August 30, 2024

# Mitsubishi Heavy Industries, Ltd. 42nd Series Unsecured Bond (The 2nd Series of Mitsubishi Heavy Industries Transition Bonds) Reporting (FY2023)

## Introduction

Mitsubishi Heavy Industries (MHI) Group has developed “Mitsubishi Heavy Industries, Ltd. Green/Transition Finance Framework” *1 with the aim of further promoting the initiatives *2 set forth in its 2040 Carbon Neutrality Declaration and Roadmap to Achieve Carbon Neutrality. We are working on " Decarbonize existing infrastructure," " Build a hydrogen solutions ecosystem," and " Build a $CO_2$ solutions ecosystem," which are Eligible businesses and/or projects of Transition Projects defined in the framework.

*1：https://www.mhi.com/finance/stock/esg/transitionbond/pdf/fw.pdf
*2：https://www.mhi.com/company/aboutmhi/carbon-neutral

The proceeds from Mitsubishi Heavy Industries, Ltd. 42nd Series Unsecured Bond (The 2nd Series of Mitsubishi Heavy Industries Transition Bonds) issued on August 31, 2023, have been allocated to new investments and refinancing of existing investments in Metals machinery (hydrogen-reduced ironmaking etc.) classified as “Build a hydrogen solutions ecosystem” and $CO_2$ capture and storage classified as “Build a $CO_2$ solutions ecosystem,” which are Eligible businesses and/or projects of Transition Projects. Both projects are proceeding as planned in terms of the allocation and the development and demonstration of technologies
MHI group's energy transition initiatives to achieve a Carbon Neutral society are progressing as planned. We will continue our efforts to achieve Net Zero by 2040 and realize a Carbon Neutral society.

## 1. Allocation Reporting (As of March 31, 2024)

The following table shows the allocation of the net proceeds from the ¥10 billion raised by 2nd Mitsubishi Heavy Industries Transition Bond, excluding issuance costs.
The unallocated balance is managed in cash or cash equivalents, and the allocation is scheduled to be completed as planned in FY2024.

(Unit: million Yen)

| Section | | | Amount |
|---|---|---|---|
| Proceeds raised (Amount Excluding Issuance Costs from the Issue Amount of the Bonds) | | | 9,952 |
| Proceeds used | | | 4,368 |
| | Metals machinery (hydrogen-reduced ironmaking etc.) – (1) | New investment | 68 |
| | | Refinancing | 617 |
| | $CO_2$ capture and storage – (2) | New investment | 2,377 |
| | | Refinancing | 1,306 |
| Proceeds to be used | | | 5,584 |

**2. Impact Reporting**

**(1) Metals machinery (hydrogen-reduced ironmaking etc.)**

① Research and development of hydrogen reduction ironmaking technology

・Project overview

The development and design for the demonstration of HYFOR (Hydrogen-based Fine Ore Reduction: Technology for 100% hydrogen reduction of fine ore generated during iron ore beneficiation. It can also be reduced with natural gas and gradually increase the hydrogen mixing ratio and does not require sintering or pelletizing process due to the fluidized bed.)

・Period

FY2021-2025 (planned)

・Implementation of the pilot plant.

・Development and design associated with the demonstration of prototype plant.

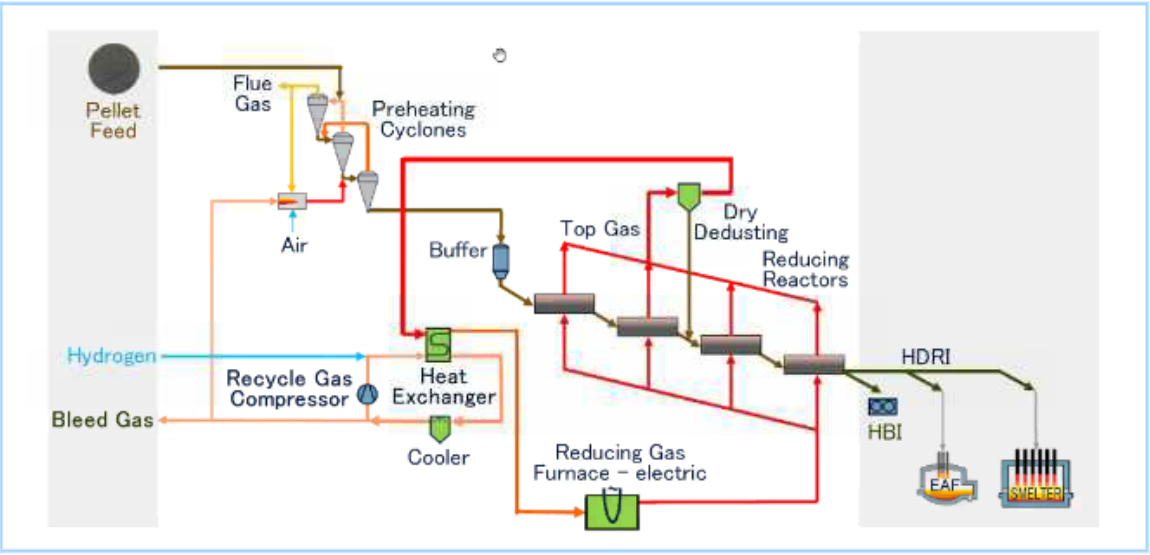
・Progress

The Hydrogen-based fine-ore reduction (HYFOR) developed by Primetals Technologies, MHI Group, is the world´s first direct reduction process for iron ore fines concentrates from ore beneficiation whose $CO_2$ footprint is close to zero because as reduction agent 100% hydrogen is used instead of conventional coal and which does not require any agglomeration like sintering or pelletizing.

December 2022, Primetals Technologies, Fortescue, and voestalpine signed a Memorandum of Understanding (MoU) for partnership for engineering an industrial-scale prototype plant at the voestalpine site in Linz, Austria.

In the first half of 2021, HYFOR pilot plant was commissioned at the voestalpine site in Donawitz, Austria and first tests were successful with modifications and improvements to the plant. Various ore types have been being tested to verify the commercial viability of this technology since 2022.

The schematic flowsheet of the industrial-scale prototype plant, the next step after the pilot plant, is shown in the figure below. After successful pre-heating, the material (iron ore concentrates) is reduced with hydrogen in multi-stage reduction reactors via a buffer. Hydrogen is injected from the inlet of the heat exchanger and is supplied to the reduction reactor via the recycle gas loop. In addition, some of the recycling gas discharged from the heat exchanger is used for the fuel of the pre-heating cyclones.



HYFOR Industrial prototype plant – Schematic flowsheet

[Relevant information]
Mitsubishi Heavy Industries Technical Review Vol. 59 No. 2 (June 2022)
HYFOR – HYdrogen-based Fine-Ore Reduction
https://www.mhi.co.jp/technology/review/pdf/e592/e592070.pdf

[Relevant information]
Mitsubishi Heavy Industries Technical Review Vol. 59 No. 4 (December 2022)
Breakthrough Pathways to Decarbonize the Steel Sector
https://www.mhi.co.jp/technology/review/pdf/e594/e594120.pdf

[Relevant news]
June 24, 2021, News release
HYFOR pilot plant under operation – the next step for carbon free, hydrogen-based direct reduction is done
https://www.primetals.com/fileadmin/user_upload/press-releases/2021/20210624/PR2021062236en.pdf

[Relevant news]
December 19, 2022, News release
Primetals Technologies, Fortescue, and voestalpine to jointly evaluate groundbreaking green ironmaking plant
https://www.primetals.com/fileadmin/user_upload/press-releases/2022/2022112746/PR2022112746en.pdf

[Relevant news]
December 6, 2023, News release
Primetals Technologies Receives Innovation Award for HYFOR from Austrian Government
https://www.primetals.com/fileadmin/user_upload/press-releases/2023/2023112996/PR2023112996en.pdf

Photo of the HYFOR direct reduction pilot plant for iron ore fines developed by Primetals Technologies and located at the voestalpine site in Donawitz, Austria. The DR process is $CO_2$-free and $H_2$-based

**(2)** $CO_2$ capture and storage

① Improvement of performance of $CO_2$ capture technology and expanding application

・Project overview

Improving $CO_2$ Capture Process Performance (strengthening core technologies such as Monoethanolamine (KS-1 and KS-21, etc.)) and expanding large to small and medium-sized product lineup, etc.

・Period

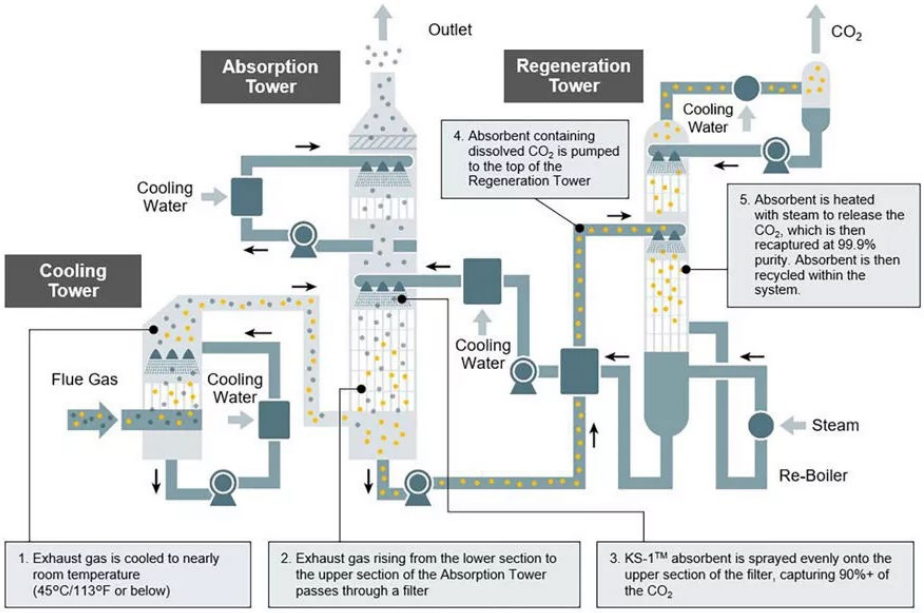
～FY 2030 (planned)

・Progress

We developed a new absorption solution "KS-21™" and a new $CO_2$ recovery process "Advanced KM CDR Process™" adopting the KS-21™ in collaboration with Kansai Electric Power Co., Inc. (KEPCO).

In 2021, at the Technology Centre Mongstad (TCM) in Norway, one of the world's largest carbon capture demonstration facilities, these technologies were tested to confirm a carbon capture rate of 95-98%, which was above the current industry standard (approx. 90%), from flue gas emitted by a gas turbine at TCM's test facility. The results indicated outstanding energy-saving performance, reduced operating costs and environmental impact compared with the existing amine-based solvent, Monoethanolamine (MEA), used in the chemical absorption process. In addition, in testing conducted under modified operating conditions, the KS-21™ solvent delivered an industry-leading carbon capture rate was 99.8% and demonstrated the successful recovery of $CO_2$ from flue gas of lower concentration than the $CO_2$ contained in the atmosphere. Identical tests were performed for flue gas emitted by a fluidized catalytic cracker at the Mongstad refinery located adjacent to TCM, and obtained identical results. We also acquired data from the testing of KS-21™ at TCM, such as degradation volumes during operation and handling, to improve its KS-21™ solvent further. In addition, amine emission data was obtained during the testing which will support the various regulatory approval processes and environmental assessments.

In 2022, MHI agreed to an alliance with ExxonMobil, one of the world's leading energy and petrochemical companies to leverage their combined operating and engineering experience and core science capabilities, and started developing a next-generation $CO_2$ capture technology that could reduce the cost of $CO_2$ capture and broaden the scope of its application.
We will continue our efforts to improve the performance of $CO_2$ capture technology and realize a Carbon Neutral society.




Carbon capture process

[Relevant information]
Mitsubishi Heavy Industries Technical Review Vol. 59 No. 2 (June 2022)
MHI Group's Recent $CO_2$ Capture Technology for Carbon Neutral Society
https://www.mhi.co.jp/technology/review/pdf/e592/e592040.pdf

[Relevant news]
March 4, 2021, News release
Mitsubishi Heavy Industries Engineering to test carbon capture technology at Technology Centre Mongstad in Norway
https://www.mhi.com/news/210304.html

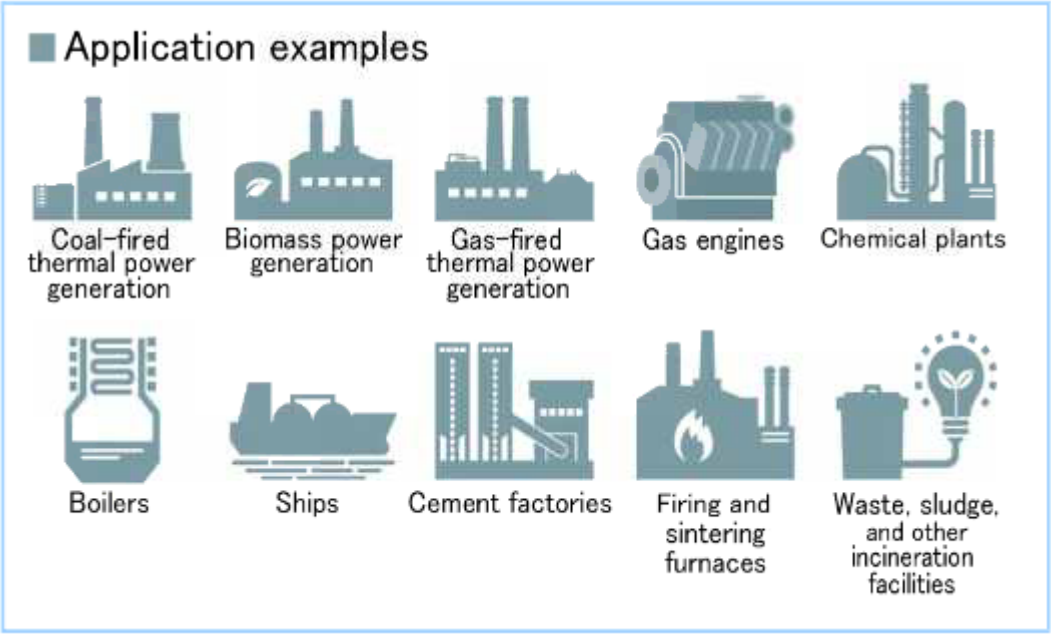
[Relevant news]
October 19, 2021, News release
Mitsubishi Heavy Industries Engineering Successfully Completes Testing of New "KS-21™" Solvent for $CO_2$ Capture
https://www.mhi.com/news/211019.html

[Relevant news]
March 1, 2022, News release
MHIENG Receives Highest Award among 2021 Outstanding Energy-Efficient and Decarbonizing Industrial Machinery & Systems-- Cited for Development of New “KS-21™” Solvent and “Advanced KM CDR Process™” for CO2 Capture --
https://www.mhi.com/news/22030102.html

[Relevant news]
November 30, 2022, News release
ExxonMobil, Mitsubishi Heavy Industries Form Carbon Capture Technology Alliance
https://www.mhi.com/news/22113001.html

[Relevant news]
January 17, 2024, News release
MHI and KEPCO Agree to Install a $CO_2$ Capture Pilot Plant at Himeji No.2 Power Station-- Promote Research and Development of $CO_2$ Capture Technologies to Further Strengthen Competitiveness --
https://www.mhi.com/news/240117.html

In addition, there is an increasing need for the application of $CO_2$ capture technology in various industrial sectors, including "hard-to-abate" industries, where it is difficult to reduce greenhouse gases including $CO_2$.
The exhaust gas emitted from each industry varies greatly in gas characteristics due to various conditions, such as trace constituents other than $CO_2$.
Therefore, we are working with our partners to apply and optimize $CO_2$ capture technology not only to thermal power plants and chemical plants, which have been drawing attention, but also to a wide range of other industries including biomass power plants, waste incineration facilities, gas engines, ships, cement factories, steel mills, ceramic baking furnaces, LNG production facilities.
In addition, the amount of capture varies from large to small depending on the size of the industrial facility.
Therefore, we have developed "CO2MPACT™", a compact $CO_2$ capture system, which can be easily and quickly introduced to a wide range of customers who are committed to carbon neutrality, by standardizing and modularizing the design while inheriting the concept of conventional custom-made plants, and by making the system into a container size that can also be transported inland and by sea.
In addition, we have developed and implemented "ΣsynX Supervision", which supports customer through fully automated operation and remote condition monitoring, and will conduct real-time remote condition monitoring and remote operate control of equipment and processes, reducing the burden on the customer required for repair and maintenance.




Application examples of compact $CO_2$ capture system

[Relevant information]

Mitsubishi Heavy Industries Technical Review Vol. 59 No. 1 (March 2022)
$CO_2$ Capture Technology Applied for Varied Fields such as Manufacturing Industries and Energy-related Facilities
https://www.mhi.co.jp/technology/review/pdf/e591/e591050.pdf

[Relevant news]
October 27, 2022, News release
Carbon Capture in the Steel Industry: ArcelorMittal, Mitsubishi Heavy Industries Engineering, BHP and Mitsubishi Development Sign Collaboration Agreement
https://www.mhi.com/news/221027.html

[Relevant news]
August 17, 2023, News release
Heidelberg Materials North America and MHI Are Working Toward First Full-Scale Carbon Capture, Utilization and Storage Solution for Cement Industry
https://www.mhi.com/news/23081702.html

[Relevant news]
October 5, 2023, News release
MHI to Provide the "ΣSynX Supervision" Remote Monitoring Service as a Digital Innovation Brand-- Full-Scale Implementation for Compact $CO_2$ Capture Systems and Transportation Systems --
https://www.mhi.com/news/23100502.html

For the reduction of $CO_2$ emissions, not only $CO_2$ capture but also fixation/storage are critical challenges. From a quantitative point of view, CCS is the most realistic choice. However, the locations of the storage sites are concentrated. In the areas away from these sites, effective utilization of captured $CO_2$ and fixation technology are required. MHI Group is trialing various applications in this regard, for example, in chemical products, fuels and direct use, thus dedicating itself to establishing a carbon cycle from $CO_2$ capture to reuse and fixation. We continue to work on technological development to contribute to $CO_2$ reduction, while cooperating not only among our group companies but also with any related organizations such as companies and municipalities.

[Relevant information]
Mitsubishi Heavy Industries Technical Review Vol. 59 No. 4 (December 2022)
Initiatives to Develop $CO_2$ Capture and Effective $CO_2$ Utilization Technology Systems
https://www.mhi.co.jp/technology/review/pdf/e594/e594080.pdf

[Relevant information]
Mitsubishi Heavy Industries Technical Review Vol. 61 No. 2 (June 2024)
Demonstration of $CO_2$ Capture from Flue Gas of Waste Incineration Facility for Use in Methanation
https://www.mhi.com/technology/review/sites/g/files/jwhtju2326/files/tr/pdf/e612/e612080.pdf

[Relevant news]
July 28, 2023, News release
Launch of Demonstration Experiment for $CO_2$ Capture from Waste-to-Energy Plant Flue Gas for Use in Methanation-- Joint Project by the City of Yokohama, Tokyo Gas, and MHI Group to Establish a CCU Chain Based on Regional Cooperation --
https://www.mhi.com/news/23072802.html

[Relevant news]
October 16, 2023, News release
MHI Group Launches Joint Demonstration Testing of $CO_2$ Liquefaction for $CO_2$ Handling to Expand CCUS Application
https://www.mhi.com/news/231016.html

**3. MHI Group's Transition Initiatives**

Realizing a Carbon Neutral Society is a global issue, and we believe that as a technology leader, with a proven track record in the field of decarbonization, it is MHI's responsibility to help lead the fight against climate change.
The steady execution of its Energy Transition Strategy will contribute to the realization of the Government of Japan's goal of carbon neutrality by 2050.
MHI considers the execution of Green/ Transition Finance as the funding for our initiatives toward achieving MHI group's Net Zero in 2040, and believe that dialogue with stakeholders through the framework of green and transition finance, annual reports, integrated reports, etc. will serve as an opportunity to disseminate our company's Initiatives. MHI's long-term strategy will be reviewed when government policies or other assumptions change.

**4. External Review**

MHI has received an annual review of the performance up to March 2024 from DNV Business Assurance Japan K.K. and has posted the review results on our website.