-carbon fuel in 2018, I had doubts about its feasibility for technical reasons due to its poor combustion characteristics, and for safety reasons due to its toxicity. I wasn't sure that those challenges could be overcome. However, the limited options for achieving IMO's carbon reduction targets have since prompted the push for commercialization of ammonia-fueled ships.

Multiple engine manufacturers are nearing completion of the development of ammonia fuel engines and their commercialization is expected in 2025. The IMO is rapidly progressing the development of ship safety provisions and is planning to implement an interim guideline in 2025.

Ship owners should consider using ammonia as a fuel, but uncertainties such as the economics and safety of ammonia fuel, availability of fuel supply, and related regulations add to the complexity of ship owners' decision making. However, looking at recent trends and the predictions of the international community, there is a trend towards resolving the uncertainty of ammonia as a fuel.

Economics

LNG-fueled ships, due to their fuel storage tanks and fuel supply facilities, currently command the highest new construction price of all alternative fueled ships, followed by ammonia-fueled ships and methanol-fueled ships. As for the operating costs required, fuel costs and, additionally, regulatory costs due to environmental regulations such as carbon taxes must be considered. As regulations continue to be strengthened, these costs will increase. Fossil fuels, currently used in most ships, benefit from lower fuel prices, but in the future, green fuels such as biofuels or e-fuels will be competitive due to increasing regulatory costs. The predicted future price of fuel varies depending on the data, but considering the average value of each predicted price, green ammonia is expected to be the most dominant of the green fuels.

According to KR's analysis of the economic feasibility of alternative fuels for mid to large-sized ships (although the analysis does contain some uncertain factors), LNG-fueled ships are the most economical when considering both new construction prices and operating costs, followed by ammonia-fueled ships. Since ammonia-fueled ships have not yet been commercialized, it is expected that they will be able to achieve greater competitiveness if sufficient orders for ammonia-fueled ships and bunkering infrastructure are realized.

Safety

To ensure the safety of ammonia-fueled ships, KR conducted a risk analysis and joint research with the industry for ammonia toxicity, and also studied cases of land-based ammonia plants alongside safe ammonia concentration standards applied to the workplace. Based on this study, an agenda document proposing safety principles and safety requirements for ammonia-fueled ships was submitted to the IMO and this document is now being used to develop the industry safety standards for ammonia-fueled ships.

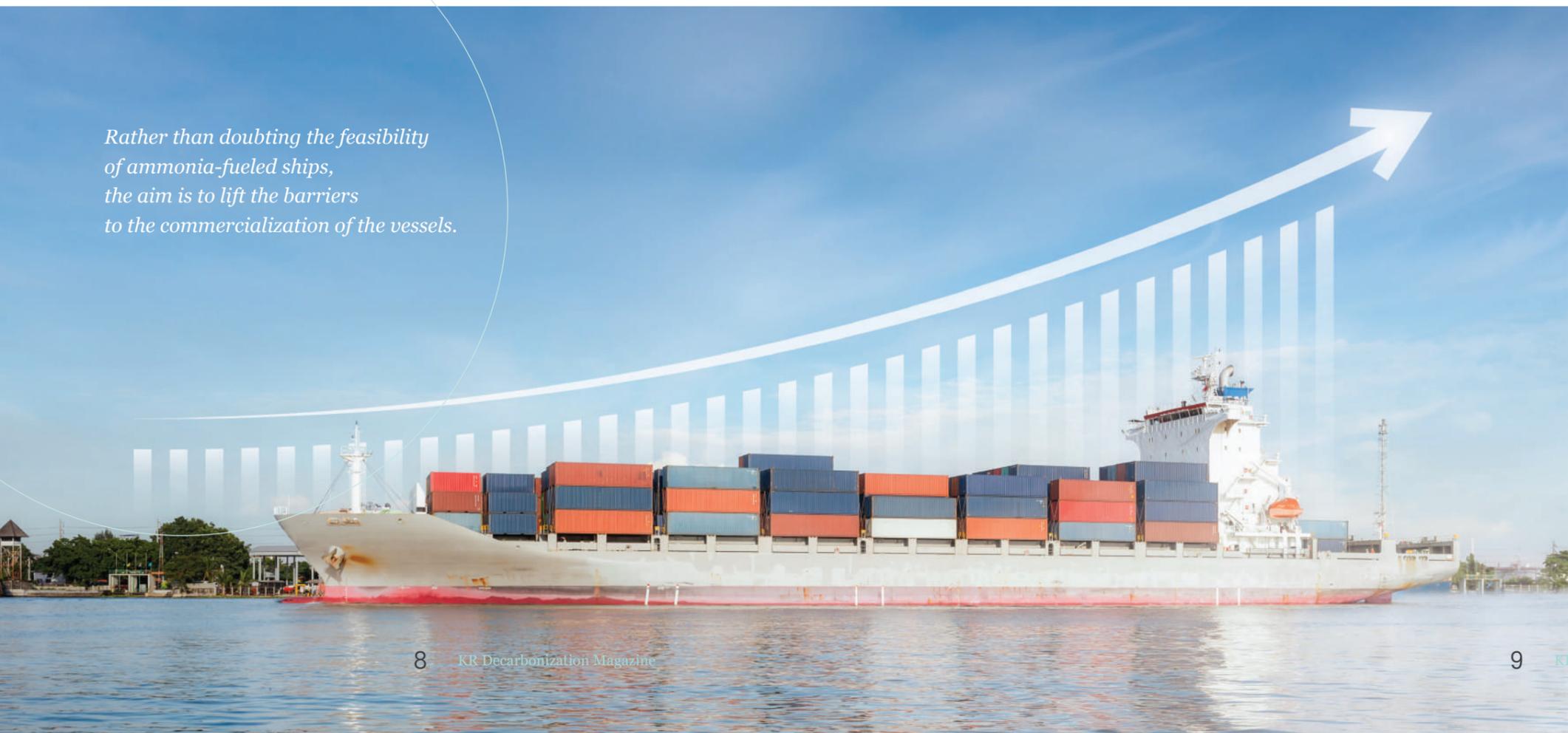
Since ammonia can pose a fatal risk to human health even at low concentrations, it is necessary to determine the ammonia concentration level that is harmless to the human body and take safety measures to prevent crew members from being exposed to concentrations exceeding this. Anticipated sources of release within the ammonia fuel system can be identified and technology exists that is able to abate the concentration of released ammonia within limits.

In addition, in engine rooms where there is a high risk of gas leakage, the fuel supply pipe is composed of a double walled pipe. Any gas leakage in the engine room can then be prevented by detecting gas leakage within the double pipe system and activating fuel shutdown systems. This is a safety concept that has been applied to LNG-fueled ships for a long time, and the safety of gas leak prevention within the engine room can be regarded as verified.

Accommodation spaces are isolated from toxic areas, and any sources of gas release such as ventilation outlets and fuel pipe vent outlets in gas hazardous areas are provided with ammonia treatment systems to ensure safety by reducing the ammonia concentration to an allowable concentration.

In an emergency situation such as a fire, it is not realistic to dispose of huge amounts of ammonia gas released from the pressure relief valves of fuel tanks, so a safe haven onboard with safety measures for crew members is provided.

In addition, in order to ensure the safety of crew members, the human element such as management and operating procedures of ammonia facilities are important in addition to the ship safety system. Therefore, the training of seafarers is an important issue, and it is expected that additional requirements for ammonia fuel will be developed based on IMO's STCW Code A-V/3 (training requirements for seafarers working on IGF ships).



The Challenges to Commercialization for Ammonia-fueled Ships

Although the industry and regulatory bodies are making great efforts to use ammonia as a fuel for ships, there are many challenges that must be resolved for the commercialization of ammonia-fueled ships. At this point, I would like to suggest a way forward to address the following challenges of operating ammonia-fueled ships.

Social License

Social consensus and the efforts of various stakeholders are needed to resolve concerns about community sensitivity, crew safety, and port safety due to the toxicity of ammonia. In order for ammonia fuel to be socially accepted, efforts must be made to share the justification of ammonia fuel for GHG reduction and to explain its safety by utilizing the verified safety records of existing onshore facilities such as ammonia terminal facilities. The international community should also share the experiences of first mover countries that have already introduced ammonia-fueled ships.

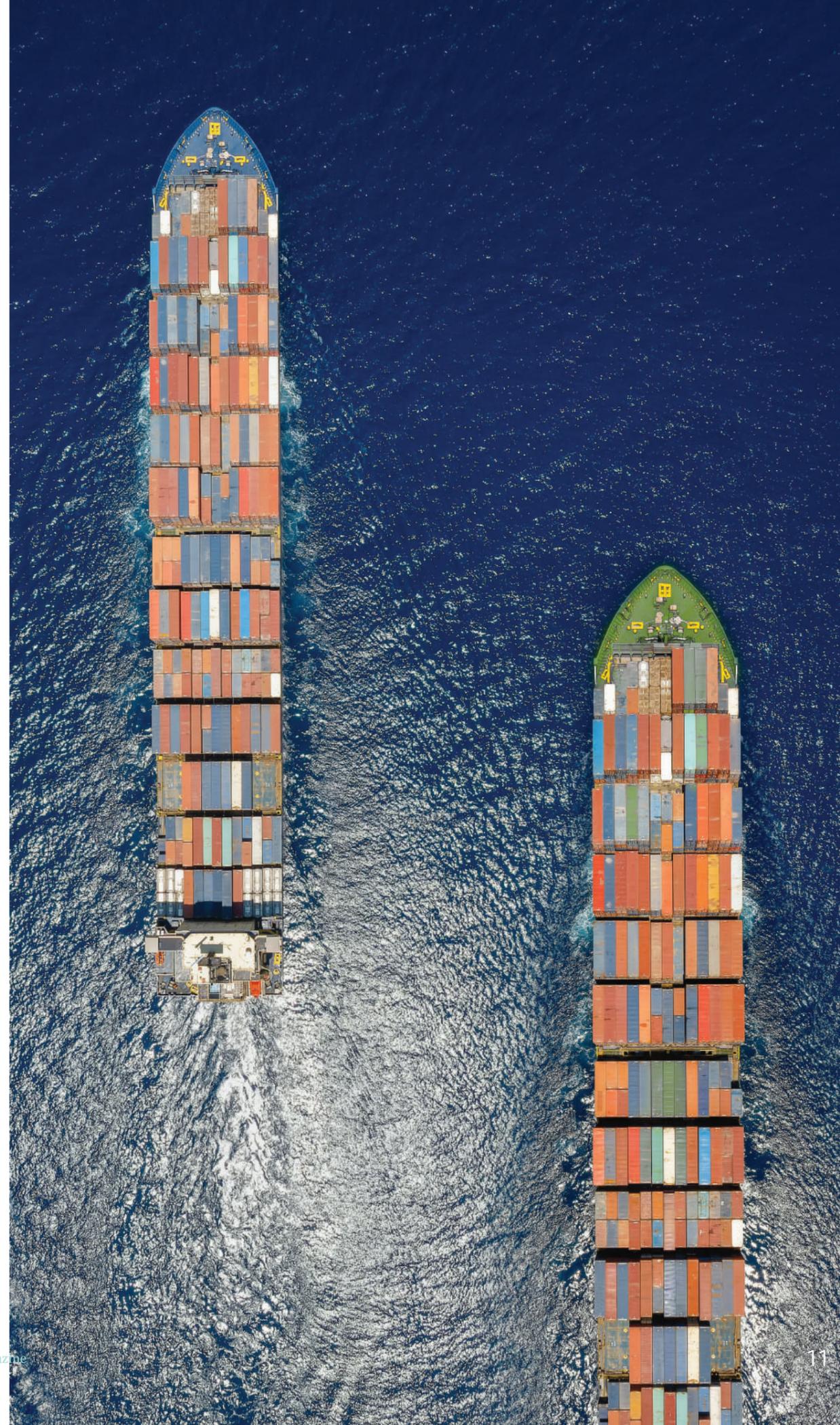
Ship Safety Regulations and Port Regulations

At the 9th meeting of the CCC held in September this year, three draft Interim Guidelines were proposed, and based on these, there was intensive discussion on safety regarding the toxicity of ammonia. As a result, a consensus was almost reached on the safety principles (ammonia leak scenario, toxic concentration criteria for crew safety, etc.) that form the basis for safety provision development. The corresponding group during the session will develop a high-maturity draft, with the final draft expected to be developed at the 10th CCC.

In order to commercialize, in addition to ship safety provision, port regulations must be established in a timely manner to enable ship entry and bunkering. To achieve this, communication and collaboration between flag state and port authority is necessary. In addition, unlike ship safety regulations, port regulations are implemented in each country, experiences should therefore be shared to build best practice and international organizations such as IAPH and SGMF should provide guidelines for safe port entry and bunkering.

Availability of Fuel and Scalability of Infrastructure

Currently, production costs are high because the demand and production technology for green ammonia are not yet mature, but production costs are expected to decrease as production efficiency and technology develop due to an increase in supply. It is certain that demand for green ammonia will expand not only for ship fuel but also for power generation and hydrogen transportation, and as a result, production volume will increase and supply infrastructure will also expand. In addition, if governments implement a policy to help bunkering operators, and along with shipping companies they receive financial support, the operation of ammonia-fueled ships and the construction of bunkering infrastructure will accelerate.



Education and Qualifications of Seafarers

Education and qualifications are critical to ensure the safety of crew members. Especially when you consider that most accidents at existing industrial ammonia sites are caused by the human element such as poor maintenance, poor driving, and non-compliance with safety procedures rather than safety standards or technical problems. Requirements for the training and qualifications of seafarers are covered in the STCW Code. With the adoption of the IGF Code at the 95th MSC, IMO revised the STCW Code and added the training and qualification requirements for seafarers working on IGF ships as A-V/3. STCW Code A-V/3 is not limited to LNG and considers all possible low flash point and gaseous fuels, so it also addresses toxicity. IMO should prioritize the development of crew training and qualification requirements for ammonia-fueled ships based on the STCW Code A-V/3 and ensure that training requirements are prepared in line with the implementation of the ammonia-fueled ship interim guidelines.

Various Stakeholders

The commercialization of ammonia-fueled ships involves various stakeholders, including regulatory bodies (flag state and port authority), ship owners, shipyards, engine manufacturers, and fuel suppliers. Communication and collaboration among stakeholders are important. Additionally, in order to elicit active implementation commitment and investment from these stakeholders, solutions to uncertain issues such as access to capital, regulation, and sustainability must be presented. Institutional policies such as green shipping corridors could motivate stakeholders to promote the rapid establishment of infrastructure for ammonia-fueled ships. Through green shipping corridors, government will be able to provide incentives and financial support for the operation of ammonia-fueled ships and fuel supply infrastructure and establish port and bunkering regulations.

Preparing for the Era of Ammonia-fueled Ships

Rather than having doubts about the feasibility of ammonia-fueled ships, the international community is identifying barriers to the commercialization of ammonia-fueled ships and discussing ways to resolve these. The IMO is developing safety requirements by considering all possible risk scenarios to protect crews from the toxicity of ammonia, and the industry is accelerating the development of effective safety equipment for ammonia fuel. Some first movers are conducting pilot projects for ammonia-fueled ships aiming to operate in 2025. Singapore, a bunkering hub, and many other countries, are preparing to build ammonia bunkering infrastructure. The era of ammonia-fueled ships is fast approaching and now is the time for us to prepare for ammonia-fueled ships.