

[ ENGLISH ]



Decarbonization  
Magazine

**PROVIDING THE BEST SERVICES, CREATING A BETTER WORLD**

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KR is a world-leading, technical advisor to the maritime industry, safeguarding life, property and the environment through the pursuit of excellence in its rules and standards.

## CONTENTS

<u>Editor's Note</u>	04	Editor's Note
<u>Insights</u>	08	Greenhouse Gas Regulation and Choosing the Right Green Fuel
	10	Marine Fuel and Life Cycle Assessment
	12	Introduction of EU Fit for 55 and Strategic Decarbonization Measures
<u>Regulatory Updates</u>	18	IACS established a new Panel working for safe decarbonisation to support the implementation of new fuels and technologies
	19	IMO, GHG Reduction Initial Strategic Objective Upgrading and Accelerating Discussion on Introduction of Mid to Long-Term Reduction Measures
<u>Inside KR</u>	23	KR & DSME Collaborate on Large Scale Liquefied CO <sub>2</sub> Carrier Technology
	24	KR & DSME Collaborate on Eco-Friendly Ship Propulsion Systems
	25	KR Approved Samsung Heavy Industries' Ammonia-Ready VLGC Design
	26	Introduction of KR-GEARs at SMM2022
	28	KR Awarded AIP for '120kW Fuel Cell Power System'
	29	KR Hosted CCUS+Transportation Technology & Vision Seminar

There is no question that the most pressing issue currently faced by the maritime industry is decarbonization.



Decarbonization is not an option for choosing, but a critical issue to ensure the sustainability of international shipping. Only those businesses that will be able to achieve GHG reduction targets will stay competitive and enjoy sustainable growth. However, finding the right solutions to effectively deal with the decarbonization initiatives is not simple nor easy.

One of the challenges of decarbonizing shipping is making a sound and effective strategic plan amidst overwhelming amount of information available. It is likely that IMO's emission reduction targets will be bolstered and become more complex. Coupled with this, the geopolitically driven GHG initiatives introduced by various national and regional regulators such as the EU's Fit for 55 will make it difficult to envisage the future regulatory developments.

Moreover, the maritime stakeholders such as shippers, charterers, ship financiers, insurers, etc., have implemented their own GHG reduction initiatives which provide financial benefits to ships that emit less GHG. To comply with these regulatory and industry demands, the maritime stakeholder such as shipbuilders, engine manufacturers, equipment manufacturers are striving to develop new and innovative technologies which will help the maritime industry stay in compliance with the GHG reduction requirements.

Another GHG reduction challenge we all face is the diversity and uncertainty surrounding the ways in which we could achieve decarbonization. In particular, we face the challenge of finding alternative fuel(s) that will be able to substantially reduce or eliminate carbon emission in a safe and efficient manner.

Those uncertainties include the extent to which the regulatory requirements will be strengthened, whether or not the related technologies such as engines, fuel supply systems, and after-treatment equipment will be timely developed and whether the alternative fuels can be produced and supplied in large quantities for shipping. The shipping companies, therefore, are faced with the challenges of analyzing the pros and cons and the cost-effectiveness of each GHG reduction method and finding a solution that is flexible enough to effectively deal with such uncertainties.

In the face of overwhelming information and the uncertainties surrounding decarbonization, it is essential that shipping stakeholders openly exchange information and closely cooperate with each other to enable decarbonization of international shipping. As a part of such information exchange, KR has launched "KR

Decarbonization Magazine" and will publish a new edition regularly. The magazine is designed to provide our customers and stakeholders with the latest information related to decarbonization initiatives effecting the maritime industry.

The magazine will cover international trends and activities associated with:

1. the government and nongovernmental sectors such as IMO, EU, shippers, charterers, financial sectors, etc.
2. the new ship design and the technology development of shipping companies, shipbuilders, engine manufacturers, etc.
3. the production and supply of alternative fuel
4. the development of international conventions and classification rules developed and amended by IMO and IACS
5. the development of key technology and researches undertaken by KR

KR is committed to helping our customers and stakeholders achieve decarbonization by undertaking technological cooperation with the maritime industry stakeholders and taking actions to accelerate the change toward zero carbon shipping.

In this respect, we hope that "KR Decarbonization Magazine" will provide our customers and stakeholders with prompt and accurate information and serve as a channel for effective communication regarding GHG reduction initiatives.

KR Chairman & CEO LEE Hyungchul

KR Decarbonization Magazine

# Insights\_



## Deepening Concerns Over Strengthening Environmental Regulations

### Greenhouse Gas Regulation and Choosing the Right Green Fuel

By Lim Sunghwan,  
Senior Vice President of KR Business Support Team



In the face of the gradual strengthening of environmental regulations, the driving decarbonization of financial and insurance industries, social pressure, and other decarbonization movements, it is not easy to decide which fuel is the main fuel for new builds from the shipowners' perspective.

In line with this broader trend of new building orders, most dedicated cargo carriers, such as LNG carriers, LPG carriers, and methanol carriers, have decided to use transported cargo as fuel. However, shipowners are being prudent to make the decision to adopt LNG as fuel in the use of container ships, bulk carriers, or tankers, since only approximately 20 percent of those ships are LNG-fuelled ships. This is a tactical strategic plan to invest in changing to a lower carbon fuel after uncertainties are resolved rather than making a preemptive choice in a situation where technologies, regulations, and supply chains have not been resolved.

In the midst of a great change called 'decarbonization', major shipping companies are trying to set a goal to accomplish GHG goals and secure a fuel supply chain between various options such as ordering methanol-propulsion LNG ships. There are various options for alternative fuels, however, the shipping industry has not yet to find the impeccable one to solve all challenges that we have. This means that we need to keep an eye on the latest regulation updates and technology development trends to find an ideal solution for each shipping company.

Under the ever-changing conditions of decarbonization and uncertainty, what would be the best way to maintain industry competitiveness?

## The Ultimate Alternative Fuels

It is more critical than ever to evaluate the overall economic feasibility, including the possibility of changing regulations when planning to contract newbuilds. In particular, consideration of GHG emissions from the fuel lifecycle perspective, Market-Based Measurement (MBM) including carbon tax and the impact of the EU's Emission Trading System (ETS) is to be considered.

Shipping companies that choose methanol fuel intend to achieve carbon neutrality by using green methanol from the view of lifecycle assessment, even if the current emission of carbon dioxide emitted from the ship is more than that of LNG. Securing green methanol is an imperative requirement, however, it is not easy to expect ordinary shipping companies to secure green methanol.

The real concern for shipping companies ordering newbuilds at this point is whether to choose LNG fuel now. In the face of decarbonization needs continue to grow, it is time to choose whether to use LNG, a low-carbon fuel that can immediately reduce GHG emissions, or to use conventional fuel and order an alternative-fuel-ready ship to prepare for more advanced green fuels like ammonia.

In the case of ships that need to be built now, if LNG fuel supply chain is available, choosing LNG as fuel may be a better choice, despite the higher initial CAPEX costs. The main reasons for reluctance to use LNG fuel are probably the cost of the initial purchase and the fear of environmental restrictions. However, it is undeniable that LNG is the most viable alternative as other alternative fuels are expected to take a lot of time to become competitive and fully commercialized in terms of cost and responding to regulations.

In terms of cost, LNG application CAPEX was an additional 30% of the price of new ships in the past, but now it has decreased to 10-20% due to increased supply. Considering the production cost, it is expected that the amount will not be go down than it is now. If one decides to retrofit the vessel, it would inevitably cost more compared to new construction. Even looking at the current LNG or LPG fueled vessel, the cost of retrofitting is nearly twice that of the additional cost of newbuilds.

Several regulatory measures are currently being discussed, but the level of regulation on LNG can be estimated through FuelEU Maritime of the "Fit for 55" legislation announced by the EU, which is likely to become a measure of environmental regulation in the global shipping sector. FuelEU Maritime is a regulation that restricts the GHG emission ratio for each fuel according to the fuel's lifecycle emission standard. Under the regulation, LNG propulsion ships are expected to be fine-free for a limited period of time. This shows that low-carbon alternative fuels such as LNG are regarded as transitional fuels and allowed to be used from a mid-term perspective, and the use of renewable energy-based carbon-free alternative fuels is required from a long-term perspective.

It is true that some argue the use of LNG is not an eco-friendly fuel considering methane slip and the LNG production process. However, in response to these criticisms, innovative projects have been proposed to convert LNG into bio-LNG or synthetic LNG, which are carbon-neutral fuels, from the perspective of supplying LNG to the entire lifecycle of the vessels.

Nevertheless, if LNG fuel is not able to be applied during the construction of new ships due to various circumstances, choosing an alternative fuel-ready ship is the next best option. In this process, it should be noted that the alternative fuel readiness level should be practical enough to minimize additional costs for retrofitting.

Besides, technically applicable energy saving devices such as wind assist propulsion systems, air lubrication systems, and waste heat recovery systems that can reduce the use of expensive alternative fuels as much as possible, should be actively considered. For optimal operation, measures like route management, and hull cleaning also be undertaken. After properly integrating and applying all these technologies, it is believed that applying the most competitive alternative fuels is the right path the shipping industry should take to decarbonize shipping.

## Collaboration in the Era of Decarbonization

Stringent requirement and strengthening regulation for decarbonization are inevitable. As they go through energy transition, shipowner and yard concerns are getting deeper and deeper. Regulations, the economy, maritime trade volumes, the direction of the energy industry's development, and the level of technological development, are all uncertain. To overcome these uncertainties and secure competitiveness in the era of decarbonization, close cooperation between maritime stakeholders is more critical than ever. To meet these needs, KR is also working closely with the maritime sector and carrying out research and development in various fields. We have been performing joint research projects with major shipbuilders on ammonia-propulsion ships, hydrogen carriers, biofuels and various alternative fuels, participation in state-led research projects, and establishing rules and standards for the latest technologies. As a close maritime sector partner KR will support maritime stakeholders in choosing the right green fuels and responding to the uncertainties of a greener future together.

## Marine Fuel and Life Cycle Assessment

By HA Seungman  
Senior Surveyor of KR International Relations Team



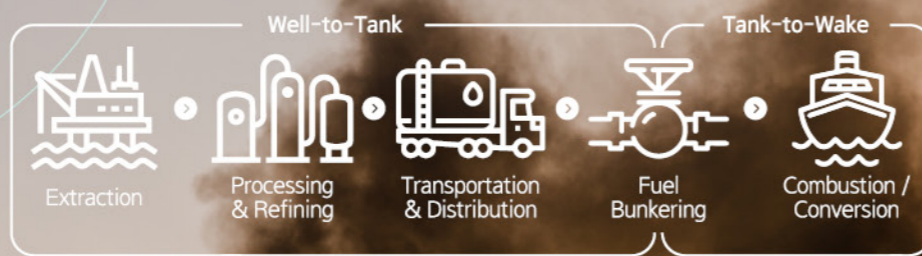
Life Cycle Assessment, a holistic environmental approach to any alternative fuel option, is an invaluable criterion for fuel selection.

As the international maritime industry moves toward carbon neutrality, the use of alternative fuels for ships is expected to increase over the next few years. This will lead to rising demand for the use of biofuels along with zero-carbon fuels such as ammonia, hydrogen, and electric propulsion.

However, when evaluating the 'eco-friendliness' or 'sustainability' of these alternative fuels from a life cycle perspective, they may have a more negative impact on the environment compared to conventional fuels, depending on the fuel production method. For example, hydrogen produced by the natural gas reforming method is evaluated negatively than conventional fuels such as HFO because it emits a larger amount of greenhouse gas (GHG) emissions during the fuel production process. The current IMO's ship energy efficiency indexes, EEOI, AER, EEDI and EEXI, have limitations in assessing the sustainability and comprehensive environmental impact of marine fuels since they only consider GHG emitted by the fuel oil used on board ships.

A Life Cycle Assessment (LCA) involves quantifying the amount of energy and materials consumed and emitted (e.g., GHG emissions) throughout the life cycle of a product or process to determine their environmental impacts and evaluate them comprehensively to improve the environment. The life cycle can be described as a Well-to-Wake (WtW) process, which combines Well-to-Tank (WtT) process and Tank-to-Wake (TtW) process. In the WtT process, for example, HFO is obtained as follows. First, crude oil is extracted from the production area. It is then transported domestically via oil carriers, processed and refined into HFO at oil refineries. After the processing and refining stage, HFO is distributed through pipelines to bunkering ships or onshore bunkering facilities. For the TtW process, the final stage of the process covers using the bunkered HFO in the vessel as fuel.

Well-to-Wake (WtW) Process



In the case of an electric propulsion ship, for the WtT process, firstly raw materials, such as coal and natural gas, produced through extraction, processing, and transportation, are supplied to the power plant. Secondly, the generated electricity is transmitted, distributed and charged on the ship. In the TtW process, the electricity produced is directly used onboard.

LCA can comprehensively evaluate the environmental performance and sustainability of fuels by evaluating various environmental impacts in other categories, such as resource consumption, ozone layer depletion, photochemical oxide production, eutrophication, and acidification in addition to the global warming impact caused by greenhouse gas emissions.

Decarbonization and carbon neutrality are becoming unavoidable norms not only in international shipping but also globally. In order to assess the eco-friendliness of carbon neutrality, an LCA-based approach is required to identify and improve the particular stage of the process that requires high energy consumption and pollutant emissions. The LCA-based approach is being used widely in various fields, including the UN Sustainable Development Goals (UNSDGs), Environmental, Social, and Governance (ESG) measures, and Carbon Border Tax, with highlighted significance for future applications, including sustainability evaluation. A notable example of an LCA-based approach can be found in the establishment of the Green Shipping Corridor for carbon neutrality, which was attempted through the Clydebank Declaration at the 26<sup>th</sup> United Nations Framework Convention on Climate Change (COP 26), and the updated pledges made in the Green Shipping Challenge at COP 27.

The IMO also recognized the limitations of the evaluation scope for current Ship Energy Efficiency Indexes and decided to develop the "Lifecycle GHG and carbon intensity guidelines for

marine fuels" as a short-term measure in an initial strategy for the reduction of GHG emissions from ships to encourage the uptake of sustainable alternative fuels. Through this work, IMO plans to develop a methodology and guidelines for quantifying GHG emissions from marine fuels during the "Well-to-Wake" process.

At the beginning of the IMO discussion, some member states were reluctant to introduce the LCA framework into IMO instruments because it was beyond the scope of international shipping. Currently, the most relevant stakeholders understand the necessity and importance of reducing GHG emissions based on an LCA-based approach and are actively developing the relevant guidelines. It should be noted that the sulfur content regulation, which took effect in 2020, is similar to the LCA framework in that it can be considered as a regulation outside the scope of international shipping because onshore fuel suppliers must supply fuel that meets the sulfur content regulation.

The 2021 United Nations Climate Change Conference (COP 26)



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### The Impact of Developing 'GHG Lifecycle and carbon intensity guidelines for marine fuels'

Currently, the IMO has set up a Correspondence Group to develop and finalize the draft LCA guidelines by July 2023. The guidelines are expected to cover default WtT and TtW emission factor values for each fuel and a certification system with the use of enhanced emission factor values. Along with the development of guidelines, a robust discussion on the application of emission factor values to IMO regulations will also take place.

The life cycle GHG assessment of marine fuels will have a significant impact on the selection of future fuels, depending on the outcome of the discussion on the development of the LCA guideline and whether it can be combined with the upcoming basket of GHG measures for the decarbonization of international shipping sector. Taking into account that the implementation of GHG lifecycle emission regulations will have a profound impact on the shipping industry, such as increasing fuel costs, KR has been coordinating closely with the relevant stakeholders to support and develop the regulatory frameworks, new technologies and classification notations for the introduction of sustainable marine fuels.

## Introduction of EU Fit for 55 and Strategic Decarbonization Measures

*By* KIM Jinhyung,  
Principal Surveyor of KR Machinery Equipment Research Team



### EU Fit for 55 package legislation to meet European climate law targets

Following the European Green Deal proposal, the European Commission (EC) announced the EU Fit for 55 package bill in July 2021. Fit for 55 refers to a package of several legislative proposals applied to various industries to achieve the mid-term reduction target of European climate law (at least 55% reduction by 2030 compared to 1990). The legislative proposals of the Fit for 55 package that relate to the shipping sector are the European Union's Emission Trading Scheme (ETS) and the use of renewable and low-carbon fuels in maritime transport (FuelEU Maritime).

Fit for 55 Highlights



© EU Council

Progress after the announcement of EU Fit for 55

What measures should we take accordingly?

### EU ETS: Another challenge for the shipping industry

The EU ETS is a system in which allows to buy or sell the emission permits for greenhouse gas (GHG) emissions. So far, the EU ETS has been applied to land-based installations since 2005 and the aviation industry since 2012. As one of the EU ETS revision proposals for the Fit for 55 package, maritime shipping emissions will be included in the EU ETS from 2024. The EU Commission, Parliament, and Council have been discussing revisions to the EU ETS through Trilogues. It is expected that consensus will be achieved and a revision adopted at the end of 2022 or early 2023.

EU ETS Price Trends



© ICE (Intercontinental Exchange)

EU ETS applies to greenhouse gas (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O) emissions from ships of 5,000 GT and above calling at EU ports. Unlike the method applied to other existing industries, all emission permits corresponding to GHG emissions generated while calling at an EU port must be purchased and surrendered to the EU authorities. In other words, it is a regulatory structure based on the polluter pays principle. The regulated of GHG emissions is calculated 50% of emissions from extra-EU voyage and 100% of emissions from intra-EU voyage from 2024, and 100% of emissions from all EU voyage from 2027.

Emissions allowances can be traded at the emission trading exchange or via direct trading, with 1 tonne of GHG (tonne CO<sub>2</sub>eq) being the unit of transaction. The price of emission permits has price fluctuation due to various factors such as supply and demand. The price of EU emission permits is traded at about 66 euros as of 11 October 2022. If one fails to surrender emission permits, this will result in a fine of 100 euros per tonne corresponding to the un-surrendered emissions, and must be surrendered as part of emission permit applications in the following year.

According to EU MRV report data in 2021, the 12,131 vessels worldwide are subject to EU ETS. Their emissions are estimated to be 82 million tonnes based on 50% of emissions from extra-EU voyage and 100% of emissions from intra-EU voyage, and 125 million tonnes based on 100% of emissions from all EU voyages. Based on this, if 66 euros per tonne of emission permit price is applied, it is estimated that the cost will be 5,440 million euros per year for emissions of 82 million tonnes, and 8,220 million euros per year for emissions of 125 million tonnes.


We analyzed the economic feasibility of the cost of credits following the introduction of alternative fuel vessels with the same criteria. The analysis method is as follows:

First, the annual consumption of each fuel was derived by applying the calorific value of each comparative fuel based on a ship using 3,000 tons of HFO per year. And based on this, by applying the CO<sub>2</sub> emission factor for each fuel, the CO<sub>2</sub> emissions are calculated based on 50% of emissions from extra-EU voyage and 100% of emissions from intra-EU voyage. If the cost of emission permits for each fuel is calculated by applying 66 euros per tonne, the cost of each emission permit is as shown in the following graph. It will be possible to calculate the overall economic feasibility based on the cost of alternative fuels and the cost of alternative ships powered by alternative fuels based on the analysis.

**The task of the EU ETS**

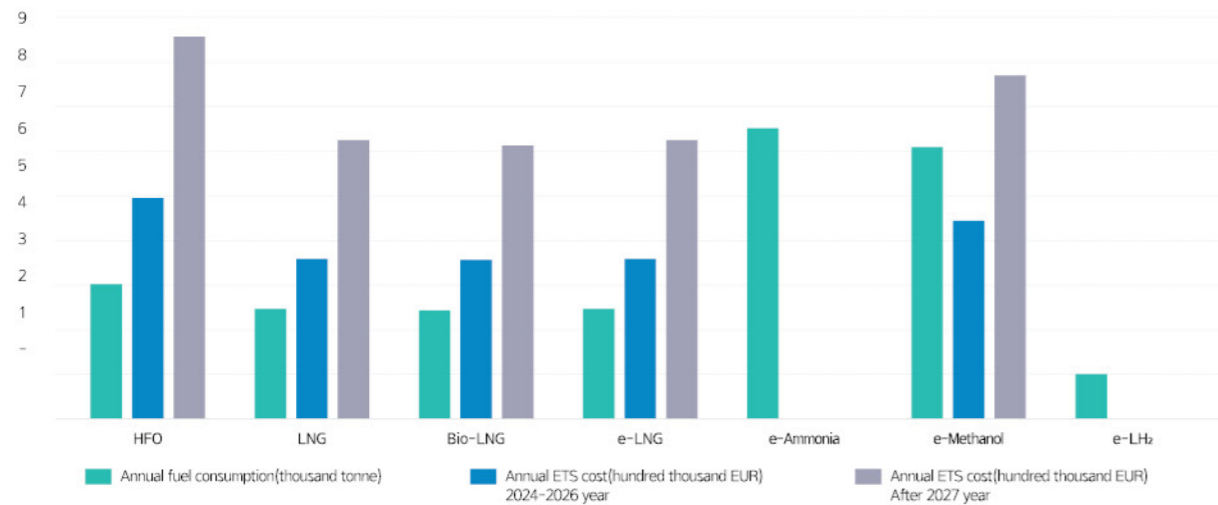
**Reform of the EU emissions trading system explained**

The EU's emissions trading system (EU ETS) is one of the world's largest carbon markets and the EU's key tool for reducing greenhouse gas emissions.



© EU Council

Comparison of EU ETS Costs for each fuel types



**FuelEU Maritime: The beginning of mandatory use of green fuel**

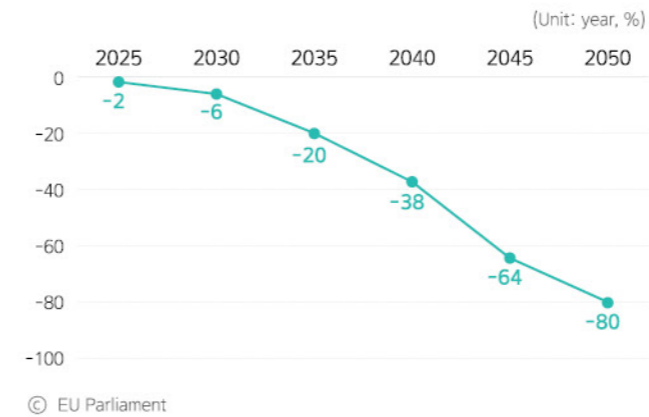
FuelEU Maritime, which is expected to come into effect in 2025, is a legislative initiative designed to create new regulations on the use of renewable or low-carbon fuels in maritime transport. Its goal is to stimulate the demand for eco-friendly ship fuel by gradually increasing the limit on GHG emissions intensity of ships calling at EU ports by 2050.

The GHG emissions intensity represents GHG emissions per mega joule calculated based on the whole process emission (Well-to-Wake, WtW), which includes emissions from the process of fuel production to supply (Well-to-Tank, WtT) and the process of using the fuel (Tank-to-Wake, TtW).

In the case of using fuel with a higher intensity than the GHG intensity limit, the penalty is calculated considering the difference between GHG intensity of fuel types used by the vessel and the GHG intensity limit, the fuel consumption and the specified penalty. The intensity limit will be strengthened every five years from 2025.

As of October 2022, the EU Parliament plenary has approved the FuelEU Maritime legislation. Trilogues with the EU Commission, Parliament and the Council will be held accordingly. Based on the proposal of the European Parliament plenary session, the reduction target for GHG intensity limit will be -2% from 2025, -6% from 2030, -20% from 2035, -38% from 2040, -64% from 2045, -80% from 2050 based on the 2020 EU MRV reference value. In addition, from 2030, it is mandatory to use Renewable Fuels of Non-Biological Origin (RFNBO) up to 2% of a ship's total energy consumption. Moreover, container and passenger ships are required to connect on-shore power supply or use zero-emission technologies when a ship at berth in a EU port of call for more than two hours.

Reduction factor for GHG intensity limit of FuelEU Maritime (based on EU Parliament opinion)



**Time to prepare for a comprehensive decarbonization response**

Based on the two regulations cited above, it is clear that the shipping sector must prepare for the transition to carbon neutral and the time to make a strategic decision is rapidly approaching. In order to respond to the Fit for 55 regulations, it is necessary to make arrangements for the transition to a future green ship, such as using ammonia and methanol as fuel. Furthermore, one must think beyond simply building an eco-friendly ship to make these vessels compliant. It is necessary to establish a comprehensive strategy that takes into account various factors such as achieving mid-to long-term decarbonization reduction targets throughout the pre-production, manufacturing and in-use phase; the life cycle of a ship; the price of alternative fuels; supply stability; and whether to build infrastructure. In addition, in order to effectively respond to financial measures, such as the emission trading system, it is necessary to consider a financial strategy that breaks away from the traditional regulatory response method and enhance response capabilities comprehensively.

Above all, the participation and collaboration of stakeholders from each sector is needed. Decarbonization is a challenge for many shipping companies. Collaboration of maritime stakeholders, including individual shipping companies, shipyards and classification societies will have a more significant impact than individual shipping companies going it alone.

KR has been continuously analyzing Fit for 55's impact, as well as developing technical solutions through collaborations with maritime leaders, to achieve decarbonization. Our recent accomplishments with joint research projects with major shipyards, ship owners, and energy companies have led to the commercialization of alternative fuel vessels and propulsion systems, including liquefied CO<sub>2</sub> carriers, methanol dual-fuel vessels and ammonia-powered very-large gas carriers (VLGCs).

In addition, KR is attempting to establish a collaborative system between industries through a wide range of technical services, such as EEXI/CII response simulations, carbon-emission information and cost management solutions to implement EU ETS regulations to support the integration of international/regional GHG regulations.

The technological transition toward carbon neutrality is no longer a choice, but an inevitable and obvious challenge of our era. The time has come to consider the right approach and its speed before taking action. Despite the regulatory, technical and economic uncertainties that may seem overwhelming, the EU and the international community remain committed to decarbonizing shipping. In this regard, we need to prepare for a comprehensive and flexible decarbonization response through close collaboration of maritime stakeholders.





KR Decarbonization Magazine

# Regulatory Updates\_

## IACS established a new Panel working for safe decarbonisation to support the implementation of new fuels and technologies

The IACS Council, the highest governing body of the association, approved the establishment of a new 'Safe Decarbonisation Panel' (SDP) at its 85<sup>th</sup> session meeting held in June 2022.

These are the efforts taken by IACS for effective action, recognizing that the ambitious targets of decarbonisation must be progressed quickly and safely in collaboration with key stakeholders. IACS Panels are permanent working groups to discuss technical matters. The formation of the SDP demonstrates IACS' clear determination to support the industry by setting a long-term goal.

The SDP is composed of experts with the necessary knowledge and experience in decarbonisation, such as new fuels and new technologies, ship machinery, structure, safety, and environment.

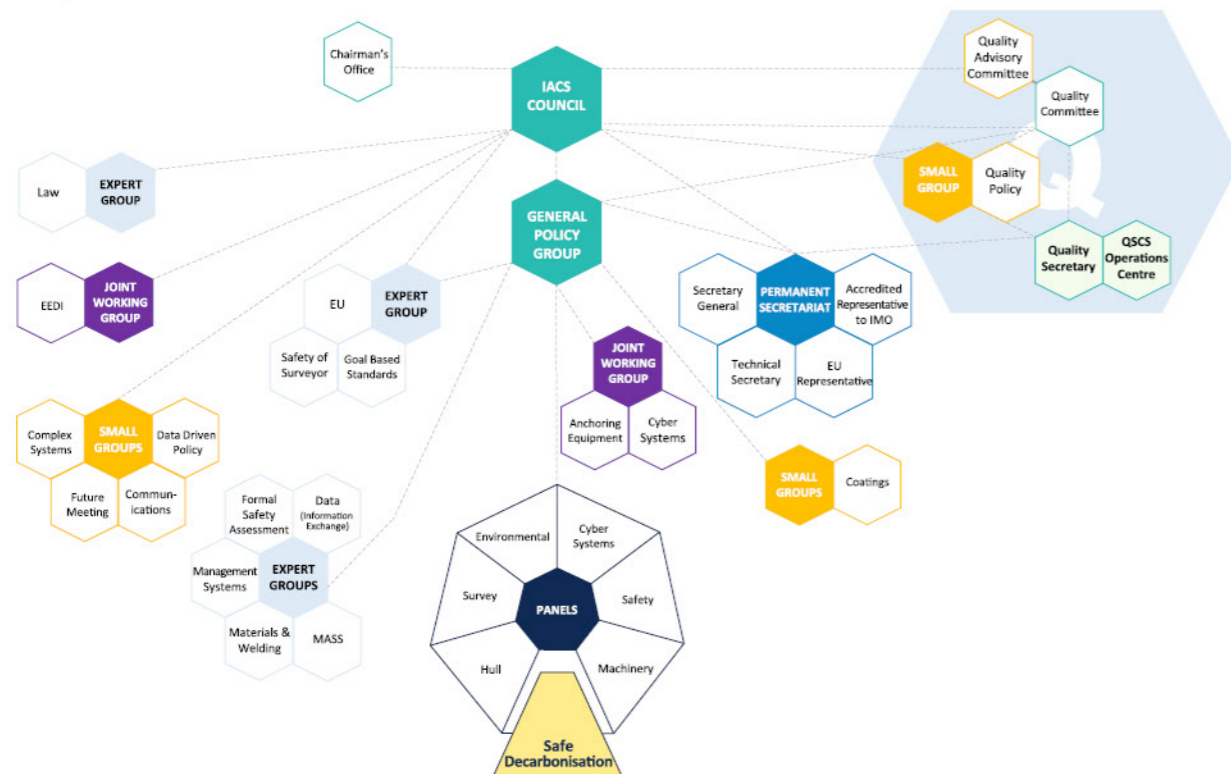
While there is still a lot of technical uncertainty in relation to alternative fuels, the new Panel plans to form four Project Teams to quickly provide common technical requirements related to new fuels to lead research on candidate fuels and technologies. The Project Teams will examine the possibility of developing appropriate IACS common requirements for ships using ammonia, hydrogen, carbon capture and storage and batteries as fuel, respectively. Additionally, the Panel will also evaluate current work streams at IMO on methyl/ethyl alcohols with a view to undertaking further work as appropriate. The Safe Decarbonisation Panel aims to have the first results by the end of 2023 and will begin work as soon as the project teams are established.



At the 78<sup>th</sup> Marine Environment Protection Committee (MEPC) meeting, the main topics discussed were the revision of the IMO GHG initial strategy to include raising reduction of the GHG target from international shipping for by 2050 and the introduction of mid-/ long-term measures to achieve the reduction target. These selected measures for further development are expected to be completed by 2023. The MEPC also made a decision to approve a Unified Interpretation of the use of biofuel blends and to establish a correspondence group (CG) for the development of LCA guidelines.

## IMO, GHG Reduction Initial Strategic Objective Upgrading and Accelerating Discussion on Introduction of Mid to Long-Term Reduction Measures

IACS Organisation  
(Compiled from the IACS Annual Review)



The main topics that discussed were as follows:

- 1) **Revision of the Initial IMO GHG Strategy and Level of ambition for 2050**
  - A thorough impact assessment on developing countries, particularly Small Island Developing Countries and Least Developed Countries, was discussed, along with revisions to the initial strategy, such as strengthening the level of motivation and a new introduction of any additional checkpoints for 2040.
  - It was decided to continue the discussion through the 13<sup>th</sup> ISWG-GHG meeting on how to maintain efforts to eradicate GHG emissions in international shipping along with more specific suggestions.
- 2) **Development of mid/long-term measures to reduce GHG**
  - Attention was drawn to the results of the 13<sup>th</sup> ISWG-GHG meeting on the proposed measures. As the second stage of the work plan, the proposed measures will be evaluated based on feasibility, effectiveness and impacts on states. For further development, discussions will be held to select mid to long-term measures.
- 3) **Approval of Unified interpretation on Bio-fuel Blends**
  - MEPC 78 approved MEPC.1/Circ.795/Rev.6 containing unified interpretations to regulation 18.3 of MARPOL Annex VI. Accordingly, marine diesel engines that use less than 30% biofuel blended are permitted to use the fuel without onboard NOx verification procedures.
- 4) **LCA Guidelines Developments**
  - Matters needing further discussion, such as setting basic emission factor values and developing certification system standards, were discussed, and a correspondence group (CG) was established for further development. The final report will be submitted when the 80<sup>th</sup> MEPC is held.
- 5) **Onboard CO<sub>2</sub> Capture (CO<sub>2</sub> removal)**
  - MEPC 78 considered a proposal suggesting options to reflect CO<sub>2</sub> emission reduction by onboard CO<sub>2</sub> capture system by amending the current EEDI and EEXI calculation formulas. Interested member states and organizations are invited to submit more information and concrete proposals to a future session for further consideration.

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# Inside KR\_



## KR Decarbonization News At a Glance



## KR & DSME Collaborate on Large Scale Liquefied CO<sub>2</sub> Carrier Technology

KR and Daewoo Shipbuilding & Marine Engineering (DSME) will be developing a new 40,000m<sup>3</sup> LCO<sub>2</sub> carrier featuring a next generation cargo handling system. The two Korean firms signed an MOU at Gastech 2022 in Milan, Italy on 7 September to help meet the growing demand for vessels capable of transporting carbon dioxide at scale from emissions sources to storage sites.

Carbon Capture, Utilization and Storage (CCUS) technologies are fast growing as the world seeks to achieve carbon neutrality and build an international carbon capture infrastructure.

However, carbon dioxide is a complex cargo to handle, having a triple point which is higher than atmospheric pressure, meaning that it can liquefy only at low temperatures and high pressures. Even a small environmental change can see CO<sub>2</sub> transform into a gas, liquid or solid state. The new design will feature a reliable Ship and Cargo Containment System (CCS) using its accumulated technologies in the field of liquefied gas carriers, such as LNG and LPG carriers.

DSME will also develop a Cargo Handling System (CHS) using the latest technology to prevent CO<sub>2</sub> emissions and ensure navigational stability.

KR plans to verify compliance with its own Rules and The International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) for the cargo containment and handling systems developed by DSME.

Awarding new AIPs and signing joint collaboration projects of green ship development

Introducing the KR's latest green technology at SMM

## KR & DSME Collaborate on Eco-Friendly Ship Propulsion Systems

KR and Daewoo Shipbuilding & Marine Engineering (DSME) will be working closely together to develop new propulsion systems capable of handling green fuels including ammonia and hydrogen.

In September 2022, the two organisations signed a Memorandum of Understanding (MOU) to jointly collaborate at Gastech 2022, Milan, Italy. The move follows announcements that KR would be jointly developing a liquefied CO<sub>2</sub> carrier with DSME.

Whilst the global maritime industry is introducing operational measures such as limiting engine output and installing energy-saving devices to meet stringent greenhouse gas regulations, in the longer term green fuels will be needed to achieve substantial emission reductions.

There is a high level of market interest in propulsion systems and materials for operating with green fuels such as ammonia, hydrogen and methanol.

Ammonia and hydrogen, widely recognized as green alternatives, but are considered to have more sensitive characteristics than commonly used LNG fuels. To be used as a marine fuel, extra technical requirements need to be addressed. These include the toxicity of ammonia, hydrogen embrittlement, cryogenic conditions equivalent to -253°C, diffusion characteristics, as well as ensuring the same level of safety as existing ships.

This joint research agreement between the two parties will build on the unique strengths and accumulated technology of each company.

DSME aims to commercialize ammonia-powered container ships by 2025 based on its advanced technology, and is at an advanced stage in developing eco-friendly fuel technologies, including low-carbon ammonia carriers and liquefied CO<sub>2</sub> carriers.

KR has also been actively seeking better options for decarbonization pathways. As well as publishing guidelines for ammonia-fueled ships, the classification society is developing its own hydrogen-powered ship rules and is working on enhanced decarbonization initiatives to ensure ship safety and a greener future.



## KR Approved Samsung Heavy Industries' Ammonia-Ready VLGC Design

KR has granted an Approval in Principle (AIP) for a new ammonia-fuel ready vessel design developed by Samsung Heavy Industries (SHI) on September 5. The Very Large Gas Carrier (VLGC) will be capable of using ammonia as a fuel as well as carrying it as bulk cargo.

Jointly developed by SHI and KR, the new design represents a significant step forward in the expansion of an international supply chain for the clean fuel.

Ammonia is a stable, cost-effective and clean energy source, however it could cause stress corrosion cracking in carbon manganese steel or nickel steel. To minimize these risks, management of the tensile stress and corrosive environment of the steel is essential concerns to be considered. The SHI design maintains the actual yield stress of the ammonia tank steel within the KR's Rule requirements and is able to maintain a temperature close to boiling point.

The new design is the largest ammonia-ready vessel which have been approved by KR. The classification society also recently approved designs for a 60,000m<sup>3</sup> ammonia-fueled ammonia carrier and a 38,000m<sup>3</sup> ammonia carrier/bunkering vessel. KR is further supporting the development of ammonia-related technologies by developing its guidance for ammonia-fueled ships, and its participation in the Green Ammonia Marine Transport and Bunkering Consortium.

Introduction of  
KR-GEARs  
at SMM2022

KR participated in the Shipbuilding, Machinery and Marine Technology trade fair 2022(SMM 2022), one of the world's three largest shipbuilding and marine exhibitions, and extensively promoted KR-GEARs to 2,000 companies from 100 countries worldwide from September 6 to September 9 in Hamburg, Germany.

KR-GEARs, launched in July 2019, is a GHG emission authentic reporting system that could guide shipowners and operators to manage EU Monitoring, Reporting and Verification (EU MRV), IMO Data Collection System (IMO DCS), Carbon Intensity Indicator (CII) and EU Emissions Trading System (EU ETS) within a single platform. The event was also a great opportunity to introduce GHG verification service and technical guidelines for SEEMP Part III, which will take effect in 2023.

As the energy efficiency ratings of all ships have become transparent due to the introduction of the CII regulation, continuous fleet management support beyond simple regulatory implementation has become necessary. To support the maritime sector in complying with stringent GHG regulations, KR presented its CII simulation module, energy efficiency improvement scenario and prediction service. This was a great opportunity for the KR team to share its ongoing efforts and technological expertise with the maritime industry.

Besides participating in SMM 2022, KR visited Briese Schifffahrts GmbH & Co. KG(Hereafter, Briese), a German company that owns about 100 multi-purpose small-ships, approximately 10,000 DWT or less. During the visit, KR and Briese exchanged thoughts on how KR-GEARs could help Briese to prepare for upcoming GHG regulation, also, the two companies agreed to collaborate further on technology exchange.





KR has issued the first Korean Approval in Principle(AIP) to Vissen Co., Ltd. for its 120kW fuel cell power system.

Vissen Co., Ltd. is specialized in manufacturing eco-friendly small-sized ships and propulsion systems, especially in electric and hydrogen hybrid.

The 120kW fuel cell power system is an integrated system that produces electric power not only for main propulsion but also for various auxiliary systems mounted on the ship. This system consists of a hydrogen storage system, an air treatment system for filtering, air & hydrogen supplying system to the fuel cell module, a thermal control device for cooling the fuel cell module and BOP system, and a power conversion device for supplying the generated power to the grid. The fuel cell module composed of two fuel cell stacks has been developed to produce continuous power of 120kW by application of PEMFC suitable for small-sized ships.

The AIP is an opportunity to preemptively secure technology for developing and distributing eco-friendly ships. Competition in this sector is intensifying and this AIP will enhance the product's competitiveness and accelerate the realization of carbon-free ships.

### KR Awarded AIP for '120kW Fuel Cell Power System'

### KR Hosted CCUS+Transportation Technology & Vision Seminar

On September 27, KR and Maritime Cluster Networking in Korea (MacNet) co-hosted the CCUS+Transportation Technology & Vision Seminar called 'What should be prepared in the era of large CO<sub>2</sub> carriers.'

Carbon Capture, Utilization and Storage (CCUS) is a technology that collects large-scale carbon dioxide generated from thermal power plants, steel mills, and refineries and stores it in waste oil fields, waste gas fields, or marine sediments. It is considered one of the key technologies for achieving global carbon neutrality. As marine transportation is emerging as a representative method of transporting captured carbon dioxide to the storage location, the global marine transportation market is preparing for the carbon-neutral era by rapidly placing orders for carbon dioxide carriers.

CHUN Kangwoo, KR General Manager of the Green Ship Technology Team, proposed a new research plan for the development of CO<sub>2</sub> carrier technology that can transport high-purity CO<sub>2</sub> in large quantities. The project aims to develop technologies regarding cargo tanks, cargo management, loading and unloading for innovation in CO<sub>2</sub> carriers.

In addition, a total of five topics were presented during this seminar: carbon dioxide capture demand and technology development in the domestic industry; domestic and overseas carbon dioxide storage in the ocean; carbon dioxide transport and storage using oil and gas fields; global carbon dioxide carrier construction technology trends; and international regulations.

KR is committed to continuing to take the lead in technological cooperation for Decarbonization with the maritime industry stakeholders and take actions to accelerate achieving carbon neutrality.

### CCUS+Transportation Technology & Vision Seminar

What should be prepared in the era of large CO<sub>2</sub> carriers?

Date: **27 September 2022** | Venue: KR Headquarters





In keeping with our passion for the protection of the natural environment, KR offers survey and certification services for renewable energies, including wind and ocean power. KR is continuously working on new and innovative green ship technologies to reduce emissions and fuel usage, using these advances to enable our customers to meet their environmental goals.





Providing the best services, Creating a better world

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