Trends in Alternative Fuel Ships and Activity of the Society

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1. INTRODUCTION

The International Maritime Organization (IMO) adopted new targets for greenhouse gas (GHG) reduction at the meeting of the Marine Environment Protection Committee (MEPC80) held in July 2023. Prior to MEPC80, the targets adopted in 2018 called for improvement of fuel efficiency by at least 40 % compared to 2008, to be achieved by 2030, and as reductions in GHG emissions, a reduction of total emissions by at least 50 % by 2050 and zero GHG emissions "as soon as possible in this century." In the new targets, IMO set goals of reducing GHG emissions by 70 to 80 % by 2040, aiming at "net-zero GHG emissions from international shipping close to 2050." (Fig. 1)

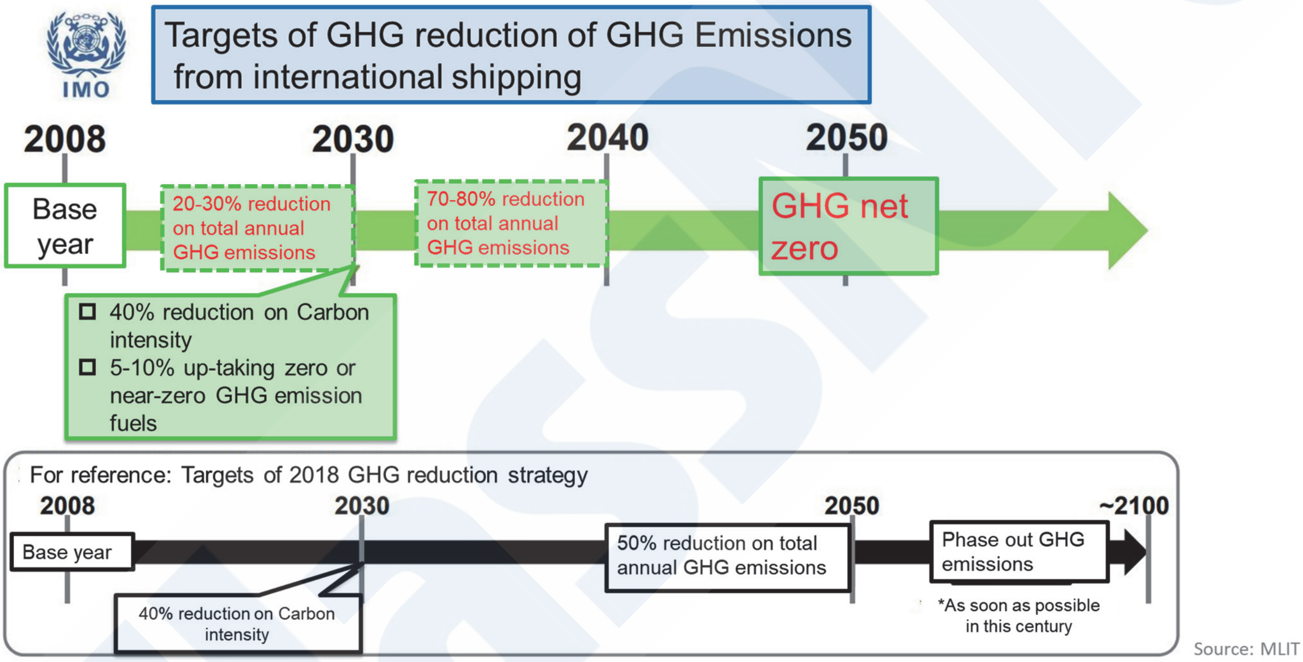


Fig. 1 Targets for reduction of GHG emissions from international shipping

Achievement of the target of IMO strategy for 2030 is considered possible by improving the energy efficiency of existing ships and newbuilding ships with high energy efficiency. However, to achieve the targets for reduction of GHG emissions from international shipping for 2040 and 2050, which are substantially more stringent than the previous 2018 targets, the use of GHG reduction technologies and low-carbon or zero-carbon alternative fuels is considered indispensable. Against this background, construction of ships that introduce low-carbon or zero-carbon alternative fuels is expected to increase, and in fact, many projects are being launched in Japan and other countries.

This report introduces the trends in alternative fuel ship and the initiatives of the Society.

2. ALTERNATIVE FUEL CERTIFICATION SCHEMES

As alternative fuels which are either already in use in shipping or can be assumed as alternative fuels, LNG, LPG, methanol, ammonia and hydrogen may be mentioned. Table 1 shows IMO and Society codes and guidelines for the alternative fuel ships and the related technologies.

Table 1　Codes and guidelines for alternative fuel ships and related technologies

<table>
<tr><th>Alternative fuel/
related technology</th><th>IMO code/guideline</th><th>ClassNK rules/guideline</th></tr>
<tr><td>LNG</td><td>IGF Code</td><td>Technical Rules and Guidance,
Part GF, Ships Using Low
Flashpoint fuels</td></tr>
<tr><td>Methanol</td><td>Interim Guidelines for Ships Using
Methyl / Ethyl alcohol as Fuel
(MSC.1/Circ.1621)</td><td rowspan="4">Guidelines for Ships Using
Alternative Fuels (Edition 3.0)
(Methyl/Ethyl Alcohol, LPG,
Ammonia, Hydrogen)
Aug. 2024</td></tr>
<tr><td>LPG</td><td>Interim Guidelines for the Safety of Ships
Using LPG Fuels (MSC.1/Circ.1666)</td></tr>
<tr><td>Ammonia</td><td>Under development
(Finalized at Sept. 2024 CCC10 and will
be adopted at MSC109 in December,
2024)</td></tr>
<tr><td>Hydrogen
(as fuel)</td><td>Under development
(to be finalized at CCC11, Sept. 2025)</td></tr>
<tr><td>(Ships transporting
liquefied hydrogen)</td><td>Interim Recommendations for Carriage of
Liquefied Hydrogen in Bulk
(Res.MSC.420(97))</td><td>Guidelines for Liquefied
Hydrogen Carriers (Edition 2.0)
Sept. 2023</td></tr>
<tr><td>Fuel cells</td><td>Interim Guidelines for the Safety of Ships
Using Fuel Cell Power Installations
(MSC.1/Circ.1647)</td><td>Guidelines for Fuel Cell Power
Systems on Ships (Edition 2.0)
Sept. 2023</td></tr>
</table>

IMO has issued the IGF Code for LNG-fueled ships, and the Society has also issued Technical Rules and Guidance, Part GF (Ships Using Low Flashpoint Fuels), which corresponds to the IGF Code. For alternative fuels and related technologies other than LNG, IMO Guidelines for methanol, LPG, liquefied hydrogen carriers and ships using fuel cells have been issued, and the Society has also issued guidelines based on these IMO guidelines. Guidelines for ammonia fuel and hydrogen fuel are also under development in IMO, and the guideline for ammonia fuel was finalized at CCC10 in September, 2024, and will be adopted at MSC109 in December, 2024.

As described up to this point, the only alternative fuel for which IMO code has already been established is LNG. Other fuels are still in the Interim Guidelines stage, and codes have not yet been established. For fuels of this type, codes that allow application of alternative are provided in the IGF Code, IGC Code and SOLAS. (Fig. 2)

■ IGF Code 2.3 "Alternative design" for ships using low flashpoint fuels (other than liquefied gas carriers)

2.3 Alternative design

Fuels, appliances and arrangements of low-flashpoint fuel systems may be designed for use of a fuel not specifically addressed in this Code provided that these meet the intent of the goal and functional requirements concerned and provide an equivalent level of safety of the relevant chapters.

■ IGC Code 16.9 "Alternative fuels and technologies" for liquefied gas carriers using cargo as fuels

16.9.1 Alternative fuels and technologies

If acceptable to the Administration, other cargo gases may be used as fuel, providing that the same level of safety as natural gas in this Code is ensured.

■ SOLAS II-1 Part F Reg.55 "Alternative design and arrangements"

2. General

Machinery, electrical installation and low-flashpoint fuel storage and distribution systems design and arrangements may deviate from the requirements set out in parts C, D, E or G, provided that the alternative design and arrangements meet the intent of the requirements concerned and provide an equivalent level of safety to this chapter.

Fig. 2 Scheme of alternative design for alternative fuel ships

The IGF Code applies to ships other than liquefied gas carriers that use low flashpoint fuels with flashpoints of less than 60 °C. For example, this IGF Code also applies to ships that use hydrogen fuel, but at present, detailed requirements are only provided for LNG fuels.

Since similar detailed safety requirements have not been provided for hydrogen fuel, the use of hydrogen fuel can be approved by the Administration after confirming the same level of safety as that specified in the IGF Code, when the alternative design requirements of that code are applied.

When cargo gas is to be used as fuel by a liquefied ammonia carrier or liquefied hydrogen gas carrier, the IGC code which is applied also contains provisions for "Alternative fuels and technologies," and this allows the use of cargo gases other than methane as fuels with the approval of the Administration, on the condition that the same safety as that required for methane is ensured.

In the case of ammonia-fueled ships other than liquefied gas carriers, the provisions of "Alternative designs and arrangements" in SOLAS Chapter II-1 Part F, Regulation 55 apply. Use of ammonia fuel can be approved by the Administration, based on confirmation of safety equal to the provisions applied to existing ships of the same type.

For alternative fuels and alternative technologies without detailed application rules related to safety, it is necessary to ensure the same level of safety as that in the provisions applicable to existing ships, based on the existing rules that recognize the use of alternative designs, and finally, to obtain the approval from the Administration, that is, the flag state of the ship concerned.

3. TRENDS OF VARIOUS TYPES OF ALTERNATIVE FUEL SHIPS

3.1 LNG-Fueled Ships

Among LNG-fueled ships classified by the Society, as of the end of August 2024, 15 were in service and the Society had received applications for classification for more the 60 other vessels. Many have already entered the shipbuilding stage at shipyards in various areas. The types of ships span a diverse range, including PCC, bulk carriers, containerships and chemical tankers, among others. In addition, the Society also performs Approval in Principle (AiP; approval of the basic ship design) for ammonia-ready LNG-fueled ships.

Fig. 3　LNG-fueled ship, M/V CENTURY HIGHWAY GREEN

3.2　LPG-Fueled Ships

As of the end of August 2024, 18 LPG-fueled ships classified by the Society were in service and applications for classification had been received for more than 10 others. Some ships had also reached the shipbuilding stage. As the ship type, all are LPG carriers which use the cargo LPG as fuel.

In view of the expected increase in demand for ammonia transportation, an increasing tendency can also be seen in specifications that enable loading of ammonia in addition to LPG. There is also an increasing tendency to perform conceptual design for use of the cargo ammonia as a fuel when ships are designed in order to acquire the Society's ammonia-ready ship class notation.

Fig. 4　LPG-fueled LPG/ammonia carrier, M/V PHOENIX HARMONIA

3.3　Methanol-Fueled Ships

As of the end of Augst 2024, 4 methanol-fueled ships classified by the Society were in service. In all cases, the ship type was chemical carrier, and the ships use cargo methanol as fuel.

In addition, shipbuilding projects involving coastal chemical tankers, bulk carriers and container carriers are increasing, and the Society is participating in risk assessments and responding to safety verifications and approvals by the Administration.

3.4　Ammonia-Fueled Ships

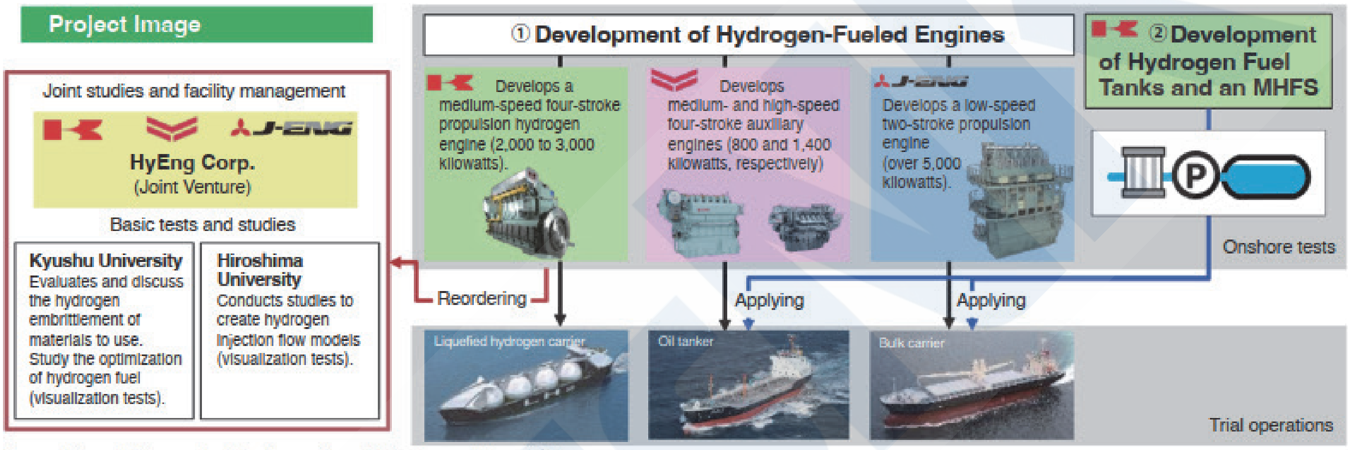
As of the end of August 2024, one ammonia-fueled ship classified by the Society had received class registration. This vessel is the tugboat “Sakigake.” Research and development were carried out by Nippon Yusen Kaisha and IHI Power Systems Co., Ltd., and the vessel was registered as an ammonia-fueled ship.

In addition to the start of construction projects for ammonia fuel-fired bulk carriers and liquefied gas carriers, to date, the Society has also issued AiP certificates for ammonia-fueled ships for car carriers, bulk carriers and VLGC, among others.

3.5 Hydrogen-Fueled Ships

A project aiming at application of hydrogen fuel to hydrogen carriers that will use cargo hydrogen as fuel is being carried out, and the Society is also participating in that initiative. There are also examples of practical application of hydrogen-fueled fuel cell ships that employ fuel cells using hydrogen to small-scale ships such as small ferries and others.

On the other hand, engines using hydrogen fuel are also under development, and in Japan, development projects aiming at realization of various types of hydrogen engines including a medium-speed, 4-stroke propulsion engine, a high-speed 4-stroke auxiliary engine, and a low-speed 2-stroke propulsion engine are underway, centering on engine manufacturers and persons with expert knowledge and experience. (Fig. 5)



Sources: Kawasaki Heavy Industries, Yanmar Power Technology and Japan Engine

Fig. 5 System for development of engines using hydrogen fuel

3.6 Liquefied Hydrogen Carriers

As of the end of August 2024, one ship had received class registration as a liquefied hydrogen carrier. This was the “SUISO FRONTIER,” which was constructed by Kawasaki Heavy Industries, Ltd. and is the world’s first liquefied hydrogen carrier. The Society also issues AiP certificates for the cargo tanks, cargo transfer equipment, dual-fuel boilers, dual-fuel engines and other equipment of large-scale liquefied hydrogen carriers.

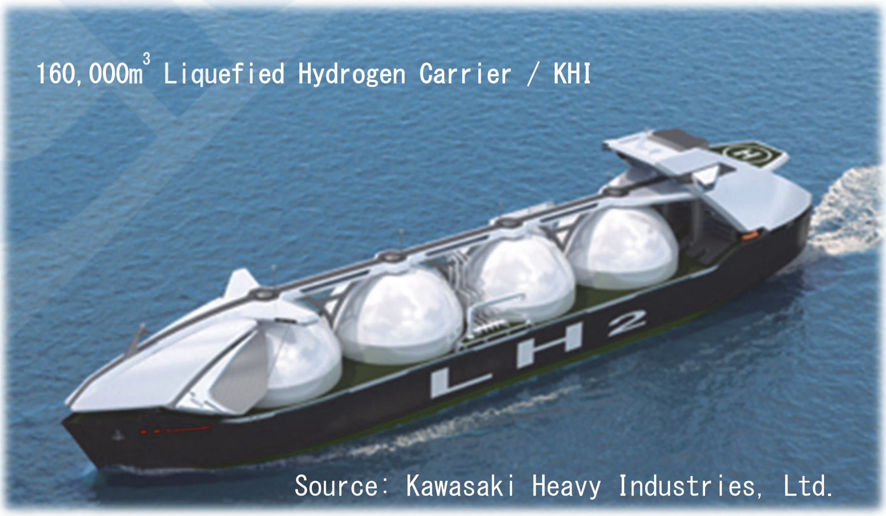


Fig. 6 Liquefied hydrogen carrier

3.7 Initiatives Related to Biofuels

In addition to a large number of trials of biofuels on ships classified by the Society, there are also actual results of vessels using liquid biomethane and biomethanol derived from livestock excreta. The Society has issued Technical Guidance for the use of biofuels. This Technical Guidance describes the features of biofuels and the conceivable problems when using them, efforts related to conventions (statutory requirements) on the use of biofuels as fuels, and the future potential of biofuels.

4. CONCLUSION

In order to achieve the GHG reduction targets of IMO, the use of new technologies toward the introduction of alternative fuels and zero-emission fuels will be indispensable.

The Society aims to contribute to the maritime industry by safety assessments and design certification of alternative designs, as well as support for their certification by flag states, etc., through cooperation with the industry and participation in various projects, and using the knowledge acquired, to contribute to the formulation of conventions and guidelines related to the safety of ships utilizing new technologies in IMO and other committees.