



**Sea Japan 2022  
International Conference  
Keynote speech**

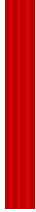
**Low-carbonization and  
Decarbonization Strategy  
to Achieve Net Zero**

**April 21, 2022**



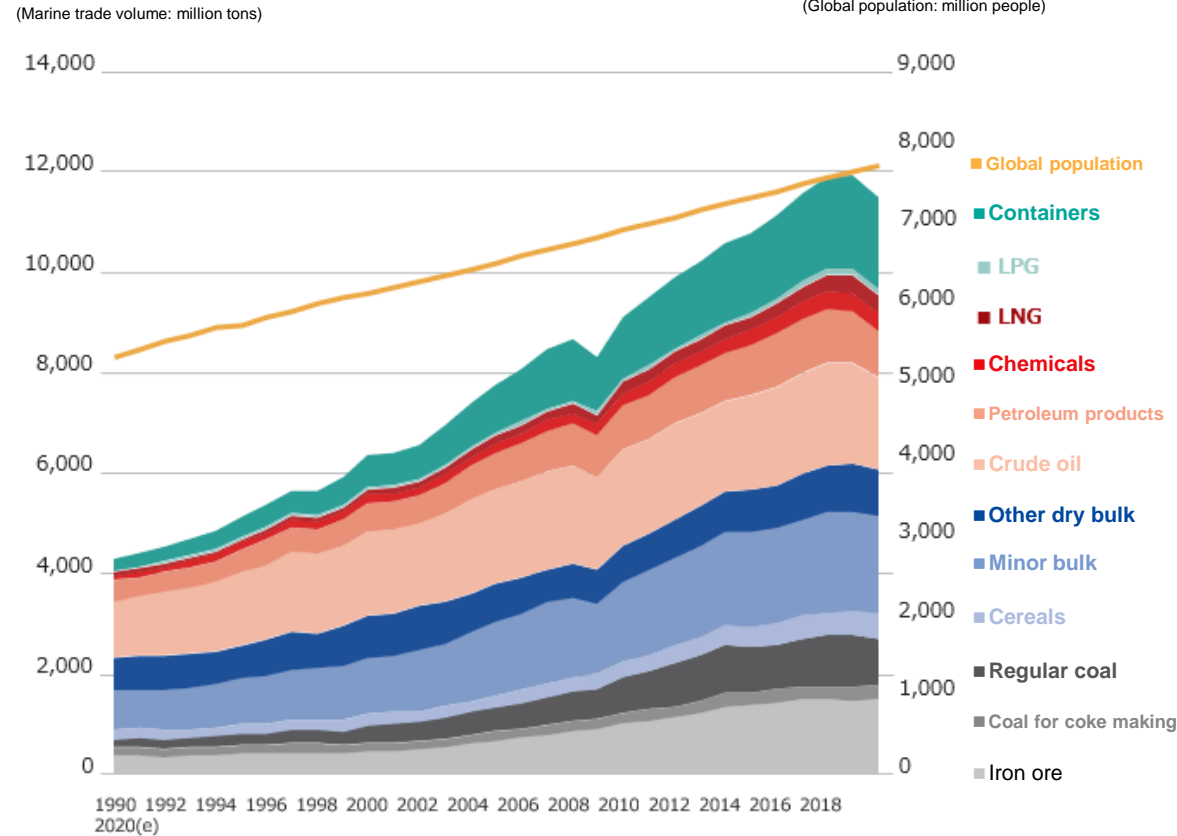
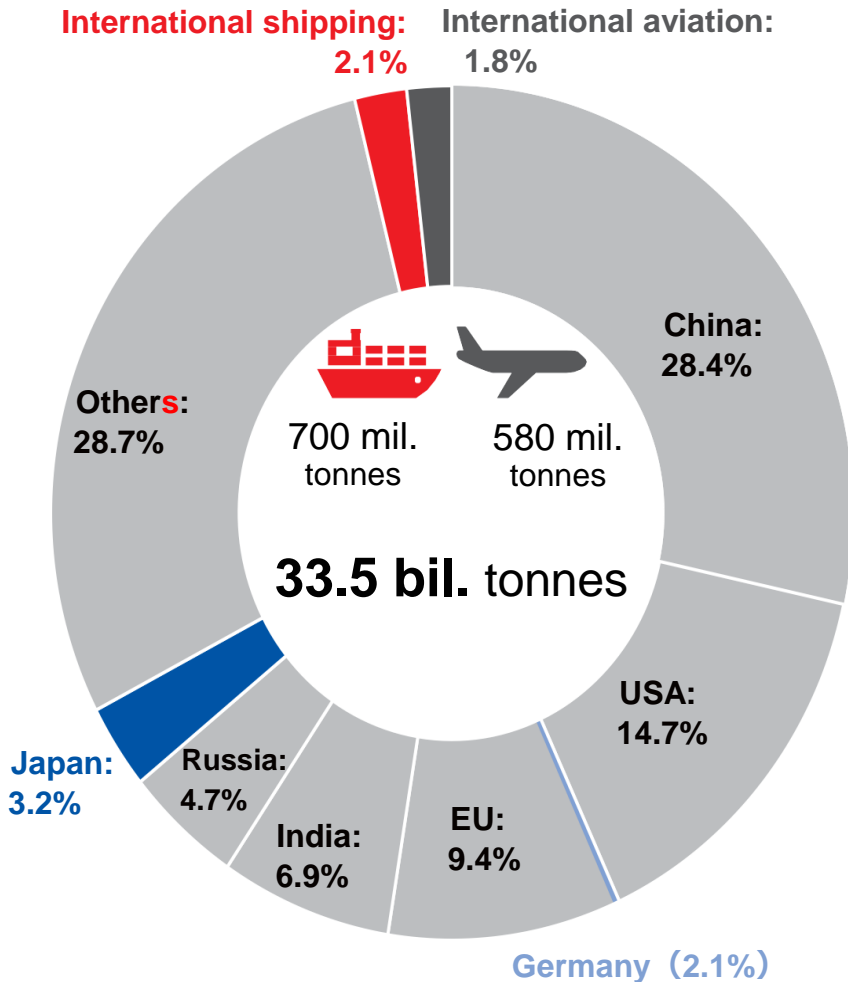
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- International shipping initiatives to reduce greenhouse gas emissions
- Trends and initiatives to achieve net zero greenhouse gas emissions
- Low-carbonization and decarbonization
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  - Net zero initiatives
  - New technology initiatives
- Supporting the decarbonization of society



## Initiatives for reducing international shipping greenhouse gas(GHG) emissions

## Current status of initiatives for reducing international shipping GHG emissions



- There are about 50,000 ships engage in international maritime transport. The resulting CO2 emissions are equivalent to the entire those in Germany.

**Marine Transport continues to expand as the world economy grows. While CO2 emissions efficiency has been greatly improved through technological innovation, further efforts are needed to reach zero emissions.**

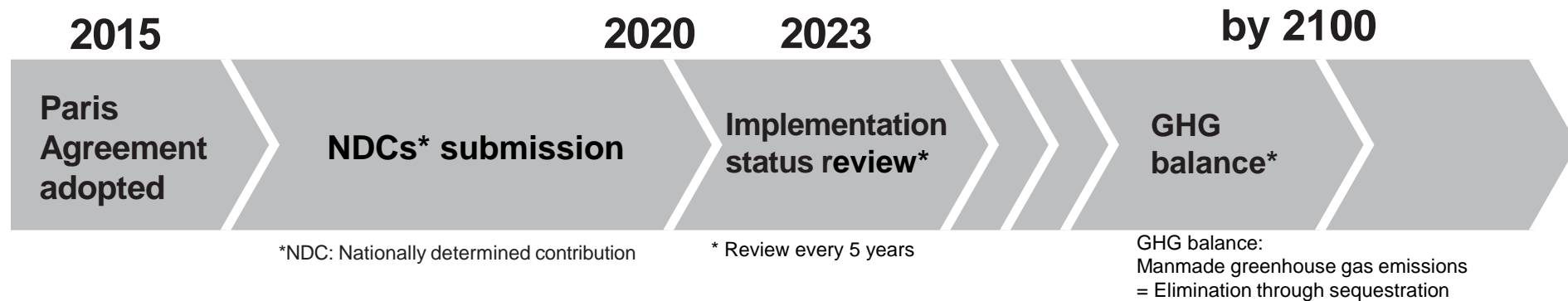
Source: Own-edited by "K" LINE based on materials from Japan's Ministry of Land, Infrastructure, Transport and Tourism and the Japanese Shipowners' Association.

Source: Global maritime trade volume and population (Own-edited by "K" LINE based on information from Clarksons, the database of Japan's Ministry of Internal Affairs and Communications, and other sources.)

## History of global GHG emission reduction efforts (Paris Agreement)

**Paris Agreement  
long-term target**

Limit global warming to well below **2**, preferably to **1.5 degrees Celsius**



	Contribution by country	Long-term targets by country
EU	▲55% by 2030	Zero by 2050
Japan	▲46% by 2030	Zero by 2050
Canada	▲45% by 2030	Zero by 2050

	Contribution by country	Long-term targets by country
China	▲65% by 2030	Zero by 2060
India	▲35% by 2030	Zero by 2070
Brazil	▲43% by 2030	Zero by 2050

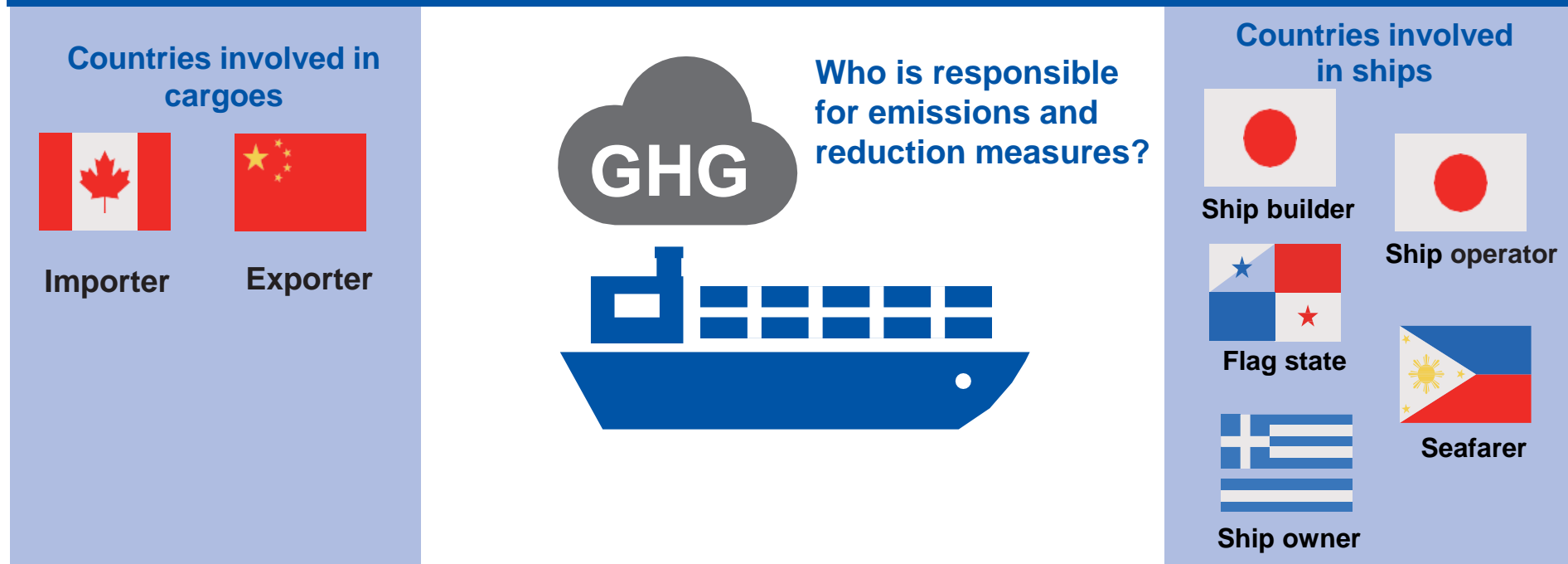
## History of initiatives for reducing international shipping GHG emissions

The countries involved in international shipping are many and diverse. Accordingly, a country-by-country examination of actions, which is the basis of the Paris Agreement, is difficult for the international shipping sector.



As a framework separate from the Paris Agreement, the International Maritime Organization (IMO), a specialized agency of the United Nations, is investigating and implementing industry-wide measures.

### Examples of countries involved in international shipping

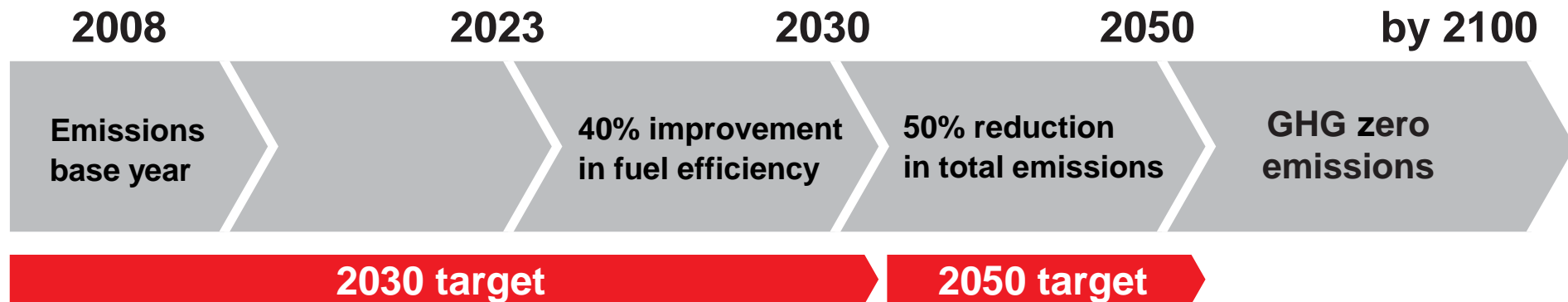


## IMO strategy for reducing GHG emissions

Adopted GHG reduction strategy in April 2018



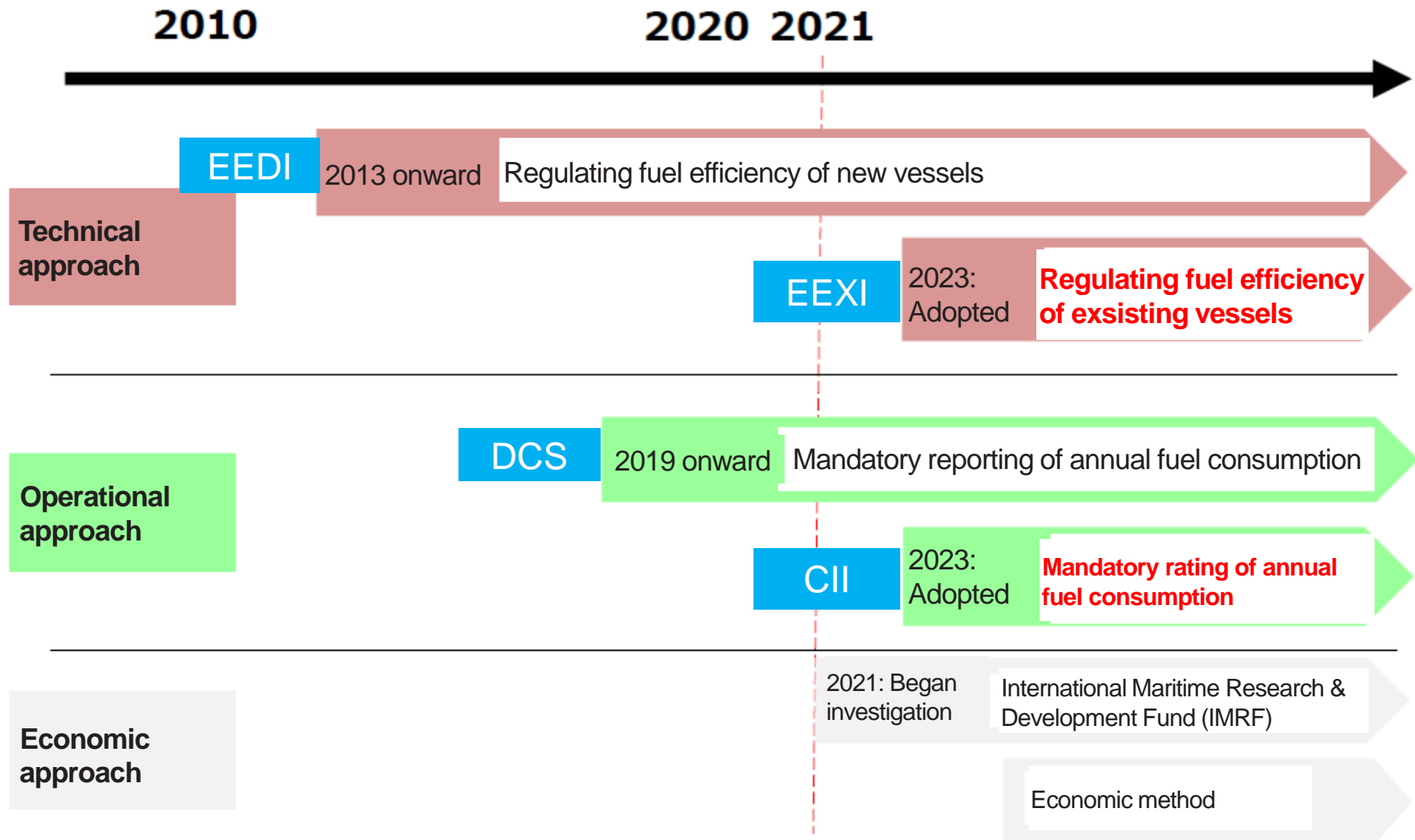
Set medium and long-term targets for **GHG zero** emissions by the end of this century



### Key measures to reduce GHG emissions

- Adoption of low and zero-emission fueled vessels
- Operation efficiency , regulations
  - Tightening fuel efficiency regulations for new vessels(EEDI)
  - Launching an operation data reporting system(DCS)
  - Implementing fuel efficiency performance rules and rating system for existing vessels(EEXI , CII)

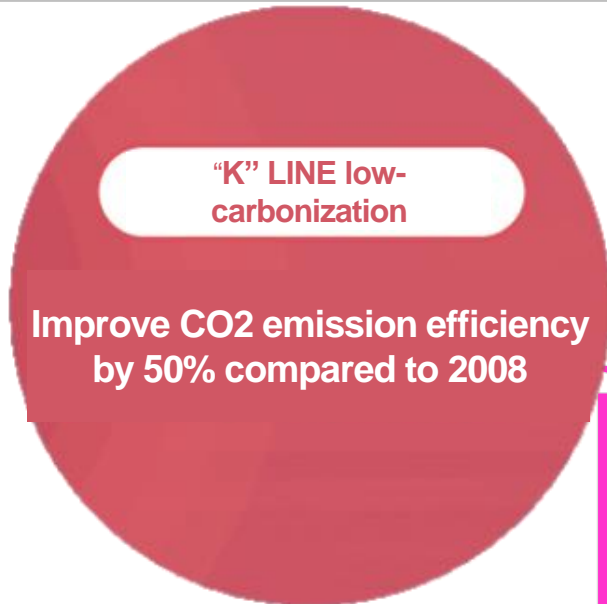
# IMO rules for reducing GHG emissions





# “K” LINE’s Environmental Vision 2050 and IMO’s GHG emissions reduction targets

## 2030 interim target



CO2 emissions reduction target set at 50%, exceeding IMO’s 40% target

## 2050 target



Target revised to net zero by 2050 (Nov 2021)



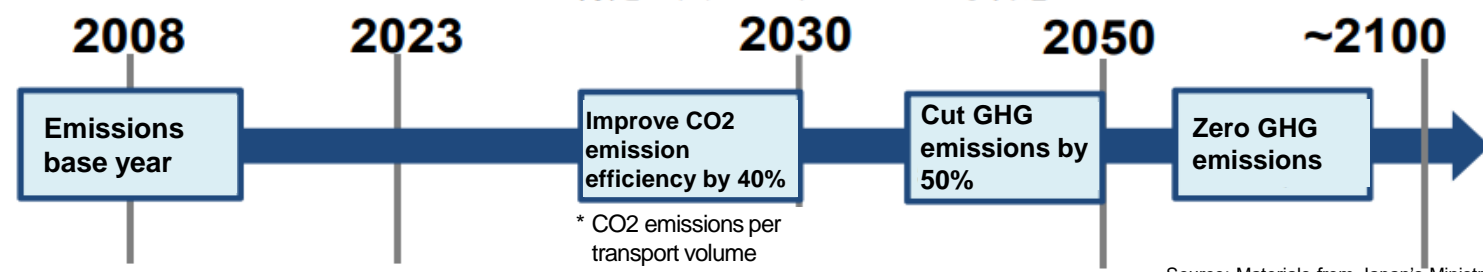
IMO

## Emissions reduction strategy adopted in April 2018

### Long-term target

Aiming for **zero GHG emissions** from international shipping as soon as possible within this century.













\* World’s first global agreement for a specific sector



IMO is reviewing the GHG reduction strategy adopted in April 2018 and will complete the review in 2023.

# Trends and initiatives to achieve net zero GHG emissions

# Net zero emissions targets for major countries

	2030	2040	2050	2060	2070
	▲46% (vs 2013)	 Net zero			
	▲55% (vs1990)	 Net zero			
	▲50-52% (vs2005)	 Net zero			
	▲68% (vs1990)	 Net zero			
	Shift to reducing CO2 emissions	 Net zero			
	Renewable energy ratio of 50%	 Net zero			

## Shipping companies declared for net zero by 2050

**“K” LINE: Announced in Nov 2021**

**Mitsui O.S.K. Lines: Jun 2021**

**NYK Line: Sep 2021**

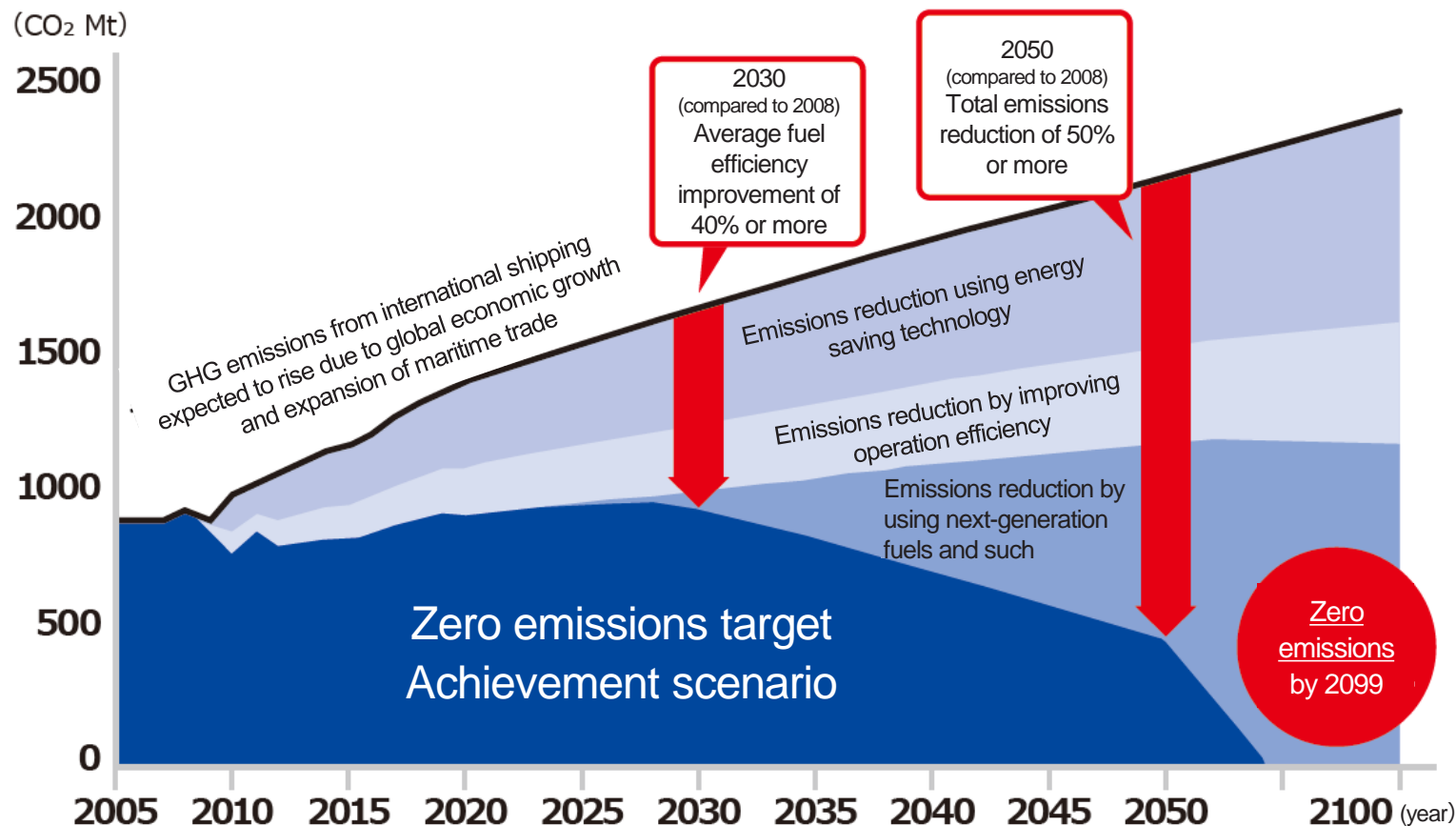
**Japanese Shipowners' Association: Oct 2021**

**Maersk: Jan 2022 \*2040 target**

## Coalition for the decarbonization of shipping

- **Getting to Zero Coalition**  
Aiming to achieve commercial operation of zero-emission vessels by 2030  
International coalition of more than 150 companies and government agencies involved in the maritime industry  
(Shipping participants include Maersk, ONE, "K" LINE, Mitsui O.S.K. Lines, and NYK Line.)
- **Shipping Zero Emission Project**  
Collaboration project involving industry, academia, and public sectors, organized by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and Japan Ship Technology Research Association (JSTRA).  
The Roadmap to Zero Emission from International Shipping is now aiming for commercial operation of zero-emission vessels by 2028.
- **Collaboration toward decarbonization is becoming more visible across industries and borders. Efforts are being promoted not only for vessels but also for the entire supply chain. This includes the development of production and supply infrastructure for next-generation fuels like ammonia and hydrogen.**

# Plan for reduction of GHG emissions from international shipping



## Efficiency improvement of 40% (by 2030)

### Measures to improve efficiency

- \* Low-carbon fuels (such as LNG)
- \* EEXI regulations
- \* Fuel efficiency indicator (CII)
- More efficient operation /Speed reduction/adding energy-saving equipment.

## Half of total emissions or net zero (by 2050)

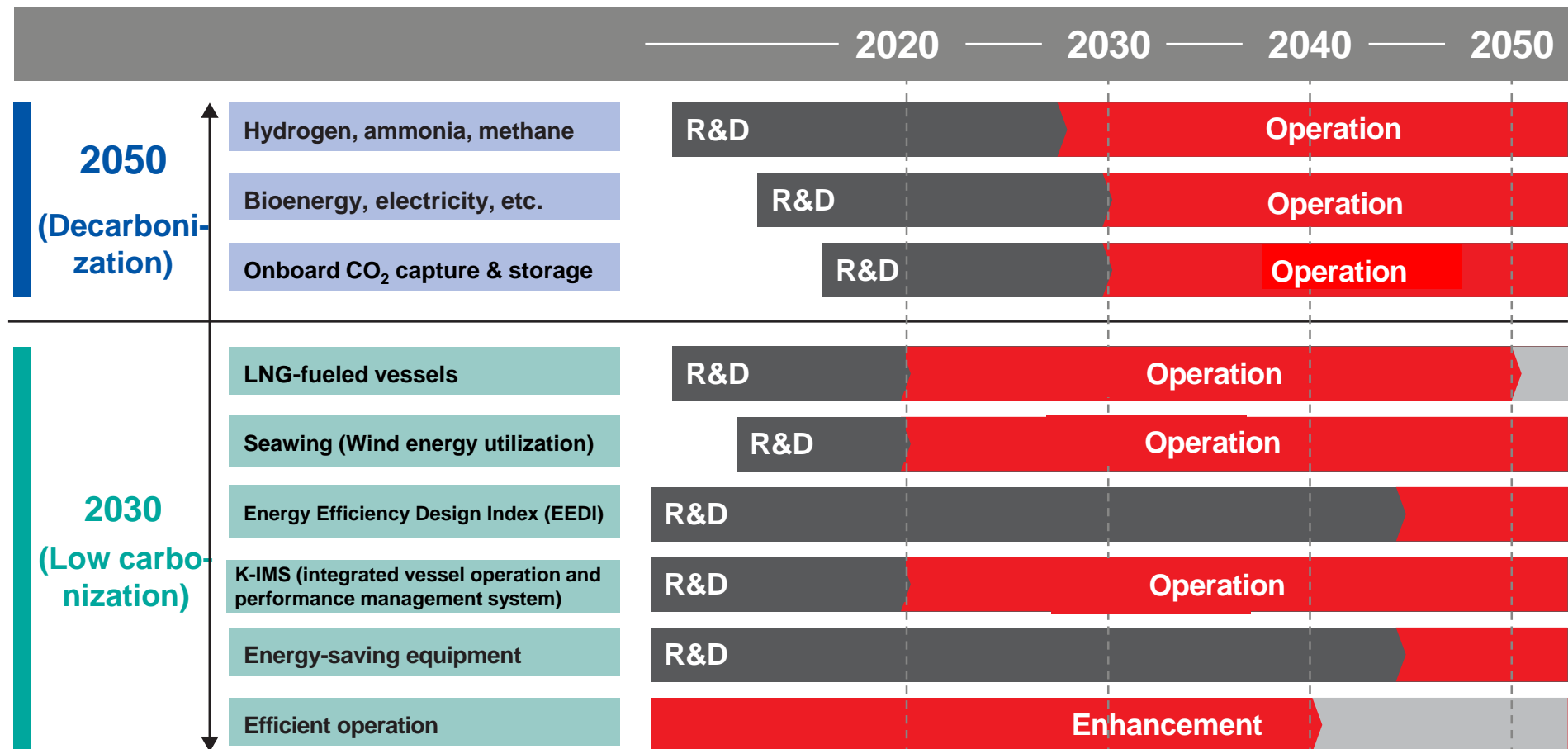
### Net zero measures

- \* If measures do not take global economic growth into account, the total amount of greenhouse gas emissions will increase. Conversion to zero-emission fuels is essential.
- \* Various initiatives have been under research/discussion concerning ways to achieve net zero including regulations and promotion incentives. However, there is no definite answer/consensus yet.

# Roadmap for low-carbonization and decarbonization

Support low-carbonization and decarbonization of society

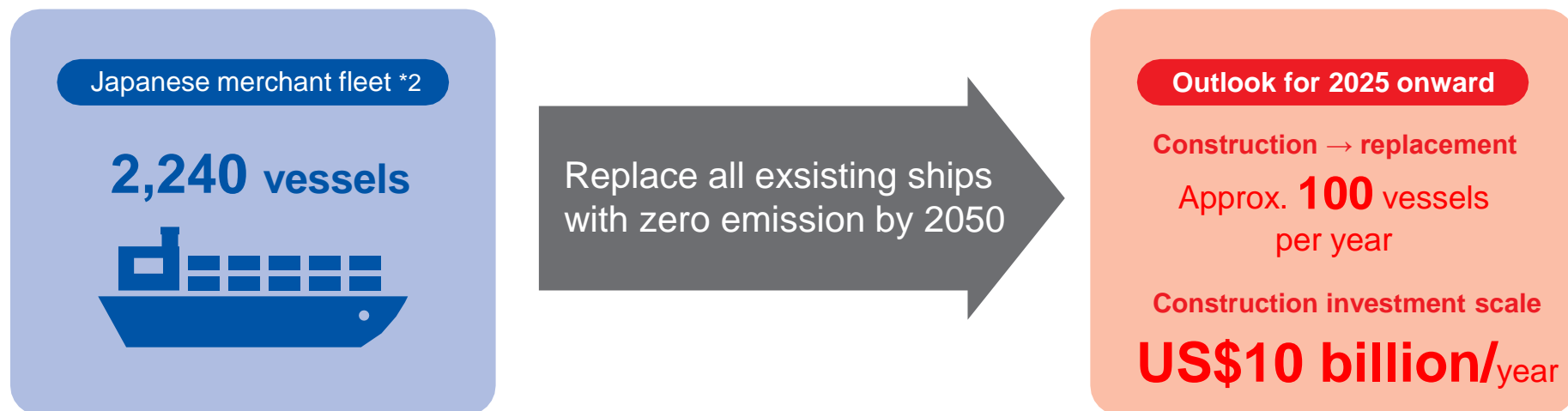
Low-carbonization and Decarbonization



## Challenge for 2050 (fleet replacement with eco-friendly vessels)

- Shipbuilding and dismantling capacity at shipyards (vessel lifecycle is 20-30 years)
- In order to manage the supply chain, it is impossible to build and replace all ships at once.
- Finding large amounts of capital investment along with technological innovation to build eco-friendly vessels

The investment amount per vessel is considerable, and a detailed investment plan is required. It is necessary to ascertain technology development trends (avoiding obsolescence risk) and the status of supply network development.



\*1 A preliminary calculation indicates that 1,000 to 2,000 ships will need to be built and put into service replacing conventional ships every year worldwide (total global merchant fleet: approx. 50,000 ships)

\*2 Ships operated by Japanese shipping companies

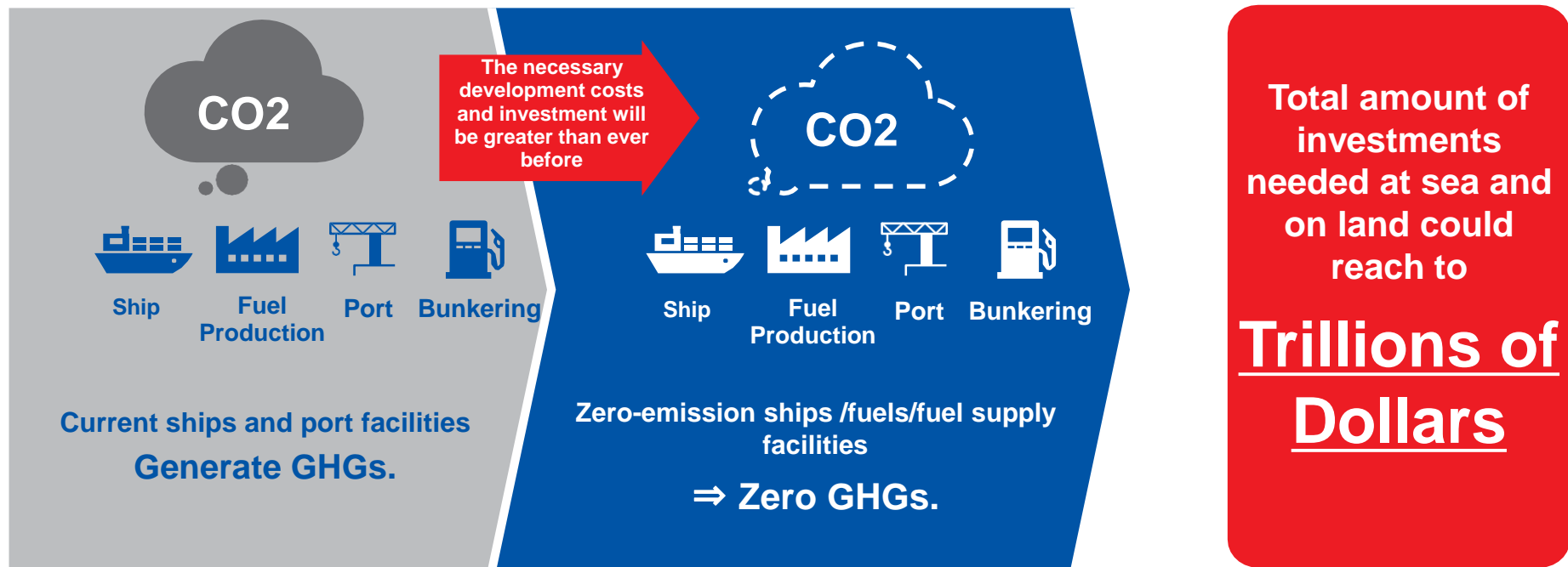


## Challenge for 2050 (securing supplies of alternative fuels)

- Collaboration with the energy industry will be essential to ensure that the right fuels can produced and supplied worldwide.
- Vessels need to supply fuel in ports all over the world, and collaboration with ports will be important for building a new global fuel supply chain.
- Providing bunkering vessels including seafarer



The required investment is estimated to be trillions of US dollars. This is because it must cover not only the building of ships but also the development of fuel production and supply infrastructure.



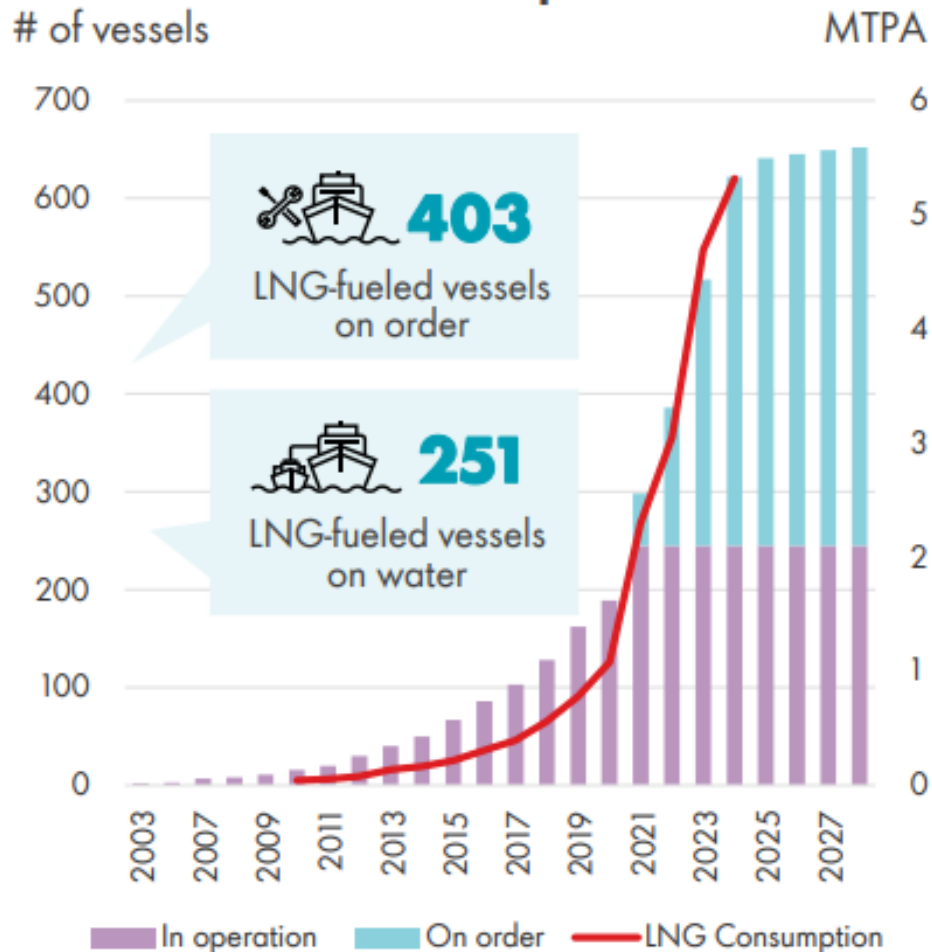


# Low-carbonization and Decarbonization

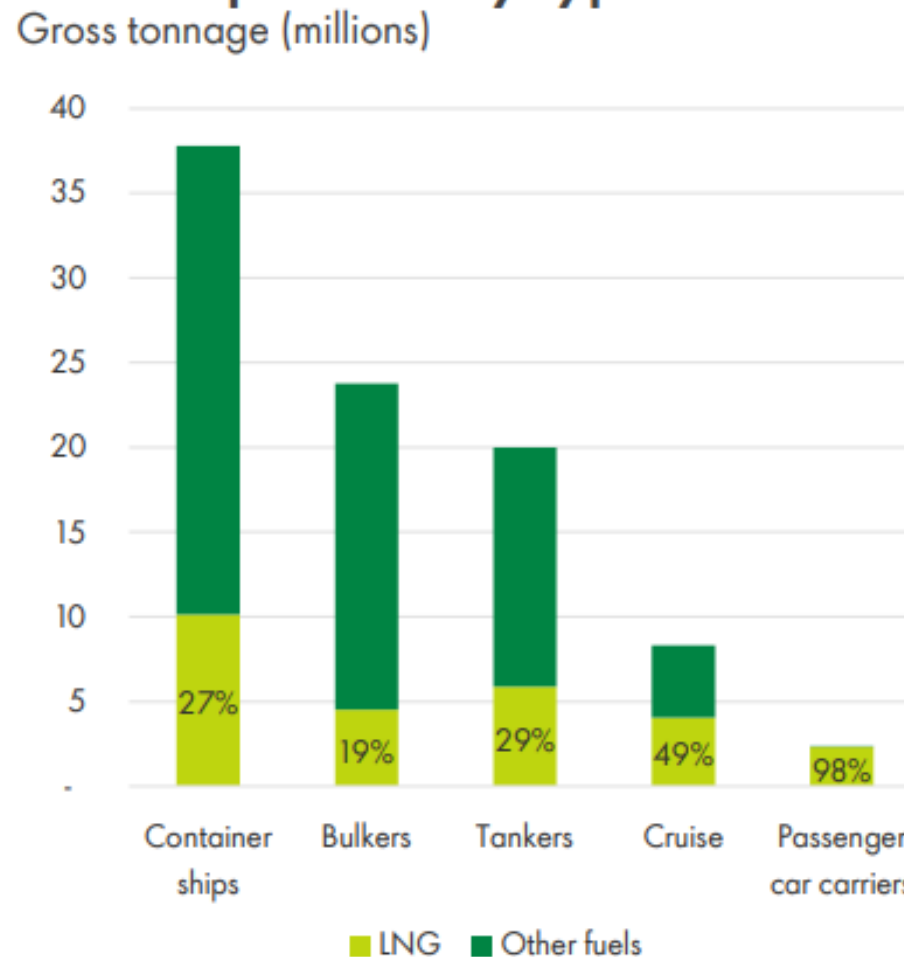
Low-carbonization initiatives

# Status for adoption of LNG-fueled vessels

## LNG vessels & fuel uptake



## New ship orders by type\*\*



\*\*Only larger size vessels: containers >12000TEU, tankers > 85000DWT, bulkers > 65000DWT

- 251 LNG-fueled vessels have been in operation worldwide (as of 2021)
- Approximately 30% of new vessels are LNG-fueled (based on gross tonnage)

## Adoption of LNG-fueled vessels



CENTURY HIGHWAY GREEN

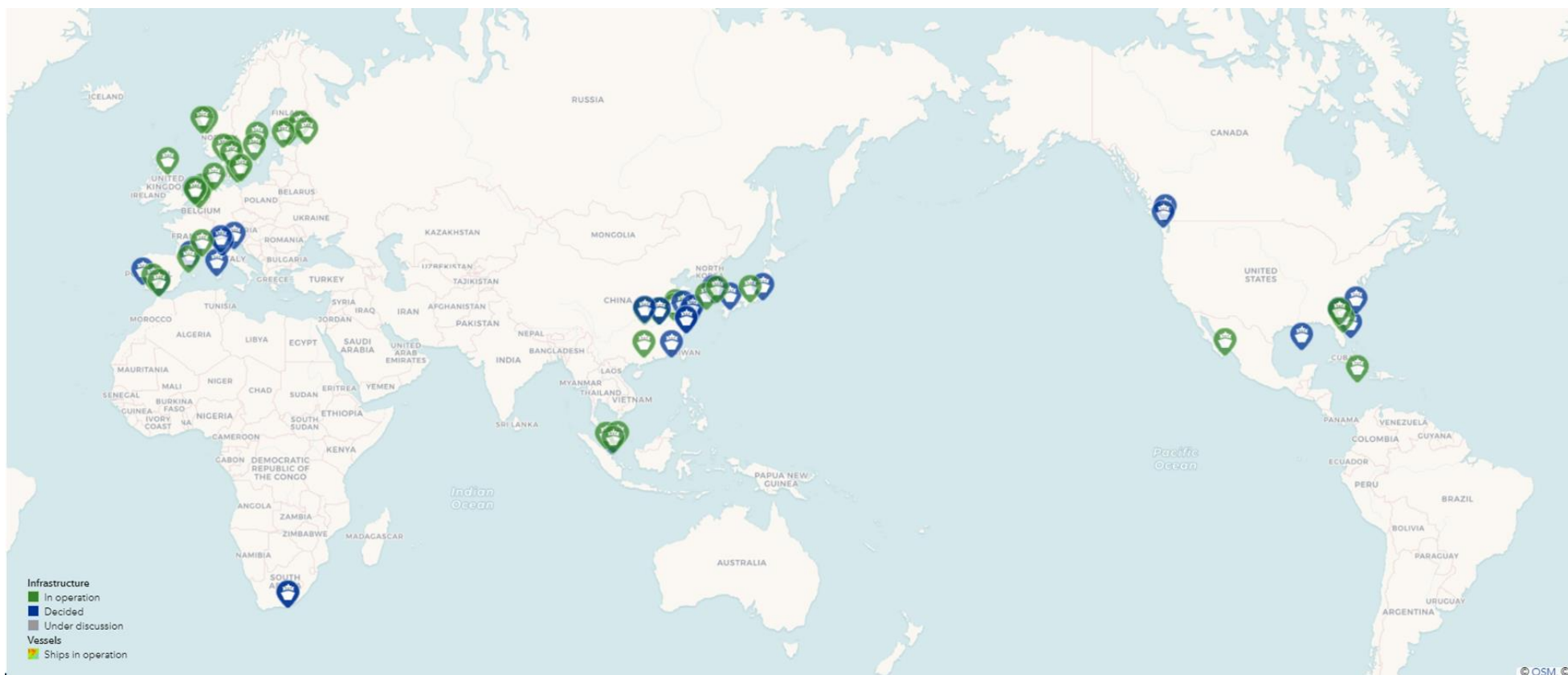
- Delivered LNG-fueled car carrier CENTURY HIGHWAY GREEN in March 2021
- Approximately 25% to 30% reduction in CO2 emissions by using LNG fuel
- Funding for the vessel construction has been secured through the first climate transition loan-in Japan.
- Delivery 8 LNG-fueled car carrier in FY2023-2025



LNG-fueled Capesize bulk carrier

- Signing of a Long-term Consecutive Voyage Charter for a LNG-fueled Capesize Bulk Carrier with JFE Steel Corporation
- Our first LNG-fueled bulk carrier will be built by Nihon Shipyard Co., Ltd., and the vessel is scheduled to be delivered in the first half of 2024
- The vessel will also install “Seawing” ,automated kite system utilizing wind power
- **Approximately 40 LNG-fueled vessels will be added to our fleet by 2030**

# Development of a LNG fuel supply network



Source: DNV GL

- About 30 LNG-fueled vessels are now operating worldwide, and the number is expected to increase to about 50 by 2023.
- There are about 20 ship-to-ship LNG bunkering sites worldwide. The number is expected to increase.

# Development of an LNG fuel supply network



LNG bunkering vessel "KAGUYA" with a capacity of 3,500 m<sup>3</sup>



LNG bunkering vessel with a capacity of 7,500 m<sup>3</sup>  
"FUELNG BELLINA"

- In October 2020, we launched a vessel LNG fuel supply business in the Chubu region of Japan through a joint venture with JERA, Toyota Tsusho, and NYK Line.
- Japan's first ship-to-ship LNG bunkering service
- Providing ship management of LNG-fueled vessels to FueLNG Pte Ltd, a joint venture between Keppel and Shell, which operates an LNG bunkering service in Singapore.

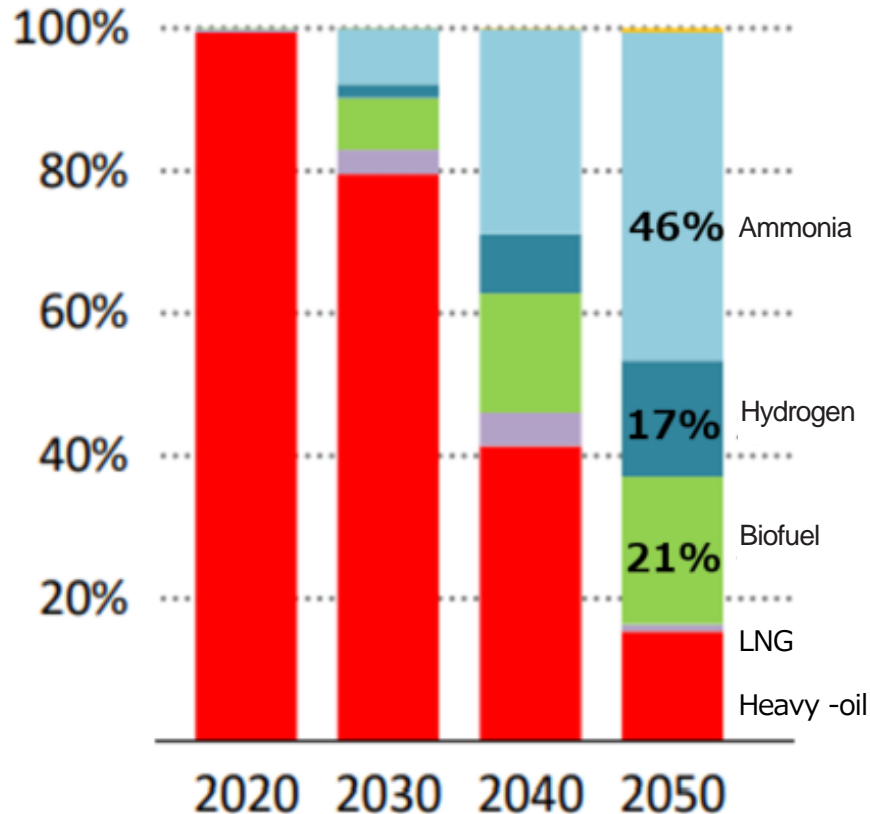


# Low-carbonization and Decarbonization

Net zero initiatives

# Roadmap for low-carbonization and decarbonization

## Fuel conversion ratio scenario to achieve net zero (Net Zero Emissions (NZE) by 2050 scenario)



- According to the International Energy Agency (IEA) pathway scenario for achieving net zero by 2050, about 20% of current fuels will be replaced with alternative fuels by 2030, and about 80% by 2050.
- In the shipping sector, hydrogen, ammonia, and biofuel are the main alternative fuels, and ammonia is expected to account for 46% by 2050, due to its energy density and availability.

Source: IEA, "Net Zero by 2050: A Roadmap for the Global Energy Sector"



# Joint research on the adoption of ammonia-fueled vessels by the social implementation

Participation in an industry framework for studying common issues relating to ammonia as an alternative marine fuel

A total of 34 companies and organizations are investigating the following common issues for the adoption of ammonia as a marine fuel. The companies include those involved in energy, mining, steelmaking, electric power, chemicals, terminals, shipping, shipbuilding, manufacturing, and marine fuel supply, as well as the Japanese ship classification society.

- (1) Safety evaluation of ammonia-fueled vessels
- (2) Safety evaluation for ammonia fuel supply
- (3) Ammonia specifications as marine fuel
- (4) Net CO2 emissions from ammonia production

## Participating companies and organizations:

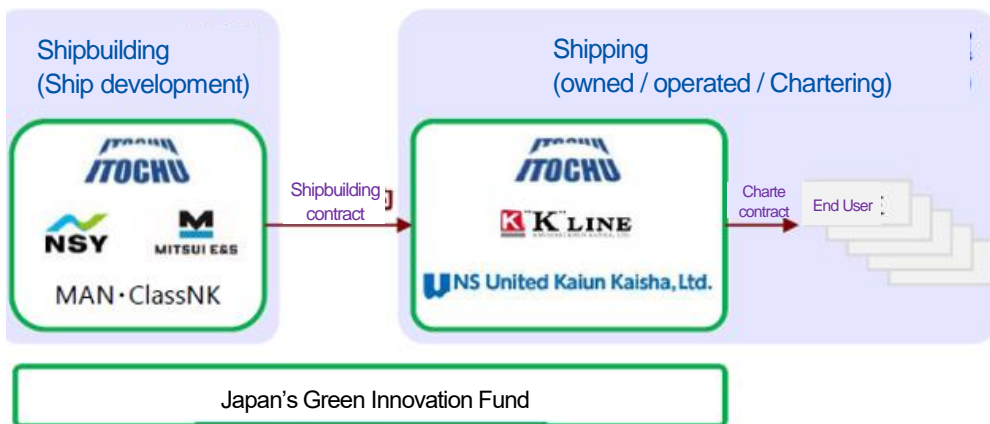
ITOCHU , ITOCHU ENEX, Uyeno Transtech, Ube Industries, NS United, "K" LINE, JERA, Nihon Shipyard, Nippon Kaiji Kyokai, Mitsui E&S Machinery, ABS, ANGLO AMERICAN, DNV, EQUINOR, FORTESCUE FUTURE INDUSTRIES, GENCO SHIPPING & TRADING, MAN ENERGY SOLUTIONS, PAVILION ENERGY, TOTAL ENERGIES, TRAFIGURA, UNIPER SE, VALE, VOPAK TERMINAL SINGAPORE,



INPEX, JFE Steel, ANGLO EASTERN, BHP, BUREAU VERITAS, CMA CGM, LLOYD'S REGISTER, MAERSK, NAVIOS GROUP, RIO TINTO, and VITOL ASIA

# Initiative to promote ammonia-fueled vessels

Participating in a joint project for the development of ammonia-fueled vessels adopted by Japan's Green Innovation Fund



Role of each company	
Company	Role
Mitsui E&S Machinery	1. Development of ammonia fuel tank & a fuel supply system
	2. Development of technology related to ammonia-fueled main engine
	3. Development of safety features specific to ammonia-fueled ship
	4. Demonstration of related to ammonia-fueled engine & supply system
Nihon Shipyard Co., Ltd.	1. Development of a hull equipped with ammonia fuel tanks
	2. Ammonia fuel handling system onboard
	3. Safety system onboard
	4. Verification of R&D through shipboard demonstration
"K" LINE, ITOCHU, and NS United Kaiun	Operational demonstration of ammonia-fueled ship

The project aims to deploy Japan-led implementation of ammonia-fueled Capesize bulk carriers into society as soon as possible or by 2028. We will develop propulsion systems and hulls and to acquire and operate such vessels ahead of other countries

# Participating in the ammonia bunkering business

## Participating in a joint study to realize ammonia bunkering to ships in Singapore

### Investigating the following:

- (1) Design and development of ammonia bunkering vessels
- (2) Infrastructure development including the marine transportation and storage necessary for ammonia bunkering
- (3) Establishment of a supply chain to enable ship-to-ship ammonia bunkering
- (4) Development of operational guidelines, laws and regulations for ammonia bunkering

### Participating companies

(June 2021)

A.P. Moller - Maersk A/S

Fleet Management Limited

Keppel Offshore & Marine

Sumitomo Corporation

American Bureau of Shipping

Maersk Mc-Kinney Moller Center for Zero Carbon Shipping

(April 2022)

Maritime & Port Authority of Singapore

Kawasaki Kisen Kaisha, Ltd.

## Adoption of ammonia-fueled vessels



- Together with Shin Kurushima Dockyard, we obtained joint AIP for the concept design approval for an ammonia-fueled car carrier from Nippon Kaiji Kyokai (ClassNK).
- As ammonia fuel does not emit carbon dioxide (CO<sub>2</sub>) during combustion, it is attracting attention as a next-generation marine fuel that will greatly contribute to the International Maritime Organization's (IMO) strategic goal of GHG reduction by 2050, which is to reduce total GHG emissions by 50% from the 2008 level.
- “K” LINE, Shin Kurushima Dockyard, and ClassNK have performed risk assessment and are establishing safety measures for using ammonia as a vessel fuel.
- We are now investigating ammonia-fueled vessels while paying close attention to trends concerning international regulations on ammonia fuel and the status of infrastructure development.

# Adoption of ammonia/LPG carrier



Ammonia carrier

- From 2007 to 2019, we operated a 38,000-m<sup>3</sup> ammonia transport vessel between Australia and Far East Asia. It made approximately 350 voyages, transporting approximately 7 million tons.
- The ammonia carrier was sold in 2019, and the crew was reallocated to our LPG carrier.
- Ordered LPG/ammonia carrier in 2021



Provided by Kawasaki Heavy Industries

Rendering of completed LPG/ammonia carrier

Ship builders	Kawasaki Heavy Industries Sakaide Works
Delivery date (planned)	2023
Total length / width / depth / draft	Approx. 230 m / 37.2 m / 21.9 m / 11.7 m
Tank capacity	86,700m <sup>3</sup>
Total tonnage	Approx. 110,800 m <sup>3</sup>

- Aiming to participate in the ammonia fuel transport in the future.



# Low-carbonization and Decarbonization

New technology initiatives

# Utilization of renewable energy



- “Seawing”, automated kite system developed by AIRSEAS which was spin off from AIRBUS ,will be installed on a large bulk carrier.
- Mounted on the bow of the ship, “Seawing” is deployed using controls on the bridge under certain wind conditions and directions, and it harnesses wind power to boost vessel propulsion.
- With the specific routes and speeds of the vessels on which the system will be installed, a CO2 emission reduction effect of 20% or more is expected.
- The energy (fuel) supply method is easier to implement than other comparable methods.
- We have signed a joint research agreement with Airseas to further improve the performance of the Seawing system by utilizing the operation and performance data obtained from the K-IMS ,integrated vessel management system,installed on our vessels.

Method	Supply system	Effect
Wind power (renewable energy)	Not necessary	Reduction of GHG, SOx, NOx, and PM emissions all at the same time
Fuel conversion	Necessary	SON, NOx, and PM emissions remain depending on the fuel choice

## LNG-fueled large bulk carrier + Seawing

- “Seawing” will be installed on a large LNG-fueled bulk carrier scheduled to be delivered in 2024.
- CO2 emissions reduction effect  
LNG fuel (25% to 30%) + Seawing (20%) = 45% to 50% emissions reduction



(Large Capesize bulk carrier + Seawing)



# History of Seawing development



- 2017: Start joint study with Airseas for “Seawing” installation.
- Jun 2019: Announced installation on “K”Line’s large bulk carrier
- Aug 2020: Obtained design approval in principle (AIP) from ClassNK
- Nov 2021: Seawing factory testing for Airbus vessel
- Dec 2021: First system installed on Airbus vessel
- Jan-Feb 2022: Seawing factory testing for “K” LINE vessel



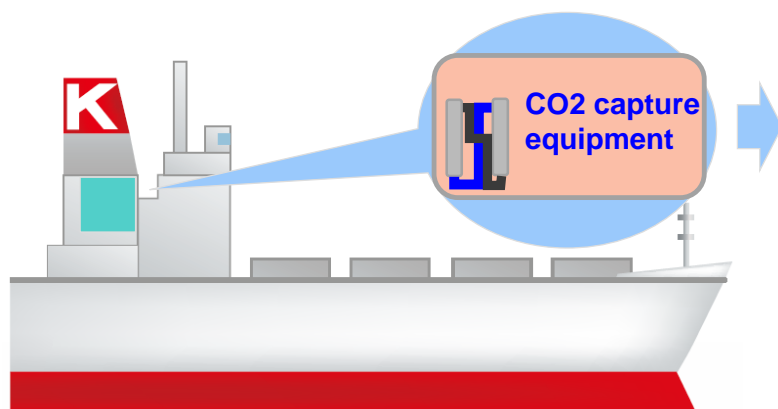
- 2022: First installation on “K” LINE vessel



# Onboard CO2 capture technology

## CC-Ocean project: Installation of onboard CO2 capture equipment

- Supported by Japan's Ministry of Land, Infrastructure, Transport and Tourism under its program for research and Development for advancing marine resources technologies.
- Joint research with Mitsubishi Shipbuilding and ClassNK
- End of July 2021: Completed installation of demonstration plant on the ship and began demonstration project
- October 2021: Successfully captured CO2 from exhaust gas



Installation on the vessel

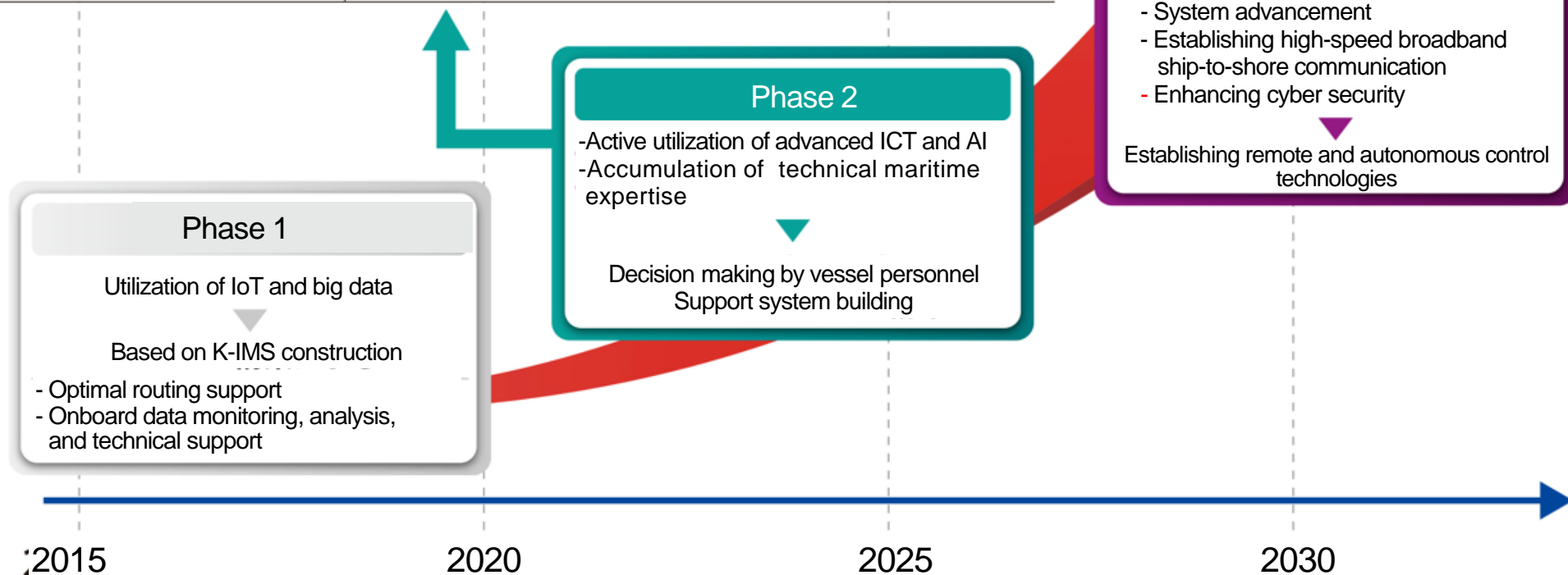
### (CO2 capture initiative)

1. The vessel exhaust gases are cleaned and cooled using a scrubber.
2. CO2 is captured by passing the scrubbed and cooled exhaust gas through an absorption liquid (amine solution).
3. The absorption liquid is then heated to separate out the CO2.



# Initiative to enhance crew member technical support for safe vessel operation and to realize autonomous vessels in the future

Phase 2 initiative details	Development planed				
	2021	2022	2023	2024	2025
Lookout and vessel maneuvering support	Prototype completion		Trial	Implementation	
Safe berthing embarking support	Prototype completion		Trial	Implementation	
Optimal route navigation while at sea	Navigation system updating				Implementation
Engine plant operation support	Prototype completion		Trial	Implementation	



**|** Supporting the decarbonization of society

# National targets for Offshore Wind Power Generation

## Target of Japanese Government

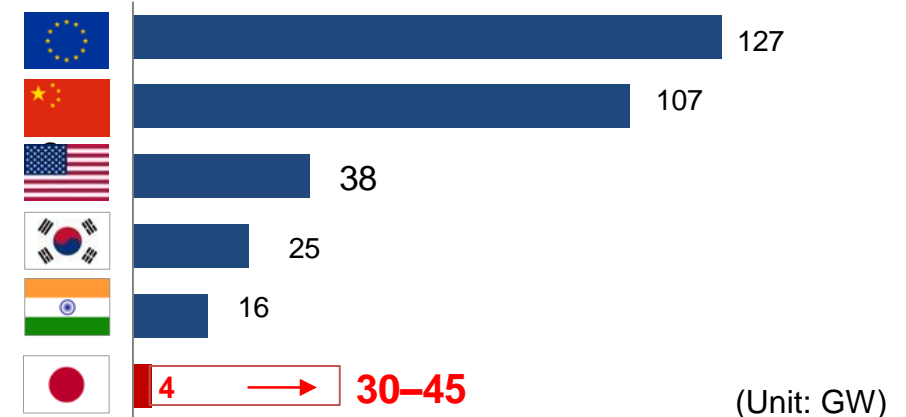
**Continuing to designate promotion zones to generate approx. 1GW of wind power per year for 10 years** and awarding capacity of **10GW by 2030** and **30-45GW**, including floating wind turbines, **by 2040**

- \* 45 GW by 2040 would create the world's third largest offshore wind power market.
- \* To achieve 45 GW capacity, the costs of floating wind turbines must to be significantly reduced, through the technology development and mass-production.

### National Targets for Offshore Wind Power Generation

Region /Country	Target	
EU	60GW	2030
	300GW	2050
Germany	40GW	2040
USA	22GW	2030
China	5GW	2020
Taiwan	5.5GW	2025
	15.5GW	2035
South Korea	12GW	2030

### IEA-forecasted offshore wind power generation based on government targets in each country ( 2040)

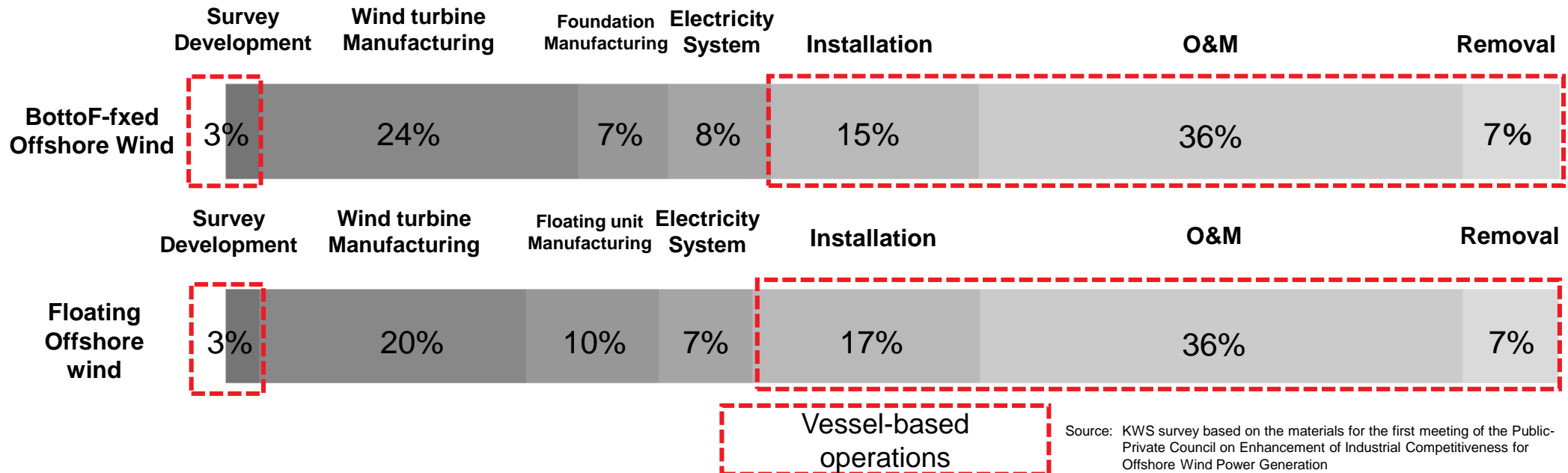


IEA Offshore Wind Outlook 2019 (public policy scenario)

# Supply chain for Offshore Wind Power Business

- More than 60% of total supply chain of offshore wind required vessel related operation.
- Vessels will be needed not only for seafloor surveys, equipment installation, and maintenance, but also for the transport of wind turbine components.
- More requirement for maritime expertise while the floating offshore wind develops.

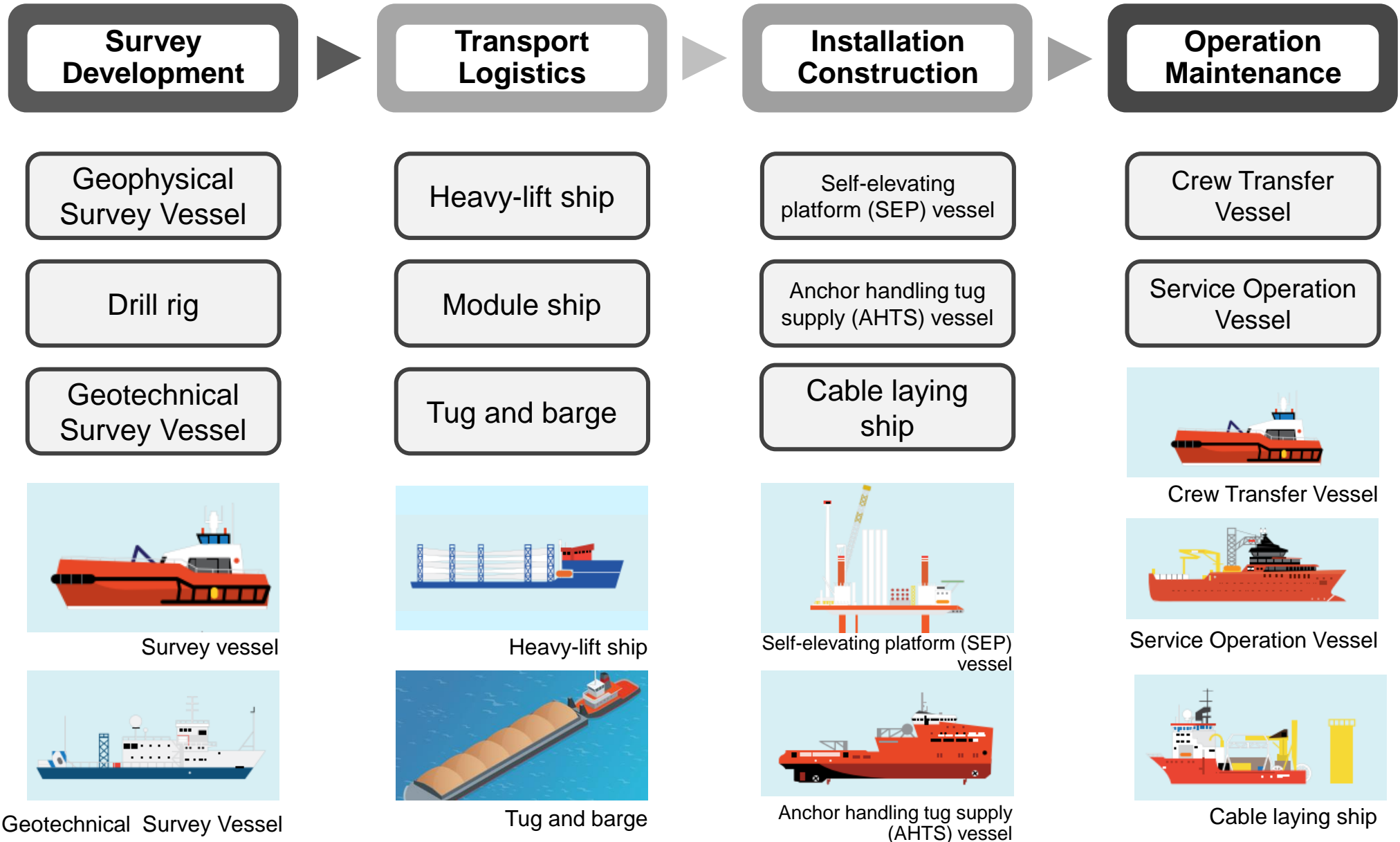
## Offshore wind power supply chain and share of cost (%)



- Since Japan has a limited shallow water area where bottom-fixed offshore wind turbines can be installed, there is a high expectation to floating offshore wind as the major renewable energy source.

# Vessels required for Offshore Wind Projects

■ A various types of vessels are used for offshore wind projects



# “K” LINE Group Targets for Offshore Wind Power Projects

- Established “K” Line Wind Service, Ltd. in June 2021
- KWS is specializing in offshore wind power projects with the comprehensive strengths of the “K” LINE Group
- KWS will play a central role in the “K” LINE Group as a platform for business development in the offshore wind power field.
- By pursuing operation and suitable vessel design for Japanese water, we contribute to the development of a new cluster of maritime industries for Offshore Wind Power in Japan.





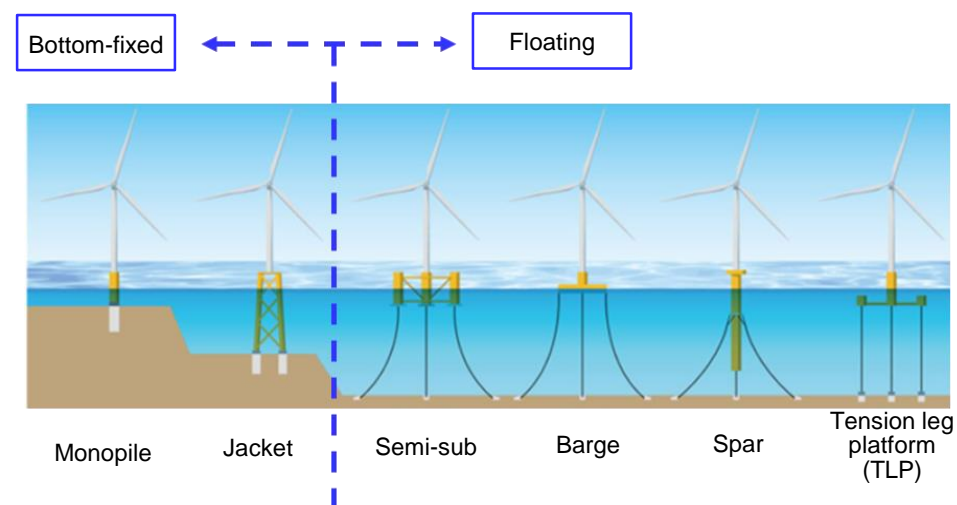
## NEDO Green Innovation Fund Project:

### Mass-production and Cost Reduction of Floating Offshore Wind Power Generation (1)

- “K” LINE Group targets at mass-production and cost reduction of floating offshore wind power projects

#### Bottom-fixed and floating

- European countries tool lead in offshore wind power development followed by China, Taiwan and United States.
- Most of these projects so far have been installed into shallow waters with a depth of about 50 meters.
- Since there are limited shallow water area around Japan, there is a high expectation to promote floating offshore wind which can be developed despite of the depth of ocean.



#### Adoption as a NEDO Green Innovation Fund Project

- Project name: Mass production and cost reduction of Floating Offshore Wind Power Generation
- Consortium: “K” Line Wind Service, Ltd.  
Japan Marine United Corporation  
Nihon Shipyard Co., Ltd.  
TOA Corporation
- NEDO Green Innovation Fund: Green Innovation Fund of the New Energy and Industrial Technology Development Organization (NEDO)

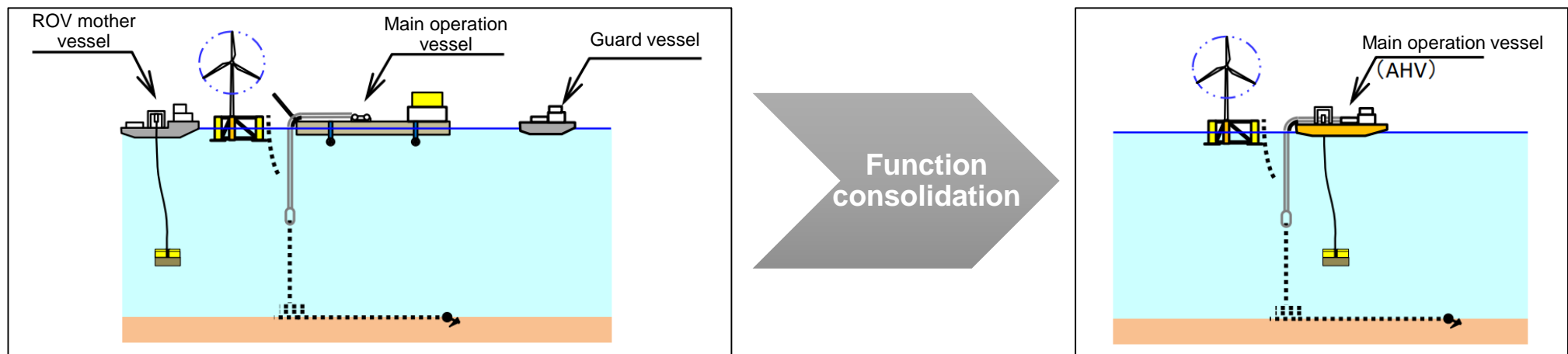
#### Role of “K” Line Wind Service

- Development of floating foundation installation (Cost Competitive Installation procedure)

# NEDO Green Innovation Fund Project: Mass-production and Cost Reduction of Floating Offshore Wind Power Generation (2)

- High-performance Anchor Handling Tug Supply Vessels (“AHTSVs”) to reduce costs

Single vessel achieves a fleet optimization and process improvement



Source: Summary of a fiscal 2017 empirical research report concerning a floating offshore wind power project in Fukushima prefecture



## The most powerful AHTSVs in the world to be utilized

- Large chain lockers and deck space (①)
- Strong holding power and winch capacity (②③④)
- Great seaworthiness and high utilization ratio (①②③④)



Floating wind turbine towing



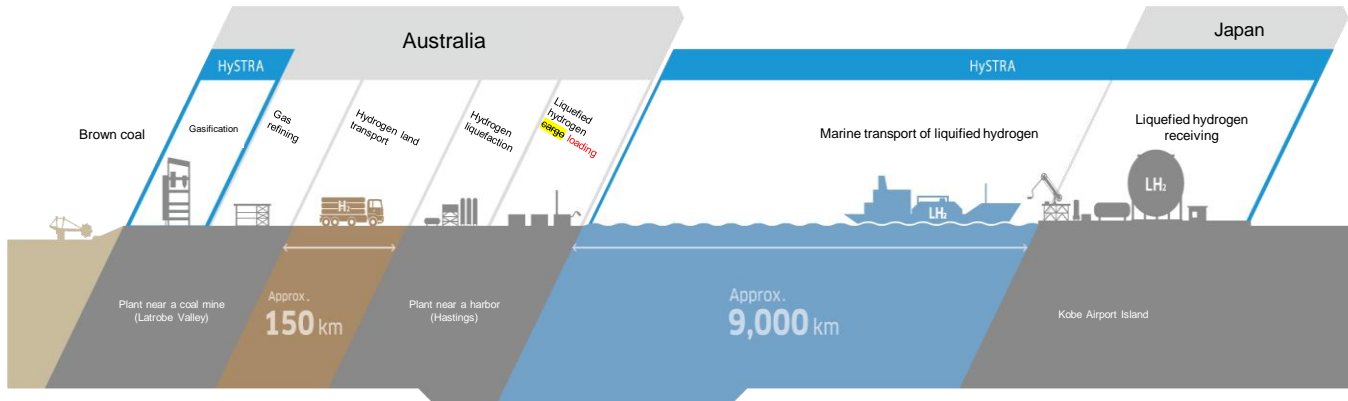
Storage in a chain locker Underside of operation deck

➔ **KWS targets to establish operational standards of installing floating wind turbines with large-sized AHTSVs and to contribute to cost reduction by developing the best practice in Japanese Ocean.**

# Hydrogen transportation



- Participating the Hydrogen Energy Supply-chain Technology Research Association (HySTRA), which promotes relevant technology creation and demonstration. The aim is to build a carbon-free hydrogen supply chain consisting of hydrogen production, transport, storage, and utilization.



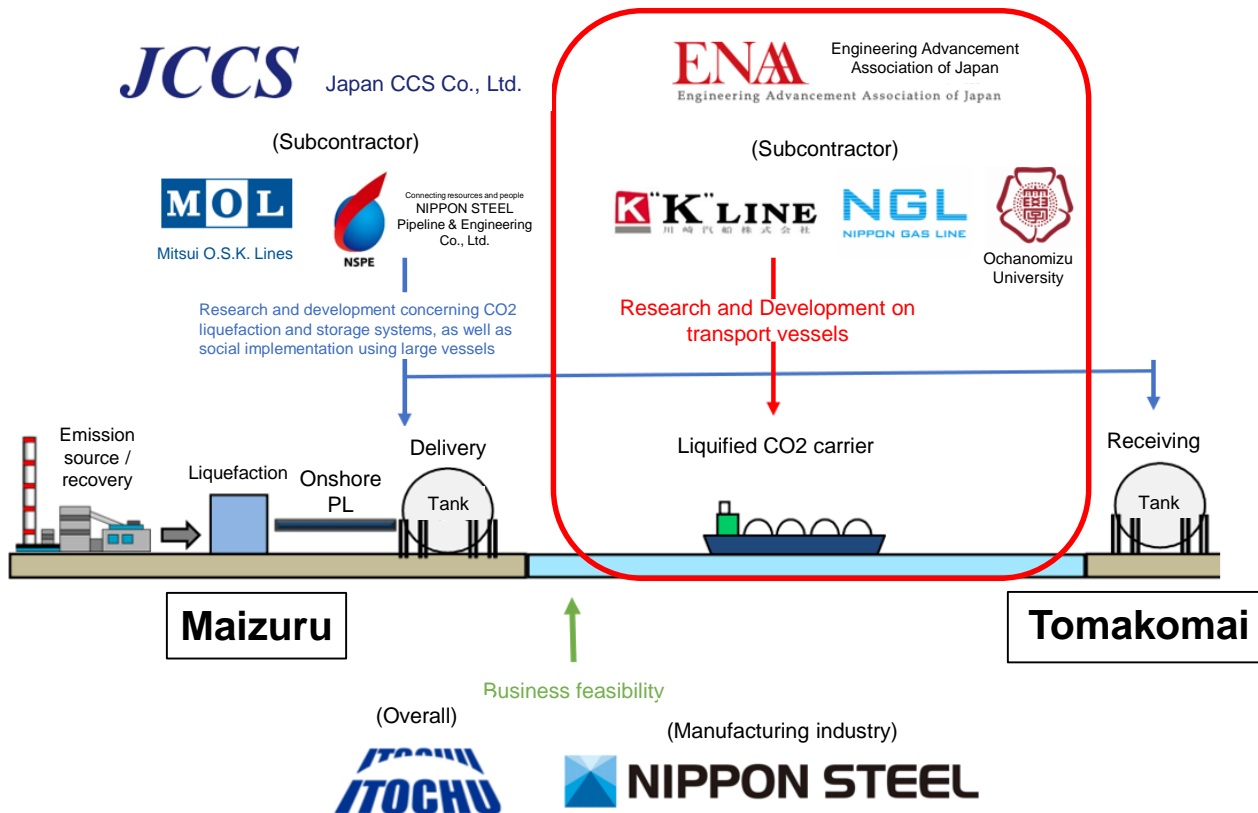
Liquefied hydrogen carrier SUIISO FRONTIER



We have completed a demonstration of a CO<sub>2</sub>-free energy supply chain between Australia and Japan. Hydrogen made in Australia from brown coal was transported to Japan using the world's first liquefied hydrogen carrier SUIISO FRONTIER.

# CCUS and liquefied CO2 Transportation

Research and Development concerning transport vessels



Demonstration project system

- Since 2021, “K” Line is participating in NEDO’s “CCUS R&D and Demonstration Related Projects / CCUS Large-Scale Demonstration Test in Tomakomai / Demonstration Test on CO2 Transportation” from 2021.
- In this CCUS R&D program, the operation method and necessary technologies of an integrated transport system will be verified. (liquefying CO2 emitted from the Maizuru coal-fired power plant of KEPCO, transporting it by a ship, and receiving it in Tomakomai)
- “K” Line is in responsible for risk assessment of LCO2 transportation and loading/discharging operation and tackle towards the commercial scale development of LCO2 marine transportation.



**Thank you for listening.**