

## MOL's Environmental and Emission-Free Businesses

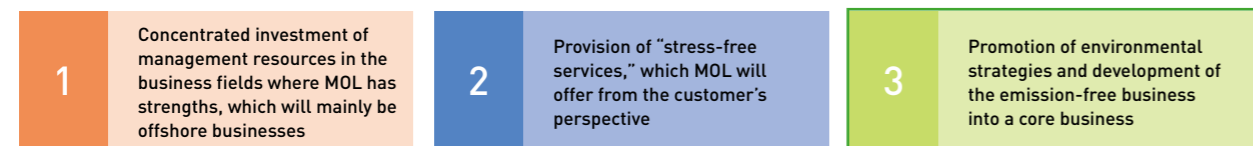
"Promotion of environmental strategies and development of the emission-free business into a core business" is one of the three core strategies of the MOL Group for the realization of its management vision. Why is a marine transport company involved in environmental businesses? Which issues is MOL tackling and in what ways? By introducing three specific projects, this section sheds some light on such questions.

### An Overview of Our Environmental and Emission-Free Businesses

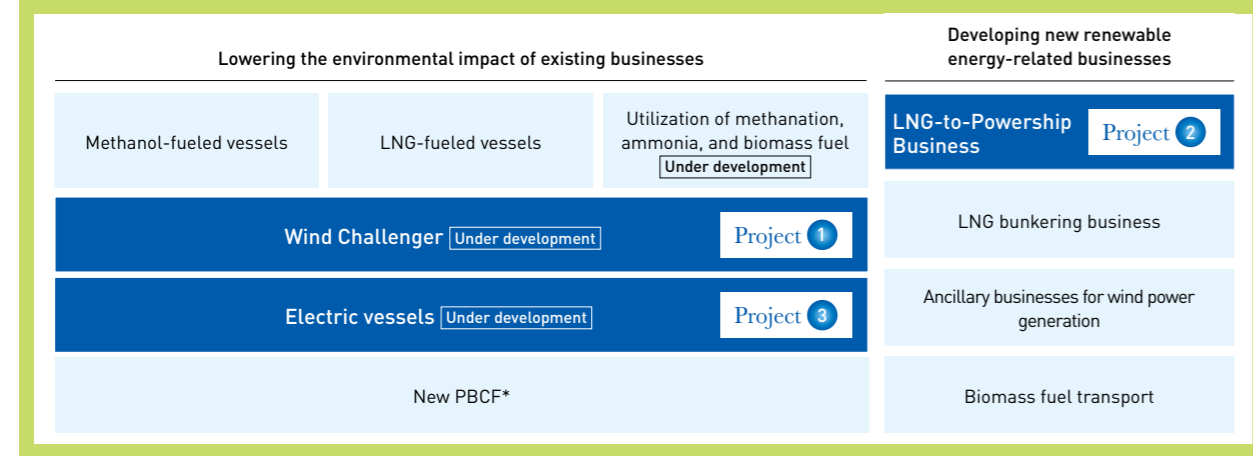
Marine transport, the MOL Group's main business domain, is being greatly affected by global trends toward environmental preservation and decarbonization for two main reasons. (1) Vessels themselves are one of the major causes of environmental impact in the form of carbon dioxide (CO<sub>2</sub>) and SO<sub>x</sub> emissions. (2) Our business transports a wide range of fossil fuels and related products, including crude oil, coal, LNG, and liquefied petroleum gas (LPG). With respect to (1), we are

engaging in the development of technologies for the reduction of environmental impact, such as alternative-fuel vessels and electric vessels. As for (2), we are making forays into clean energy-related fields, including wind-assisted vessel propulsion, vessels for offshore wind turbine installation, biomass fuel transport, and LNG power generation. We refer to both types of initiative collectively as environmental and emission-free businesses.

#### Three Core Strategies to Realize the Management Vision



#### Examples of Environmental and Emission-Free Businesses



\* Propeller Boss Cap Fins, which are energy-saving devices. For details, please visit this website. <https://www.pbcf.jp/>

### Our Approach to Project Advancement

As the above chart shows, the activities of the MOL Group's environmental and emission-free businesses encompass projects for lowering the environmental impact of existing businesses and for developing renewable energy-related businesses. Consequently, in advancing these projects, crucial roles are played not only by the New Business Creation Team, which is in charge of new ventures, and the Technical and Smart Shipping divisions, which are responsible for technology development, but also by the sales divisions of existing businesses. That is to say, projects that incorporate environmental technologies into businesses in many different ways are being tackled throughout the Company and creating added

environmental value both for new and existing businesses. Moreover, this approach is establishing a virtuous cycle in which the added value created by an array of projects is then shared Companywide to become the basis for further advances. We take a flexible approach to advancing individual projects after their launch. Departments engaged in existing businesses lead projects if they are strongly linked to the businesses. If a project is in a new business field, the New Businesses Creation Team or the Technical Division take the lead. We also use cross-divisional project teams that enable relevant departments to coordinate their efforts.

## Project 1



### Summary

This ambitious project will lower environmental impact by using wind-assisted propulsion for large cargo vessels—which are mostly dependent on fossil fuel for propulsion at present—thereby reducing fuel consumption.

Greenhouse gas reduction **Approx. 8%**  
[For a single-sail vessel on a Japan–North American West Coast trade route]

### Sailing Vessels—Reborn and Full of Potential

Reaching the challenging targets of MOL Group Environmental Vision 2.0 through the adoption of just a single environment-friendly technology would be difficult. A major attraction of Wind Challenger, a wind-assisted vessel propulsion system, is that it is compatible with and adds to the benefits of other energy-saving measures and technology, such as conversion from heavy oil to LNG, methanol, and other alternative fuels and subsurface energy-saving systems. Single sail is expected to reduce vessels' greenhouse gas emissions by approximately 5% on Japan–Australia and 8% on Japan–North American West Coast trade routes. In the future, we aim to equip vessels with multiple sails and use them in combination with other measures for greenhouse gas reduction, thus developing a viable solution for realizing environmental goals. In October 2019, our Wind Challenger design of a hard sail system acquired an approval in principle from Nippon Kaiji Kyokai, or ClassNK, while our new coal carrier, equipped with this system, is scheduled to begin operations in 2022.

#### History and Roadmap Going Forward

2009	Began examining basic technologies through a joint industry-academia research project with the University of Tokyo
2013	Received a subsidy for next-generation marine environment-related technology research from the Ministry of Land, Infrastructure, Transport and Tourism
2017	Entered the commercialization phase led by MOL and Oshima Shipbuilding
2019	Obtained an approval in principle from Nippon Kaiji Kyokai for the design of a hard sail system
2022	Plan to begin operations of a new coal carrier equipped with a hard sail

#### Project Members

**MOL Mitsui O.S.K. Lines** **Oshima Shipbuilding Co., Ltd.**

- Graduate School of Frontier Sciences, the University of Tokyo
- Ouchi Ocean Consultant, Inc.
- Kanazawa Institute of Technology Innovative Composite Center
- Tokyo Keiki Inc.
- Iknow Machinery Co., Ltd.
- Kansai Design Company, Ltd.
- GH Craft Ltd.
- ACT Co., Ltd.
- MOL Techno-Trade, Ltd.

### Message from a Project Member

The Wind Challenger Project is an epoch-making initiative that will significantly reduce CO<sub>2</sub> emissions by employing the latest technologies to resurrect sailing vessels, which disappeared with the introduction of steamships. Rather than steel, the sail is made of glass fiber-reinforced plastic, a light and strong material. Further, the Wind Challenger system efficiently converts wind energy into propulsive force by using automated control to rotate and telescopically extend or contract the sail.

At the development stage, the greatest challenge was lightening the sail as much as possible while maintaining its strength. Careful examination of the sail's effect in light of meteorological data revealed that almost no fuel-saving benefit was produced by the sail's upper segment, designed for use in weak winds. Therefore, we solved the weight and strength dilemma by reducing the sail's segments from five to four.

As well as equipping more MOL vessels with the sail following an inaugural wind-assisted vessel completion aimed for 2022, we want to help preserve the environment by disseminating Wind Challenger technology worldwide.



**Hidetoshi Fukushima**

Sub-team Leader  
Technical Innovation Team  
Technical Division

## Project 2

# KARMOL LNG-to-Powership Project



### Summary

Under the KARMOL brand, MOL and Karpower International B.V. (Karpowership)\*<sup>1</sup> are jointly making an unprecedented attempt to develop an LNG-to-Powership business. This fledgling business enables the establishment of power generation in a manner that, compared with the construction of onshore power plants, is lower cost, has shorter lead times, and results in less environmental impact.

CO<sub>2</sub> reduction of LNG versus oil **Approx. 25%**

\*1 Karpower International B.V. is a subsidiary of Karadeniz Holdings A.S., an energy company based in Turkey. A pioneer in the field of powerships, Karadeniz Holdings is the world's only company that builds, owns, and operates powerships. Under the Karpowership brand, Karadeniz Holdings deploys a fleet of more than 20 vessels to operate powership businesses in approximately 10 countries.

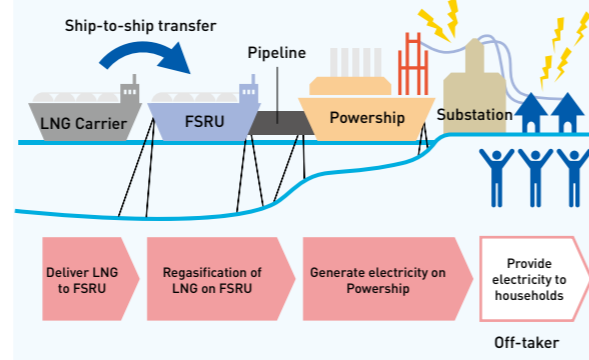
### LNG-to-Powership—A New Option in Electricity Infrastructure

Given the present need for rapid countermeasures to environmental issues, demand for LNG-fired power generation is growing worldwide as it produces lower environmental impact than other fossil fuels. In addition, securing the power infrastructure needed for industry is a pressing issue for emerging countries' economic development. However, the construction of new onshore facilities requires significant time and expenditure. The KARMOL LNG-to-Powership business offers a new option that solves a range of issues, including cost, lead time, and environment friendliness. The business provides integrated solutions that cover the use of FSRUs to receive and regasify LNG through to the supply of electricity by powerships. We will use the Mozambique Project—which we are currently working on—as an initial step on the way toward contributing to development and reducing environmental impact in regions worldwide.

#### History and Roadmap Going Forward

- 2017 Information acquired by the Offshore Project Division and initial contact made with Karadeniz Holdings through our chief country representative in Turkey
- 2019 Concluded an agreement under which MOL and Karpowership are to jointly own FSRUs and powerships and began working on an LNG-to-Powership project in Mozambique under the newly established KARMOL brand

#### Overview of LNG-to-Powership Business



### Message from a Project Member

Many regions of the world still do not have sufficient electricity. Society also calls for curbing the CO<sub>2</sub> emissions that result from power generation. Leveraging MOL's experience in LNG transport and FSRU operation, the LNG-to-Powership Project is ideally suited to help realize "Affordable and Clean Energy," the seventh Sustainable Development Goal (SDG). While the project's business format differs from the cargo transportation role of traditional marine transport, I am proud that we are able to help improve the quality of people's lives and strengthen the foundations of industry by providing stable electricity supplies as a regionally rooted infrastructure business.

Restrictions on international travel and reductions in flights resulting from the COVID-19 pandemic have made it difficult to visit customers in emerging countries and on remote islands. On the other hand, the increased use of online meetings has enabled us to talk with customers more frequently as well as have discussions with people in relatively inaccessible locations. Without a doubt, electricity demand will continue rising as the populations of emerging countries grow over the medium to long term and their economies develop. Precisely because we are in unpredictable times, the need for powerships is growing as they are less costly and have shorter introduction lead times than onshore facilities.



**Kyoya Nitta**  
Executive Officer  
General Manager of Offshore Gas Project Division

## Project 3

# e5 Electric Vessel Project



### Summary

Through e5 Lab Inc., we will advance the development and spread of electric vessels, thereby enabling the establishment of new marine transport infrastructure services centered on electric vessels.

#### e5 Lab participants

Asahi Tanker Co., Ltd.\*: 30% Exeno Yamamizu Corporation: 30%  
Mitsui O.S.K. Lines, Ltd.: 20% Mitsubishi Corporation: 20%

\*2 An equity-method affiliate in which MOL has a 29.03% equity interest

Targeting  
**Zero Vessel Emissions**

### Zero-Emission Electric Tankers—Toward a World First

In March 2020, it was decided to construct two of the world's first zero-emission electric tankers, or "e5 tankers," which were planned and designed by e5 Lab. Groundbreaking vessels that are powered by large-capacity lithium-ion batteries, e5 tankers realize zero emissions of CO<sub>2</sub>, SO<sub>x</sub>, NO<sub>x</sub>, soot, and smoke. As they also produce little noise or vibration, the vessels help improve crew members' work environment and reduce the impact on areas in and around ports. Upon delivery between March 2022 and March 2023, the e5 tankers will operate in Tokyo Bay as bunkering vessels.

Through the application of the latest technologies, e5 Lab will help address issues that the marine transport industry currently faces. Also, the company is advancing initiatives to make the marine transport industry sustainable in fields other than tankers. For example, in December 2019 e5 Lab and MOL began planning the development of a car carrier equipped with a hydrogen fuel cell system and large-capacity batteries that achieves zero emissions while underway in coastal waters and in ports.

#### History and Roadmap Going Forward

- August 2019 Established e5 Lab
- October 2019 Obtained approval from the Ministry of Land, Infrastructure, Transport and Tourism for a plan to introduce advanced vessels with the aim of researching, developing, and introducing battery vessels
- December 2019 Began joint study of a hydrogen hybrid car carrier
- March 2020 Two of the world's first zero-emission electric tankers, "e5 tankers," were decided to be built by a member of e5 Lab
- March 2022– Planned delivery of e5 tankers

#### Five Focus Areas for e5 Lab's Activities



### Message from a Project Member

Marine transport is essential for our country. By realizing electric vessels, e5 Lab will create new businesses and societal infrastructure that contribute to the common good and provide many different stakeholders with added value. In this way, the company will help realize sustainable marine transport that can be passed to the next generation.

The possibilities of electric vessels are numerous. As well as zero emissions, they promise to lighten crew members' workloads and reduce accidents and risks. Moreover, electric vessels will create demand for electricity-supply infrastructure for vessels, vessel batteries, and hydrogen fuel cells. There is also potential to use the vessels in emissions trading and as part of virtual power plant (VPP) systems.\*<sup>3</sup> Furthermore, as they are equipped with large-capacity storage batteries, electric vessels can be used as emergency power sources during disasters. Looking ahead, as the integration of electric vessel technologies with communications technologies, the IoT, and other digital technologies gathers momentum, electric vessels are expected to evolve and enable smart marine mobility that combines outstanding environmental and economic performance. Through the activities of e5 Lab, MOL will create new environment- and people-friendly businesses that open up a bright future for marine transport.

\*3 VPP systems optimize the supply-demand balance of power grids by using the latest IT to coordinate a large number of small-scale power generation facilities.



**Tomoaki Ichida**  
General Manager of Energy Business Strategy Division  
President, e5 Lab Inc.