PROJECT MEET NEWS

Mitsubishi Marine Energy & Environment Technical Solution-System

24

24th Issue
October 2023

Decarbonization Activities for the Maritime Industry
- Season 6 -

MET Turbochargers Operation Test on Engine Completed for World's First Dual-fuel Methanol Engine for Large Containership

First Licensed MET Turbocharger by Mitsui E&S Completed

30th Anniversary of Steering Gear's License Agreement with Yoowon

Groundbreaking Ceremony for New Jiangsu Masada's New Factory

Delivery of Deck Cranes Exceeds 9,000 Units

MET New After-Sales Service Base in Bahrain

Hot Standby Function Enables Main Boiler to Be in Regular Operation Quickly

Establishment of Superheater Tube Thickness Measurement Method for Mitsui E&S's Main Boilers

MHI-MME 10th ANNIVERSARY

CEO Message

MITSUBISHI HEAVY INDUSTRIES
Mitsubishi Heavy Industries Marine Machinery & Equipment Co., Ltd.

MOVE THE WORLD FORWARD MITSUBISHI HEAVY INDUSTRIES GROUP

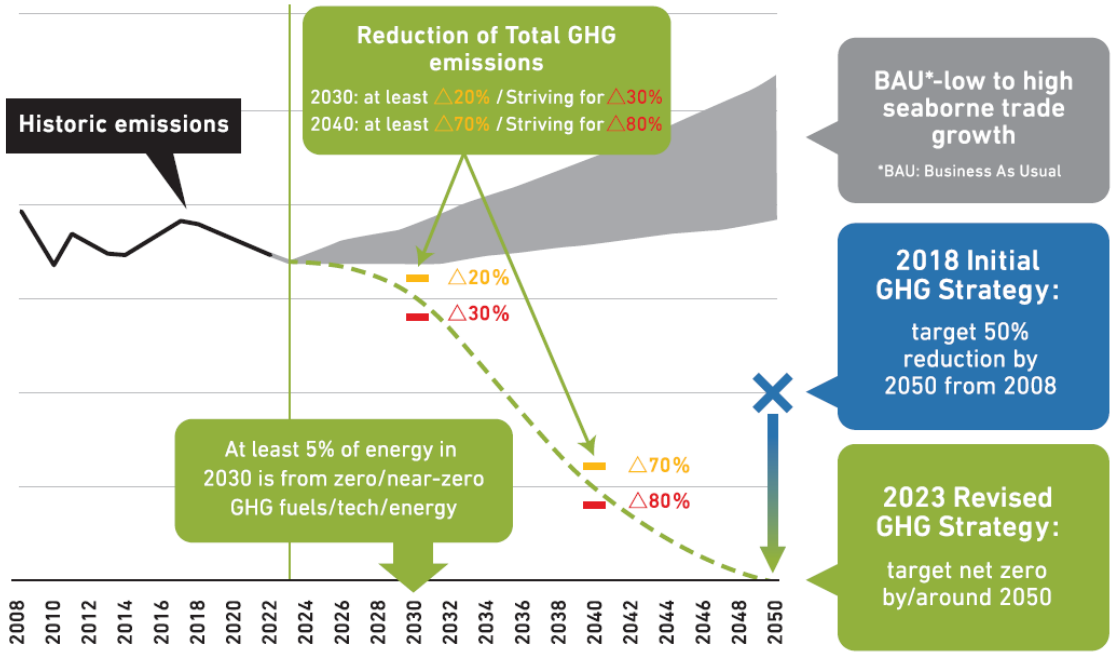
Decarbonization Activities for the Maritime Industry - Season 6 -

Reassessment of Greenhouse Gas Emission Reduction Targets in the Maritime Industry

During MEPC80(*1), held in London from July 3 to 9, the following revisions to greenhouse gas (GHG) reduction targets were adopted, and it is expected that activities toward decarbonization will be further accelerated.

★ Achieve net-zero GHG emissions by or around 2050.
★ Uptake zero/near-zero GHG fuels/tech/energy at least 5% of energy in 2030
★ As intermediate targets, reduce GHG emissions by at least 20% (striving for 30%) compared to 2008 levels by 2030 and by at least 70% (striving for 80%) by 2040.

(*1) MEPC = The Marine Environment Protection Committee of the IMO



Collaboration with Leading Global Research Centers for Maritime Industry Decarbonization

1) Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping (MMMCZCS)

The Mitsubishi Heavy Industries (MHI) Group has been a founding partner since 2020 and has participated in numerous projects as a strategic partner. On May 23 and 24, the Group took part in the Accelerate Partners Summit held in Copenhagen, addressing challenges and solutions across the entire value chain from upstream to downstream for advancing decarbonization in the maritime industry in each of the sessions. On June 23, MMMCZCS and the Lloyds Register Maritime Decarbonization Hub (MDH) jointly presented a proposal for the design and operation of ammonia-fueled ships based on risk analysis in various academic domains. Members from our group also contributed to the proposal.

With MMMCZCS CEO Mr. Bo Cerup-Simonsen

2) Global Maritime Forum (GMF)

Mitsubishi Heavy Industries Marine Machinery & Equipment (MHI-MME) signed a memorandum of understanding with GMF, based in Copenhagen, on September 7, aiming to explore opportunities for closer collaboration and form partnerships to promote and achieve shared targets in decarbonizing the maritime industry. In conjunction with this, we will actively participate in various projects and events with the company, contributing as a technology provider to address the many challenges faced by the maritime industry ecosystem.

With GMF CEO Ms. Johannah Chistensen

3) Global Centre for Maritime Decarbonisation (GCMD)

The Mitsubishi Heavy Industries Group started the dialogue with Singapore based GCMD(Global Centre for Maritime Decarbonisation). After several bilateral meetings, both parties recognized that collaboration as a partner in the maritime industry, especially focusing on the alternative fuel bunkering projects and onboard / onshore decarbonization projects in Singapore and overseas could accelerate the decarbonization in shipping.

Singapore is a strategic shipping/port spot in transitioning to alternative fuels in the Asia-Pacific region, and we will consider a wide range of activities from fuel production, storage, transportation, power generation, bunkering, etc.

With GCMD CEO Prof. Lynn Loo

Participation in Global Exhibitions, Conferences, and Seminars

With the end of the COVID-19 pandemic, many global exhibitions, conferences, and seminars that had been forced to postpone or cancel have resumed in full swing. In response, the MHI Group has actively engaged in product presentations and networking activities. Notable events include:

1) Singapore Maritime Week 2023 and Sea Asia 2023

Singapore Maritime Week was held from April 24 to 28, with Sea Asia 2023 taking place concurrently. The MHI Group participated as a member of the Japan Ship Machinery and Equipment Association. During this period, the group visited the Singapore Shipping Association (SSA) to engage in discussions about decarbonization and digitalization in the maritime industry. The commitment to further collaboration was confirmed during these discussions.

A scene from Sea Asia Exhibition

Meeting with the Singapore Shipping Association

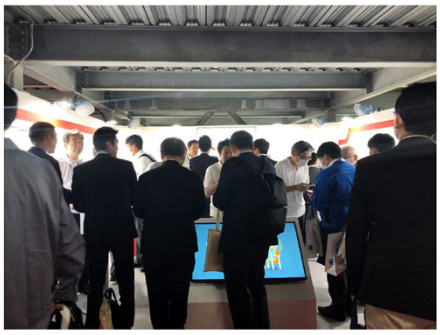
2) Bari-Ship 2023

From May 25 to 27, we had an exhibit at Bari-Ship 2023 held in Imabari. This was the first time in four years that the exhibition has been held, and it attracted many visitors. During the event, we conducted seminars on the following three key themes, which gathered a large audience.

a) Latest developments in MET turbochargers

b) Introduction of decarbonization technology in the MHI Group's for the maritime industry

c) Products and services from Mitsubishi Shipbuilding's engineering business



At a booth

At a seminar

3) Nor-Shipping 2023

Nor-Shipping 2023 was held in Oslo from June 6 to 9. Our company's executives and European representatives visited the venue, which provided an opportunity for market research and discussions with customers. We reaffirmed our commitment to these efforts as part of our greenhouse gas (GHG) reduction activities and the need to provide MET turbochargers for new fuel engines using alternative fuels such as methanol and ammonia. Mitsubishi Shipbuilding participated in the Japan Pavilion and conducted presentations on the progress of LCO2 transport vessels.

Japan Pavilion Opening Ceremony

4) CIMAC 2023 Busan Congress

From June 12 to 16, we participated in the CIMAC 2023 Busan Congress, which had been postponed for a year. We presented data demonstrating the successful operation of MET turbochargers for ultra-large methanol-fueled 2-stroke engines, along with papers on our efforts in adapting to alternative fuels. Other companies in the internal combustion engine industry also reported making steady progress in technology development to achieve decarbonization by 2050.

Presenting a paper on
the MET turbocharger at CIMAC

5) Malaysia Maritime Week 2023

In conjunction with Malaysia Maritime Week 2023 (June 20 to 22), a Malaysia Maritime Technology Seminar was held on June 21. Our company's executives delivered a speech as representatives of the Japan Ship Machinery and Equipment Association, and our local representatives visited the area and interacted with Malaysian customers. Malaysia has plans for the construction of many offshore supply vessels (OSVs) in the future, and there is a strong interest in Japan's maritime manufacturers and their environmentally friendly technologies. The technology seminar attracted a large audience.

A scene from the Malaysia
Maritime Technology Seminar

MET TURBOCHARGER FOR METHANOL ENGINE

MHI-MME Completes Onboard Operation of MET Turbochargers for the World's First Dual-Fuel Methanol Main Engine for Large Containership

Mitsubishi Heavy Industries Marine Machinery & Equipment Co, Ltd. (MHI-MME) delivered MET turbochargers for the world's first dual-fuel methanol main engine (MAN ES 8G95ME-C10.5-LGIM) for large containership and verified that the turbochargers satisfied the required performance by attending the onboard operation.

This main engine is equipped with a MET90MB, the largest turbocharger in the world, and a MET60MBII.

The adoption of the large MET90MB has made it possible to reduce the number of installed turbochargers from three to two, achieving both high efficiency and reduced maintenance costs.

The vessel is the first in a series of 12 containerships with a capacity of 16,000 units being built by A.P. Moller Maersk and powered by a dual-fuel methanol main engine.

Starting with this project, orders for vessels equipped with dual-fuel methanol main engines have been increasing, and orders for MET turbochargers have also been received.

MHI-MME will continue its efforts as a turbocharger manufacturer to provide our customers with optimal, environmentally friendly solutions.

Dual-fuel methanol main engine equipped with a MET turbocharger (MAN ES 8G95ME-C10.5-LGIM)

MET TURBOCHARGER LICENSEE

Mitsui E&S Completes First MET Turbocharger Manufactured Under License from MHI-MME

Mitsui E&S Co., Ltd. (President & CEO: Takeyuki Takahashi; Head Office: Chuo-ku, Tokyo; "Mitsui E&S"), which signed a license agreement with Mitsubishi Heavy Industries Marine Machinery & Equipment Co., Ltd. (MHI-MME) to manufacture and sell MET turbochargers in 2022, has now completed the first two turbochargers under license, the MET66MBII and MET42MB.

The two turbochargers will be installed in the 6G80ME-C10.6-EGRTC marine main engine being manufactured by Mitsui E&S. The engine adopt a sequential turbocharging system (*1) that combines two turbochargers.
Mitsui E&S plans to expand licensed production to other models in the future.
MHI-MME and Mitsui E&S will keep on the collaboration for the further growth of the marine engine and turbocharger business for the next decades.

MET42MB (left) and MET66MBII (right) turbochargers manufactured by Mitsui E&S

(*1) Sequential turbocharging system:

A set up that enables efficient turbocharging by installing more than one turbocharger on an engine and concentrating the exhaust gas to one of the turbochargers at lower engine speeds to obtain turbocharging when the amount of exhaust gas is small. When there is a large amount of exhaust gas, the gas is directed to either both turbochargers and/or to the larger turbocharger for efficient turbocharging at a broader range of engine speeds.

30th Anniversary of Steering Gear's License Agreement with Yoowon

MHI-MME celebrated its 30th anniversary of the license agreement with Yoowon Industries Co., Ltd. (hereinafter, "Yoowon"). In honor of this milestone, a commemorative ceremony was held at Yoowon's steering gear factory, and was attended by the presidents and other related parties from both companies.

The individuals had not met in person since the start of the COVID-19 pandemic, but the 30th-anniversary celebration provided a great opportunity for reuniting the parties, fostering a joyous atmosphere.
Yoowon is a manufacturer of ship equipment established in Busan, South Korea, in February 1977. It produces and sells ship steering gear, fuel and lubricating oil filters, etc. Our license agreement with Yoowon dates back to August 1993, to manufacturing of the Rapson slide-type steering gear, and production numbers have grown significantly.
Currently, Yoowon supplies approximately 140 units of our branded products to shipyards in South Korea and China each year, and the cumulative number of units delivered exceeded 3,000 earlier this year. We aim for further growth and will maintain a strong relationship to continue providing high-quality products and services to our customers.

STEERING GEAR LICENSE

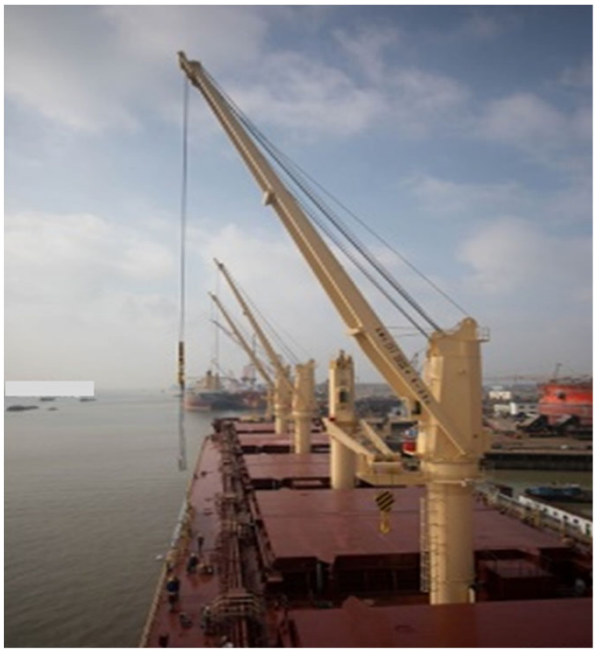
Groundbreaking Ceremony for Jiangsu Masada's New Factory

The president and other representatives from MHI-MME attended the groundbreaking ceremony for Jiangsu Masada Heavy Industries Co., Ltd.'s new factory. Jiangsu Masada, established in Nantong, Jiangsu Province, China in 2005, manufactures licensed ship equipment under the Mitsubishi Heavy Industries brand, including deck cranes, deck machinery, and steering gears. We entered into a license agreement with the company in February 2012 for the Rapson slide-type steering gear, and we have seen a steady accumulation of manufacturing achievements. As of the end of September 2023, Jiangsu Masada has supplied a cumulative total of 688 units. Further, starting in 2020, we began a partnership to use Jiangsu Masada as a production base for retractable fin stabilizers sold overseas. The new factory will handle assembly of retractable fin stabilizers, in addition to increased production of steering gears. We look forward to strengthening the positive relationship between the companies and contributing to the provision of high-quality products in the growing Chinese market.

DECK CRANE DELIVERY

Delivery of Deck Cranes Exceeds 9,000 Units

Mitsubishi Heavy Industries Machinery Systems (MHI-MS) has a production record of over half a century since introducing deck cranes to the market in 1972.
In October 2023, the number of delivered units exceeded 9,000. MHI-MS is the sole manufacturer supplying products in the primary deck crane markets of both Japan and China, and it has achieved top market shares in both countries.
With a product lineup that features the own brand hydraulic motors, data logging function, electrically driven cranes, and other cutting-edge technologies, MHI-MS will continue to support global logistics.



Mitsubishi Electrically driven Deck Cranes

MHI-MS has a record of delivering electrically driven deck cranes in addition to conventional electric-hydraulic-driven cranes, offering superior environmental performance.

MET TURBOCHARGER SERVICE NETWORK

MET New After Sales Service Base in BAHRAIN

A global service network of authorized repair agents consisting around the world, has been established for MET Turbochargers. Swift and appropriate servicing can be ensured around the world through this framework.
This issue introduces our new authorized repair agents in Bahrain.

GULF TURBO W.L.L.

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Hot Standby Function Enables Main Boiler to Be in Regular Operation Quickly

Mitsubishi Heavy Industries Marine Machinery & Equipment provides a hot standby function (our patented technology) that allows the main boiler to be in regular operation quickly.

This function maintains the boiler at low pressure by using a desuperheater, traditionally used for temperature control of superheated steam for turbines, as a boiler water heater. In case of emergencies, a simple line switch can swiftly bring the boiler into regular operation.

Recently, the planning and construction of floating storage units (FSU) and floating storage & regasification units (FSRU) have been increasing worldwide as alternatives to onshore LNG receiving terminals. As a result, there is a growing number of projects involving the conversion of existing steam turbine-driven LNG vessels into FSRU/FSU. FSRU vessels operate the boiler at low loads rather than the conventional high load and run only one of the two boilers during open-loop operations in the summer (utilizing seawater for LNG vaporization) and when used as an FSU vessel. However, during emergency boil-off gas (BOG) processing or emergency unberthing due to bad weather conditions, there is a need to bring the main boiler into regular operation as quickly as possible.

To meet these requirements, we recommend the addition of the hot standby function. In the future, we plan to extend support for LNG vessels equipped with main boilers, not only from our production but also from Mitsui E&S Co., Ltd. (formerly Mitsui E&S Machinery Co., Ltd.) with whom we have a service agreement.

Steam Inlet Line and Drain Line Added with the Hot Standby Function

[Inquiries]

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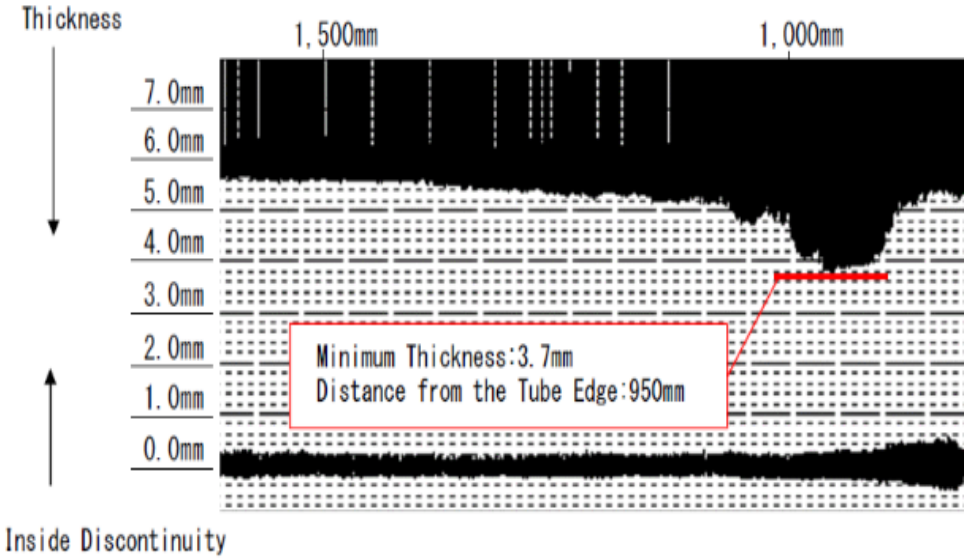
Establishment of Superheater Tube Thickness Measurement Method for Mitsui E&S's Main Boilers

Mitsubishi Heavy Industries Marine Machinery & Equipment has established a new method for thickness measurement using internal ultrasonic measurement for superheater tube of main boilers manufactured by Mitsui E&S Co., Ltd. (formerly Mitsui E&S Machinery Co., Ltd.), with whom we have a service agreement. We have initiated proposals for diagnostics based on measurements across the entire circumference and height.

Main boilers installed on LNG ships are primarily designed for continuous operation, and stopping the boiler can impact the ship's operation. As a result, during regular drydock inspections, our engineers dispatched from our company conduct inspections of the boiler body, superheaters, economizers, thickness measurements, control devices, and automatic control equipment.

In particular, regarding the superheaters, they are exposed to high-temperature gases exceeding 1,000° C externally while being used under steam temperatures ranging from 515°C to 560° C internally. Measuring the thickness during each drydock inspection is essential for assessing the remaining service life and significantly contributes to the safe operation of the ship.

With the technology developed, we aim to contribute to the safety of LNG ship operations by applying this inspection method not only to our products but also to boilers manufactured by Mitsui E&S.



Example of Measurement with an Ultrasonic Thickness Gauge

[Inquiries]

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MHI-MME celebrates its 10th anniversary

We deeply appreciate everyone's support of our business. We will take this opportunity to make even greater efforts to provide products and services that exceed your expectations.
We humbly ask for your continued support and patronage. Here, we will introduce the history of our company over the past 10 years.

2013

Founding

On October 1, 2013, Mitsubishi Heavy Industries' marine machinery and engine development, design, after-sales service, and licensing operations were succeeded by Mitsubishi Heavy Industries Marine Machinery & Engine Co., Ltd.

2014

Licensing of Propellers to CZZH

We granted the first ever manufacturing and sales rights for marine propellers to China's privately-owned marine propeller manufacturer, Changzhou Zhonghai Marine Propeller Co., Ltd.

2015

50th Anniversary of MET Turbocharger Manufacturing

It has been 50 years since the development and manufacturing of the completely non-water cooled turbocharger—the forerunner of the MET Series—in 1965.

2016

MET Turbochargers Cumulative Delivery Reached 30,000 units

We have delivered a cumulative total of 30,000 units of MET turbochargers,
with our own-developed technology.

2017

Company Name Change

On April 1, 2017, the engine business was transferred to Kobe Diesel Co., Ltd., and Japan Engine Corporation was established.
Our company changed its name to the current "Mitsubishi Heavy Industries Marine Machinery & Equipment Co., Ltd."

2018

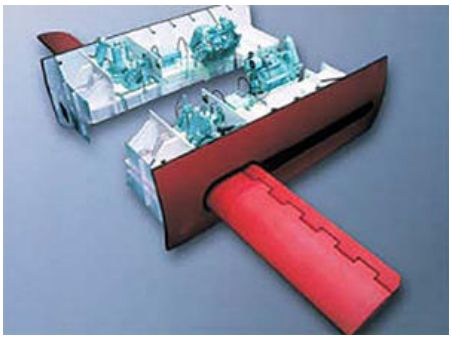
Delivery of MET Turbochargers for the World's Largest DF Engine

We shipped the MET83MB turbocharger for the world's largest DF engines installed on ultra-large container ships.

2019

Retractable Fin Stabilizers Cumulative Shipment Reached of 200 Units

The cumulative total of delivered fin stabilizers, known for their proven reliability in reducing roll, especially for ferries and RORO ships, reached 200 units.



2020

Delivery of First New Model Turbocharger MET MBII

In December 2020, the first unit of MET53MBII was shipped.

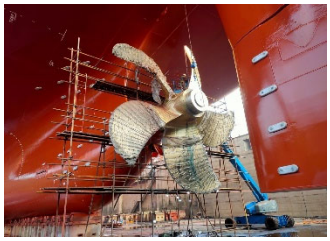
2021

Marine Boilers Cumulative Shipment Reached 6,000 Units

Starting with the Scotch boiler (cylindrical boiler) in 1885, in August, we reached the milestone of 6,000 boilers shipped.

Retrofit Propellers Cumulative Order Reached 100 Units

The cumulative total of orders for retrofit propellers, which contribute to fuel efficiency and GHG reduction, reached 100 units.



2022

Licensing of MET Turbochargers to Mitsui E&S

We reached an agreement to provide manufacturing and sales licenses for MET turbochargers to Mitsui E&S Machinery Co., Ltd., and concluded a licensing agreement.

2023

10th Anniversary of Founding

On October 1, 2023, we celebrated our 10th anniversary with the support of many from both inside and outside the company.

On the Occasion of Our 10th Anniversary

Our products have a history that dates back to the production of the first marine boiler in 1885. In the early 1900s, we began manufacturing marine turbines and propellers.

Subsequently, we expanded our product range with the introduction of steering gears in 1935, MET turbochargers in 1965, and retractable fin stabilizers in 1989, which make up the core of our product lineup today.

As the shipbuilding market transitioned from Europe to Japan, South Korea, and China, we initiated a licensing program, starting with the licensing of marine main turbines to Hyundai Heavy Industries in 1992. We continued this trend by licensing steering gears, MET turbochargers, marine boilers, and propellers to companies in Japan, South Korea, and China, thus expanding the presence of Mitsubishi Heavy Industries-branded products.

Currently, over 50% of ships in operation worldwide with a capacity of 10,000 DWT or more—roughly 30,000 vessels in total—are equipped with our branded products.

In October 2013, we established ourselves as "Mitsubishi Heavy Industries Marine Machinery & Engine Co., Ltd." and later, in April 2017, we changed our name to "Mitsubishi Heavy Industries Marine Machinery & Equipment Co., Ltd." following the transfer of marine engine business to Japan Engine Corporation.

We continue to strive to grow as a maritime technology provider, sharing and utilizing the knowledge of the MHI Group, and aiming for zero GHG emissions in the maritime sector.

Thank you for your ongoing support.

Toshiaki Hori, President & CEO
Mitsubishi Heavy Industries
Marine Machinery & Equipment

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