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ClassNK

Pathway to Zero-Emission in International Shipping
— Understanding the 2023 IMO GHG Strategy —
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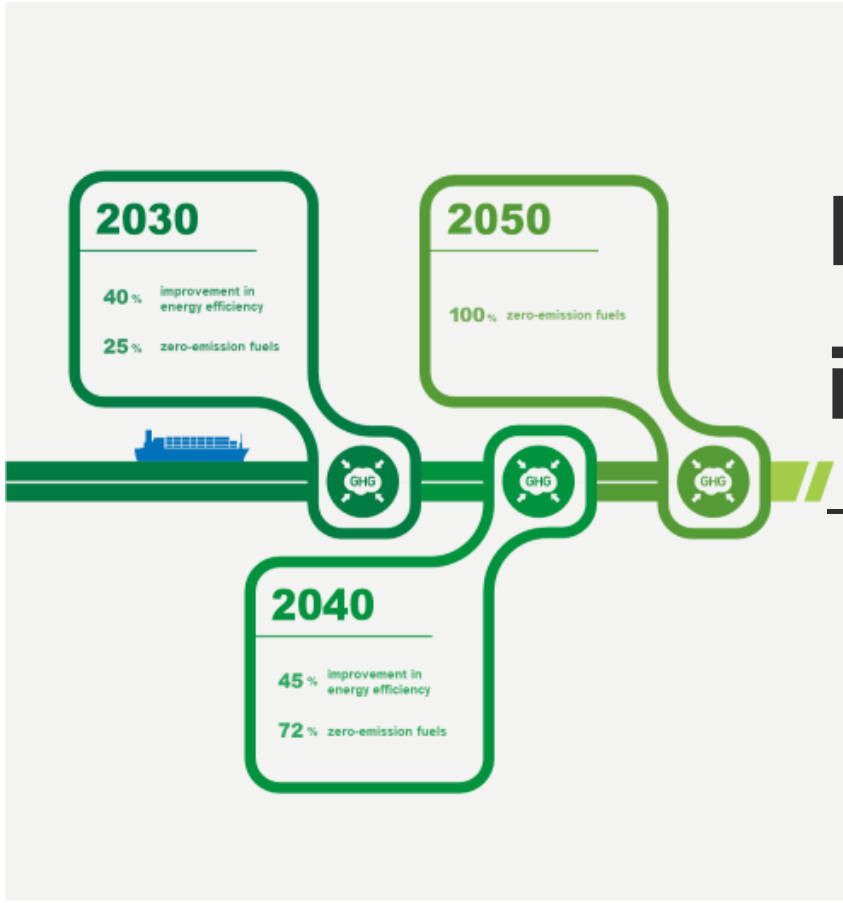
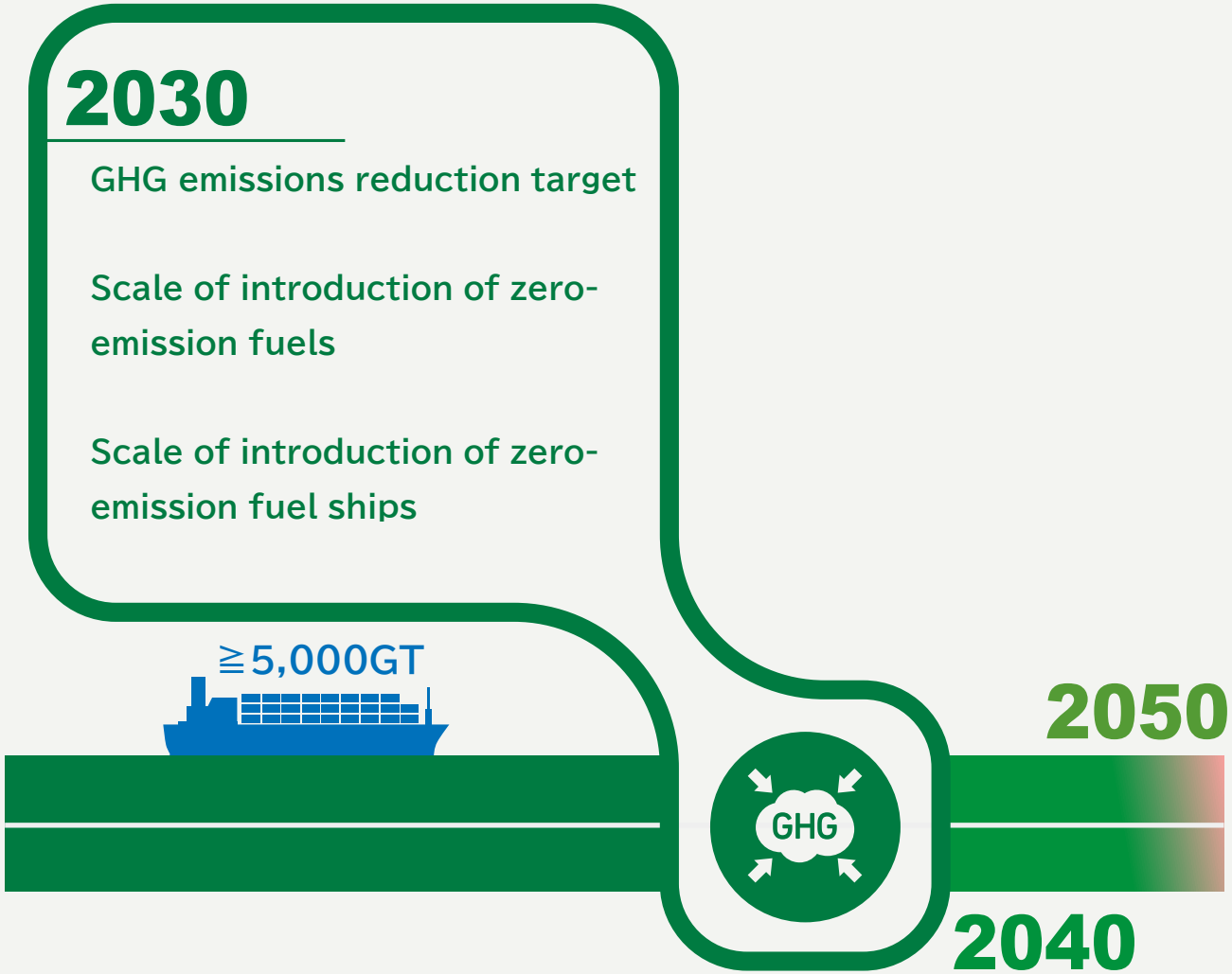


Pathway to Zero-Emission in International Shipping

— Understanding the 2023 IMO GHG Strategy —

September 2023
Nippon Kaiji Kyokai (ClassNK)

Towards achieving the 2030 GHG emissions reduction target IMO GHG Strategy



In order to contribute to encouraging broad discussions among stakeholders and accelerating efforts towards decarbonization of international shipping, ClassNK tried to visualize the actions required by the revised IMO GHG Strategy in quantitative terms by estimating*1 the total GHG emissions, the scale of introduction of zero-emission fuels, and the scale of introduction of zero-emission fuel ships required to achieve the 2030 zero-emission fuels introduction target and GHG emissions reduction target of the revised IMO GHG Strategy.

*1This applies to ships of 5,000 GT and above engaged in international voyages (subject to IMO DCS).

	2018 Initial Strategy	2023 Revised Strategy
Scope of Emissions	Onboard emissions (Tank-to-Wake)	Life cycle emissions (Well-to-Wake) to be taken into account
Levels of ambition (compared to 2008)	Reduce by at least 50% by 2050 Phase out as soon as possible within the century	Reach net-zero GHG emissions by or around 2050 Peak GHG emissions as soon as possible <Indicative checkpoints> 2030: Reduce by at least 20%, striving for 30% 2040: Reduce by at least 70%, striving for 80%
Carbon intensity target (compared to 2008)	2030: Reduce by at least 40% 2050: Reduce by at least 70%	2030: Reduce by at least 40%*1
Zero-emission technologies, fuels and energy sources introduction target	–	2030: Represent at least 5%, striving for 10%*2

*1Indicator is CO_2 emissions per transport work (Tank-to-Wake base)
*2Consumption energy base

Major Changes

- ✓ Reach net-zero GHG emissions by or around 2050.
- ✓ Consider not only onboard emissions, but also life cycle emissions, including fuel production, transportation, and storage.
- ✓ Monitor progression in terms of total GHG emissions, and adopt a target of uptake of zero or near-zero GHG emission technologies, fuels, and/or energy sources to increase.

GHG emissions (Unit: million ton CO_{2eq})	2008 (Base Year)	2021 (Latest Result)	2030 Reduction Target	2040 Reduction Target
Life cycle emissions (Well-to-Wake)	**731**	**798**	**585 (20% reduction)**	**219 (70% reduction)**
(Breakdown) Well-to-Tank	110	122		
Tank-to-Wake	621	676		

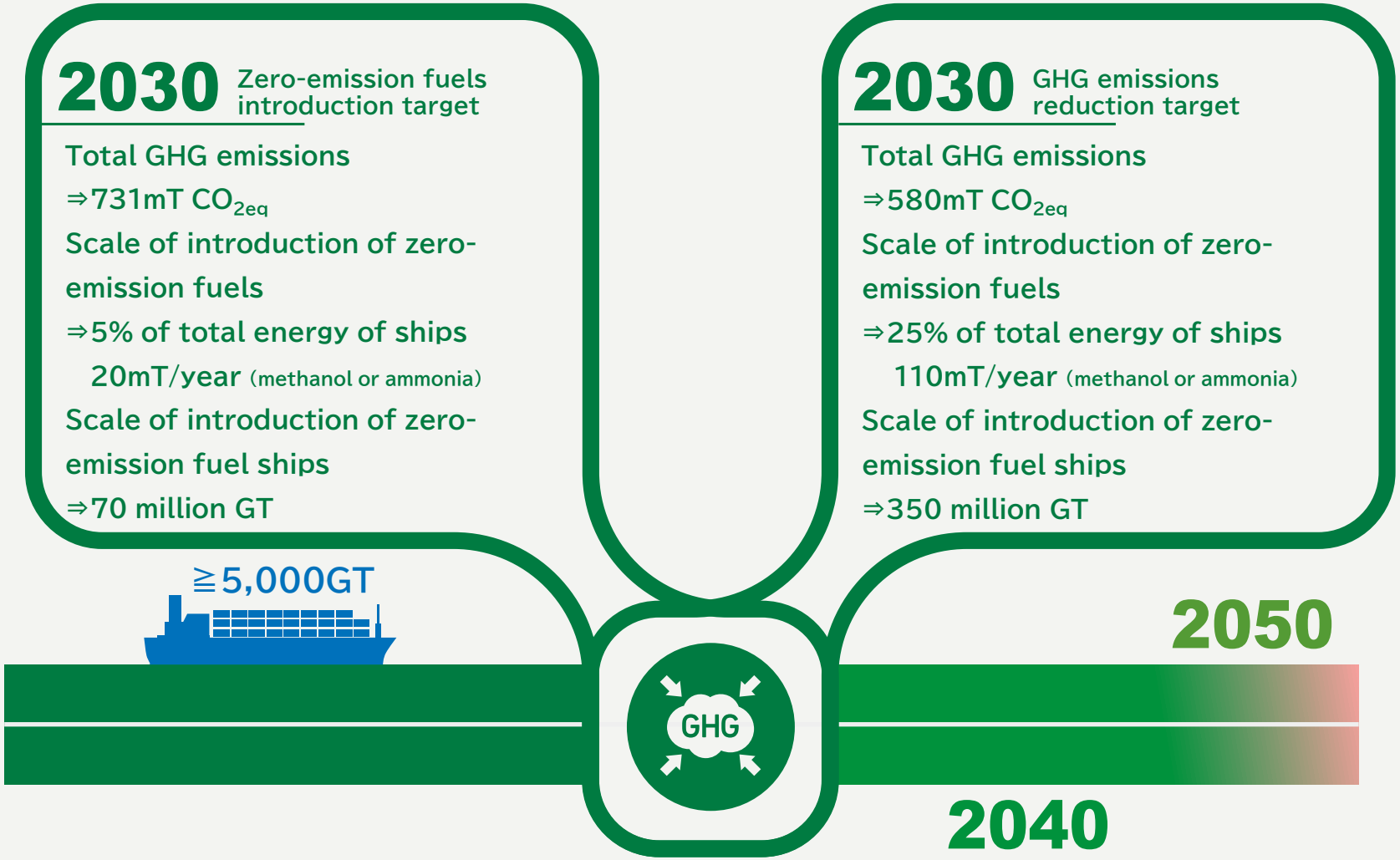
(Note) Estimated only for ships of 5,000 GT and above engaged in international voyages (subject to IMO DCS)

		2030 Zero-emission fuels introduction target achieved (5% zero-emission fuels)	2030 Reduction target achieved (25% zero-emission fuels)	Current production capacity for all sectors
Amount of zero- and low-emission fuels introduced	In case of Methanol	21 million ton	106 million ton	106 million tons/year (of which zero-emission fuels account for less than 1% of the total)
	In case of Ammonia	23 million ton	114 million ton	183 million ton/year (of which zero-emission fuels account for less than 1% of the total)
	In case of Biodiesel	—	66 million ton	42 million ton/year
Life cycle GHG emissions		731 million ton CO_{2eq} (0% reduction from 2008)	580 million ton CO_{2eq} (21% reduction from 2008)	—
Amount of zero-emission fuel ships introduced (In case of methanol/ammonia)	- 2026	12 million GT	12 million GT	—
	2027 - 2030	Newbuilding: 15 million GT/year	Newbuilding: 60 million GT/year Retrofits: 25 million GT/year	

Keynotes

- To achieve the 2030 zero-emission fuels introduction target and the 2030 indicative checkpoint, a substantial amount of zero-emission fuels supply chain shall be developed in a short time.
- Given the current scale of zero-emission fuel production, prompt investment promotion in the manufacturing and distribution of fuels, surpassing the pace of decarbonization in the overall energy sector, will be necessary. Early adoption and implementation of a regulatory framework, including effective carbon pricing, is essential.
- With regard to zero-emission fuel ships supply, assuming stable newbuilding orders will be made, there will not appear to be a significant bottleneck in supply capacity towards achieving the 2030 zero-emission fuels introduction target and the 2030 indicative checkpoint. It is crucial to ensure supply capacity of zero-emission fuel ships in line with the pace of developing the zero-emission fuel supply chain.
- Coordinated efforts among international organizations, member states, the maritime industries, the energy sector, shippers, and the financial sector are urgently needed.

Towards achieving the 2030 GHG emissions reduction target
IMO GHG Strategy



- White paper with details of this analysis (background and details of the estimation, information after 2040, etc.) will be published soon.
- To be continuously updated through dialogue with stakeholders.
- ClassNK will continue to focus on support services for zero-emission efforts.

【Reference】Summary of Estimation

Estimation *1 of GHG emissions as reduction targets

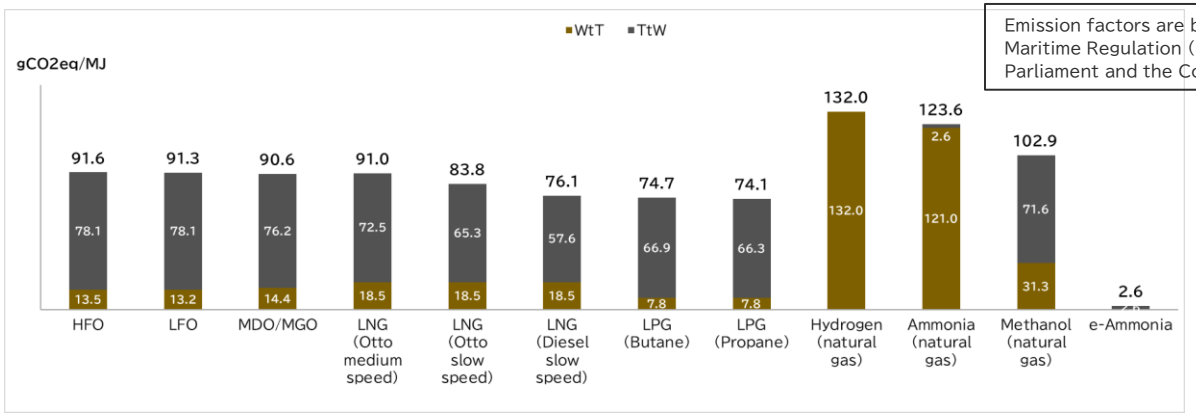
*1Estimated only for ships of 5,000 GT and above engaged in international voyages (subject to IMO DCS)

(Unit: million ton CO_{2eq})

GHG emissions	2008 (Base Year)	2021 (Latest Result)	2030 (Estimation)	2040 (Estimation)
Life cycle emissions (Well-to-Wake)	731	798	585 (20% reduction)	219 (70% reduction)
Breakdown Well-to-Tank	110	122	—	—
Tank-to-Wake	621	676		

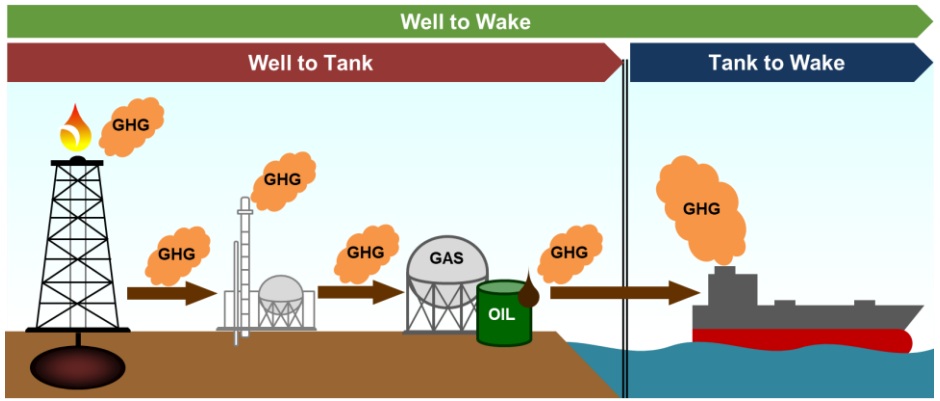
(Note) Well-to-Tank and Tank-to-Wake emissions are estimated based on published fuel consumption data (IMO DCS data).

GHG emissions per unit heat value for Well-to-Tank and Tank-to-Wake for typical fuels (GHG Intensity)



Emission factors are based on the EU's FuelEU Maritime Regulation (adopted by the European Parliament and the Council of the EU).

Image for Well-to-Tank and Tank-to-Wake



Study of scenarios to achieve 2030 zero-emission fuels introduction target and GHG emissions reduction target

The scenarios were developed and visualized to determine how to achieve the 2030 zero-emission fuels introduction target and GHG emissions reduction target.

Method

1. The amount of energy consumed by ships in 2030 is estimated by converting the fuel consumption of ships in 2021 into the energy equivalent and multiplying it by the rate of increase in marine transportation volume and the rate of improvement in energy efficiency of ships from 2021 to 2030.
2. The energy consumption of ships in 2030 is allocated to conventional and zero-emission fuels under a set of scenarios, and their life cycle GHG emissions are compared with the estimated reductions. Examples of such scenarios are presented.

Energy consumption of ships in 2030

Energy equivalent of fuel consumption of ships in 2021[*1]	×	Marine transportation volume growth rate[*2]	×	Ship energy efficiency improvement rate[*3]	
8.79 EJ[*4]	×	1.25	×	0.77	= 8.47 EJ

[*1]Calculated based on fuel use breakdown (fuel oil 93% and LNG 7%) in 2021
[*2]Assumed an average increase based on the Fourth IMO GHG Study 2020 scenario of increased marine transportation volume
[*3]Assumed a 2.55% annual improvement by 2030, based on the assumption that the 2030 carbon intensity target (40% improvement compared to 2008) will be achieved.
[*4]Exajoules (exa is 10 to the power of 18)

Example scenario for achieving the 2030 GHG emissions reduction target

Assumption: Zero-emission fuels will be introduced to achieve the 2030 GHG emissions reduction target.

Result of study: If methanol or ammonia are used as zero-emission fuels, the 2030 GHG emissions reduction target would be achieved by introducing them to account for 25% of the total energy consumption (approximately 110 million tons annually). As the current production volume across all sectors is around 10,000 to 20,000 tons per year, significant investments are necessary to greatly expand the production and distribution of zero-emission fuels.

Zero-emission fuel type	Required amount of zero-emission fuels	Current production capacity for all sectors*1
Methanol	106 million ton	106 million tons/year (of which zero-emission fuels account for less than 1% of the total)
Ammonia	114 million ton	183 million ton/year (of which zero-emission fuels account for less than 1% of the total)

*1The majority of methanol/ammonia currently produced is derived from natural gas (which means it is not zero-emission over its life cycle) and is used for purposes other than fuel.

	Conventional fuels*2	Zero-emission fuels	Total
Energy consumption of ships	6.35 EJ (75%)	2.12 EJ (25%)	8.47 EJ (100%)
Life cycle GHG emissions	575 million ton CO_{2eq}	5 million ton CO_{2eq} (Methanol/Ammonia)	580 million ton CO_{2eq}
2030 GHG emissions reduction target	—		585 million ton CO_{2eq}

*2LNG fuels are assumed to account for 10% of conventional fuels in 2030, up from 7% in 2021.

Example scenario for achieving the 2030 GHG emissions reduction target (Reference: case of biodiesel)

* Currently, biodiesel (mainly FAME) is recognized as low-emission fuels, Its carbon intensity is assumed to be 15 gCO_{2eq}/MJ (equivalent to waste cooking oil-derived), which is an 84% reduction compared to fuel oil. Its calculations have been conducted for reference. It should be noted that the majority of currently produced biodiesel fuels are consumed on land.

Assumption: Biodiesel fuels are introduced to achieve the 2030 reduction target.

Result of study: The 2030 GHG emissions reduction target would be achieved by introducing biodiesel fuels to account for 29% of the total energy consumption (66 million tons annually). As the current production volume is 42 million tons per year, mainly for land-based sectors, further expansion of the current production and distribution is required.

Fuel Type	Required amount of fuels	Current production capacity for all sectors
Biodiesel	**66 million ton**	42 million ton/year

	Conventional fuels*1	Biodiesel fuels	Total
Energy consumption of ships	6.01 EJ (71%)	**2.46 EJ (29%)**	8.47 EJ (100%)
Life cycle GHG emissions	544 million ton CO_{2eq}	37 million ton CO_{2eq}	**581 million ton CO_{2eq}**
2030 GHG emissions reduction target	—		**585 million ton CO_{2eq}**

*1LNG fuels are assumed to account for 10% of conventional fuels in 2030, up from 7% in 2021.

Scale of introduction of zero-emission fuel ships

Result of study

- ✓ To achieve the 2030 introduction target, approximately 15 million GT/year of zero-emission fuel ships need to be built from 2027 to 2030.
- ✓ To achieve the 2030 reduction target, all ships built from 2027 to 2030 must be zero-emission fuel ships, and retrofitting existing ships (approximately 100 million GT) into zero-emission fuel ships is also necessary.

		2021	2026	2027-30 zero-emission fuel ships deployment volume		2030
				Newbuildings	Existing ship retrofits	
2030 introduction target (5% zero-emission fuels)	Zero-emission fuel ships	750 thousand GT	12 million GT	60 million GT	-	71 million GT
	Total fleet	1.25 billion GT	1.33 billion GT			1.43 billion GT
2030 reduction target (25% zero-emission fuels)	Zero-emission fuel ships	750 thousand GT	12 million GT	240 million GT	100 million GT	350 million GT
	Total fleet	1.25 billion GT	1.33 billion GT			1.43 billion GT

Assumptions of the analysis

- ✓ Calculations are based on ships of 5,000 GT and above engaged in international voyages.
- ✓ Until 2026, the current orderbook is used as the basis.
- ✓ From 2027 onward, an annual delivery of 60 million GT for ships is assumed.
- ✓ To make up for the shortfall in achieving the 2030 introduction and reduction target, these calculations also factor in the retrofit of existing ships to zero-emission fuel ships.

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