Environment: Executive Summary

The JFE Group strives to maintain its businesses in harmony with the environment for the prosperity of society. We have positioned climate change as a key management concern and formulated the JFE Group Environmental Vision for 2050 toward achieving carbon neutrality by 2050. To this end, we are exploring ways to reduce CO_2 emissions in steelmaking processes and expand our contribution to reducing CO_2 emissions in society as a whole. The entire Group is working in concert to establish a framework for environmental management and address climate change and other environmental issues such as environmental protection and the effective use of resources.

The JFE Group systematically addresses climate change by reflecting the TCFD's philosophy in its management strategies. In the steel business, we created a roadmap for achieving carbon neutrality by 2050 and are working on CO_2 emission reduction initiatives toward short-, medium-, and long-term targets. Our overall goals are to reduce CO_2 emissions by 18% by the end of FY2024, compared to FY2013, and by more than 30% in FY2030. Until 2030, we will continue to shift to low-carbon steelmaking processes and at the same time develop ultra-innovative technologies, mainly the carbon-recycling blast furnace, to achieve carbon neutrality by 2050. This year, we achieved some progress on the construction work for the test furnaces in verifying each technology and started to apply some of them for tests. In the first half of FY2023, we started supplying the JGreeX™ brand, a variety of green-steel products that will significantly lower CO_2 emissions in the steel manufacturing process based on the mass balance approach, compared to conventional products. There are several plans to adopt JGreeX™ in shipbuilding and for other applications, and we are expanding supplies.

In the engineering business, we plan to contribute 25 million tonnes of CO_2 reduction to society as a whole in FY2030 by provisioning renewable energy power generation facilities. We also intend to further expand our renewable energy power generation by leveraging the Group's collective strength and accelerating the offshore wind power generation business. This year, we completed the construction of the country's first monopile manufacturing plant and started production in April 2024.

We are developing and providing environmentally sound processes and products as part of our contribution to the environment through our businesses, including the reduction of our environmental impact as stated in our environmental policy. In addition, we have set aggressive targets to manage initiatives such as effectively using resources in the mainstay steelmaking processes, preventing air and water pollution, and efficiently using water resources, and we are actively addressing these concerns. Furthermore, we are striving to minimize the impact on the ecosystem surrounding our business sites and analyzing the impact on diversity of using our steel slag products.

Targets and Results for Environment-Related Material Issues of Corporate Management

➤ Material Issues of Corporate Management and KPIs (P.18)

Key Initiatives

- Promoting the acquisition of Environment Management System certification, conducting internal and external environmental audits
- Executing initiatives for achieving the JFE Group Environmental Vision for 2050 (P. 52) and carbon neutrality
- Expanding the supply of JGreeX™, green steel products based on the mass balance approach (P. 61)
- Development of ultra-innovative technologies (P. 63), mainly the carbon-recycling blast furnace
- Group-wide effort to accelerate the commercialization of the offshore wind-power generation business (P. 77)
- Development and provision of environmentally sound products and processes
- Development of products that take advantage of steel's excellent recyclability, contribution to reducing plastic waste
- Effective use of water resources (P. 119) in steelmaking processes (high recirculation rate)
- Improvement and assessment of the environment at and around business sites, contribution to biodiversity (P. 127) from using steel slag products

Environmental Management

Basic Policy

JFE Group companies are developing innovative technologies and international cooperation for the protection of the global environment by operating in harmony with the global environment, as well as protecting it, in accordance with the Group's environmental philosophy and policy.

Environmental Philosophy

The JFE Group puts top priority on protecting and enhancing the global environment to maintain its business in harmony with the environment and ultimately for the prosperity of society as a whole.

Environmental Strategies

1. Reduce the environmental impact of all businesses
2. Contribute through technologies and products
3. Contribute through businesses for resource conservation and energy efficiency
4. Communicate with society
5. Facilitate international cooperation

Management Structure

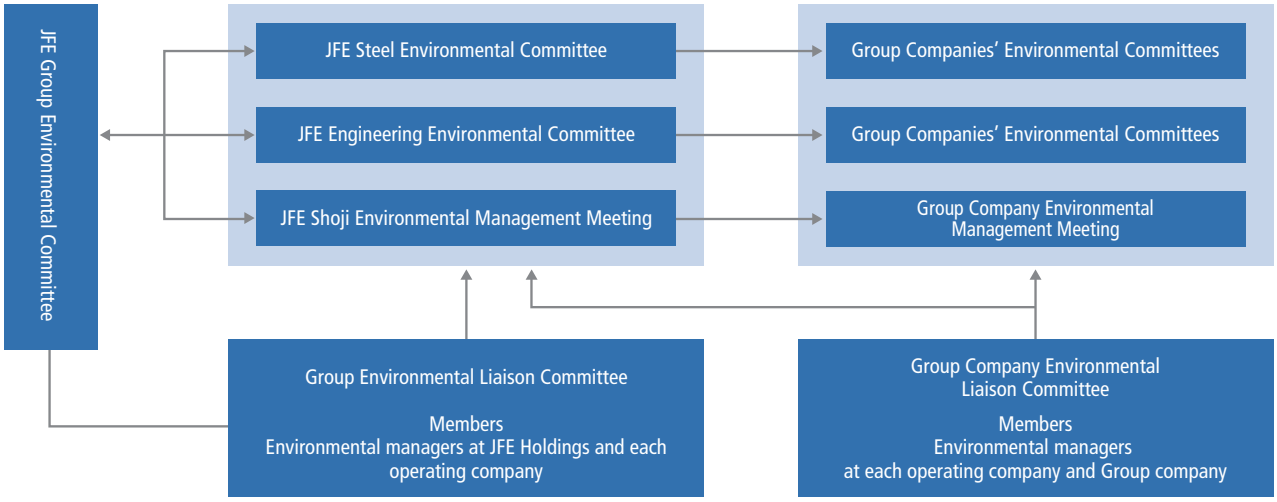
Framework for Environmental Management

The JFE Group Environmental Committee, chaired by the president of JFE Holdings and operating under the JFE Group Sustainability Council, sets goals for environmental protection, monitors the progress of these initiatives and works to improve the Group's overall environmental performance. Key issues for corporate management such as climate change are deliberated at the Group Management Strategy Committee as well and reported to the Board of Directors. The board oversees environmental challenges by discussing the reported material. Additionally, specialized committees set up by JFE Group operating companies and affiliates implement specific activities.

In our Seventh Medium-term Business Plan, we positioned climate change as a top-priority business concern and formulated the JFE Group Environmental Vision for 2050. To this end, we are aggressively pushing forward to achieving our CO_2 reduction targets and achieving carbon neutrality by 2050.

For further details, refer to:
➤ System for Promoting Sustainability (P.10)
➤ Seventh Medium-term Business Plan (P.22)
➤ JFE Group Environmental Vision for 2050 (P.52)

■ **Environmental Management System**



Initiatives

Environmental Management System

Acquiring ISO 14001 certification is a key part of every JFE Group company's environmental program. All global production sites of JFE Steel and JFE Engineering and major offices of JFE Shoji have been certified, encompassing 67% of 43,994 employees at 82 companies covered in this report and 52% of all sites. In FY2023, there were no major violations of environmental laws or regulations by Group companies (air, water, soil, etc.) that resulted in a fine or other penalty.

For quantitative data related to ISO 14001 for each business, please refer to the following information.

➤ List of ISO 14001-certified companies (https://www.jfe-holdings.co.jp/en/common/pdf/sustainability/environment/env_manage/iso14001.pdf)

JFE Steel Environmental Committee and Environment Management Committees Provide Appropriate Management Supervision

JFE Steel maintains Environment Management Departments at its head office and in each business office, as well as an Environmental Committee, chaired by its president and Environment Management Committees in each local office.

➤ Environmental Management System (Environmental Strategies) (Japanese only)
(https://www.jfe-steel.co.jp/research/environment.html)

JFE Engineering Environmental Committee Oversees Environmental Management

JFE Engineering maintains an Environment Management Department at each of its major locations, including production sites and branch offices as well as all divisions in charge of products. The Environmental Committee, chaired by the president, oversees environmental management for the entire company. Under its Environmental Management System, JFE Engineering works to minimize environmental impact at production sites, branch offices and construction sites and contribute to environmental protection through all products and services. The major strategies for FY2024 are (1) promote environmental contribution through products for mitigating global warming and climate change, (2) promote environmental protection, effective energy conservation, and resource recycling in business activities, and (3) ensure thorough compliance with environmental laws and regulations. We are reflecting these strategies into the related operations. These strategies are incorporated into related operations and are addressed.

JFE Shoji Expand ISO 14001 Certification Acquisition Coverage

JFE Shoji obtained ISO 14001 certification for its head office, Osaka branch, and Nagoya branch in 2000 and later expanded the scope of certification to all domestic offices. JFE Shoji also applies the same environmental management system to domestic Group companies, promoting the same environment management activities and striving for the same certification. Overseas coil centers are also planning to acquire ISO 14001 certification.

Environmental Audit

In addition to the regular internal and external audits at ISO 14001-certified sites, the audit and environment departments at each operating company's head office conduct independent environmental audits at their production sites.

JFE Steel Conduct Detailed Audits

Once a year, JFE Steel's Audit Department and the Environment, Disaster Prevention and Recycling Department conduct an environmental audit at each operational site. JFE Steel categorizes Group companies based on the result of risk assessment considering owned equipment and conducts detailed audits every one to five years using checklists.

Document audit at a domestic Group company on-site audit at a domestic Group company

On-site audit at a domestic Group company

JFE Engineering Conduct Audits to Confirm Compliance with Environmental Laws and Regulations

JFE Engineering places a top priority on complying with environmental laws and regulations.

The Safety and Environment Department conducts annual audits at about 50 locations selected from the manufacturing sites, construction sites in Japan, and Group companies to confirm compliance with environmental laws and regulations. JFE Engineering also conducts internal audits on its own environmental management system to evaluate and enhance the effectiveness of various environment-related initiatives. Furthermore, environmental inspections are conducted at all construction sites by the department responsible for construction to verify compliance with the laws and regulations, and annual self-checks are conducted at the Tsurumi, Tsu, and Kasaoka manufacturing sites to confirm legal compliance.

JFE Shoji Conduct Internal Audits and Environmental Audits

At JFE Shoji, the ISO Environmental Audit Department annually confirms that processing centers and warehouses of ISO 14001-certified Group companies comply with relevant environmental laws and regulations. For non-certified Group companies, the department conducts an environmental audit every three years.

For quantitative data related to environmental audits, please refer to the following information.

➤ Environmental Data (P.235)

Environmental Education

The JFE Group actively provides education to foster a corporate culture of environmental protection. Education at operating companies includes training for new recruits and newly promoted employees as well as specific environmental-protection training by position and job.

For Group-wide environmental training, we hold an annual Review Session on Environment-Related Laws and Regulations, to which lawyers specialized in environment-related laws and regulations are invited to give lectures on the latest information related to the enactment and revision of these laws, as well as associated violations and court decisions. Employees from wide-ranging departments, including the environment, disaster prevention, legal affairs, general affairs, and manufacturing departments of the operating companies and their group companies, who are involved in environment-related activities, attend these annual sessions as the basis for planning their activities, such as educating employees and raising awareness about the Group's policies and initiatives.

JFE Steel Promote Pollution Control Managers Acquire Qualifications

JFE Steel encourages employees to obtain qualifications as pollution-control managers. A training program for environmental managers at group companies was launched in FY2011. In addition, JFE Steel provides employees with training to ensure compliance with environmental laws, disseminates information about regulatory revisions at its Environmental Liaison Committee meetings for Group companies, and organizes brush-up training in waste management skills for on-site personnel.

JFE Engineering Provide General Environmental Education

JFE Engineering educates all employees about environmental issues to increase their understanding of the company's policies and initiatives. To ensure proper environmental management at production and construction sites, training is often tailored to specific employee operations, helping to enhance their capabilities. In FY2023, JFE Engineering launched an initiative to identify training needs at greater detail, such as automatically tracking the number of employees participating in trainings via video-distribution.

JFE Shoji Provide General Environmental Training and Specialized Training for Internal Audit Staff

JFE Shoji provides all employees with general environmental training in compliance with ISO 14001 and specialized training for internal audit staff. All employees within the scope of certification receive a pocket-size ISO Employee Card to carry with them so they can check the details of ISO 14001 activities at any time. In addition, each company performs a self-check using its own extensive checklist to ensure understanding and rigorous compliance with environmental laws. Also, JFE Shoji provides environmental training to new executives and information about revised laws and regulations to environmental management personnel.

For quantitative data related to environmental education, please refer to the following information.
➤ Environmental Data (P.235)

Environmental Impact Reduction Initiatives

The JFE Group regards co-existence and mutual prosperity with local communities, the global environment, and society at large as a critical managerial challenge in terms of business continuity. It strives to control air and water pollutant emissions and aggressively invests in environmental protection. Related internal controls and education are steadily being strengthened as well. Also, the transfer and widespread application of proprietary technologies, mainly in developing countries, contribute to pollution prevention on a global scale.

For quantitative data related to reducing environmental impact, please refer to the following information.
➤ Environmental Data (P.235)

Controlling Air Emissions

JFE Steel

Initiatives to Further Reduce SOx and NOx Emissions

JFE Steel is installing low-nitrogen oxides (NOx) burners in reheat furnaces, switching to low-sulfur fuels and deploying desulfurization and denitration devices in sintering plants, all major sources of sulfur oxides (SOx) and NOx emissions. It has concluded agreements with local administrations that stipulate conditions that are stricter than the total volume restrictions required by the Air Pollution Control Law. The company is continuing to further control emissions at a level that is less than the amount set forth in the agreement. In addition, the company suppresses dust dispersion through measures that include enhancing on-site cleaning, installing sprinklers and windbreak fences in raw material yards, and improving the performance of dust collectors.

JFE Engineering

Appropriate Management in Place to Restrict SOx and NOx Emissions

To ensure compliance with the Air Pollution Control Law and relevant local regulations, JFE Engineering properly manages facilities that emit soot and smoke at its Yokohama head office, Tsurumi works, and Tsu works, so NOx and Sox emissions from those facilities are maintained at a level sufficiently lower than the total annual volume restriction (NOx: 18,000 Nm^3, Sox: 100 Nm^3). In addition, efforts are being made at construction sites to protect the environment through the use of construction machinery and on-site vehicles in compliance with the Automotive NOx and PM Law and Act on Regulation, Etc. of Emissions From Non-road Special Motor Vehicles (Off-Road Vehicle Law).

Management of Chemical Substances and Emission Control

JFE Steel

Initiatives to Reduce VOC Emissions

JFE Steel lowers its environmental impact by voluntarily reducing the chemical substances it releases. Release and transfer amounts of substances subject to Japan's Law concerning Pollutant Release and Transfer Register (PRTR Law) are reported in accordance with the law.

The Japan Iron and Steel Federation formulated a voluntary action plan to reduce VOC emissions by 30% from FY2000 levels by FY2010. As part of this action plan, JFE Steel set a target for reducing emissions to 1,078 tonnes or less. As a result of our initiatives, we achieved a significant reduction that exceeded the 30% reduction target in FY2010 and have been consistently cutting VOC emissions, by more than 50%. Going forward, we will continue to maintain the emissions below 1,078 tonnes and take the necessary steps to prevent any increase.

Emissions of benzene and dichloromethane are kept at low levels. We will continue to set targets for the two substances and maintain low emissions levels.

JFE Engineering

Management of Chemical Substances in Accordance with the PRTR Law

Major chemical substances subject to the PRTR Law for the JFE Engineering works in Tsurumi, Tsu, and Kasaoka include organic solvents such as xylene used for painting products, manganese and its compounds generated during welding. We report the release and transfer amounts of these substances in accordance with the law.

PCB Waste Management at JFE

Polychlorinated biphenyl (PCB) waste is properly stored and managed at the JFE Group's facilities. High concentration PCB waste is treated in accordance with guidelines set by the Japan Environmental Storage & Safety Corporation (JESCO). The Yokohama Eco Clean Plant of J&T Recycling Corporation treats insulating oil contaminated with slight amounts of PCB, helping to reduce pollutants both in and outside the JFE Group.

Environmental Accounting

Basic Policy

The JFE Group is saving energy and reducing its environmental impacts by making its production facilities increasingly efficient and introducing more environmentally friendly equipment. Any equipment or facilities related to energy conservation and environmental protection are categorized as environmental investment, while all activities related to environmental protection and impact reduction are categorized as environmental expenses.

Through these environmental investments and expenses, we are working to lower unit-based CO_2 emission to prevent global warming and to reduce final-disposal waste by maintaining a high recycling rate to effectively use natural resources. We are also striving to reduce emissions of pollutants into the water and air, which contributes to environmental protection and ensures thorough compliance with statutory regulations concerning exhaust gas emissions and discharged water.

For quantitative data related to environmental accounting, please refer to the following information.

➤ Environmental Data (P.235)

Related Links

➤ Material Flow (P.235)
➤ JFE Steel: Environmental Initiatives (Japanese only) (https://www.jfe-steel.co.jp/research/environment.html)
➤ JFE Engineering: 360° JFE Engineering—Protecting Natural Environments (https://www.jfe-eng.co.jp/en/360_jfe_engineering/#env)
➤ JFE Shoji: Environment Management (https://www.jfe-shoji.co.jp/en/csr/environment/)

Initiatives to Address Climate Change Issues

Basic Policy

Climate change is a critical business concern for the JFE Group from the perspective of business continuity. Our steel business, which emits 99.9% of the Group's total CO_2 emissions, has been developing various technologies for saving energy and reducing these emissions. We have applied these technologies to steel manufacturing processes to enable production with low levels of CO_2 emission intensity.

Furthermore, we have developed and maintained a variety of eco-friendly products and technologies, including high-performance steel materials that help save energy when customers use them, as well as renewable energy power generation.

We will continue to develop and promote the widespread use of these processes and products. We consider this as an opportunity to apply the technologies we have fostered across the globe and at the same time contribute to tackling climate change.

JFE announced its endorsement for the TCFD recommendations in May 2019 and has identified climate change-related issues based on the scenario analysis advocated in the TCFD to formulate strategies for sustainable growth. In September 2020, JFE disclosed its target of reducing CO_2 emissions in FY2030 in the steel business, which accounts for most of the Group's CO_2 emissions. It also **announced its intention to achieve carbon neutrality by 2050**, ahead of the Japanese government's announcement of the same goal.

In February 2022, **the target of reducing CO_2 emissions in FY2030 was revised upward to 30% or more, compared to FY2013,** considering advances in measures for carbon neutrality and improvement of external surroundings in the steel sector.

To achieve these targets, the JFE Group will work hard to reduce CO_2 emissions and energy consumption.

JFE Group Environmental Vision for 2050

The JFE Group intends to strengthen sustainability through solutions that address global climate change issues while restructuring its business in response to changes in the environment surrounding the steel business. We regard 2020 as a milestone year for further reinforcing our efforts to tackle climate change, and we are actively promoting initiatives for reducing CO_2 emissions.

In 2021, we positioned climate change as a top-priority issue in the Seventh Medium-term Business Plan and **formulated the JFE Group Environmental Vision for 2050 toward achieving carbon neutrality by that year.**

We will systematically address climate change by **reflecting the TCFD's principles in the business strategies** of our JFE Group Environmental Vision for 2050. In the steel business, we **will reduce CO_2 emissions by 18% from FY2013 levels by the end of FY2024.** In addition, we announced that **the target of reducing CO_2 emissions in FY2030 is 30% or more, compared to FY2013,** in the steel business. To explore all possibilities for realizing carbon neutrality in 2050, we will take on the challenge of developing ultra-innovative technologies such as **carbon-recycling blast furnaces developed with our proprietary technology** while also adopting a multitrack approach for pursuing other technologies. In our engineering business, we will widen our contribution to the reduction of CO_2 in society as a whole by expanding and advancing renewable power generation and carbon-recycling technologies, supplying high-performance steel products, and other initiatives. Furthermore, we will apply Group strengths to accelerate the commercialization of **our offshore wind-power business.**

JFE Group Environmental Vision for 2050

- **Climate change is a critical business concern for JFE, and we are aiming to achieve carbon neutrality by 2050.**
- **We will accelerate our research and development of new technologies and pursue ultra-innovative technologies.**
- **We will seek business opportunities that allow us to enhance corporate value by contributing to CO_2 emissions reduction across society.**
- **The principles of TCFD will be reflected in our business strategies and systematically deployed.**

The Target of Reducing CO_2 Emissions in FY2024 (Seventh Medium-term Business Plan Initiatives)

▶Reduce steel-business CO_2 emissions in FY2024 by 18%, compared to FY2013 (steel business)

The Target of Reducing CO_2 Emissions in FY2030

▶Reduce steel-business CO_2 emissions in FY2030 by 30% or more, compared to FY2013 (steel business)

Initiatives for Carbon Neutrality by 2050

(1) Reduce steel-business CO_2 emissions

- ▶ Pursue ultra-innovative technology for carbon-recycling blast furnaces and CCU.
- ▶ Develop hydrogen-based ironmaking (direct reduction) technology.
- ▶ Leverage top-in-class electric arc furnace technology for high-quality, high-performance steel manufacturing, high efficiency, etc.
- ▶ Develop transitional technologies for carbon neutrality, including ferro coke, increased use of steel scrap in converters, energy savings, and low-carbon energy transformations.

(2) Expand contributions to CO_2 emissions reduction in society

- ▶ JFE Engineering: Expand and develop renewable energy power generation and carbon-recycling technologies. (Reduce CO_2 emissions by 12 million tonnes in FY2024 and 25 million tonnes in FY2030)
- ▶ JFE Steel: Develop and market eco-products and eco-solutions.
- ▶ JFE Shoji: Increase trading in biomass fuels, steel scrap, etc., and strengthen business in supply chain management (SCM) for eco-products.

(3) Offshore wind-power generation business (Group-wide effort to accelerate commercialization of the offshore wind-power business)

- ▶ JFE Engineering: Manufacture monopiles and other seabed-fixed structures for offshore wind-power generation.
- ▶ JFE Steel: Produce large and heavy plates by using new continuous casting machine in Kurashiki.
- ▶ JFE Shoji: Carry out SCM for steel materials and processed products.
- ▶ Japan Marine United Corporation: Manufacture offshore wind-power generation floating structures and construct work vessels.
- ▶ Group-wide: Operation and maintenance (O&M) making maximum use of Group resources.

Notes.

1. Carbon-recycling blast furnace: A technology that converts CO_2 from the blast furnace into methane, which is then used as reducing material in the blast furnace
2. CCU: Carbon dioxide capture and utilization
3. Transitional technologies: Technologies that advance the transition to carbon neutrality
4. Ferro coke: Innovative blast furnace raw material that improves the reduction efficiency of iron ore and reduces CO_2 generation from the blast furnace

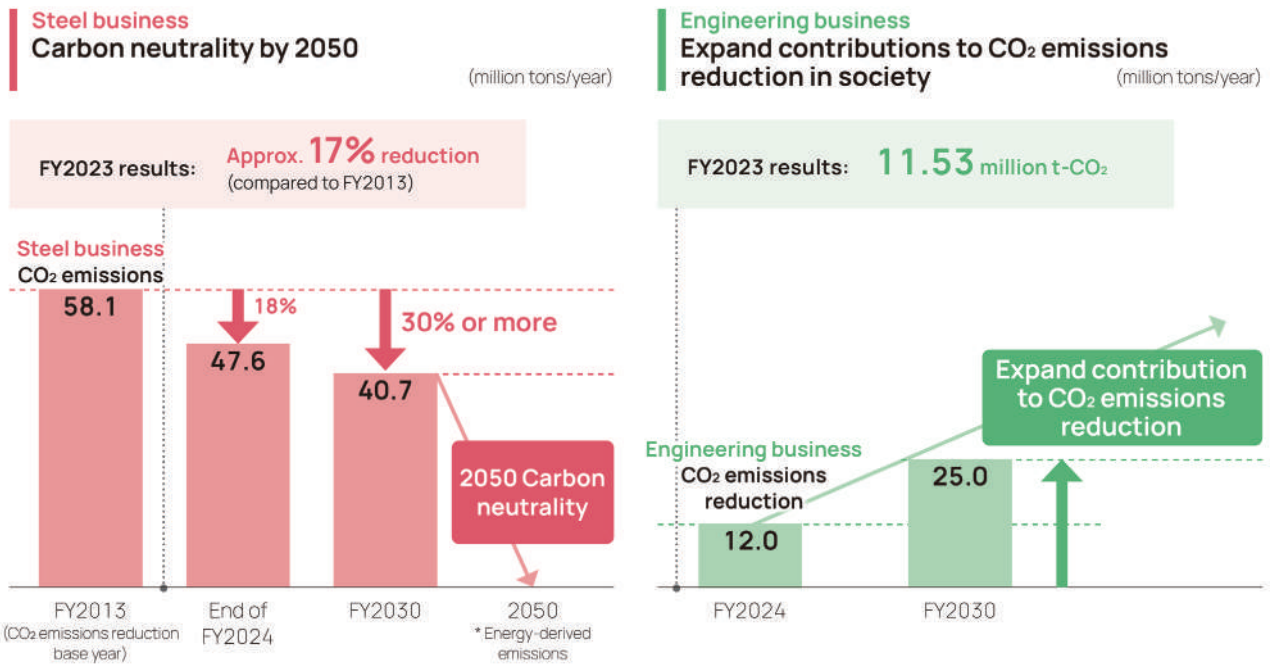
➤ Seventh Medium-term Business Plan (P.22)

➤ JFE Group Environmental Vision for 2050, Presentation Material
(https://www.jfe-holdings.co.jp/en/common/pdf/investor/climate/2021-210525-release01.pdf)

Developing processes to mass produce high-quality, high-performance steel with zero CO_2 emissions is essential for a sustainable world. Huge R&D and equipment replacement costs will be inevitable as JFE executes strategies targeting carbon neutrality. Society must decide how these costs should be shouldered, including government support.

Working toward the lofty goal of carbon neutrality by 2050, JFE is focusing on establishing the necessary decarbonization technologies as quickly as possible, ahead of global competitors, assuming that we have the decarbonization infrastructure in place and ability to compete on an equal footing globally.

■ JFE Group's Activities for Carbon Neutrality



Information Disclosure Based on TCFD Recommendations

On May 27, 2019, JFE Holdings announced its endorsement for the final report of the Task Force on Climate-related Financial Disclosures (TCFD)*.

TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

*The TCFD was established by the Financial Stability Board (FSB) at the request of G20 finance ministers and central bank governors.

Climate-related risks and opportunities will significantly impact medium- to long-term corporate finance. To reduce the risk of instability in the financial market, the G20 called on the FSB to establish the TCFD. The TCFD considers disclosure methodologies that can be used to appropriately assess climate-related risks and opportunities and releases its findings as a final recommendations report.

It is important for investors to accurately understand the financial impact of climate-related risks and the opportunities of investee companies when they make financial decisions. In this context, the task force recommends disclosures to be made in four core elements of organizational management: governance, strategy, risk management, and metrics and targets.

For the TCFD content index, click on the following link.

➤ Guideline Content Indices (P.278)

Governance (Management Structure: JFE Group)

Under the JFE Group Standards of Business Conduct, the JFE Group actively strives to exist in harmony with the global environment and create a society that is comfortable and convenient. We are aware that efforts to protect the global environment, such as reinforcing our environmental protection activities and addressing climate change issues, are extremely important for creating a sustainable society.

In FY2016, we identified the mitigation of global warming as a material CSR issue to facilitate the PDCA cycle and promote appropriate management of ongoing initiatives, such as reducing CO_2 in the iron and steelmaking processes and developing and providing eco-friendly products. In 2021, we relaunched the initiative as a top priority by adding economic perspectives to the material issues and by selecting other vital matters of importance. As part of this effort, we set our goal for helping to address climate change (initiatives to achieve carbon neutrality by 2050) as an area of focus and identified reducing the JFE Group's CO_2 emissions and contribution to CO_2 emissions reduction in society as two material issues.

The JFE Group Environmental Committee, chaired by the president of JFE Holdings and operating under the **JFE Group Sustainability Council,** sets goals for environmental protection, monitors the progress of these initiatives and works to improve the Group's overall environmental performance.

Key managerial issues such as climate change and other environmental challenges are deliberated on by the **Group Management Strategy Committee** and reported to the **Board of Directors.** The board also deliberates on these issues and supervises the initiatives.

■ Examples of Climate Change-Related Agenda Items Involving Board of Directors Decisions and Reports

- Declaration of endorsement for the final TCFD recommendation report
- Information disclosure consistent with TCFD recommendations (scenario analysis and other information)
- Formulation of the Seventh Medium-term Business Plan, JFE Group Environmental Vision for 2050
- Review the CO_2 emissions reduction target for FY2030
- Use of climate-related metrics to determine executive remuneration

➤ Corporate Governance System (P.215)
➤ Framework for Environmental Management (P.46)

JFE Group's Climate Change Strategy

Various risks and opportunities related to climate change are integrated into the JFE Group's business strategy. The Group formulated the Seventh Medium-term Business Plan as the main guide for business operations from FY2021 to FY2024, and we positioned efforts to address climate change as the key to achieving sustainable growth and increased value over the medium to long term. Under the plan, the Group defined ensuring environmental and social stability as a core strategy and **formulated the JFE Group Environmental Vision for 2050 for achieving carbon neutrality by 2050**. Then we concentrated our efforts on our business strategy and **reflected the principles of the TCFD recommendations in our management strategy**, enabling us to systematically address climate change. Furthermore, we are disclosing information based on the TCFD recommendations, including the scenario analysis, leveraging them to identify and evaluate risks and opportunities, and reflecting them in our management strategy.

For further details on the Results of Scenario Analysis and the JFE Group Environmental Vision for 2050, refer to the following source material.

➤ Scenario Analysis in Line with the TCFD Recommendations (P.104)
➤ JFE Group Environmental Vision for 2050, Presentation Material
(https://www.jfe-holdings.co.jp/en/common/pdf/investor/climate/2021-210525-release01.pdf)

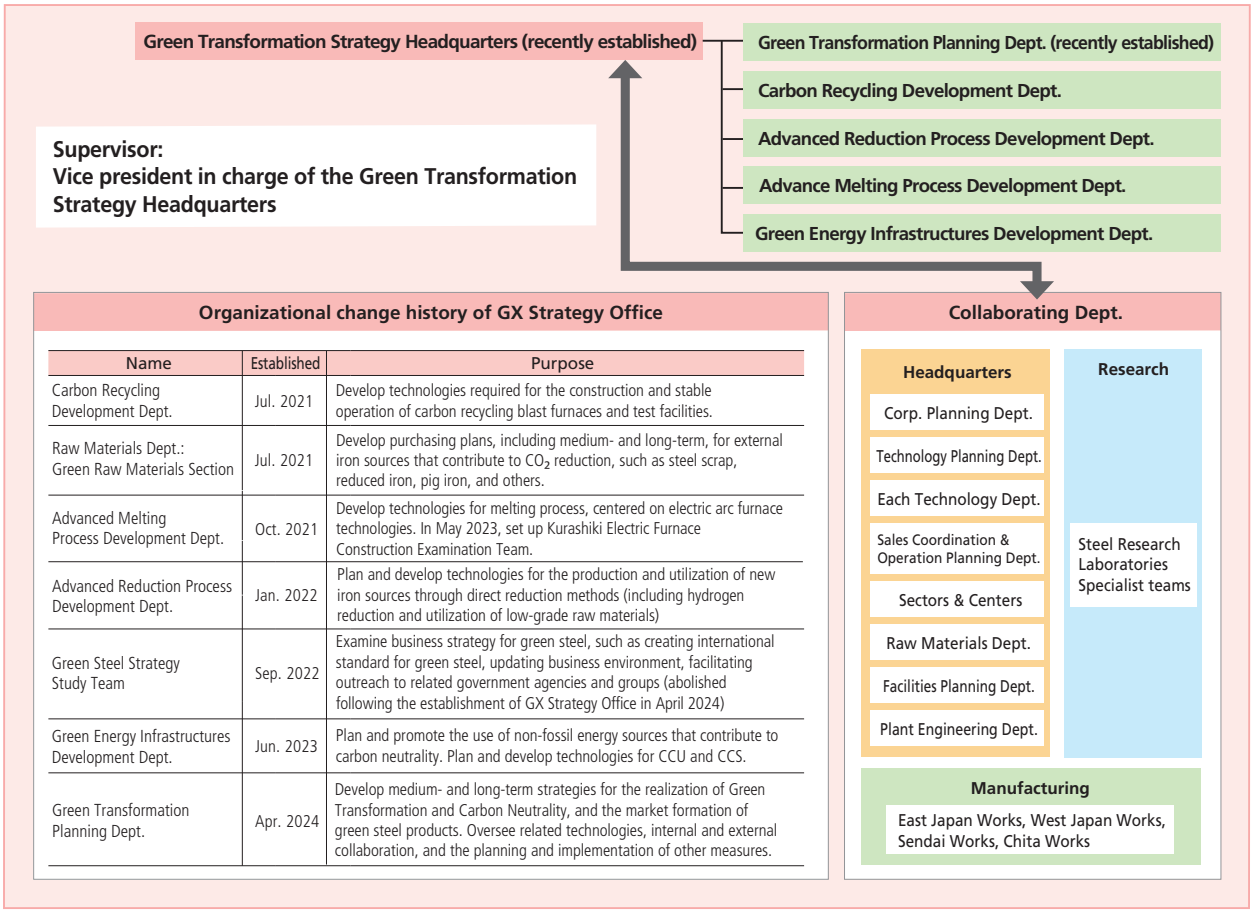
In the JFE Group Environmental Vision for 2050, our efforts to achieve carbon neutrality are based on the following three key strategies: reduce CO_2 emissions at JFE Steel, expand contributions to the reduction for society as a whole, and accelerate Group-wide commercialization of the offshore wind-power business. In the steelmaking process, along with efforts to reduce CO_2 emissions, we will also actively work on reducing environmental impact through reusing water resources and energy, developing environmentally sound products and process technologies, and providing resource recycling solutions.

JFE Steel's Management Structure to Promote Carbon Neutrality

Governance (Management Structure: JFE Steel)

The key for ensuring JFE Steel's sustainable growth is to develop and implement a medium- to long-term strategy for realizing Green Transformation (GX). In addition to developing and investing in technologies related to carbon neutrality, other necessary tasks are required for increasing the sales of green steel products, such as forming new markets and strengthening cooperation with government authorities. In April 2024, the Green Transformation Strategy Headquarters was established to formulate and promote a Company-wide strategy to realize Green Transformation. The office is comprised of the recently established Green Transformation Planning Department and departments responsible for developing technologies, specifically the Carbon Recycling Development Department, Advanced Reduction Process Development Department, Advanced Melting Process Development Department, and Green Energy Infrastructures Development Department . The Green Transformation Planning Department is responsible for developing medium- and long-term strategies for realizing Green Transformation and the market formation and sales of green steel products. It also oversees related technologies, internal and external collaboration, and the planning and implementation of other measures.

■ JFE Steel's Management Structure to Promote Carbon Neutrality



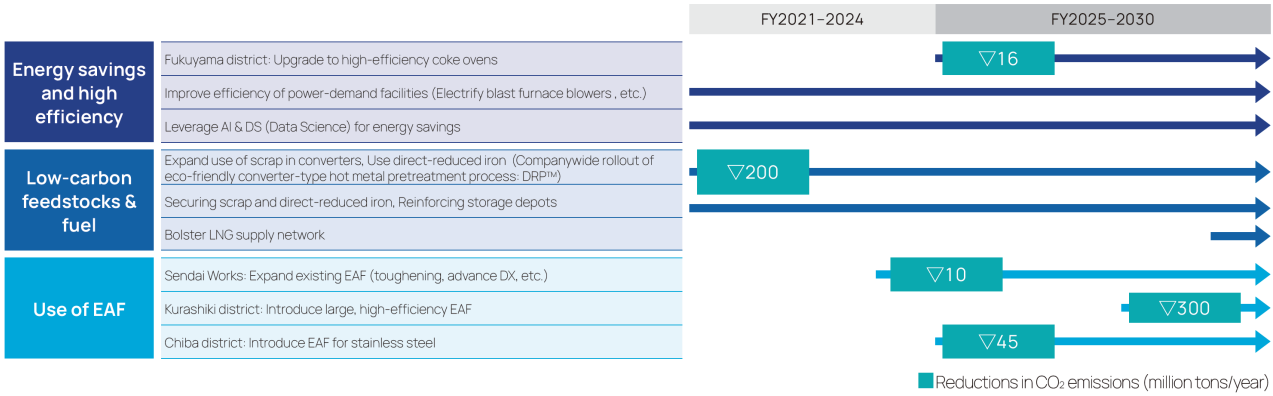
Name	Established	Purpose
Carbon Recycling Development Dept.	Jul. 2021	Develop technologies required for the construction and stable operation of carbon recycling blast furnaces and test facilities.
Raw Materials Dept.: Green Raw Materials Section	Jul. 2021	Develop purchasing plans, including medium- and long-term, for external iron sources that contribute to CO_2 reduction, such as steel scrap, reduced iron, pig iron, and others.
Advanced Melting Process Development Dept.	Oct. 2021	Develop technologies for melting process, centered on electric arc furnace technologies. In May 2023, set up Kurashiki Electric Furnace Construction Examination Team.
Advanced Reduction Process Development Dept.	Jan. 2022	Plan and develop technologies for the production and utilization of new iron sources through direct reduction methods (including hydrogen reduction and utilization of low-grade raw materials)
Green Steel Strategy Study Team	Sep. 2022	Examine business strategy for green steel, such as creating international standard for green steel, updating business environment, facilitating outreach to related government agencies and groups (abolished following the establishment of GX Strategy Office in April 2024)
Green Energy Infrastructures Development Dept.	Jun. 2023	Plan and promote the use of non-fossil energy sources that contribute to carbon neutrality. Plan and develop technologies for CCU and CCS.
Green Transformation Planning Dept.	Apr. 2024	Develop medium- and long-term strategies for the realization of Green Transformation and Carbon Neutrality, and the market formation of green steel products. Oversee related technologies, internal and external collaboration, and the planning and implementation of other measures.

JFE Steel's Strategy to Reduce CO_2 Emissions

The JFE Group has adopted a multipronged approach, including the development of ultra-innovative technologies, to achieve carbon neutrality by 2050. In the steel business, we have set a target for reducing CO_2 emissions by 18% as of the end of FY2024 and by 30% or more by FY2030, compared to FY2013. We have defined the period up to 2030 as a transition phase and the period after that as an innovation phase. In the transition phase, we will focus more on initiatives to reduce emissions through an expanded application of low-carbon technologies to steadily advance toward achieving the CO_2 reduction target in FY2030. In this phase, we will also accelerate the development of ultra-innovative technologies to prepare for the innovation phase. In the innovation phase, we will advance initiatives for the wise use of resources, including the commercialization of carbon-recycling blast furnaces that leverage our proprietary carbon-recycling technology and direct reduction steelmaking, as well as the expansion of CCU applications. Furthermore, we will undertake CO_2 sequestration through CCS to create a carbon-neutral society together with local communities and industrial complexes. We will achieve carbon neutrality through initiatives under these three themes.

Transition to Low-Carbon Steel Processes

Our multi-pronged approach includes developing ultra-innovative technologies for achieving carbon neutrality by 2050. We have defined the period up to 2030 as a transition phase and the period after that as an innovation phase. In the transition phase, the steel business is promoting energy-saving and high-efficiency improvements in existing processes and the use of electric furnace technology. We anticipate that achieving the CO_2 reduction target for FY2030 may require investments and loans of around one trillion yen, and approximately 300 billion yen has been approved by FY2023. We intend to steadily advance toward obtaining the necessary investments and loans to achieve the reduction target.



Development of Electric Arc Furnace Process Technology

An electric arc furnace process is one of the JFE Group's development efforts in steelmaking technologies for carbon neutrality. With this technology, steel products are manufactured by melting steel scrap and direct-reduced iron in an electric arc furnace. So far, we have managed to reduce CO_2 emissions from this steelmaking process down to one-quarter of that of the blast furnace-converter method. We are striving to eliminate CO_2 emissions generated by the electric arc furnace process in the future by using the aforementioned hydrogen-reduced iron as the raw material and non-fossil electricity.

Although the electric arc furnace process has the advantage of reducing CO_2 emissions, there are two major problems compared to the blast furnace-converter method: the productivity of the electric arc furnace process in general is about 30% lower than that of the blast furnace-converter method, and the use of scrap as the raw material inevitably increases the concentration of impurities, which limits the production of high-quality, high-performance steel products. We are working to address these issues, for utilizing Transition Finance, to establish technologies that will enable the production of high-quality, high-performance steel with high productivity using the electric arc furnace process. The innovative electric furnace is the super-advanced technology that can be most quickly implemented. We view it as a replacement for one of the blast furnaces in Kurashiki District, which is due for refurbishment in FY2027. We are planning to make the investment decision within FY2024, subject to government support, and begin operation in FY2027.

Use Electric Arc Furnaces to Increase the Use of Scrap

JFE Steel is planning to increase the production capacity of the electric arc furnaces in the Sendai Works by approximately 0.14 million tonnes per year by FY2024 through reinforcing the electric arc furnaces in the Sendai Works, implementing capacity-boosting DX measures, and improving the load handling equipment. This is expected to result in a reduction of approximately 0.10 million tons of CO_2 emissions per year.

We are planning to install a new electric arc furnace in the Chiba district for stainless steel production. This will allow the facility to replace part of the feedstock from molten iron from blast furnaces with scrap and thus reduce CO_2 emissions. This could increase by up to six times the volume of scrap used, and we expect to reduce CO_2 emissions by a maximum of about 450,000 tons per year.

Furthermore, in the Kurashiki district, we are considering switching to a newer process technology by replacing one of the blast furnaces, which needs to undergo preventive maintenance within the period of 2027–2030, with a large, high-efficiency electric arc furnace.

Feasibility Study on New Venture Business to Secure Reduced Iron Supply

In the transition phase up to 2030, we expect a shortage in domestic scrap supply. The use of direct-reduced iron is considered an effective way to supplement this in the production of high-quality steel using electric arc furnaces and in the reduction of CO_2 emissions from blast furnaces.

JFE Steel has agreed with EMSTEEL, the largest steel producer in the UAE, and ITOCHU Corporation (ITOCHU) to jointly conduct detailed feasibility studies on the establishment of a supply chain of reduced iron with low carbon emissions. Under a joint venture to be established in the UAE, we are focusing on producing direct-reduced iron with low carbon emissions from the second half of FY2025 using CCUS (EOR*), which takes full advantage of the geographic location of the UAE.

*Enhanced oil recovery

Collaboration to Establish a Supply Chain of Ferrous Raw Material for Green Ironmaking with Low Carbon Emissions

JFE Steel regards the use of green ferrous raw material as a key initiative for reducing CO_2 emissions. We are participating as a core member in the establishment of a reduced iron supply chain with low carbon emissions along with ITOCHU and EMSTEEL, and we are jointly pursuing a detailed feasibility study with Abu Dhabi as a candidate project site.

At the Japan-UAE Business Forum that was held on July 17, in the presence of Japanese Prime Minister Fumio Kishida, JFE Steel has signed and exchanged a memorandum of understanding (MOU) with ITOCHU, EMSTEEL, and the Abu Dhabi Ports Group (ADPG) to develop collaborative systems for the establishment of a supply chain to handle ferrous raw material for green ironmaking with low carbon emissions.

ADPG, the state-owned port operator and economic and industrial zones developer in Abu Dhabi in which the project is planned to be developed, owns 10 ports and 550km^2 of economic and industrial areas. The parties have agreed that ADPG will participate fully in project-related port development and operations, land leasing and services, and infrastructure development. Collaboration with ADPG will provide the undertaking with access to a suitable site for building a distribution and logistics system capable of stably importing raw materials and shipping products for the envisioned supply chain.

● Overview of EMSTEEL
Company name: EMSTEEL
Representative: HE Engineer Saeed Ghumran Al Remeithi (Group CEO)
Business: Steel

● Overview of ADPG
Company name: Abu Dhabi Ports Group
Representative: Captain Mohamed Juma Al Shamisi
Business: Port operations, shipping, logistics and special economic zone development

Improve productivity of the electric arc furnace process

To improve productivity of the electric arc furnace process, the JFE Group have developed ECOARC™, our proprietary, eco-friendly, high-efficiency electric arc furnace, and installed it at our operating companies. With this technology, a shaft is attached to the upper part of the electric arc furnace and is used to continuously feed scrap materials into the furnace. It uses the high-temperature exhaust gas from the furnace to preheat the scrap material, allowing for subsequent high-efficiency and high-speed melting. As well as improving the productivity of the electric arc furnaces, the technology also reduces the energy (electricity) required for the melting process.

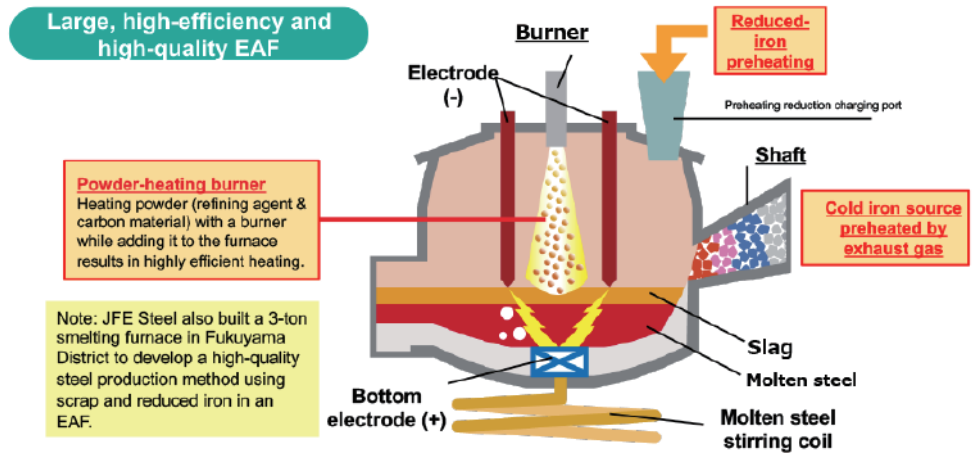
The Group already has achieved industry-leading productivity and energy (electricity) efficiency with these technologies, but we are working to raise productivity even further.

Overview of the Demonstration Tests

We are developing a process that reduces the electric arc furnace's melting power consumption and also enables high-speed melting of cold iron sources (scrap and reduced iron). We will verify the following during demonstration tests.

- Optimal methods for preheating and feeding reduced iron
- Methods for using heating burners
- Optimal methods for molten steel stirring

■ Research and Development for Electric Arc Furnaces



Manufacturing Higher-Grade Steels Using the Electric Arc Furnace Process

The electric arc furnace process uses scrap and reduced iron as raw materials. The higher concentration of impurities in these materials, such as copper, causes material degradation, including surface defects and reduced workability in steel sheets and deterioration of properties in electrical steel sheets. We are working on two technologies to address the issue, one to remove impurities and another to detoxify impurities, so that we can use the electric arc furnace process to produce high-quality steel products such as steel sheets for automobiles and electrical steel sheets.

East Japan Works (Chiba District) to Produce Stainless Steel with Electric-Arc Furnace

JFE Steel has decided to install a new electric-arc furnace at the No. 4 steelmaking shop at the East Japan Works (Chiba district) in the second half of FY2025 (planned). Scrap melting capacity is expected to increase by up to six times compared to the conventional process, to approximately 300,000 tonnes per year (planned), and CO_2 emissions are expected to be reduced by up to about 450,000 tonnes per year. We have defined the period up to 2030 as a transition phase toward carbon neutrality and consider the electric furnace process to be an effective means of reducing CO_2 emissions. Looking ahead, we will continue to develop ultra-innovative technologies in a multi-pronged approach and make steady progress toward realizing carbon neutrality.

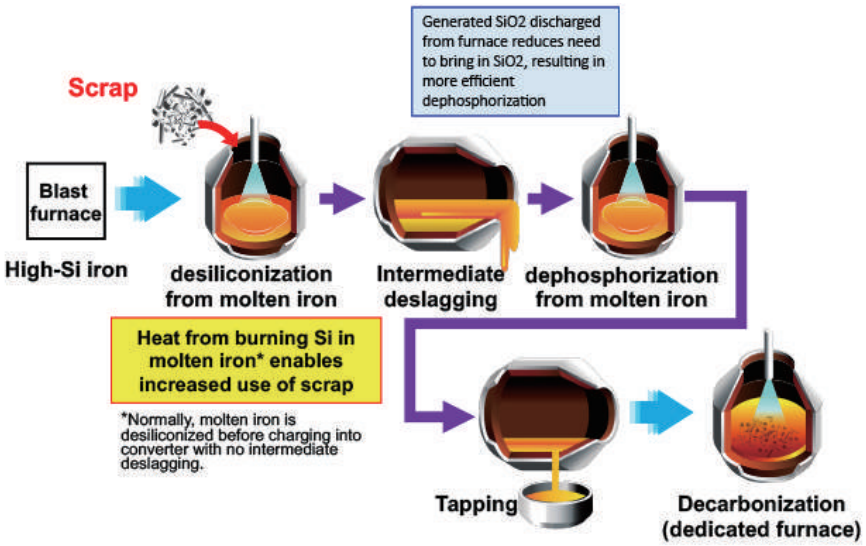
Increased Use of Scrap Iron in Steelmaking

JFE Steel completed introducing the Double-slag Refining Process (DRP™), an eco-friendly converter-type molten-iron pretreatment process, in all of its sites in 2021. This increased the amount of scrap iron to be used in converters, leading to reduced CO_2 emissions.

DRP makes full use of silicon in molten iron as a heat source, thereby increasing the amount of scrap iron to be used in converters. It allows reducing the molten-iron blending ratio (molten iron vs. scrap charged into the converter) to 82%, down from 90% through conventional methods.

The Company introduced this process in all of its steelmaking facilities, and the increased use of scrap iron in converters enabled us to reduce CO_2 emissions by approximately 0.60 million tons per year in FY2022. In the future, we will develop technologies to increase heating margins to further boost the use of scrap and invest in facility expansion to reduce CO_2 emissions by about 2 million tons per year by FY2030.

■ Eco-friendly converter-type molten iron pretreatment process DRP™: Double-slag Refining Process



Started supplying JGreeX™ green steel products

■ Name origin: JFE + Green + GX
We invited the relevant departments to propose names and selected this name from the suggestions because it clearly expresses being a green steel product provided by JFE Steel.
■ Logo design:
The logo combines the letter X with an arrow to express our intention to move forward toward carbon neutrality.

In the first half of FY2023, JFE Steel began supplying JGreeX™, a brand of green steel products that significantly reduce CO_2 emissions in the steel manufacturing process compared to conventional products. With the current technology, it is difficult to immediately supply green steel products with significantly lower or zero emissions, so the reductions created by our technologies are allocated to any steel products by applying the mass balance method*1 and then supplied as green steel products. With regard to the amount of CO_2 emission reductions and the emission intensity of each product, we have obtained a third-party certification from Nippon Kaiji Kyokai (ClassNK), which verified 600,000 tonnes of CO_2 emission reductions in FY2022.

In October 2023, JGreeX™ was selected by Sumitomo Corporation for its new office building, tentatively named Suidobashi PREX (Photo 1) . This was the first application of green steel materials in both the real estate and construction industries. In October of the same year, it was selected for transformers that will be manufactured in Europe. Grain-oriented electrical steel was selected. This was the first order for JGreeX™ outside of Japan and its first use in electrical steel sheets.

Its application in shipbuilding is expanding. In December 2023, shipping company Kawasaki Kisen Kaisha, Ltd. selected JGreeX™ for an Ultramax dry bulk carrier*2 to be built by Imabari Shipbuilding Co., Ltd. (Photo 2). All steel materials*3 used in the construction of this vessel will be JGreeX™ products, making it one of the world's largest ships made entirely of green steel. JFE Steel expects to supply 7,000 tons of JGreeX™ products starting in 2024, and the vessel is slated for commissioning in 2026. Separately, shipping company Daiichi Chuo Kisen Kaisha selected JGreeX™ for two coastal dry bulkers to be built by Higaki Shipbuilding Co., Ltd., and based on this development, JFE Steel expects to supply 7,000 tons of JGreeX™ products between 2024 and 2026. All told, JGreeX™ has now been selected by five companies for a total of nine dry bulk vessels, bringing JFE Steel's total expected supply of JGreeX™ products to approximately 36,000 tons. In June 2024, the first bulk carrier built entirely with JGreeX™ was launched (Photo 3). A naming and launch ceremony was held at the headquarters of Higaki Shipbuilding Co., Ltd., with the ship receiving the name BRIGHT QUEEN. It is the world's first ship built entirely with green steel. This is the first of two bulk carriers that Higaki Shipbuilding is constructing for shipping company NYK Bulk & Projects Carriers Ltd. (NBP) and for which JGreeX™ was selected back in June 2023. The vessel is also expected to be the first to receive the a-EA (GRS)*5 designation, indicating a hull structure made of green steel materials, in accordance with new environmental guidelines*4 developed by ClassNK, a Japanese non-profit NGO engaged in ship classification and environmental protection.

In January 2024, JGreeX™ was selected for pinback buttons (can badges) produced and sold by MoNo Factory, marking the first use of JGreeX™ in consumer products as well as tin-plated steel. In February 2024, JFE Steel started selling JGreeX™ green steel to Hock Seng Hoe, a leading steel wholesaler in Singapore that wholesales steel plates for shipbuilding, construction and offshore structures in Southeast Asia. This marks the first sale of JGreeX™ to a Southeast Asian company. In June 2024, JGreeX™ was selected by the world leading manufacturer of IT data center transformers in the United States, marking the first application of JGreeX™ in that country. In July 2024, it was selected for use in resource-recycling containers (Photo 5: LOOPOX) and logistics warehouses (Photo 6: tentatively named Shin-Harumi Warehouse) , with additional applications expected.

Reduction of CO_2 throughout the supply chain is rapidly progressing. JFE Steel will contribute to the decarbonization of society by expanding its capacity for supplying JGreeX™ and further reducing CO_2 emissions through the use of advanced low-carbon technologies as well as energy-saving, high-efficiency technologies.

*1 Consolidate the environmental value of CO_2 emission reductions from the entire product manufacturing process, allocate the value to some steel products, and regard them as having low CO_2 emission intensity.
*2 Cargo ships that transport large quantities of dry cargo

*3 Steel products purchased directly by shipbuilding companies

➤*4 Environmental guidelines developed by ClassNK, a Japanese non-profit NGO
(https://www.classnk.or.jp/hp/ja/hp_news.aspx?id=10943&type=press_release)

*5 Advanced Environmental Awareness (GRS). The vessel is expected to receive this designation when it enters service in September 2024.

■ Photo 1

■ Photo 2

■ Photo 3

■ Photo 4

■ Photo 5

LOOPOX containers with removable and reusable JGreeX™ handles (410 x 340 x 200 mm; approx. 1.5 kg; load capacity: 30 kg)

■ Photo 6

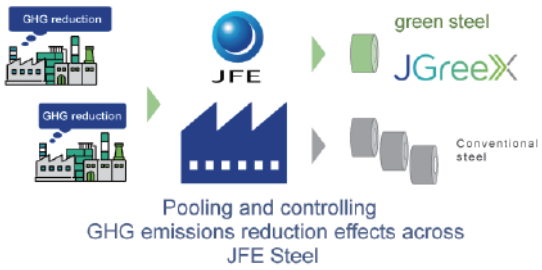
■JGreeX™ Adoption Status in Dry Bulk Carriers

	Shipping Company	Status	Related News Release
1	NYK Bulk & Projects Carriers, Ltd.	Launched in June 2024	June 20, 2023 Large Cargo Ships to be Made Exclusively with JFE Steel's JGreeX™ Green Steel (https://www.jfe-steel.co.jp/en/release/2023/230620-2.html)
2	NYK Bulk & Projects Carriers, Ltd.	—	
3	MOL Drybulk Ltd.	—	
4	Toko Kaiun Kaisha, Ltd.	—	
5	Kawasaki Kisen Kaisha, Ltd.	—	December 20, 2023 JFE Steel's JGreeX™ Green Steel Selected for Large Dry Bulk Carrier—Working with Shippers to Promote the Value of CO_2 Reduction (https://www.jfe-steel.co.jp/en/release/2023/231220.html)
6	Daiichi Chuo Kisen Kaisha	—	
7	Daiichi Chuo Kisen Kaisha	—	
8	NYK Bulk & Projects Carriers, Ltd.	—	
9	NYK Bulk & Projects Carriers, Ltd.	—	

■ Overview of green steel JGreeX™

Supply start	First half of FY2023
Supply capacity	Approx. 260,000 tons (FY2023)
Target products	All steel products produced by JFE Steel
Certification body	Nippon Kaiji Kyokai (ClassNK)

■ Overview of the steel mass balance approach



STEP.1
Calculate the emissions intensity of any steel product to apply this approach
STEP.2
Identify emissions reduction projects and determine their emissions reduction levels
STEP.3
Issue a reduction certificate based on the determined reduction level, grant the certificate, and supply steel materials.

*This certificate and the GHG emission reductions listed in this certificate do not represent carbon credits and cannot be transferred or sold to third parties.
*The scope of GHG emissions calculation is within the scope of Scope 1, Scope 2 and Scope 3.
*Reduction allocations are within the scope of Scope 1 and Scope 2.

Innovations toward Carbon Neutrality

We will work on developing carbon-recycling blast furnaces (CR blast furnaces), hydrogen steelmaking (direct reduction), and electric arc furnace process (high-efficiency, large-scale electric arc furnaces) in a multi-pronged approach to achieve carbon neutrality by 2050 as announced in the JFE Group Environmental Vision for 2050. We are particularly focused on a technology that combines a CR blast furnace and CCU, which allows us to efficiently mass produce high-grade steel and reuse the CO_2 in the blast furnace. This technology is focused on achieving virtually zero emissions by using the remaining CO_2, which cannot be fully reused to manufacture basic chemicals such as methanol.

Demonstration Tests for NEDO Project (GREINS) for Hydrogen Utilization in Iron and Steelmaking Processes

JFE Steel formed a consortium with Nippon Steel Corporation, Kobe Steel, Ltd., and the Japan Research and Development Center for Metals and jointly commissioned the Green Innovation Fund Project (GREINS) of the New Energy and Industrial Technology Development Organization (NEDO) for Hydrogen Utilization in Iron and Steelmaking Processes, and work toward achieving carbon neutrality by 2050.

In order to further advance the development of ultra-innovative technologies to achieve carbon neutrality by 2050, JFE Steel has decided to construct all the necessary facilities for the demonstration tests for the project centrally in the East Japan Works (Chiba district) to increase the efficiency of the development effort. We will work together with consortium members to accelerate the development of ultra-innovative technologies.

Details of the Planned Demonstration Tests
- Carbon-recycling pilot blast furnace (150m³)
  Start construction in 2023, start demonstration tests in April 2025, complete demonstration tests by 2026
- Direct reduction compact bench pilot furnace
  Start construction in 2023, start demonstration tests in the second half of 2024, complete demonstration tests by 2026
- Pilot electric arc furnace (10 t pilot furnace)
  Start construction in 2023, start demonstration tests in the second half of 2024, complete demonstration tests by 2025

Details for each are as follows.

Technical Features of a CR Blast Furnace

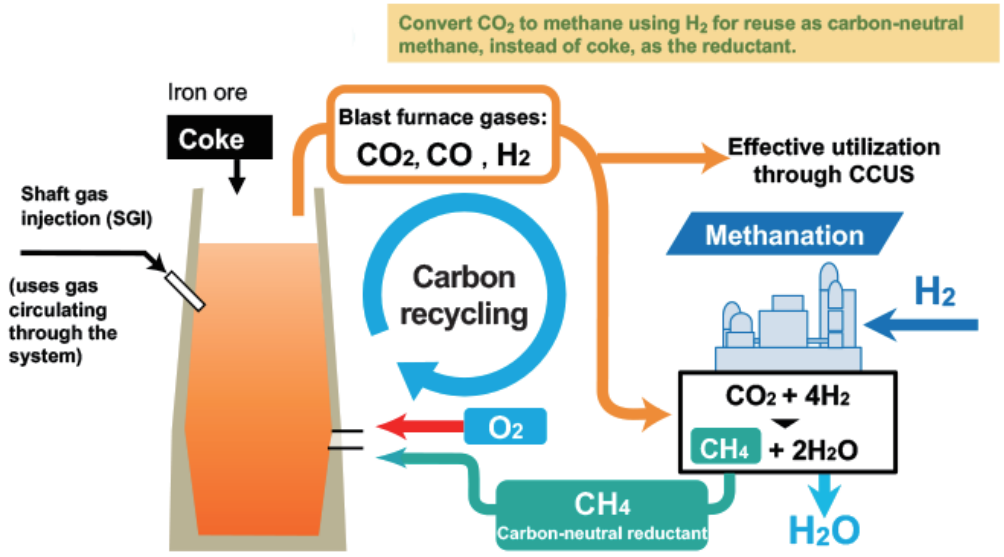
The CR blast furnace incorporates an ultra-innovative technology that converts CO_2 in the furnace exhaust gas into carbon-neutral methane through methanation, which is then reused as reducing material in the furnace. The technology is expected to reduce CO_2 by 50% in the blast furnace process and to ultimately help achieve carbon neutrality by leveraging CCU/CCUS. The thermal efficiency of the process can be further enhanced by replacing the air blown into the blast furnace with pure oxygen, as the energy used to heat the nitrogen in the air can then be used to heat methane. In addition, the lack of nitrogen facilitates the separation of CO_2, so the equipment necessary to separate CO_2 for methanation can be more compact and efficient while more effectively using gas at CCUS.

Overview of the Demonstration Tests

We are planning to develop a process that converts the CO_2 produced in the blast furnace into methane using hydrogen, allowing the carbon to be repeatedly used in the furnace as a reducing agent and thus reducing CO_2 emissions. We will verify the following during demonstration tests.

- Methods for blowing a large volume of methane along with oxygen into the furnace
- Applications for the heating burner that uses the circulation gas
- Methods for linking the operations of the furnace and the methanation facility that converts CO_2 from the blast furnace gases to methane

■ **Overview of Carbon-recycling Directs Furnaces**



Development of Direct Hydrogen Reduction Technology (Carbon-Recycling Direct Reduction Process)

Hydrogen reduction ironmaking technology is another steelmaking process that the JFE Group is working on to achieve carbon neutrality. With this technology, the natural gas currently used in direct reduction ironmaking is replaced by 100% hydrogen to eliminate CO_2 emissions when iron ore is reduced.

Technology for Processing Raw Materials

Currently, the only raw material that can be used for direct reduction ironmaking is high-grade iron ore. Its production volume, however, is limited, and we expect it will become even more difficult to obtain in the future if direct reduction ironmaking were to expand worldwide.

To address this, JFE and one of its iron ore suppliers, BHP, are collaborating in the development of a new raw material processing technology for low- and medium-grade ores, which are currently used as raw materials for blast furnaces due to their large production volume. We are hoping that this new technology will allow us to use low- and medium-grade ores as raw materials for direct reduction ironmaking, thus expanding the raw material sourcing for direct reduction ironmaking.

Technology for Pre-Heating Raw Materials, Technology for Heating Hydrogen Gas

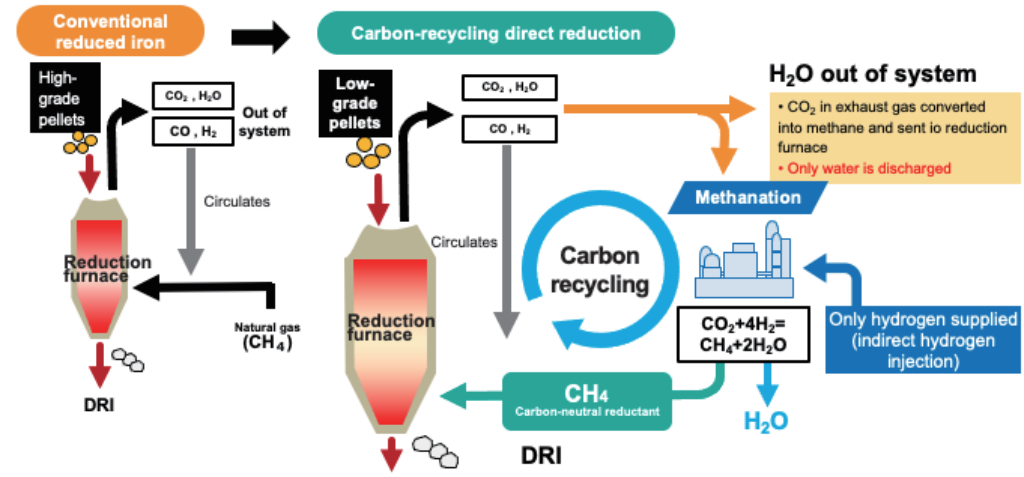
One challenge of hydrogen reduction is that the reduction of iron ore by hydrogen is an endothermic reaction, which means that heat must be applied externally for the reaction to proceed. A sufficient reduction reaction may not take place if there is not enough heat. Thus, technologies for heating raw materials and hydrogen gas must be developed.

Overview of the Demonstration Tests

We are developing a process to convert the CO_2 produced in the direct-reduction furnace into methane using hydrogen, allowing the carbon to be repeatedly used in the furnace as the reducing agent and thus reducing CO_2 emissions. We will verify the following during demonstration tests.

- Optimal methods for recycling CO_2 through methanation
- Methods for using low-grade ores

■ Carbon-Recycling Direct Reduction Process



Practical Applications of CO_2 Utilization Technologies

JFE Steel is working on the Optimum System for Methanol Synthesis Using CO_2, an R&D project, in collaboration with the Research Institute of Innovative Technology for the Earth (RITE) (Figure 1). On-site construction of a test facility commenced in FY2022 in the Fukuyama district of the West Japan Works, with operations scheduled to start in FY2023 and integrated practical application tests to be completed by the end of FY2025. The project focuses on establishing an optimal overall methanol synthetic system, mainly by developing technologies for low-cost CO_2 separation and high-efficiency methanol synthesis. The ultimate goal is to combine this newly established system with carbon-recycling blast furnaces and other ironmaking processes to achieve large-scale CCU process.

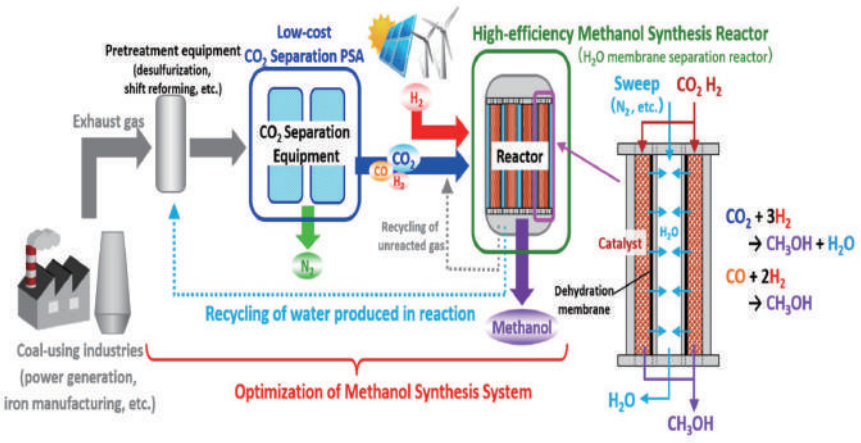
JFE Steel is also working on an R&D project, Innovative CO_2 Sequestration Technology through Quick, Large-quantity Carbonation of Steel Slag, in collaboration with Ehime University (Figure 2). Construction for a practical application test facility is scheduled to commence in FY2023 in the Chiba district of the East Japan Works. The process principles will be verified by FY2022, and tests will be conducted during the FY2024–FY2025 period. The project will develop a new technology to sequester the CO_2 generated from ironmaking processes such as carbon-recycling blast furnaces and from nearby thermal power plants in slag, and at the same time verify technologies for recovering heat after carbon sequestration and for converting the steel slag to roadbed materials and other products.

Japan Petroleum Exploration Co., Ltd. (JAPEX), JGC Holdings Corporation (JGC HD), Kawasaki Kisen Kaisha, Ltd. ("K" LINE), The Chugoku Electric Power Co., Inc. (EnerGia), Nippon Gas Line Co., Ltd. (NGL), and JFE Steel have agreed to jointly evaluate the establishment of a CCS (Carbon Capture and Storage)*1 value chain originated from Japan and concluded a Memorandum of Understanding (MOU). The six companies will conduct the joint evaluation, collaborating with the CCS commercialization project development, to establish the CCS value chain, from CO_2 separation and capture at JFE Steel's steelworks and EnerGia Group's power plant to marine transportation (including domestic marine transportation in the Setouchi area) of liquefied CO_2 to the receiving point(s) in Malaysia, including estimation of required facilities and costs.

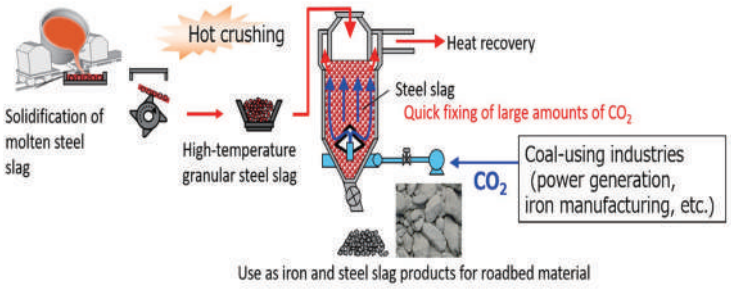
By executing the joint evaluation for the early commercialization of the CCS project, JAPEX, JGC HD, "K" LINE, JFE Steel, EnerGia, and NGL aim to contribute to realizing carbon neutrality by 2050, including the realization of a de-carbonized society in Asia targeted by the Asia Energy Transition Initiative (AETI)*2.

*1 A technology for capturing CO_2 from exhaust gases and storing it underground.
*2 The Japanese Government's initiative announced in May 2021 for simultaneously achieving sustainable economic growth and carbon neutrality in Asia.

■ Figure 1



■ Figure 2



➤ Development and Provision of Eco-friendly Processes and Products (P.135)

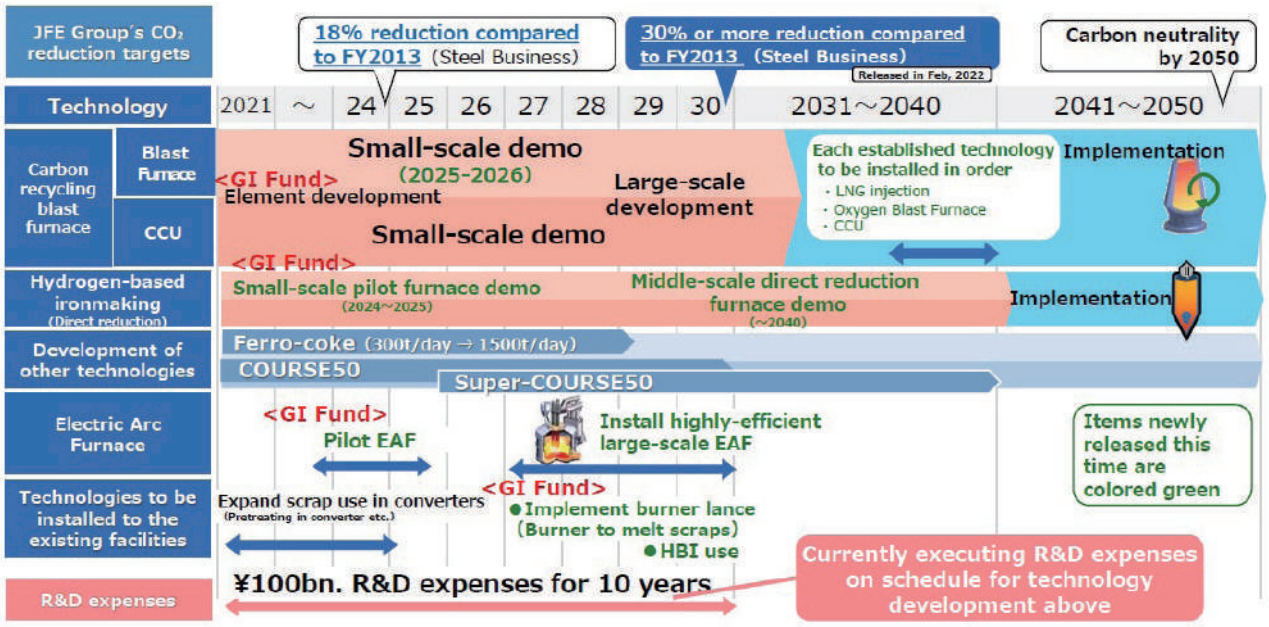
■ Related Products and Technologies

Reduce CO_2 Emissions at JFE Steel		
Carbon neutrality	Key Initiatives	JFE Steel Carbon Neutrality Strategy Briefing (https://www.jfe-steel.co.jp/en/company/pdf/carbon-neutral-strategy_220901_1.pdf)
		JFE Steel Challenge to Achieve Carbon Neutrality through Green Transformation (https://www.jfe-steel.co.jp/en/movie/#movie-gx)
	Demonstration tests	Demonstration Tests for NEDO's Hydrogen Utilization in Iron and Steelmaking Processes project (Japanese only) (https://www.jfe-steel.co.jp/release/2022/06/220615-2.html)
Green steel products	Begin supplying green steel products	JFE Steel to Begin Supplying JGreeX™ Green Steel (https://www.jfe-steel.co.jp/en/release/2023/230508-2.html)
	Adoption of green steel products	"JGreeX" Green Steel Selected by Sumitomo Corporation for its New Office Building in Tokyo – the first application in the real estate and construction industries (https://www.jfe-steel.co.jp/en/release/2023/231002.html)
		First Transformers Made with JGreeX™ Green Steel to be Produced in Europe (https://www.jfe-steel.co.jp/en/release/2023/231026.html)
		JGreeX™ Green Steel Selected for Large Dry Bulk Carrier - Working with Shippers to Promote the Value of CO_2 Reduction (https://www.jfe-steel.co.jp/en/release/2023/231220.html)
		MoNo Factory to Use JGreeX™ Green Steel to Produce Pinback Buttons (https://www.jfe-steel.co.jp/en/release/2024/01/240129.html)
		JFE Steel to Sell JGreeX™ to Singapore-based Steel Wholesaler Hock Seng Hoe (https://www.jfe-steel.co.jp/en/release/2024/02/240201.html)
		First Dry Bulk Carrier Made Entirely with JFE Steel's JGreeX™ Green Steel Launched (https://www.jfe-steel.co.jp/en/release/2024/06/240606.html)
		JGreeX™ Green Steel Selected by the world leading manufacturer of IT data center transformers in the U.S. (https://www.jfe-steel.co.jp/en/release/2024/06/240620.html)
		JGreeX™ Green Steel Selected for Use in Resource-recycling Containers (https://www.jfe-steel.co.jp/en/release/2024/07/240716.html)
		"JGreeX" Green Steel Selected for Construction of New Logistics Warehouse - First application in Japan's Hokkaido region (https://www.jfe-steel.co.jp/en/release/2024/07/240723.html)

Reduce CO_2 Emissions at JFE Steel		
Carbon-recycling blast furnace	Carbon-recycling blast furnace technology	JFE Steel Carbon Neutrality Strategy Briefing: Reducing CO_2 via CR Blast Furnaces (https://www.jfe-steel.co.jp/en/company/pdf/carbon-neutral-strategy_231108_1.pdf)
		Challenge Zero: Challenge for development of super-innovative technologies focusing on Carbon-recycling Blast Furnace+CCU (https://www.challenge-zero.jp/en/casestudy/812)
	CCU/CCUS	Challenge Zero: Technology of CO_2 utilization (https://www.challenge-zero.jp/en/casestudy/391)
New technology to process raw materials for hydrogen reduction ironmaking	Development of technology for direct hydrogen reduction	JFE Steel Carbon Neutrality Strategy Briefing: Direct Hydrogen Reduction (https://www.jfe-steel.co.jp/en/company/pdf/carbon-neutral-strategy_231108_1.pdf)
	Collaboration with a material supplier	JFE Steels and BHP to address decarbonization in steelmaking process (https://www.jfe-steel.co.jp/en/release/2021/210210.html)
Expanded use of scrap and reduced iron	Eco-friendly converter-type molten iron pretreatment process DRP™	Increased Use of Scrap Iron in Steelmaking Process to Reduce CO_2 Emissions (https://www.jfe-steel.co.jp/en/release/2022/220621.html)
	Feasibility study on new venture business to secure reduced iron supply	Feasibility Study on Building a Supply Chain of Reduced Iron with Low Carbon Emissions (https://www.jfe-steel.co.jp/en/release/2022/220901.html)
		Collaboration to Establish a Supply Chain of Ferrous Raw Material with Low Carbon Emissions (https://www.jfe-steel.co.jp/en/release/2023/230718.html)
	Development of electric arc furnace process technology	JFE Steel Carbon Neutrality Strategy Briefing: Large, High-efficiency EAFs (https://www.jfe-steel.co.jp/en/company/pdf/carbon-neutral-strategy_231108_1.pdf)
	Adoption of electric arc furnace process technology	JFE Steel's Chiba District Facility to Produce Stainless Steel with Electric-arc Furnace (https://www.jfe-steel.co.jp/en/release/2023/230508-1.html)
CO_2 utilization and storage technology	CO_2 utilization technology	Novel Processes for Manufacturing Valuable Materials Using Coal-Derived CO_2 Selected for NEDO Projects (https://www.jfe-steel.co.jp/en/release/2021/211015.html)
	Testing for practical use	JFE Steel Moves Ahead with Testing CO_2-utilization Technologies Aimed at Achieving Carbon Neutrality (https://www.jfe-steel.co.jp/en/release/2022/220620-2.html)

Reduce CO_2 Emissions at JFE Steel		
CO_2 utilization and storage technology	Establish CCS value chain	Agreed on Joint Evaluation with JFE Steel Corporation to Establish CCS Value Chain Originated from Japan Aligned with CCS Study in Malaysia (https://www.jfe-steel.co.jp/en/release/2023/230619.html)
		KEPCO and JFE Steel signed a MOU to jointly study possible CCS Projects (https://www.jfe-steel.co.jp/en/release/2023/231019.html)
		The Chugoku Electric Power and Nippon Gas Line Participate in the Joint Evaluation to Establish CCS Value Chain Originated from Japan for the CCS Project in Malaysia (https://www.jfe-steel.co.jp/en/release/2024/02/240226.html)

■ Roadmap to Carbon Neutrality in 2050



Source: Material for the JFE Group's investors' meeting held on May 6

➤ Seventh Medium-term Business Plan (P.22)

➤ JFE Group Environmental Vision for 2050, Presentation Material
(https://www.jfe-holdings.co.jp/en/common/pdf/investor/climate/2021-210525-release01.pdf)

Expand Contributions to CO_2 Emissions Reduction in Society

The JFE Group promotes various initiatives to reduce CO_2, mainly through JFE Engineering's businesses. Furthermore, in areas where demand is expanding, such as electrical steel sheets, we are working with the relevant operating companies to maximize the effectiveness of these initiatives.

Contribution to CO_2 Reduction through our Engineering Business

Demand is expected to rise for power generation plants using renewable energy sources that do not emit carbon. Through JFE Engineering, the JFE Group is handling the design, procurement, construction, and operation of various renewable energy generation plants including biomass, geothermal, solar, and onshore wind power. We are also working to increase the amount of power generated at waste treatment facilities in order to promote recycling and the effective use of resources.

Furthermore, we are actively engaged in the retailing of electricity, which uses these renewable energies as the main power source, supporting the establishment and operation of new regional electricity companies that focus on local production and consumption of energy using renewable sources, and in expanding the Multisite Energy Total Service (JFE-METS), which optimizes energy use for multiple sites within the same corporate group through centralized management.

As new initiatives for carbon neutrality, we are developing a technology to safely and efficiently transport large amounts of hydrogen, ammonia, and CO_2, and working on demonstrating a process that separates and collects CO_2 for reuse from the exhaust gas of waste treatment facilities.

As new initiatives for material recycling, we are working on bottle-to-bottle, an effort through which collected PET bottles are recycled and used as raw material for bottles, and the recycling of solar panels that are discarded due to age-related deterioration.

These will contribute to reducing CO_2 emissions in society by 12 million tonnes by FY2024 and 25 million tonnes by FY2030.

The following key initiatives contributed to CO_2 reduction in FY2023.

Large-Scale Biomass Power Generation

Started construction work for the Tahara Biomass Power Plant, one of the largest woody biomass combustion power plants in Japan, with an output of 112,000 kW.

Tahara Biomass Power LLC, a joint venture between JFE Engineering Corporation, Chubu Electric Power Co., Inc., Toho Gas Co., Ltd., and Tokyo Century Corporation, has started construction work on the Tahara Biomass Power Plant. The plant, to be constructed in Tahara, Aichi Prefecture, is one of the largest woody biomass power plants in Japan, with an output of 112,000 kW, and is scheduled to start operations in September 2025.

Food Waste Recycling Power Generation

Construction of a new food waste recycling biogas power generation plant in Fukuoka, Fukuoka Prefecture: J&T Recycling's first food recycling business in Kyushu.

J&T Recycling Co., a subsidiary of JFE Engineering, and Kankyou Agency have jointly established Fukuoka Bio Food Recycle Co. Ltd. in Fukuoka City to engage in the food waste recycling and biogas power generation business, in which food waste is collected and fermented to produce methane gas, which is then used as fuel to generate power. The plant to be built for the project will accept up to 100 tonnes of food waste per day and generate electricity using methane gas produced by microbial fermentation as fuel (output: 1,560 kW, estimated annual generation: approx. 12,000 MWh). The project will also support the secondary use of fermented sludge and digested liquid generated in the treatment process on nearby agricultural land.

We have other projects for expanding our food waste power generation businesses throughout Japan, including Tohoku Bio Food Recycle Corporation, which is started its food waste power generation in Sendai in May 2022, and Sapporo Bio Food Recycle Corporation in Sapporo, which is constructing a new plant to expand its capacity.

Multisite Energy Total Service (JFE-METS)

The House Foods Group has agreed to adopt the Multisite Energy Total Service at 18 sites across 8 group companies, driving CO_2 reduction.

JFE Engineering has signed a basic agreement with House Foods Group Inc. to provide JFE-METS. We will install a gas cogeneration system at the House Foods Shizuoka Plant and use JFE-METS to supply surplus electricity from the system and electricity provisioned by the JFE Group to 18 sites across 8 companies in the House Foods Group nationwide. The service is expected to reduce CO_2 emissions by approximately 16.3% and energy consumption by approximately 21.5% (compared to FY2022) at these sites. Operations commenced in April 2024.

CCUS

Contract received for the construction of CO_2 liquefaction, storage and loading/unloading facilities, a large-scale, long-distance, lower cost transportation system for liquid CO_2 to realize a CCUS society.

JFE Engineering has received an order from Japan CCS Co., Ltd. to construct its CO_2 liquefaction, storage, and loading/unloading facilities (EPC project). The EPC project is aimed at constructing part of the facilities to be used in the NEDO project: Research, Development and Demonstration of CCUS Technology / Large-scale CCUS demonstration testing at Tomakomai / Demonstration testing on CO_2 Transportation. We will be involved in the design and construction of onshore facilities capable of liquefying and storing 10,000 tonnes per year of CO_2 separated and recovered from coal combustion gas supplied by the Maizuru plant of Kansai Electric Power Co.

PET Bottle Recycling (Bottle-to-Bottle)

Kyoei J&T Recycling Corporation's West Japan PET Bottle MR Center to start full commercial operation.

Kyoei J&T Recycling, a subsidiary of JFE Engineering, after starting the operations of the flake manufacturing plant in October 2021, has completed the construction of the pellet production line and started full-scale commercial operations at the PET bottle recycling raw material manufacturing plant (West Japan PET Bottle MR center) in Tsu, Mie Prefecture. With an annual processing capacity of 60,000 tonnes (approximately 10 million bottles per day), the plant can recycle approximately 10% of the total number of PET bottles shipped nationwide.

By producing flakes and pellets from used PET bottles and supplying them to bottle manufacturers, we contribute to the production of plastic bottles using 100% recycled materials, which generates 63% less CO_2 than the production of crude oil-derived pellets.

Contribute to CO_2 Reduction through Group Collaboration

The JFE Group leverages the respective strengths of each operating company and maximizes their synergies by linking projects. Three main projects being implemented through Group collaboration are: (1) initiatives related to the electrical steel sheet strategy, (2) initiatives in the Keihin waterfront areas, and (3) initiatives in the offshore wind power generation business. We will contribute to CO_2 reduction and carbon neutrality by developing projects that combine the technologies and know-how of each company.

Electrical Steel Sheets Strategy

Electrical steel sheets are widely used as core materials for electrical equipment such as motors and transformers and therefore play an important role in determining the performance of this electrical equipment. JFE Steel is contributing to reducing CO_2 emissions on a global scale by supplying high-performance electrical steel sheets.

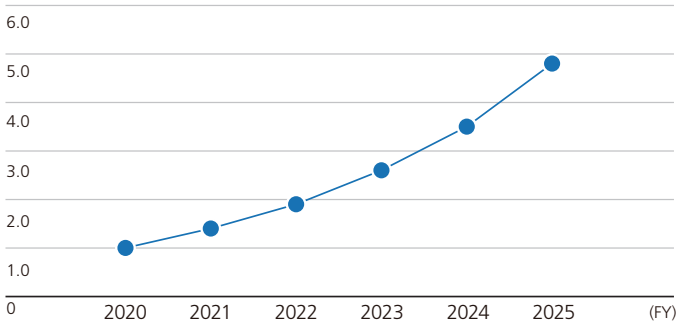
Non-Oriented Electrical Steel Sheets—Expand and Strengthen Production Capacity at the West Japan Works (Kurashiki District)

In order to achieve carbon neutrality for society as a whole, a major shift is required in the social structure, from a society that relies on fossil fuels for energy to one that primarily uses carbon-free energy sources. Transitioning to a future society in which electric vehicles (EVs) are the main mobility platform and where zero-emission electricity is the main energy source will depend on highly efficient motors, for which the key materials are high-performance, non-oriented electrical steel sheets.

Our high-grade non-oriented electrical steel sheets improve the performance of EV motors. Their excellent low iron loss property contributes to higher efficiency, while their high magnetic flux density supports downsizing. These characteristics are highly regarded, and many automobile manufacturers use them in products. Demand for such high-grade non-oriented electrical steel sheets is expected to grow rapidly, and to meet this demand, we are investing approximately 49 billion yen at the West Japan Works (Kurashiki district) to double its production capacity in the first half of FY2024.

Furthermore, as the shift toward EVs accelerates, we expect the demand for high-grade non-oriented electrical steel sheets to grow even more rapidly. We have therefore decided to further strengthen the production capacity high-grade non-oriented electrical steel sheets at the West Japan Works (Kurashiki district). Furthermore, we plan to make an additional investment of approximately 46 billion yen to triple the manufacturing capacity of high-grade non-oriented electrical steel sheets for EV main motors by the end of FY2026 (including the effect of the investment already made).

■ Demand for Non-Oriented Electrical Steel Sheets (Calculated by JFE, 2020 results = 1.0)



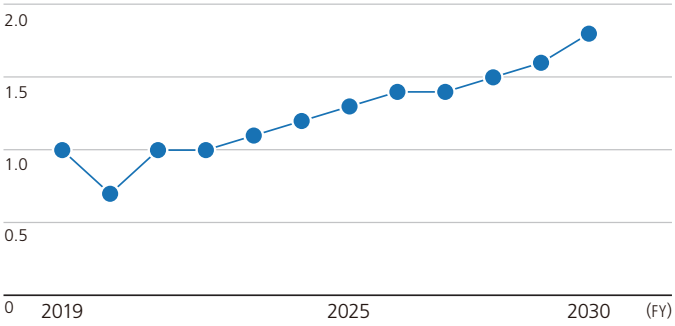
Grain-Oriented Electrical Steel Sheets—Establish a Joint Venture Company with JSW

The global demand for grain-oriented electrical steel sheets in transformers is expected to increase due to continuously growing demand for electric power and the expanding adoption of renewable energy. The demand for grain-oriented electrical steel sheets, particularly in India, is expected to increase by 1.8 times in 2030, compared to 2019.

To this end, in August 2023, JFE Steel and JSW Steel Limited (JSW) signed an agreement to establish a grain-oriented electrical steel sheet manufacturing joint venture company, JSW JFE Electrical Steel Private Limited. We will work with JSW to establish an integrated manufacturing system for this type of steel sheet in India. By locally manufacturing a full line-up of mainly high-grade, energy-efficient grain-oriented electrical steel sheets, in which JFE Steel has accumulated expertise over many years, the joint venture will contribute to the development of a greener power transmission and distribution infrastructure in India and to the remarkable growth of the Indian economy.

The total investment between the two companies is planned to be 670 million dollars, and we plan to begin full production in FY2027.

■ Demand for Grain-Oriented Electrical Steel Sheets in India (Calculated by JFE, 2019 results = 1.0)



Signed an agreement to establish a grain-oriented electrical steel sheet manufacturing joint venture company

Further Expanding the Global Supply Chain for the Steel Sheets Business (JFE Shoji)

The key factor in initiatives for countering climate change, including those for reducing CO_2 emissions, is minimizing electricity loss and using generated electricity without loss. Motors found in places such as power plants, factories and homes are responsible for 40–50% of all electricity consumed globally. In Japan, the ratio is approximately 55%. Improving the efficiency of motors by 1% in Japan would contribute to the equivalent of a 500,000 kW-class power generation plant in energy savings. Motors for electric vehicles, which are expected to become increasingly popular as we move toward a decarbonized society, and industrial motors that are essential for factory automation, need to become even more efficient and lighter through downsizing. In addition, continuous improvement in efficiency is required in transformers, which are essential for distributing electricity from source to factories and homes, in order to minimize energy loss in power transmission and distribution.

JFE Shoji has established a stable global supply chain that includes sourcing high-quality electrical steel sheets which are essential for improving the efficiency of motors and transformers from JFE Steel and other manufacturers and processing the products for meeting customer needs. Customers who require high-quality electrical steel sheets, such as manufacturers of motors and transformers, typically operate manufacturing facilities across the globe. To align with this trend, the company has been working to expand its electrical steel sheets supply chain bases in Japan, America, China, and ASEAN, and recently it has also established a new processing base in Serbia with the aim of starting operations in FY2025. JFE Shoji will continue to take actions to capture demand, such as by reinforcing its stamping facilities at locations in and outside Japan to establish the world's number one global distribution and processing system for high-quality electrical steel sheets. By further expanding its supply chain and processing capabilities and collaborations with alliance companies, JFE Shoji is striving to significantly improve the distribution and processing of electrical steel sheets.

■ Related Products and Technologies

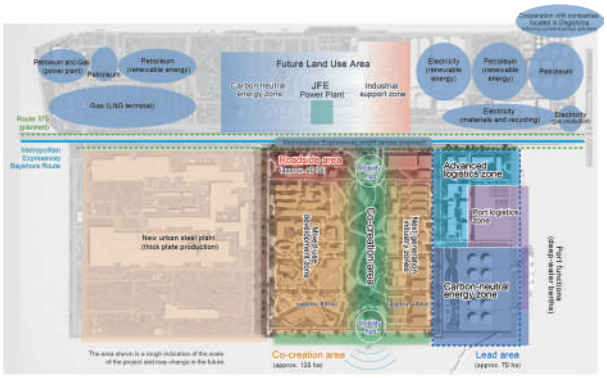
Expand contributions to CO_2 emissions reduction in society		
Contribution to CO_2 Reduction through the Engineering Business	Large-scale biomass power generation	Started Construction Work for the Tahara Biomass Power Plant, One of the Largest Woody Biomass Combustion Power Plants in Japan, with an Output of 112,000 kW (Japanese only) (https://www.jfe-eng.co.jp/news/2022/20220601.html)
	New regional electricity	Regional Electricity Retail Businesses in Partnership with the Local Municipal Governments Establishing New Regional Electricity Businesses (FY2022 CSR, P. 116) (https://www.jfe-holdings.co.jp/en/common/pdf/sustainability/data/2022/csr2022e.pdf)
	Multisite energy total service	House Foods Group Has Agreed to Adopt Multisite Energy Total Service at 17 Sites across 8 Group Companies: Driving CO_2 Reduction (Japanese only) (https://www.jfe-eng.co.jp/news/2022/20220926.html)
	Food waste recycling	Food Waste Recycling Business (FY2022 CSR, P. 115) (https://www.jfe-holdings.co.jp/en/common/pdf/sustainability/data/2022/csr2022e.pdf)
		Construction of a New Food Waste Recycling Biogas Power Generation Plant in Fukuoka, Fukuoka Prefecture: J&T Recycling's First Establishment of Food Recycling Business in Kyushu (Japanese only) (https://www.jfe-eng.co.jp/news/2022/20220401.html)
	Carbon-neutral world	Contribution to Creating a Carbon-Neutral World Through the Transport of Hydrogen and CO_2 (FY2022 CSR, P. 114) (https://www.jfe-holdings.co.jp/en/common/pdf/sustainability/data/2022/csr2022e.pdf)
		Contract Received for the Construction of CO_2 Liquefaction, Storage and Loading/Unloading Facilities—a Large-Scale, Long-Distance, Lower Cost Transportation System for Liquid CO_2 to Realize a CCUS Society (Japanese only) (https://www.jfe-eng.co.jp/news/2023/20230111.html)
	PET bottle recycling	Kyoei J&T Recycling Corporation's West Japan PET Bottle MR Center to Start Full-Scale Commercial Operations (Japanese only) (https://www.jfe-eng.co.jp/news/2022/20220421.html)

Expand contributions to CO_2 emissions reduction in society		
Electrical steel sheets	JNRF™	JFE Steel Develops JNRF™ Silicon-Gradient Steel Sheet for High-Speed Motors—Minimizes High-Frequency Iron Loss And Improves High Magnetic Flux Density (https://www.jfe-steel.co.jp/en/release/2020/201203.html)
	Facility expansion	JFE Steel to Expand Electrical Steel Sheet Production Capacity at Kurashiki Facility (https://www.jfe-steel.co.jp/en/release/2021/210401.html)
		JFE Steel Formally Decides to Further Expand Electrical Steel Sheet Capacity of the Kurashiki facility (https://www.jfe-steel.co.jp/en/release/2023/230522-1.html)
	Supply chain for electrical steel sheets	JFE Steel & JSW Steel Proposes Grain-Oriented Steel Sheet Manufacturing JV in India (https://www.jfe-steel.co.jp/en/release/2021/210507.html)
		About the Basic Agreement to Establish a Joint Venture Company in India to Manufacture Grain-Oriented Electrical Steel with JSW Steel Limited (https://www.jfe-steel.co.jp/en/release/2023/230522-2.html)
		About the Joint Venture Agreement to Establish a Joint Venture Company in India to Manufacture Grain-Oriented Electrical Steel with JSW Steel Limited (https://www.jfe-steel.co.jp/en/release/2023/230803-2.html)
		Establish a Global Supply Chain in Electrical Steel Sheet Business (https://www.jfe-holdings.co.jp/en/sustainability/environment/product/#pro_ global_supply)
High Tensile Strength Steel Sheets (HITEN) for automobiles	Development of high tensile strength steel sheets for automobiles	JFE Steel and thyssenkrupp Steel Europe Launch High-tensile Steel Sheets Capable of Cold Forming for Use in Automobile Frames (https://www.jfe-steel.co.jp/en/release/2022/220404.html)
		JFE Steel 1.5 GPa-Grade High-Tensile Strength Cold-Rolled Steel Sheets Adopted for First Time in Vehicle Body Structural Parts (https://www.jfe-steel.co.jp/en/release/2020/201223.html)

Initiatives for Achieving Carbon Neutrality in the Keihin Waterfront Areas

JFE Holdings has released OHGISHIMA 2025 , the JFE Group's conceptual plan for the reuse of land currently occupied by JFE Steel's East Japan Works (Keihin District), following the suspension of blast furnace operations and other upstream processes there, and in accordance with Kawasaki City's land use policy. The concept is to create fields of innovation and enterprise that will address the complex challenges involved in the pursuit of carbon neutrality. Through implementation of its OHGISHIMA 2050 plan, the JFE Group aims to convert the land for use on projects that will offer significant public benefit and help address some of the key challenges Japan faces. By attracting new industries and creating jobs that will benefit the country over the next 100 years, the JFE Group hopes to contribute to the sustainable development of local communities and society as a whole.

Artist's impression of the Ohgishima district as envisioned in 2050



Land use zoning in Ohgishima

Initiatives for Developing a Hydrogen Supply Hub in the Carbon-Neutral Energy Zone

The Lead Area of the Ohgishima district has been designated as a Carbon-neutral Energy Zone, where hydrogen supply facilities will be deployed. Dramatically improved access to these facilities will support carbon neutrality and innovation across the entire district.

Since April 2022, JFE Holdings, ENEOS Corporation, and JERA Co., Inc. are conducting a joint study on establishing a hydrogen and ammonia receiving and supply base. As part of this effort, we are considering using the deep-water wharves and adjacent land areas of the Ohgishima district. In March 2023, the Kawasaki waterfront area was selected as a candidate site for receiving liquefied hydrogen for the Liquefied Hydrogen Supply Chain Commercialization Demonstration Project, a joint initiative by Japan Suiso Energy Ltd. and ENEOS Corporation that is part of NEDO's Green Innovation Fund Project: Large-scale Hydrogen Supply Chain Establishment. The three companies have been actively exchanging information, and on July 2024, JFE Steel and Japan Suiso Energy Ltd. signed a land-lease agreement to initiate the necessary construction work in preparation for starting the commercialization demonstration in FY2028.

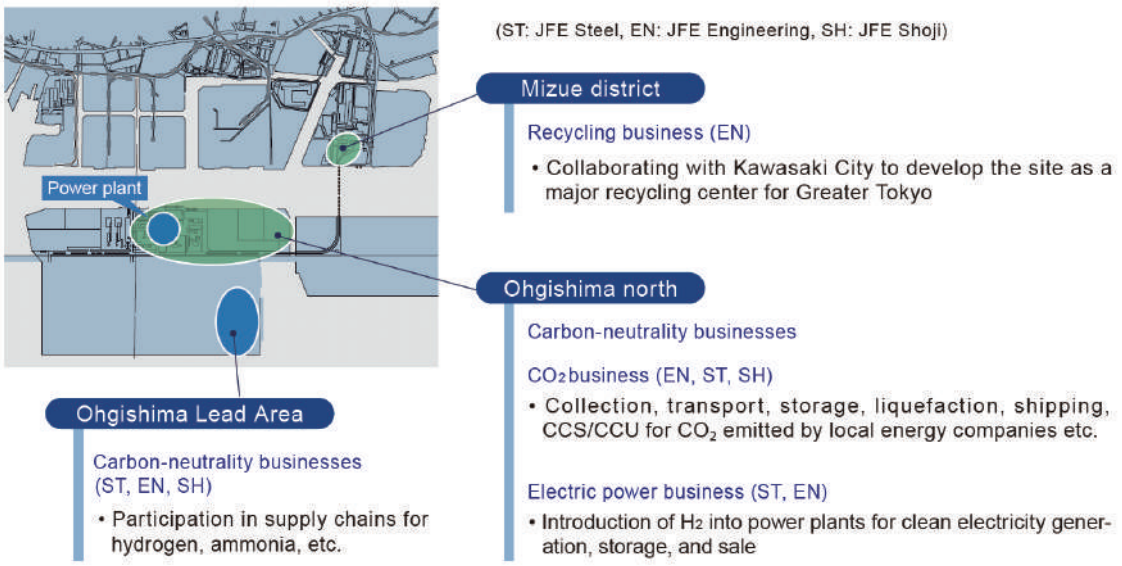
The JFE Group intends to play a role in building a stable and economical supply chain for hydrogen and other decarbonized fuels, starting with Ohgishima, and to contribute to realizing carbon neutrality in the Keihin waterfront areas and for society as a whole.

Signed a land-lease agreement with Japan Suiso Energy Ltd.

Initiatives for Developing a Recycling Hub in the Mizue District

In order to promote the sustainable development of the Keihin waterfront areas, the JFE Group is focused on comprehensive land management, encompassing site sales, leasing, and business use. In the Mizue district, we are collaborating with Kawasaki City to develop the site as a major recycling hub for the Greater Tokyo region. JFE Engineering's group company J&T Recycling Corporation established J-Circular System Co., Ltd. as a pioneering project with JR East and other companies, and in April 2024 it started constructing the J Circular System Kawasaki Super Sorting Center, a plastic recycling facility that will be one of the largest in the Greater Tokyo area. The facility is scheduled to begin full-scale operations in April 2025.

■ Land management target areas in the Keihin waterfront areas



Accelerate Group-Wide Commercialization of the Offshore Wind Power Business

Offshore wind power generation is a key initiative of the Japanese government's Green Growth Strategy to achieve carbon neutrality by 2050. We will participate in this effort by leveraging the Group's collective strength with our engineering business acting as the main driver. Specifically, the Group will work on commercializing the manufacturing and O&M* of foundation structures (monopiles, jackets) in addition to establishing a supply chain encompassing material procurement, manufacturing, and O&M. We anticipate this will significantly contribute to the JFE Group's efforts to achieve carbon neutrality as well as the government's strategy to achieve carbon neutrality.

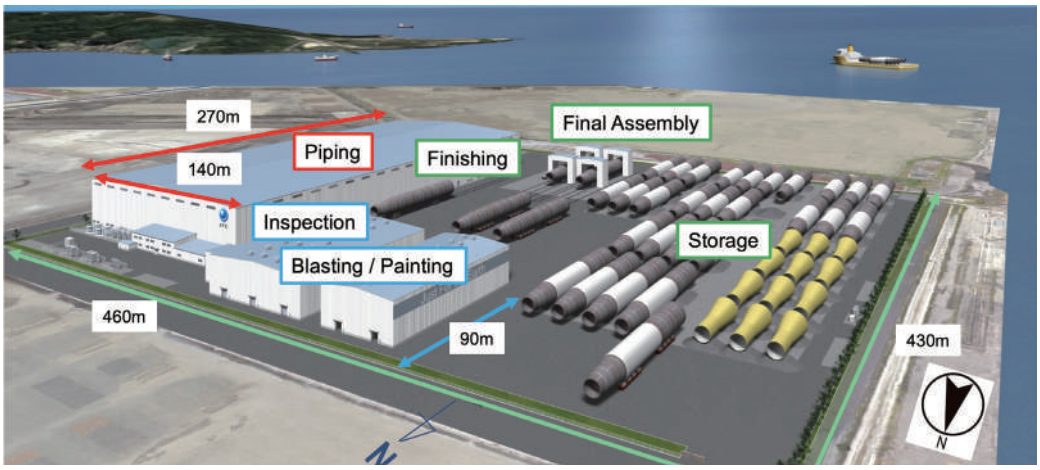
*Operation and maintenance

JFE Engineering Construction of Monopile Manufacturing Base Completed

JFE Engineering has completed construction of the monopile manufacturing plant in Kasaoka, Okayama Prefecture and operations commenced in April 2024. Monopiles are the foundational structural components for offshore wind power generation and are extremely large steel structures, approximately 10 m in diameter, 100 mm thick, and 100 m long. The plant is the only one in Japan capable of manufacturing such large structures. It was designed for production efficiency, implementing manufacturing processes based on the experiences gained in the manufacturing of large steel structures at the Tsu Works. The plant site includes extensive grounds and a quay from which manufactured structures can be directly shipped, as well as state-of-the-art equipment such as large-diameter bending machines and welding machines for extra-thick plates. When operating at full capacity, the plant is capable of manufacturing up to 100,000 tonnes annually, and it is expected to significantly contribute to the establishment of a domestic supply chain in the offshore wind power generation business and to the realization of carbon neutrality.

■ Overview of New Monopile Manufacturing Plant (Kasaoka)

Construction site	Kasaoka City, Okayama Prefecture (JFE Steel West Japan Works Fukuyama area)	Investment amount	Approximately 40 billion yen* (plant building, mechanical equipment, quay reinforcement) *Includes the facility reinforcement cost of the Tsu Works.
Construction start	June 2022	Site area	Approximately 20 ha (includes storage area)
Operation start	April 2024	Production capacity	Approximately 80,000–100,000 tonnes per year (Approx. 50 sets)
Length of shipping quay	200 m (quay total length: 400 m)	Quay depth	–11 m



Monopile manufacturing plant during its construction (May 2023)

JFE Steel

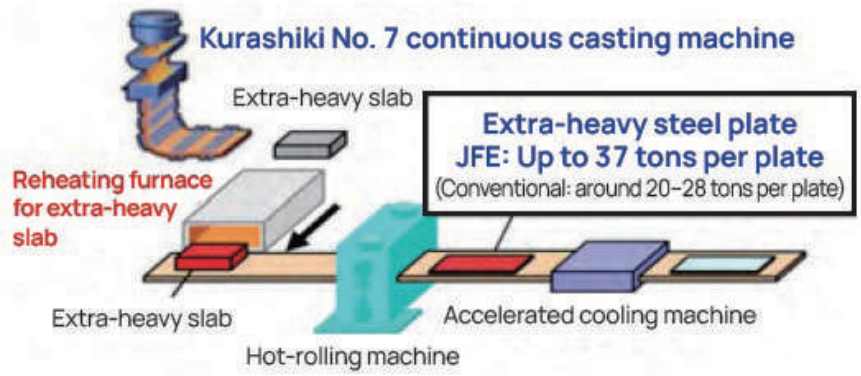
Large and Heavy Steel Plates for Offshore Wind Power Generation

The large and heavy steel plate J-TerraPlate™, produced with the No. 7 continuous caster of the Kurashiki Plant at the JFE Steel's West Japan Works, has been selected for the first time for the production of monopile foundations for offshore wind power generation.

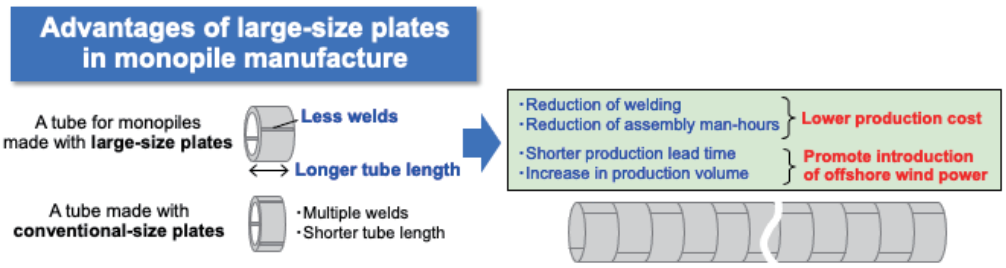
Offshore wind turbines have recently grown in size, requiring larger monopiles and other foundational structures to support them. The monopiles are manufactured by welding ultra-thick steel plates, resulting in increased welding workloads that require monopile manufacturers to improve the efficiency of the operations. Using larger and heavier steel plates makes it possible to reduce the volume of welding operations, compared to conventional small-size plates, and also helps to raise process efficiency while lower manufacturing costs.

We have been investing in equipment at the plate mills and other facilities to manufacture and supply steel plates of up to 37 tonnes (previously limited to around 20 to 28 tonnes per plate in general), the largest in Asia and capable of supporting wind turbines in harsh offshore environments over the long term and in large quantities using the extra-large slabs produced with the state-of-the-art No. 7 continuous casting machine. These investments have resulted in the first-time adoption of this product for the production of monopile foundations.

■ Manufacturing Process of Large and Heavy Steel Plates for Offshore Wind Power Generation

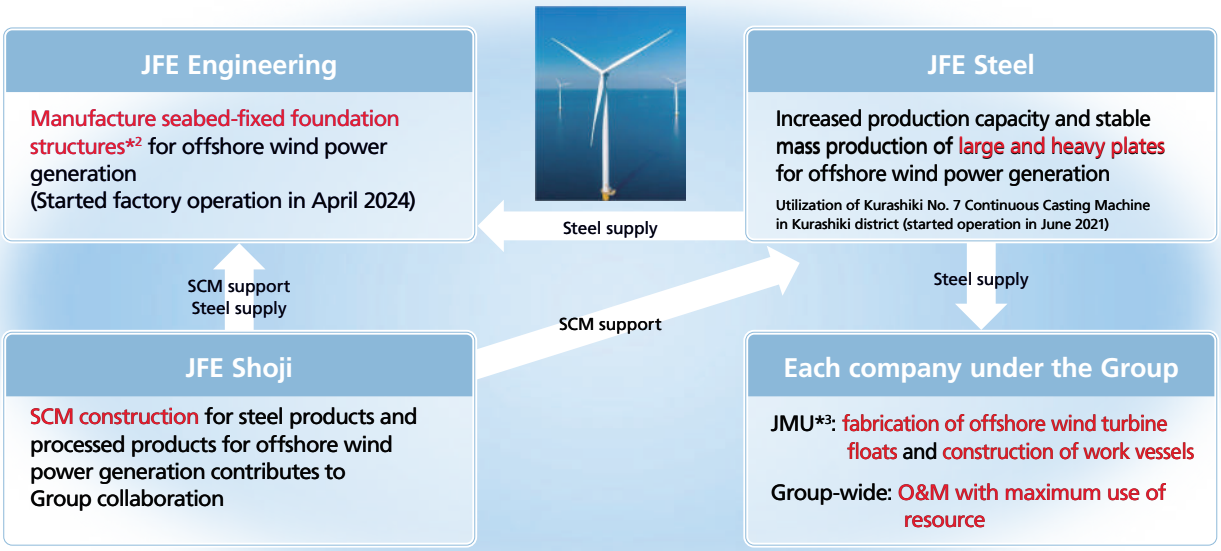


■ Advantages of Using Large and Heavy Steel Plates for Monopiles



■ Commercialization of Offshore Wind-Power Business

- By commercializing our manufacturing of foundation structures (monopiles), we will become the forerunner in the business of offshore wind-power generation and establish a supply chain across the entire Group, including foundation manufacturing and O&M.*1
- We will strive to expand business in the field of renewable energy by leveraging the JFE Group's collective strengths (synergies), with JFE Engineering as the main player.



*1 Operation and maintenance. Apply expertise of maintenance and analysis technologies.
*2 Seabed-fixed foundation structures: monopiles, jackets, etc.
*3 Japan Marin United Corporation (equity method affiliate)

■ Technologies of Group Companies

Category	Company	Details
Foundation structures	JFE Engineering	Seabed foundations (monopiles, jackets, etc.)
	Japan Marine United	Floating foundations (semi-submersible)
	JFE Steel	High-quality, large and heavy steel plates, high-strength steel (reduced using HBL series steel plates)
Construction	Japan Marine United	SEP vessels (self-elevating platform)
	JFE Engineering	JFE-RAPID (cable laying method)
		Battery systems for power storage
	GECOSS	Stands for large steel structures
	JFE Steel	Natural stone substitute materials (use of steel slags)
O&M (operation and maintenance)	JFE Engineering	Technologies for remote monitoring and operation
	JFE Advantech	Vibration measurement equipment and systems, sea monitoring tools (water quality, sea conditions)
	Japan Marine United	Offshore support vessels (work vessels)
	JFE Plant Engineering	Wind turbine maintenance (diagnosis and repair)
	JFE Technos	Technologies and expertise in planning, constructing, and maintaining onshore turbines
	JFE Techno-Research	Equipment evaluation and analysis for corrosion, fatigue, vibration, etc., diagnosis of remaining service life, strength and durability testing and evaluation techniques for large structures
Supply chain	JFE Shoji	Contribution to optimizing offshore wind power generation project execution

JFE Shoji

Building a Supply Chain for the Offshore Wind Power Generation Industry

Initiatives toward carbon neutrality are expanding around the world to tackle the shared issue of climate change. Japan has set its goal to achieve carbon neutrality by 2050 and formulated the Sixth Strategic Energy Plan in 2021 to lay out strategies to that end. These ambitious strategies include reducing greenhouse gas emissions by 46% in FY2030, boosting renewable energy in its electricity mix to 36–38%, and increasing the ratio of wind in the renewable energy mix to 5% (generating capacity of 23.6 GW) compared to the 0.9% (generating capacity of 4.5 GW) in FY2019.

As for offshore wind power generation, the industry is planning projects that will achieve 10 GW capacity by 2030 and 30–45 GW by 2040. Steadfast efforts are also being made to adopt a large number of internationally competitive technologies, such as the adoption of a demonstration project for a floating offshore wind power generation system under the Green Innovation Fund.

JFE Shoji is collaborating with a local enterprise that manufactures the windmill foundations in Taiwan, which is leading in the offshore wind power generation market, and have been achieving progress regarding supply chain of steel materials for foundation structures. Looking ahead, the company will capitalize on the knowledge acquired and contribute to the realization of carbon neutrality by establishing a supply chain that supports the domestic production of goods and the local economy while also meeting customer demand in the offshore wind power generation industry in Japan.

Adapting to Climate Change (Contribution to Achieving Societal Resilience)

Contributions to Disaster Prevention and Mitigation and Increased National Resilience

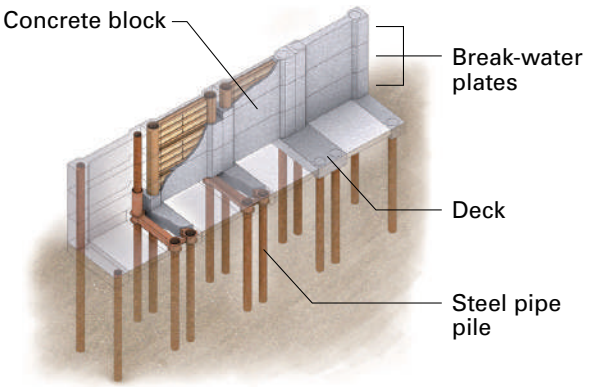
The JFE Group is not only focused on reducing CO_2 emissions (climate change mitigation); we also intend to contribute to the resilience of society in general by adapting to climate change.

With infrastructure such as hybrid tide embankments and permeable steel slit dams, the Group will contribute to preventing and mitigating disaster-related damage to infrastructure critical to daily life and economic activities, and to strengthening their resilience.

Hybrid Tide Embankments

Hybrid tide embankments are made of steel and concrete. Because of their hybrid structure, they require shorter construction time and less space.

Concrete blocks for hybrid tide embankments are precast at a JFE Group factory, while steel pipe piles for foundations are installed at the construction site, thereby reducing the time required for on-site construction by about 60%. This arrangement does not require large amounts of materials, equipment, or workers on site, so it does not interfere with other construction work. Furthermore, compared to a conventional embankment structure, the land area occupied by the embankment can be reduced by about 80%, saving considerable space. We will continue to apply and advance our technology to further contribute to disaster prevention in the region.



Cross section


Hybrid tide embankments

➤ JFE Engineering Infrastructure Using Steel Structures (Japanese only)
(https://www.jfe-eng.co.jp/products/bridge/co01.html)

Permeable Steel Slit Dams

A permeable steel slit dam is a steel pipe structure installed in a river to trap debris flows.

Made of strong steel pipes to withstand the impact of driftwood and huge debris, it has large openings to let water and sediment to pass through, which prevents the water level from rising upstream during floods and also ensuring that debris does not flow downstream. Since it does not block the flow of water, unlike a dam, it can be shaped to the slope of a riverbed to protect the ecosystem. The JFE Group is working to expand the use of permeable steel slit dams by reducing installation costs and shortening the construction period through structural innovations.

Permeable steel slit dams

Terre Armée Method

The Terre Armée method drove the spread of the reinforced soil technology in Japan. This reinforced soil wall construction method was introduced to Japan about half a century ago, and since then, it has been used in a variety of situations, mainly in domestic infrastructure development, such as highway and other road structures, and the construction of airports, schools, and defense facilities. By applying layers of steel reinforcement in the embankment, friction between the steel strips and the earth results in a vertically strong structure that exhibits excellent earthquake resistance.

JFE Shoji Terre One Corporation, a subsidiary of JFE Shoji, has developed a new Terre Armée method, with an innovative fail-safe system . The feature helps to visually confirm the health of structures after being subject to unforeseen forces, such as massive earthquakes. Being able to easily detect the internal anomalies of reinforced embankments helps to determine the safety of the infrastructure and schedule necessary maintenance work in a timelier manner.

We will contribute to building disaster-resistant roads and towns by promoting the Terre Armée method and by expanding sales of other products that contribute to disaster prevention, disaster mitigation, and national land resilience.

Application in highway walls for National Route No. 3, Kumamoto Prefecture)

Fail-Sensor indicator
(red indicating internal anomalies)

JFE Group's Strategy and Alignment with the Paris Agreement

Under the JFE Group Environmental Vision for 2050, the JFE Group designed a roadmap for achieving carbon neutrality, which included our short-, medium-, and long-term CO_2 emission reduction targets. Until 2030, the Group will focus on fully using existing technologies to promote decarbonization while at the same time developing the ultra-innovative technologies needed to achieve carbon neutrality. The Group will then focus on commercializing the ultra-innovative technologies in the 2030s and 2040s, when we expect the required social infrastructure to be in place, to accelerate decarbonization toward achieving carbon neutrality by 2050.

The technology roadmap for Transition Finance toward decarbonization in the iron and steel sector, published by the Japanese Ministry of Economy, Trade, and Industry (METI), outlines a path for accelerating decarbonization and achieving carbon neutrality by introducing innovative technologies, with the same assumption that social infrastructure such as hydrogen supply and CCUS will be in place by the 2040s. This technology roadmap is aligned with Japan's Nationally Determined Contribution (NDC) based on the Paris Agreement, and is therefore aligned with the Paris Agreement.

In 2022, the JFE Group issued transition bonds through a public offering, which was selected as the first model example in the iron and steel sector for METI's Transition Finance Model Projects in FY2021. During the evaluation process for this issuance, the Group's initiatives were certified by a third party as being aligned with METI's roadmap. We can therefore deduce that they are also aligned with the Paris Agreement.

➤ **METI: Technology Roadmap for Transition Finance in the Iron and Steel Sector**
(https://www.meti.go.jp/policy/energy_environment/global_warming/transition/transition_finance_technology_roadmap_iron_and_steel_eng.pdf)

➤ **METI: Transition Finance Case Study**
(https://www.meti.go.jp/policy/energy_environment/global_warming/transition/transition_finance_case_study_jfehd_eng.pdf)

Risk Management (Climate Change)

JFE Holdings is responsible for comprehensive risk management in accordance with its Basic Policy for Building Internal Control Systems. The JFE Group Sustainability Council, chaired by the president of JFE Holdings, consolidates information and strengthens management across the Group to reduce the frequency and impact of risks.

The executive officer responsible for risk strives to identify potential ESG risks such as those associated with climate change. As necessary, the council confirms and evaluates risks and discusses and determines countermeasures. Key managerial issues are deliberated by the Group Management Strategy Committee.

The Board of Directors supervises initiatives on ESG risks such as those related to climate change and CSR by discussing, making decisions on, and receiving reports about these matters.

Climate-related risks are identified and evaluated based on a scenario analysis conducted under the framework recommended by the TCFD in 2017. Key factors that may affect management are selected for further analysis and incorporated into formulating business strategies, such as the Seventh Medium-term Business Plan.

Monitoring Method for Climate Change-Related Risks

Issues that may affect management are monitored by the JFE Group Sustainability Council, Group Management Strategy Committee, and Management Committee. Measures are implemented based on a quarterly report on climate change-related risks deliberated by the specialized committees of each Group company (e.g., the Environmental Committee). The JFE Group Environmental Committee consolidates information and strengthens management to reduce the frequency and impact of risks and to maximize opportunities.

Countermeasures Based on Monitoring

1. Group-wide deliberations
2. Monitoring penetration of policies within the Group
3. Monitoring deployment of policies throughout the Group

For further details, refer to the following links.

➤ System for Promoting Sustainability (P.10)
➤ Risk Management (P.231)
➤ Environmental Management (P.46)

Metrics and Targets (Medium- and Long-Term Targets and Results in FY2023)

The JFE Group's steel business is led by its operating company, JFE Steel, which is a member of the Japan Iron and Steel Federation (JISF). The JFE Group is promoting the JISF's Commitment to a Low Carbon Society, which focuses on the Three Ecos initiatives and the development of innovative new iron and steelmaking processes. Under the initiative, the JISF's target for FY2030 had originally been to reduce emissions by 9 million t-CO_2. However, with the end of Phase I of this initiative in 2020, it was rebranded as the JISF's Carbon Neutrality Action Plan, and the Phase II target (FY2030 target) was revised to a 30% reduction in energy-derived CO_2 emissions in FY2030, compared to FY2013. JFE Steel is aggressively pursuing the achievement of this goal.

In addition, JISF has formulated and announced the Long-term Vision for Climate Change Mitigation in 2030 and beyond, which is intended to realize zero-carbon steel. JFE Steel played a key role in formulating this vision. Furthermore, in 2021, the JISF announced the "Basic Policy of the Japan steel industry on 2050 Carbon Neutrality sought by the Japanese government," declaring that the Japanese iron and steel industry will boldly take on the challenge of realizing zero-carbon steel.

The JFE Group intends to increase sustainability through solutions that address global climate change while restructuring to respond to developments in the environment facing our steel business. We considered 2020 to be the landmark year for further reinforcing our efforts to tackle climate change, and we declared our target to reduce CO_2 emissions in the steel business in FY2030 by 20% or more, compared to FY2013, and to achieve carbon neutrality by 2050.

In May 2021, the JFE Group placed top priority on its climate change initiatives and formulated the JFE Group Environmental Vision for 2050 as part of the Seventh Medium-term Business Plan, under which we will strive to achieve carbon neutrality by 2050. The Group also disclosed new CO_2 emissions reduction targets, and in February 2022, the FY2030 target for the steel business was revised upward to 30% or more, compared to FY2013. Major Group companies of JFE Steel have formulated CO_2 reduction targets at the same level as JFE Steel. The Group companies in Japan and overseas work together to incorporate efforts to address climate change issues into their business strategies. The Group will systematically pursue the reduction of CO_2 emissions by incorporating the TCFD's principles in its management strategies.

JFE Group's CO_2 Reduction Targets

Seventh Medium-term Business Plan Initiatives

■ Reduce steel-business CO_2 emissions in FY2024 by 18%, compared to FY2013 (JFE Steel).
Furthermore, JFE Steel's major group companies have also set their own CO_2 reduction targets for FY2024 to ensure that these targets are achieved. With this, more than 99% of the total CO_2 emissions of the entire JFE Steel Group is accounted for.
■ The target of reducing CO_2 in FY2030: 30% or more, compared to FY2013 (JFE Steel)

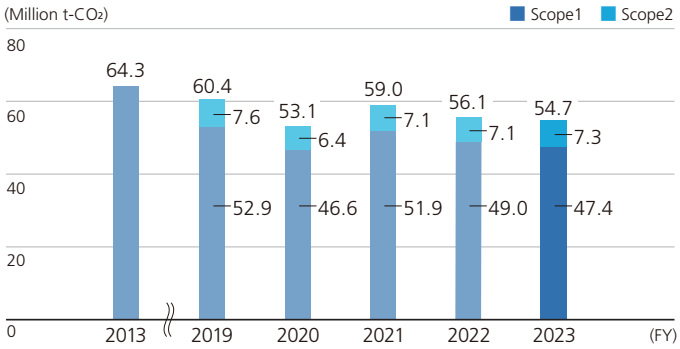
Initiatives for Carbon Neutrality by 2050

■ Reduce CO_2 emissions at JFE Steel
· Pursue ultra-innovative technologies mainly for carbon-recycling blast furnaces and CCU
· Develop hydrogen-based ironmaking (direct-reduction) technology
· Develop electric arc furnace process technology
■ Expand engineering business contributions to CO_2 emissions reduction in society
· Reduce CO_2 emissions by 12 million tonnes in FY2024 and 25 million tonnes in FY2030
■ Offshore wind-power generation business
· Accelerate commercialization of our offshore wind-power business by applying the strengths of the Group

➤ JFE Group Environmental Vision for 2050, Presentation Material
(https://www.jfe-holdings.co.jp/en/common/pdf/investor/climate/2021-210525-release01.pdf)

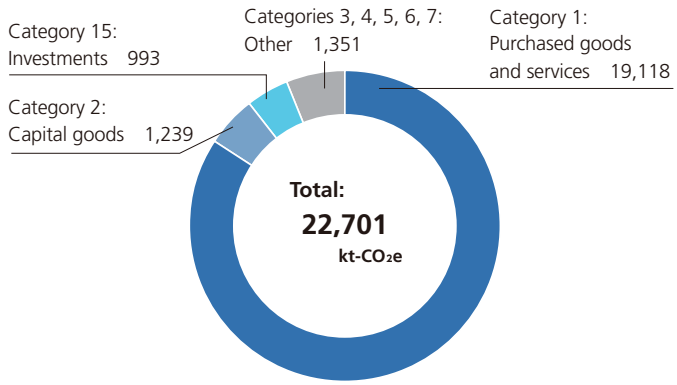
CO_2 Emissions of the JFE Group

■ CO_2 Emissions of the JFE Group



Notes:
- Data cover 75 companies
  JFE Steel and 26 major domestic and overseas subsidiaries
  JFE Engineering and 11 major domestic and overseas subsidiaries
  JFE Shoji and 35 major domestic and overseas subsidiaries
- Data for JFE Steel include CO_2 emissions from non-energy sources.
- Starting with FY2018, data for JFE Steel's subsidiaries and JFE Engineering's subsidiary include CO_2 emissions from non-energy sources.
- FY2013 figure includes data for the Sendai Works of JFE Bars & Shapes Corporation.
- Since FY2021, the figures include data for an expanded list of JFE Steel, JFE Engineering, and JFE Shoji major subsidiaries.

■ Scope 3 Emissions of the JFE Group (FY2023)



Coverage:
(Categories 1, 2, 3, 4, 5) JFE Steel, 21 JFE Steel major domestic subsidiaries, JFE Engineering, 1 JFE Engineering major subsidiary, and JFE Shoji
(Category 6, 7) JFE Steel, 21 JFE Steel major domestic subsidiaries, JFE Engineering, 12 JFE Engineering major domestic and overseas subsidiaries, and JFE Shoji
(Category 15) Japan Marine United, and 10 JFE Steel equity-method affiliates (7 domestic and 3 overseas)
Sources: Green Value Chain Platform (Ministry of the Environment) and others

For more on quantitative data related to CO_2 emissions, refer to the following information.

➤ Environmental Data (P.235)

JFE Steel

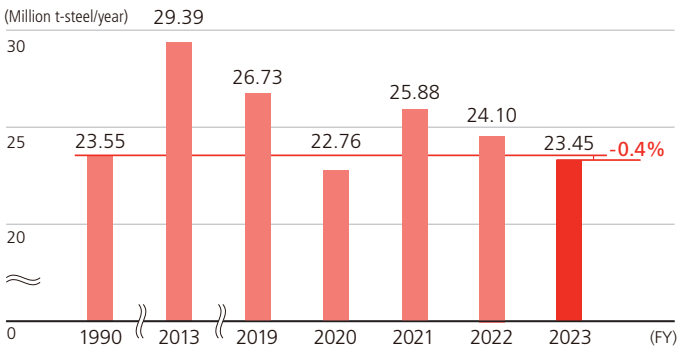
Initiatives to Save Energy and Reduce CO_2

JFE Steel has always aggressively pursued CO_2 reduction and energy savings, including the introduction of energy-saving equipment.

JFE Steel

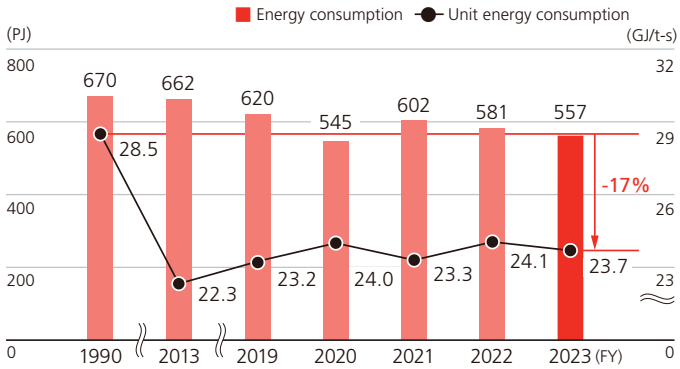
Energy Consumption and CO_2 Emissions in FY2023

■ Production of Crude Steel of JFE Steel



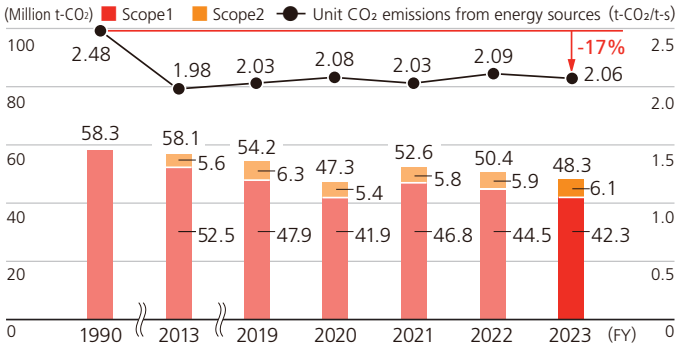
Note: FY2013 figure includes data for the Sendai Works of JFE Bars & Shapes Corporation.

■ Energy Consumption and Unit Energy Consumption of JFE Steel



Note: FY2013 figure includes data for the Sendai Works of JFE Bars & Shapes Corporation.

■ CO_2 Emissions from Energy Sources and Unit CO_2 Emissions of JFE Steel



Notes:
- The CO_2 emissions and emission intensity in FY2023 are calculated using the CO_2 emission factor for electricity purchased in FY2022, adopted by the Japan Iron and Steel Federation's Commitment to a Low Carbon Society.
- FY2022 data was revised by applying the CO_2 emission factor for electricity purchased in FY2022, as adopted by the Japan Iron and Steel Federation's Commitment to a Low Carbon Society.
- FY2013 figure includes data for JFE Bars & Shapes Corporation's Sendai Works.

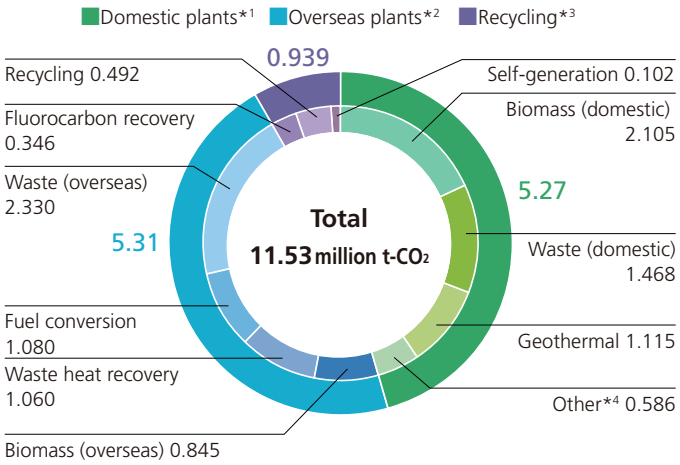
JFE Engineering

Initiatives to Reduce CO_2 Emissions through Business Operations

JFE Engineering contributes to CO_2 emissions reductions in society as a whole through its business operations, such as by expanding renewable energy generation and constructing and operating plastic and food recycling plants. In FY2023, the Company contributed to reducing 11.53 million tonnes of CO_2 emissions (a 3% increase compared to FY2022) across society. JFE Engineering will further expand its business and contribute to CO_2 emissions reductions of 12 million tonnes in FY2024 and 25 million tonnes in FY2030.

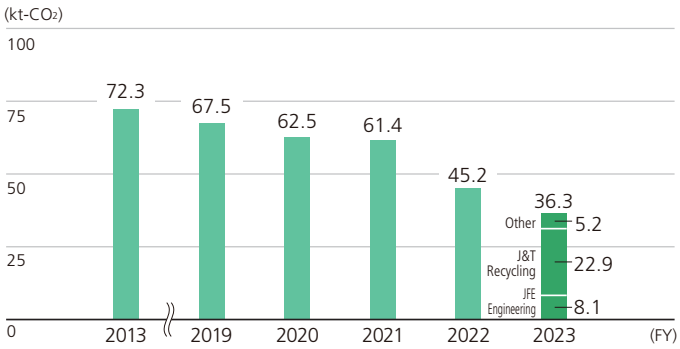
In addition, since FY2021 we have been implementing such initiatives as subscribing to on-site solar power PPA and zero-emission electricity plans at the Yokohama office and a low-emission electricity plan at the Tsu Works. As a result, in FY2023 we have achieved a 28% reduction in CO_2 emissions, compared to FY2013. We have also been working on reducing waste and implementing energy-saving activities at our steelworks and in our offices. The Company will steadfastly conduct business in ways that save resources and are environmentally sound, including expanding the use of renewable energy.

■ JFE Engineering's Contribution to CO_2 Emissions Reductions (FY2023)



*1 Data cover JFE Engineering.
*2 Data cover JFE Engineering and Standardkessel Baumgarte GmbH (SBG), a German subsidiary of JFE Engineering Corporation.
*3 Data cover J&T Recycling Corporation and JFE Urban Recycle Corporation.
*4 Other includes digestion gas, geothermal, solar, wind, waste heat recovery, fuel conversion, energy service, and logistics products.

■ JFE Engineering Group's CO_2 Emissions from Energy Sources



Notes:
- Data cover JFE Engineering and 11 major domestic and overseas subsidiaries.
- FY2021 figure includes data for an expanded list of JFE Engineering major subsidiaries.

JFE Shoji

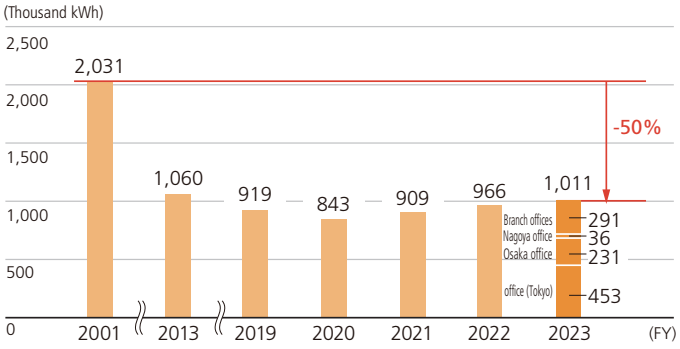
Energy Reduction Initiatives in Accordance with Environmental Strategies

Under the environmental strategies formulated in 2001, JFE Shoji is continuously implementing initiatives to reduce paper and electricity consumption and strictly manage waste separation as part of its energy reduction efforts.

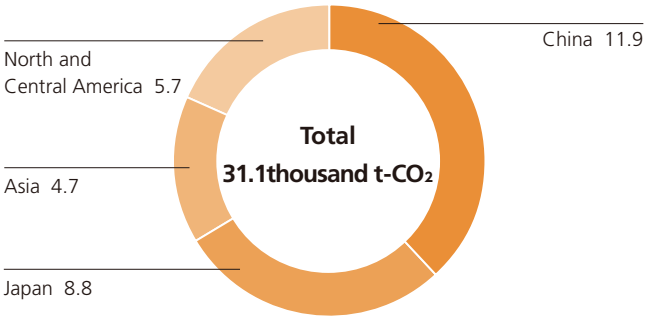
In terms of reducing paper consumption, the company continues to use recycled paper to conserve natural resources, and we also ensure that documents are printed in black and white using both sides of the paper. We are also promoting paperless meetings through the use of large monitors and web conferencing systems. Consequently, the amount of paper used per employee is on a downward trend. As for electricity consumption, JFE Shoji is reducing its environmental impact by introducing motion-sensor lighting and energy-saving equipment through office renovations, implementing leave-on-time days, improving operational efficiencies through robotic process automation (RPA), and other measures.

In addition, the company has established a new goal in the domestic operating companies to reduce CO_2 emissions by installing solar panels and purchasing electricity derived from renewable energy sources. In February 2023, we completed installing solar panels, which in October began generating electricity at JFE Shoji Coin Center Corporation in Shizuoka and then at Tochigi Shearing Corporation, a Group company that processes steel plates. As a result of this and other ongoing efforts to reduce the amount of electricity consumed, CO_2 emissions in FY2023 in the domestic operating companies were reduced by 20.7%, compared to FY2019.

■ Electric Power Consumption by JFE Shoji



■ CO_2 Emissions of the JFE Shoji Group (FY2023)



Note:
Data cover CO_2 emissions from electricity use by JFE Shoji and 35 major domestic and overseas subsidiaries (steel-processing companies).

Policy Engagement

Steel Industry Initiatives

The Japan Iron and Steel Federation (JISF) Initiatives

Long-term Vision for Climate Change Mitigation

JFE Steel is proactively engaged in a variety of activities as a member of the Japan Iron and Steel Federation (JISF). The JISF has been focusing on achieving the goals for 2020 under its Commitment to a Low Carbon Society (renamed the Carbon Neutrality Action Plan in FY2021). Furthermore, in November 2018, the JISF formulated and published its Long-term Vision for Climate Change Mitigation for 2030 and beyond, with JFE Steel playing a central role in its development. This document lays out the industry's challenge for realizing zero-carbon steel and explains the pathway for achieving the 2°C scenario for steelmaking and the necessity of ultra-innovative technologies to achieve the 1.5°C scenario. Also, on February 15, 2021, the JISF announced the "Basic Policy of the Japan steel industry on 2050 Carbon Neutrality sought by the Japanese government," declaring that the Japanese iron and steel industry will boldly accept the challenge of realizing zero-carbon steel.

➤ Relevance with the JISF's Long-term Vision for Climate Change Mitigation (P.106)

JISF's Carbon Neutrality Action Plan

In February 2021, the JISF declared that the Japanese steel industry will boldly take on the challenge of realizing carbon neutrality. The Plan on Commitment to a Low Carbon Society was amended and renamed as the Carbon Neutrality Action Plan, and the Phase II target (2030 target) was revised.

In the Eco Process of the plan, an ambitious 2030 target was set taking into account new perspectives such as the expansion of scrap use as well as the maximum introduction of best available techniques (BATs) based on energy efficiency already among the highest in the world.

Regarding Eco Product, which is intended to reduce GHG emissions at the product use stage, high-performance steel is expected to play a particularly major role in the promotion of offshore wind power and electrification of automobiles, which are among the 14 fields of the government's Green Growth Strategy. Accordingly, the Japanese initiative will accelerate practical global warming measures from a global perspective by making visible the conventional quantitative evaluation of the five types of high-performance steel.

As for Eco Solutions, the JISF will develop a system for introducing appropriate technology for transferring and spreading the production process for decarbonized steel in the Asian regions, where steel production is expected to expand.

Furthermore, regarding Innovative Technology Development, the JISF will take on the challenges of technologies such as direct hydrogen reduction and high-performance steel production using electric arc furnaces under the Green Innovation Fund, in addition to COURSE 50 and ferro-coke.

■ Overview of the Carbon Neutrality Action Plan

Eco Process
Cut energy-related CO_2 emissions (total volume) in FY2030 by 30% compared to the FY2013 level by adopting BATs to promote energy conservation, using waste plastics, adopting innovative technologies that are currently under development and scheduled to be in use around 2030, and using raw fuel with less CO_2 emissions.

Eco Product
Contribute to CO_2 emissions reduction by domestically and internationally supplying high-performance steel. This steel will reduce CO_2 emissions when used in the final product. The reduction potential in 2030 is estimated to be approximately 42 million t-CO_2 for the five steel products that have been quantitatively evaluated for their contribution to reducing emissions.

Eco Solution

Contribute to reducing CO_2 emissions worldwide by transferring and spreading the Japanese steel industry's advanced energy-saving technologies and facilities to the world's steel industry. Estimated contribution on CO_2 emissions reduction is 80 million t-CO_2 in 2030.

Innovative Technology Development

Contribute to carbon neutrality by boldly developing technologies in the following four areas.

- Hydrogen reduction technology using in-house hydrogen
- Low-carbon technology using CO_2 contained in externally sourced hydrogen or blast furnace exhaust gas
- Direct hydrogen reduction technology
- Impurity removal technology for electric furnace using direct reduced iron

Assessment of the FY2022 Carbon Neutrality Action Plan (Phase II) Results (JISF)

Total volume of energy-related CO_2 emissions in FY2022 was 150.23 million tonnes, which represents a decrease of 44.20 million tonnes, or 22.7%, compared to FY2013. The achievement rate of the FY2030 target (to reduce 30% from FY2013) has progressed to 75.8%. Energy-related CO_2 emissions and energy consumption are both declining, given continued energy-saving efforts.

While the energy efficiency of the Japanese steel industry is among the highest in the world, vigorous efforts are made to promote greater energy savings by having businesses engaged in this effort draw upon subsidies to promote investment in saving energy and other actions.

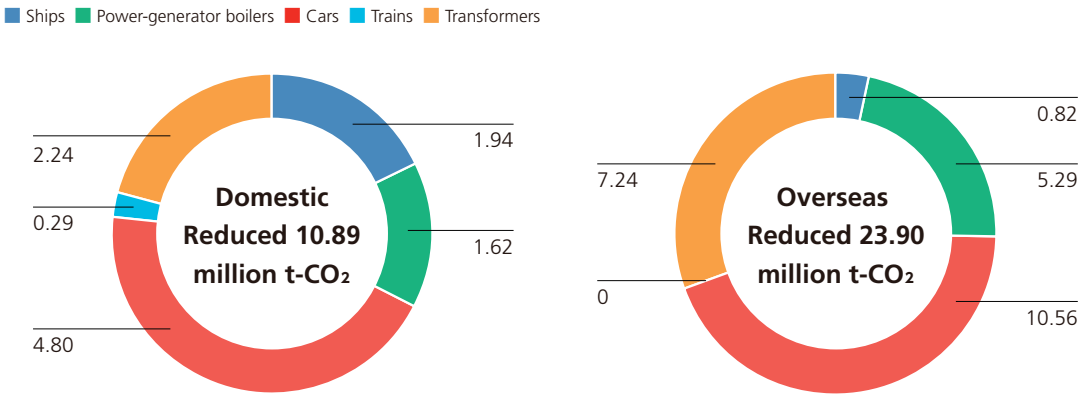
Reduced CO_2 Emissions through High-Performance Steel Materials (Effects of Eco Products)

The Japan Iron and Steel Federation (JISF) estimates the CO_2 emissions reduction impact of using high-performance steel materials. It is estimated that the use of five major high-performance steel materials in cars, transformers, ships, power generator boilers, and trains in Japan and overseas (FY2022 production: 4.36 million tonnes, 5.0% of crude steel production) helped reduce CO_2 emissions by 34.79 million tonnes (10.89 million tonnes in Japan, 23.90 million tonnes overseas) in FY2022.

Notes:

- Calculations made by the Institute of Energy Economics, Japan
- The five materials are steel sheets for automobiles, directional electrical steel sheets, thick steel sheets for shipbuilding, steel tubes for boilers, and stainless steel sheets.
- Domestic reduction figures are calculated in comparison with FY1990, while the overseas reduction figures are calculated in comparison with FY2003 for automobiles and ships, with FY1998 for steel pipes for boilers and FY1996 for electrical steel sheets.

■ CO_2 Reduction Resulting from the Use of Five High-Performance Steel Materials in Japan and Abroad (FY2022)



Related Links

- The Japan Iron and Steel Federation (JISF): Climate Change Policy page (https://www.jisf.or.jp/en/activity/climate/index.html)
- Japan Iron and Steel Federation (JISF): LCA of Steel Products page (https://www.jisf.or.jp/en/activity/lca/index.html)
- Japan Iron and Steel Federation (JISF): Publication of ISO 20915 (https://www.jisf.or.jp/en/activity/lca/iso/index.html)
- Japan Iron and Steel Federation (JISF): Publication of JIS Q 20915 (https://www.jisf.or.jp/en/activity/lca/iso/index.html)
- Japan EPD Program by SuMPO (https://ecoleaf-label.jp/en/)

Initiatives in the Business Community

Initiatives in Green/Transition Finance

JFE Holdings has established the Green/Transition Finance Framework and issued transition bonds through a public offering in 2022, which was selected as the first model example in the iron and steel sector for METI's Transition Finance Model Projects in FY2021. Achieving carbon neutrality will require significant, long-term investments in capital and R&D. We will continue to leverage transition financing and diversify our funding methods.

Formulated the Technology Roadmap for Transition Finance in the Iron and Steel Sector

The technology roadmap for Transition Finance toward decarbonization in the iron and steel sector, published by the Japanese Ministry of Economy, Trade, and Industry (METI), outlines a path for accelerating decarbonization and achieving carbon neutrality by introducing innovative technologies, with the same assumption that social infrastructure such as hydrogen supply and CCUS will be in place by the 2040s. In the process of drawing up this roadmap, JFE Steel's Fellow, Hiroyuki Tezuka , a member of the Japan Iron and Steel Federation's Energy Technology Committee, participated as a specialist in the taskforce formulating the roadmap. The roadmap is aligned with Japan's nationally determined contribution (NDC) based on the Paris Agreement and is therefore aligned with the agreement.

Green/Transition Finance Framework

The JFE Group developed this framework based on the "Green Bond Principles 2021" of the International Capital Market Association (ICMA), the "Green Loan Principles 2023" of the Loan Market Association (LMA), the Asia Pacific Loan Market Association (APLMA), the Loan Syndication & Trading Association (LSTA), the "Green Bond Guidelines (2022)," the "Green Loan Guidelines (2022)" of the Ministry of the Environment, the "Climate Transition Finance Handbook 2023" of the ICMA, and the "Basic Guidelines on Climate Transition Finance (May 2021)" of the Financial Services Agency, the Ministry of Economy, Trade and Industry, and the Ministry of the Environment. Since our initiatives have been certified by a third-party organization as being aligned with METI's roadmap, this framework of the JFE Group is also aligned with the Paris Agreement.

- METI: Technology Roadmap for Transition Finance in the Iron and Steel Sector
  (https://www.meti.go.jp/policy/energy_environment/global_warming/transition/transition_finance_technology_roadmap_iron_and_steel_eng.pdf)
- METI: Transition Finance Case Study
  (https://www.meti.go.jp/policy/energy_environment/global_warming/transition/transition_finance_case_study_jfehd_eng.pdf)
- Green/Transition Finance Framework (Japanese only)
  (https://www.jfe-holdings.co.jp/common/pdf/release/2024/01/240119.pdf)
- Transition Finance Report—Funds Raised, Allocated, and Their Impact (Japanese only)
  (https://www.jfe-holdings.co.jp/common/pdf/sustainability/environment/climate/impact_report_2024.pdf)

Adoption Status for the Green Innovation Fund Projects

The JFE Group is fully leveraging the New Energy and Industrial Technology Development Organization (NEDO)'s Green Innovation Fund project, and we are conducting research and development in collaboration with other companies in the industry toward realizing carbon neutrality. JFE Steel is working on a NEDO project called Utilizing Hydrogen in Steelmaking Processes (GREINS), while JFE Engineering is focusing on carbon neutrality in the material cycles and waste management sector as well as on lowering the cost of offshore wind power generation.

Utilizing Hydrogen in Steelmaking Processes (GREINS)

JFE Steel formed a consortium with Nippon Steel Corporation, Kobe Steel, Ltd., and the Japan Research and Development Center for Metals and jointly commissioned the Utilizing Hydrogen in Steelmaking Processes (GREINS) project to achieve progress toward carbon neutrality by 2050. The project scale is approximately 573.7 billion yen*1, and the four companies involved are receiving a total of approximately 449.9 billion yen*2 of financial support.

*1 Source: Project summary document (May 24, 2024) on NEDO's Utilizing Hydrogen in Steelmaking (GREINS) project
*2 This includes incentives subject to change depending on project progress and other factors at each stage gate.

COURSE50

In the area of developing hydrogen reduction technologies that use in-house hydrogen, we intend to achieve a 30% reduction of CO_2 emissions through hydrogen reduction along with separation and capture of CO_2 from blast furnace gases. The first facility is expected to come online by 2030, followed by other plants by 2050. JFE Steel is in charge of examining the combustion behavior of pulverized coal and reduction furnace gas and evaluating the entire process.

▶ Project scale: Approx. 72.7 billion yen*1, Financial support scale: Approx. 43.6 billion yen*2 (total for the four companies)

*1 The project scale is calculated based on the level of financial support and the subsidy rate.
*2 This includes incentives subject to change depending on project progress and other factors at each stage gate.

Carbon-recycling pilot blast furnace

In the area of developing low-carbon technologies using CO_2 contained in externally sourced hydrogen or blast furnace exhaust gas by developing and combining these technologies with other low-carbon techniques, such as using biomass and reduced iron as raw materials, we hope to achieve a greater than 50% reduction of CO_2 emissions from the blast furnace steelmaking process by 2030 through the use of medium-scale test blast furnaces, which are larger than one-fifth the size of a full-scale furnace. JFE Steel is in charge of developing carbon recycling blast furnace operation technology and elemental technology as well as overall process evaluation and review.

▶ Project scale: Approx. 285.3 billion yen*1, Financial support scale: Approx. 238.6 billion yen*2 (total for the four companies)

*1 The project scale is calculated based on the level of financial support and the subsidy rate.
*2 This includes incentives subject to change depending on project progress and other factors at each stage gate.

Direct reduction compact bench pilot furnace

In the area of developing direct hydrogen reduction technology, we intend to demonstrate the method using medium-scale test blast furnaces, which are larger than one-fifth the size of a full-size furnace, applying a technology for directly reducing the CO_2 emissions of low-grade iron ore with hydrogen by more than 50%, compared to the current blast furnace method, by 2030. JFE Steel is in charge of examining operational fluctuations and wide-ranging methanation reaction characteristics using the new bench pilot furnace, investigating reduction pulverization and gas composition that both suppresses clustering and achieves a high reduction rate, evaluating the microstructure using high-precision equipment, determining gas composition and the level of iron ore reduction and carbonization, and optimizing shape and forming.

▶ Project scale: Approx. 136.9 billion yen*1, Financial support scale: Approx. 114.1 billion yen*2 (total amount for the four companies)

*1 The project scale is calculated based on the level of financial support and the subsidy rate.
*2 This includes incentives subject to change depending on project progress and other factors at each stage gate.

Pilot electric arc furnaces

In a project for developing impurity removal technology for electric arc furnaces using direct reduced iron, demonstrations of a large-scale electric arc furnace process (processing capacity of approximately 300 tonnes) will be conducted to verify its control of the concentration of impurities (components affecting the product) to the same level as standard blast furnace methods (phosphorus 150 ppm, nitrogen 40 ppm or less), toward the goal of manufacturing high-grade steel suitable for car body panels and other parts with the directly reduced iron made from low-grade iron ore. JFE Steel is in charge of evaluating and examining the new heat sources and scrap iron preheating using a small-scale test electric furnace with a capacity of 10 tonnes and developing technologies for dephosphorization and denitrification of molten steel using an ex-core refining furnace with a capacity of 3 tonnes.

▶ Project scale: Approx. 40.4 billion yen*1, Financial support scale: Approx. 30.6 billion yen*2 (total for the four companies)

*1 The project scale is calculated based on the level of financial support and the subsidy rate.
*2 This includes incentives subject to change depending on project progress and other factors at each stage gate.

➤ NEDO: A new research focus under the Green Innovation Project: Hydrogen Utilization in Iron and Steelmaking Processes (Japanese only) (https://www.nedo.go.jp/news/press/AA5_101738.html)
➤ NEDO: Hydrogen Utilization in Iron and Steelmaking Processes (https://green-innovation.nedo.go.jp/en/project/utilization-hydrogen-steelmaking/)
➤ Consortium of the Green Innovation Fund Project: Utilizing Hydrogen in the Steelmaking Process (https://www.greins.jp/en/)

Carbon Neutrality in the Material Cycles and Waste Management Sector

The Ministry of the Environment's "Draft Medium- and Long-term Scenarios for Net Zero Greenhouse Gas Emissions in the Material Cycles and Waste Management Sector by 2050 " estimates future GHG emission and waste volume based on multiple hypothetical scenarios. It describes that even if the 3Rs (reduce, reuse, recycle) combined with heat recovery are implemented to the maximum extent possible and waste treatment facilities are expanded and consolidated, a considerable volume of waste will still require thermal treatment (incineration and thermal pyrolysis), which indicates that effective treatment of food waste through methods such as methane fermentation will be necessary. It is also expected that waste will become increasingly dominated by biomass as the 3Rs and material conversion are more strongly encouraged in response to the growing importance of resource recycling. The material cycles and waste management sector, which has traditionally relied on methods that release CO_2 into the atmosphere, such as incineration, need to reduce GHG emissions from its own sector and strive for carbon neutrality. Also, the waste treatment system must be reformed to become a major source of biomass-oriented carbon for the entire industrial sector. However, the constant fluctuation in the quantity and characteristics of waste materials (composition, calorific value, moisture content, and so forth) depending on the region, season, and weather, impedes the recovery and stable, efficient use of carbon, which increases the challenge of applying technologies such as carbon capture in other sectors. To address these issues and facilitate widespread implementation, JFE Engineering and Sekisui Chemical Co., Ltd. are jointly working on a project to develop waste-to-chemical

technology for Green Ethanol production by integrating advanced gasification and biochemical conversion technologies .

▶Project scale: Approx. 34.7 billion yen*, Financial support scale: Approx. 23.7 billion yen (total for the two companies)

*This includes incentives subject to change depending on project progress and other factors at each stage gate.

➤ NEDO: Achieving Carbon Neutrality in Waste and Resource Circulation
(https://green-innovation.nedo.go.jp/en/project/waste-resource-circulation-carbon-neutral/)

➤ NEDO: Achieving Carbon Neutrality in Waste and Resource Circulation (Japanese only)
(https://www.nedo.go.jp/news/press/AA5_101724.html)

Efforts to Lower the Cost of Offshore Wind Power Generation

The offshore wind power generation market is expected to expand rapidly in the coming years. Capturing this market will require establishing a technology for mass-producing floating offshore wind power generation facilities at a low cost. The Ministry of Economy, Trade and Industry and NEDO have therefore decided to implement a floating offshore wind power generation demonstration project as a Green Innovation Fund project, toward commercializing floating offshore wind power generation. The project is intended to develop and demonstrate the necessary elemental technologies and the integration designs for a floating offshore wind power generation system. The project will receive financial support of about 85 billion yen* from NEDO and is scheduled to run from FY2024 to FY2030. JFE Engineering and Japan Marine United Corporation are participating in the project while working to lower the cost for offshore wind power generation.

*This includes incentives subject to change depending on project progress and other aspects at each stage gate.

➤ METI: Offshore Wind Power Generation Demonstration Project (Japanese only)
(https://www.meti.go.jp/press/2024/06/20240611007/20240611007.html)

➤ NEDO: Floating Offshore Wind Power Generation Demonstration Project (Japanese only)
(https://www.nedo.go.jp/news/press/AA5_101750.html)

➤ NEDO: Cost Reductions for Offshore Wind Power Generation
(https://green-innovation.nedo.go.jp/en/project/offshore-wind-power-generation/)

Participation in the GX League

The Ministry of Economy, Trade and Industry has established the GX League, a forum that invites companies to work on GX; take up the challenge of GX in cooperation with the government, academic, and economic sectors; discuss how to transform the overall economic and social system; and drive the creation of new markets. We believe that its goal is aligned with the JFE Group's overall objective for climate change initiatives, and JFE Steel has been participating in the GX League since its establishment.

As part of its activities within the GX League, JFE Steel has been proactively participating since March 2023 in the Working Group for Studying How to Add Value to Green Products, and in December 2023, the WG published a document entitled "How to Add Value to Green Products." The document recognizes that companies wanting to invest more in decarbonization need to see the value in the level of emissions reduced through their initiatives and that this value also needs to be recognized in the global market. It presents draft guidelines on how to add value to green products and outlines some example initiatives, including JFE Steel's JGreeX™. It also introduces measurement and calculation methods for the green value of products, effective allocation, and economic utilization methods.

In addition, based on the ideas presented in the document, the Interim Report of the Study Group on the GX Product Market which Contributes to Demand Creation for Strengthening Industrial Competitiveness and Achieving Emission Reductions, published by the Ministry of Economy, Trade and Industry in March 2024, suggested "reduction achieved" as a new GX value.

➤ Final Report for the GX League (Japanese only) (https://gx-league.go.jp/action/wg/)
➤ Document regarding how to Add Value to Green Products (full version, in Japanese only)
➤ Document regarding how to Add Value to Green Products (summary version, in Japanese only)

Investment in the GX Acceleration Agency

The GX Acceleration Agency is a certified corporation established in April 2024 by the Ministry of Economy, Trade and Industry, as stipulated in the Act on Promoting a Smooth Transition to a Decarbonized Growth-oriented Economic Structure. In order to achieve GX investment of over 150 trillion yen over the next 10 years, the GX Acceleration Agency will provide financial support as debt guarantees, operate a carbon emissions trading system, and collect fossil fuel surcharges. JFE Holdings invested in the GX Acceleration Agency at the time of its establishment.

➤ GX Acceleration Agency (https://www.gxa.go.jp/en/)

Recommendations to Policymakers

8th GX Implementation Council

In February 2023, the cabinet approved the Basic Policy for the Realization of GX to simultaneously achieve three goals through Green Transformation (GX): decarbonization, stable energy supply, and economic growth. In July of the same year, the cabinet also approved the Strategy for Promoting Structural Transition based on Decarbonization (GX Promotion Strategy). Growth-oriented Carbon Pricing (CP) Concepts is the decarbonization initiative based on this strategy and is currently being actively pursued toward its realization and implementation.

At the 8th GX Implementation Council, held in November 2023, JFE Steel's President Kitano (then-Chairman of the Japan Iron and Steel Federation) explained the efforts being made by the Japanese steel industry to achieve carbon neutrality, and he called for long-term government support measures corresponding to the support provided by the government in Europe, the U.S., and China for the huge research and development and capital investment costs. He also expressed the need for long-term government support for converting to innovative processes and dealing with the increase in operational costs for non-fossil fuels, electricity, and other sources, as actions for stimulating demand for green steel materials with high environmental value through, for example, public procurement, measures to ensure the international competitiveness of industrial electricity prices, and support for building new infrastructures, including a hydrogen supply chain and a CCS scheme.

➤ Cabinet Secretariat: the 8th GX Implementation Council (Japanese only)
(https://www.cas.go.jp/jp/seisaku/gx_jikkou_kaigi/dai8/index.html)

56th Meeting of the Advisory Committee for Natural Resources and Energy's Strategic Policy Subcommittee

The 56th Meeting of the Advisory Committee for Natural Resources and Energy's Strategic Policy Subcommittee was held on June 6, 2024 to embark on formulating Japan's 7th Strategic Energy Plan. At this meeting, JFE Holdings' President Kitano gave a presentation entitled Energy Policy to Help JFE Steel Achieve Decarbonization, during which he recommended policies to promote the use of green steel products and energy policies to reduce uncertainty from the business environment related to GX. President Kitano announced that the company plans to invest in converting to the innovative electric arc furnace process at the Kurashiki district by the end of this fiscal year, based on the premise of government support, and he explained that the company also intends to build a mass production system for high-quality green steel products that could not be manufactured with existing electric furnaces. In addition, he stated that actions are required to support capital investment and operational costs as well as policies promoting the use of green steel products for Japan to compete internationally in green products. He also discussed the need to establish infrastructures for supplying decarbonized electricity and non-fossil fuels such as hydrogen and ammonia, and remarked that the government must take a leading role as the policymaker and promote DX as a national strategy, to use decarbonization as an opportunity to revive the Japanese economy.

➤ Agency for Natural Resourced and Energy: 56th Meeting of the Advisory Committee for Natural Resources and Energy's Strategic Policy Subcommittee (Japanese only)
(https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/2024/056/)

Participation in External Initiatives & Lectures

TCFD Consortium

The TCFD Consortium was established as a forum for companies that support the TCFD recommendations to collaborate in promoting its initiatives and continue discussions on effective disclosure of corporate information and ways for financial institutions to utilize the disclosed information to make appropriate investment decisions. JFE Holdings supports the recommendations of the final TCFD report and also participates in this consortium.

SPEED Research Group

The SPEED (Special Project on Eco-innovation and Eco-business for Sustainable Development) Research Group contributes to the development of eco-innovations and eco-businesses through industry-academia-government collaboration and international cooperation. JFE Holdings participates in this research group and is involved in activities such as information sharing and opinion exchange with government, universities, research institutions, and companies.

JFE Engineering Japan Climate Leaders' Partnership (JCLP)

JFE Engineering is a member of the Japan Climate Leaders' Partnership (JCLP). Established in 2009, the JCLP is a coalition of Japanese corporations that encourage the industrial community to fully recognize the urgency of climate change and take more decisive action to create a sustainable, decarbonized society. Companies fulfill their corporate responsibility by demonstrating leadership in the transition to a decarbonized society. The Company is participating in the Decarbonization Consortium, JCLP's platform for encouraging information sharing and collaboration between companies and is actively engaged in creating opportunities to learn from companies at the frontline of decarbonization efforts, and collaborating with other companies to create new solutions.

JFE Shoji United Nations Global Compact

In 2021, JFE Shoji became a signatory to the United Nations Global Compact, affirming its support for these principles. JFE Shoji will comply with the Ten Principles of the Global Compact and endeavor to achieve the SDGs. In addition, we are also a member of the Global Compact Network Japan, the local network of the Global Compact. The company has designated "Contribute to resolving climate change issues" as a material issue of corporate management. We are using the decarbonization initiatives of other participating companies as references for driving our own initiatives to reduce CO_2 emissions in the JFE Group and society as a whole.

Lectures and Publications

The JFE Group is gives talks at various events to increase awareness of our efforts to combat climate change.

- Lecture: "JFE Steel's Initiatives for Achieving Carbon Neutrality and the Challenges" at the Joint General Meeting of Okayama Employers' Association & Okayama Music Culture Association (main host: Okayama Employers' Association)
  Date: June 26, 2024
  Lecturer: Hiroyuki Tezuka (Fellow, JFE Steel Corporation)

- Article: "Chain of custody approaches in the steel sector and the role of GHG reduction certificates"
  Published on the website of the World Steel Association (Climate Action > Chain of Custody)
  Date of publication: April 8, 2024
  URL: https://worldsteel.org/climate-action/chain-of-custody/

- Lecture: "JFE Steel's Initiatives for Achieving Carbon Neutrality and the Challenges" at the Workshop for Students Tackling the Climate Change Issues (main host: the Executive Committee of the Workshop for Students Tackling the Climate Change Issues (chaired by Yukari Takamura, professor at the Institute for Future Initiatives, The University of Tokyo), co-hosts: the Ministry of the Environment, the University of Tokyo, the Tokyo Institute of Technology, Kyushu University, Keio University, and others)
  Date: March 13, 2024
  Lecturer: Hiroyuki Tezuka (Fellow, JFE Steel Corporation)

- Roundtable session: "IRA and GX Strategy: U.S.-Japan Partnership for a Net-Zero World"
  Main hosts: U.S. Embassy in Tokyo, U.S.-Japan Council, and the Institute of Energy Economics, Japan
  Date: March 3, 2024
  Lecturer: Hiroyuki Tezuka (Fellow, JFE Steel Corporation)

- Lecture: "JFE Steel Carbon Neutral Strategy Briefing—JFE's Approach for Green Steel at Low-Carbon Transition for the Built Environment" (hosts: IES/IStructE Joint Committee, NUS (National University of Singapore))
  Date: March 1, 2024
  Lecturer: Hiroyuki Tezuka (Fellow, JFE Steel Corporation)

- Lecture: "JFE Group's Carbon Neutral Strategy" at TECH+ Forum Manufacturing and Decarbonization Day 2024 Feb. (host: TECH+ Seminar Office of Mynavi Corporation)
  Date: February 15, 2024
  Lecturer: Seiya Kitajima (Senior Executive Officer, JFE Holdings, Inc.)

- Lecture: "JFE Group's Carbon Neutral Strategy" during the 16785th JPI Special Seminar (host: Japan Planning Institute)
  Date: February 14, 2024
  Lecturer: Seiya Kitajima (Senior Executive Officer, JFE Holdings, Inc.)

- Lecture: "JFE Group's Carbon Neutral Strategy" at the Carbon-Neutrality in Materials Industry Forum (host: Yano Research Institute Ltd.)
  Date: December 19, 2023
  Lecturer: Ikufumi Sumi (Leader, Global Environment Team, Green Transformation Strategy Dept., JFE Steel Corporation)

- Lecture: "JFE Group's Carbon Neutral Strategy" at the 2nd Support Seminar for Green Growth (host: Okayama Prefecture Industrial Promotion Foundation (public interest incorporated foundation))
  Date: December 19, 2023
  Lecturer: Noriaki Sueto (Business Planning Dept. Manager, JFE Holdings, Inc.)

- Lecture: "Latest Technology in Energy and Environment in the Steel Industry and Measures against Global Warming" in the Tokyo Institute of Technology's Advanced Course in Science and Technology—Advanced Science and Technology in Energy and Environment
  Date: December 13, 2023
  Lecturer: Ikufumi Sumi (Leader, Global Environment Group, Technology Planning Dept., JFE Steel Corporation)

- Lecture: Final report of the GX League's Working Group for Considering Added Value to Green Products
  Release date: December 4, 2023
  Publisher: Ministry of Economy, Trade and Industry
  URL: https://gx-league.go.jp/news/2023120401/ (Japanese only)

- Lecture: Guidelines for green steel upon the application of the mass balance approach, published under "Initiatives in the Steel Industry Green Steel" on the Japan Iron and Steel Federation's website
  Date of publication: October 26, 2023
  URL: https://www.jisf.or.jp/business/ondanka/kouken/greensteel/documents/2023_greensteel_guideline.pdf

- Lecture title: "JFE Group Environmental Vision for 2050—JFE's Approach for Green Steel"
  Event: GGX×TCFD Summit
  Date: October 5, 2023
  Lecturer: Hiroyuki Tezuka (Fellow, JFE Steel Corporation)

- Articles: "Carbon neutrality of Steel, the Fundamental Material—Full-Scale Transition to New Manufacturing Processes" (published in the September issue) and "Japan's First Monopile Manufacturing for Offshore Wind Power Generation by Maximizing Group Synergy" (published in the November issue)
  Produced through an interview by Masako Konishi (WWF Japan) for the "paint a future" section of the bimonthly magazine Chikyu Ondanka, published by Nippo Co., Ltd.)
  URLs: https://www.wwf.or.jp/activities/data/20230929_climate01.pdf (September issue)
  https://www.wwf.or.jp/activities/data/20231125climate01.pdf (November issue)

- Article: "LCA of Steel Materials and Initiatives for CO_2 Reduction" in the Journal of Chemical Engineering of Japan, June 2024, volume 088
  Author: Shiro Watakabe (Global Environment team, Green Transformation Planning Dept., JFE Steel Corporation)

Global Scale Initiatives

Global Actions to Address Global Warming

ISO 14404 is an international standard proposed by The Japan Iron and Steel Federation (JISF) to the International Organization for Standardization (ISO) as a methodology for the globally unified calculation of CO_2 intensity from iron and steel production, ultimately to assess the energy efficiency of steelworks. The Japanese steel industry is addressing global warming through international public-private collaborations, including ISO 14404-based assessment of steelworks in developing countries and recommending specific technologies best suited to India and ASEAN countries. It is continuing this effort together with the Ministry of Economy, Trade and Industry (METI) in order to enhance ISO 14404 so it can be applied to steel manufacturing facilities with more complex structures.

JFE Steel is also addressing global warming by participating in international activities, such as the Japan India Public and Private Collaborative Meeting, the Japan-ASEAN Steel Initiative and the Japan-China Steel Industries Exchange. In addition, JFE Steel is involved as a member of World Steel Association (WSA)'s Climate Action data collection programme, which uses ISO 14404 as the standard for measurement and calculation.

➤ WSA: Climate Action data collection programme
(https://worldsteel.org/steel-topics/environment-and-climate-change/climate-action/climate-action-data-collection/data-providers/)

■ **WSA Climate Action data collection programme certification**

WSA Climate Action Data Collection Programme—Contributing to Developing the LCA of Steel Material

Accurately evaluating the environmental impact of products requires assessment and quantification of impact over their entire life cycles, from raw resource mining to material production, product manufacture, use, and final disposal. Life cycle assessment (LCA) is one evaluation method.

After final products such as automobiles and buildings finish their mission in society, all of their steel components can be recycled and reused. This closed loop recycling ability is an excellent characteristic of steel materials. Taking this into account through LCA reveals that steel can be viewed as having extremely low environmental impact compared to other materials.

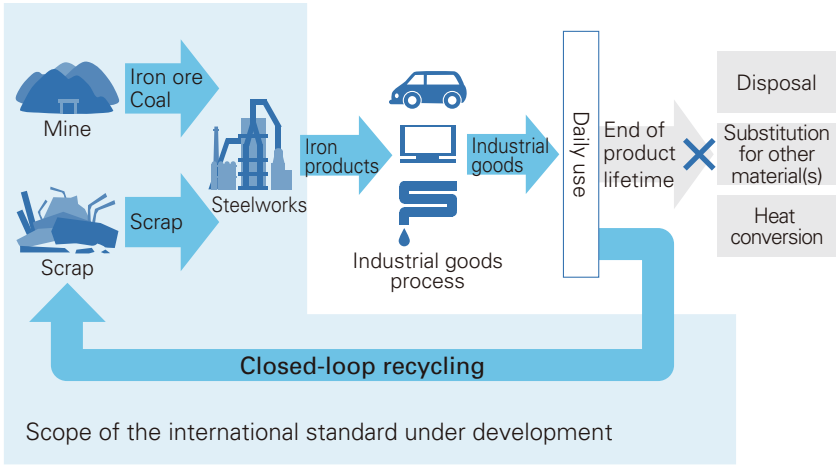
JFE Steel played a major role in the development of ISO 20915 (Life Cycle Inventory Calculation Methodology for Steel Products) and JIS Q 20915 (Life Cycle Inventory Calculation Methodology for Steel Products), initiatives led by The Japan Iron and Steel Federation (JISF), which takes into account the impact of recycling and provides life cycle inventory (LCI) calculation methods specific to steel products.

In addition, 15 Japanese manufacturers of blast furnaces and electric arc furnaces joined forces to calculate the Japanese average for LCI of different steel products. Calculations based on their FY2018 operational data were also published.

JFE Steel acquired SuMPO EPD labels, the Japan Environmental Product Declaration program run by the Sustainable Management Promotion Organization (SuMPO), for three steel sheet products for cans (tinplate, laminated steel sheet JFE Universal Brite, and tin-free steel), five building material products (H-beams, JFE Super HISLEND-H beams, extra-thick H beams, construction steel plates, and construction steel columns), three steel plate products (for offshore structures and wind power equipment, ship building, and UOE steel pipes), three steel pipes (welded steel pipe, seamless steel pipe, and Kakuhot™ seamless square steel pipe for building structures), and eight types of steel bar and wire rod products manufactured at the West Japan Works (Kurashiki district) and Sendai Works. We will continue to leverage SuMPO EPD labels to help customers promote environmental protection and to strengthen communications with them.

➤ Value of Steel (P.04)

■ Life Cycle of Steel Materials



Global Actions to Address Global Warming

1st Japan-Korea Green Steel Joint seminar

The 1st Japan-Korea Green Steel Joint Seminar was held in Seoul, South Korea, on Thursday September 21, 2023, jointly organized by the Japan Iron and Steel Federation and the Korea Iron and Steel Association. The seminar was attended by representatives from both countries, including Masaaki Izumiyama, Chairman of the Global Environment Committee of the Japan Iron and Steel Federation (Nippon Steel Corporation), and Byun Young-man, Vice Chairman of the Korea Iron and Steel Association, as well as guests of honor, including Daisuke Matsuno, Director of the Metals Division of the Ministry of Economy, Trade and Industry of Japan, and Oh Choong-jong, Director of the Metals and Ceramics Division of the Ministry of Trade, Industry and Energy of the Republic of Korea. Around 100 people from the steel industry and government organizations from both Japan and South Korea attended the seminar and exchanged opinions on wide-ranging topics related to carbon neutrality in the steel industry.

Japan India Public and Private Collaborative Meeting

The Japan Iron and Steel Federation has held the Japan-India Steel Industry Public-Private Collaborative Meeting annually since 2011 with support from the Ministry of Economy, Trade and Industry, and JFE Steel attends this meeting every year. At the meeting, we recommend policies to the Indian steel industry, drawing on the technology and experience of Japan's steel industry, which boasts the world's highest energy efficiency, and we also consider energy-saving support from Japan, including financial support.

The FY2023 meeting was held in Japan in November and introduced policies for achieving carbon neutrality in both Japan and India, initiatives by Japanese and Indian steel companies to achieve carbon neutrality, and efforts by the Japanese steel industry during the transition period, including green steel brands. JFE Steel will continue to play a major role in this meeting and contribute to CO_2 reduction in India by transferring Japanese energy-saving technologies.

Japan-ASEAN Steel Initiative

In May 2014, the Japan Iron and Steel Federation and the ASEAN Iron and Steel Council (AISC) signed a memorandum of understanding to promote regional collaboration the areas of the environment, standardization, and trade. The Japan-ASEAN Steel Initiative was launched as a public-private environmental effort to strengthen cooperation in environmental and energy-saving efforts in ASEAN countries. As part of its activities, the initiative developed a Technologies Customized List (electric arc furnaces) as well as a Technologies Customized List (blast furnaces), which include energy-saving, environmental protection, and recycling technologies for electric arc furnaces and blast furnaces suitable for the ASEAN steel industry.

This year, the ASEAN JAPAN Steel Initiative Webinar 2024 was held in February 2024. Representative organizations from ASEAN included ACE (ASEAN Centre for Energy), SEAISI (South East Asia Iron and Steel Institute), ministries and agencies related to steel and energy conservation in each country, as well as steel organizations and their members, while participants from Japan included the Ministry of Economy, Trade and Industry, the Energy Conservation Centre, the Japan Iron and Steel Federation, and members of these organizations. The meeting discussed initiatives for carbon neutrality in the steel industry in Japan and ASEAN countries, including the GX League, projects in emerging countries that contribute to energy efficiency, Japanese steel manufacturer roadmaps to carbon neutrality and energy-saving operational improvements, energy-saving technologies of engineering companies, and initiatives for carbon neutrality by Thai and Indonesian companies.

Japan-China Steel Industry Environmental Protection and Energy Conservation Technology Conference

This conference has been held since 2005, based on the memorandum of understanding that was signed at the Japan-China Steel Industry Environmental Protection and Energy Conservation Technology Conference, held in Beijing in July 2005 with the participation of top executives from both countries' steel industries. The purpose of the conference is to raise the level of environmental conservation and energy saving in both countries through information exchanges between technical experts from steel manufacturers in Japan and China. The importance of this conference has been growing as it helps to promote not only sound development of the steel industry in both countries but also the effective use of resources and environmental conservation.

The FY2023 event was held in Makuhari, Chiba City, in January 2024. Both countries shared innovative technology

developments for carbon neutrality, the Carbon Border Adjustment Mechanism (CBAM), the Green Steel/EPD Platform, and the latest energy-saving and CO_2 reduction technologies. JFE Steel's Vice President Hironori Fukushima (Chairman of the Japan Iron and Steel Federation's Environment and Energy Policy Committee) attended the meeting to represent Japan, along with JFE Steel's senior Executive Officer Takeshi Asahina and Fellow Hiroyuki Tezuka. They led lively discussions on preventing global warming through cooperation between the public and private sectors of both countries.

Lecture Events

The JFE Group provides lectures at various events to raise awareness overseas of our efforts to address climate change.

- Lecture: "Green steel with applying mass balance method" at the Korea-Japan Green Steel Joint Seminar
  Date: September 21, 2023
  Lecturer: Hiroyuki Tezuka (Fellow, JFE Steel Corporation)

- Lecture: "JFE Steel's Environmental Vision 2050" during the India-Japan Public and Private Collaborative Meeting on the Iron and Steel Industry in FY2023
  Date: November 29, 2023
  Lecturer: Shiro Watakabe (Global Environment Team, Green Transformation Planning Dept., JFE Steel Corporation)

- Lecture: "Transition Finance and Green Steel upon the Application of the mass Balance Approach" at the 14th Japan-China Steel Industry Environmental Protection and Energy Conservation Technology Conference
  Date: January 24, 2024
  Lecturer: Hiroyuki Tezuka (Fellow, JFE Steel Corporation)

- Lecture: "JFE Steel's Environmental Vision 2050"
  during the ASEAN Japan Steel Initiative (AJSI) Webinar
  Date: February 6, 2024
  Lecturer: Shiro Watakabe (Global Environment team, Green Transformation Planning Dept., JFE Steel Corporation)

Scenario Analysis in Line with the TCFD Recommendations

Initiatives

The JFE Group intends to achieve carbon neutrality by 2050, and it leverages the scenario analysis in line with the TCFD recommendations to **identify and assess climate change-related risks and opportunities and to strengthen the resilience of its organizational strategy**. Please refer to the Initiatives to Address Climate Change Issues page for governance, strategy, risk management, metrics, and targets for climate change-related issues in line with the TCFD recommendations.

➤ Initiatives to Address Climate Change Issues (P.52)

Milestones Related to Climate Change around JFE's Business and JFE's Initiatives

1997 Kyoto Protocol adopted at COP3 in Kyoto
2008 JISF's Voluntary Action Plan launched
2013 JISF's Commitment to a Low Carbon Society launched
2015 Paris Agreement adopted at COP21
2017 TCFD published the final report of its recommendations
2018 JISF announced the Long-term Vision for Climate Change Mitigation, Zero Carbon Steel
2019 **JFE Group announced its endorsement for the final report of the TCFD recommendations**
JFE Group published a scenario analysis in line with the TCFD recommendations
2020 Keidanren launched the Challenge Zero initiative
Ministry of Economy, Trade and Industry published a list entitled Companies Taking on the Zero-Emission Challenge
JFE Group published its targets in its medium- to long-term vision (target for 2030 and achieving carbon neutrality by 2050)
Prime Minister Suga declared Japan will achieve carbon neutrality by 2050
2021 JISF announced the Basic Policy of the Japan Steel Industry on 2050 Carbon Neutrality Aimed by the Japanese Government
JFE Group published its roadmap for achieving carbon neutrality in 2050 in the JFE Group Environmental Vision for 2050
Japanese government formulated the Green Growth Strategy Through Achieving Carbon Neutrality in 2050
2022 **JFE Group announced that the CO_2 emissions reduction target for FY2030 for JFE Steel has been revised upward to 30% or more compared to FY2013**
JISF published the "Evaluation of the Phase I Target (FY2020 Target)" and Phase II (FY2030 target) of reducing the total volume of energy-related CO_2 emissions by 30% in its "Activities to Combat Global Warming—Report of JISF's Carbon Neutrality Action Plan (Commitment to a Low Carbon Society) (March 2022)."
2023 The Act Concerning the Promotion of a Smooth Transition to a Decarbonized Economic Structure (the "GX Promotion Act") was enacted.

The Challenge Zero (Innovation Challenges Toward a Net Zero Carbon Society) is a new joint initiative by Keidanren (Japan Business Federation) and the Japanese government for proactively publicizing and supporting companies and organizations that pursue innovative actions toward realizing a decarbonized society as the long-term goal of the Paris Agreement.

The JFE Group endorses the Challenge Zero declaration and will rise to the challenge of pursuing innovation.

The Ministry of Economy, Trade and Industry (METI), in collaboration with Keidanren and the New Energy and Industrial Technology Development Organization (NEDO), has been tackling a project called the Zero-Emission Challenge. The project is preparing a list of companies generating innovation toward realizing a decarbonized society and providing investors and other stakeholders with useful information on them. At the TCFD Summit 2021 on October 5, 2021, approximately 600 companies, both listed and unlisted, were announced as Zero Emissions Challenge Companies. These organizations are boldly accepting the challenge of innovation to realize a decarbonized society, and the JFE Group was selected as one of them.

The JFE Group publishes information on specific initiatives through the following website.

➤ Challenge Zero (https://www.challenge-zero.jp/en/member/34)

➤ Zero-Emission Challenge (https://www.meti.go.jp/english/press/2021/1005_002.html)

Scenario Analysis

Tools and Methods

Scenario analysis is used to portray an accurate understanding of climate-related risks and opportunities and assess implications to the current business strategy, thereby enabling an organization to establish strategies that reflect the results of the assessment. As our business could be significantly affected by climate change, we have created both a 2°C scenario and a 4°C scenario. In FY2022, we expanded the scope to also include a 1.5°C scenario.

All three scenarios are based on those developed by the International Energy Agency (IEA). Analysis was conducted under the assumption that uniform carbon pricing is implemented by major emitting countries to increase the feasibility of achieving the 1.5°C target. Under the long-term scenario analysis, our goal is to achieve carbon neutrality by 2050. We conducted risk assessments that take into account the prospect of achieving the 2°C scenario and the necessity of ultra-innovative technology for the 1.5°C scenario (IPCC 1.5°C Special Report) in steelmaking for carbon neutrality by 2050.

<table>
<tr><th colspan="2">Selected Scenario</th><th>1.5/2°C Scenario</th><th>4°C Scenario</th></tr>
<tr><td rowspan="2">Reference Scenario</td><td>Transition Risks</td><td>Transition scenarios developed by the IEA
· Sustainable Development Scenario (SDS)*1
· 2°C Scenario (2DS)*2
· IPCC Special Report on Global Warming of 1.5°C
· NZE2050*3</td><td>Transition scenarios developed by the IEA
· New Policies Scenario (NPS)*1
· Reference Technology Scenario (RTS)*2</td></tr>
<tr><td>Physical Risk</td><td colspan="2">Climate change projection scenario developed by the Intergovernmental Panel on Climate Change (IPCC)
· Representative Concentration Pathways (RCP) Scenario*4</td></tr>
<tr><td colspan="2">How Society will Look</td><td>Dynamic policies will be adopted and technical innovations will progress to limit the average temperature rise by the end of this century to 2°C and realize sustainable development.
Assume a society in which our business is affected by social changes accompanying transition to a decarbonized society.
· Worldwide/industry-wide uniform carbon pricing*5
· Increase in the ratio of sales of electric vehicles to overall vehicle sales</td><td>Despite new policies implemented in each country based on approaches under the Paris Agreement, the average temperature will rise by about 4°C by the end of this century.
Assume a society in which our business is affected by temperature rise and other climate change.
· Increase in the occurrence of flooding
· Sea level rise</td></tr>
</table>

*1 Source: IEA's World Energy Outlook 2018

*2 Source: IEA's Energy Technology Perspectives 2017

*3 Source: IEA's Net Zero by 2050—A Roadmap for the Global Energy Sector

*4 Source: IPCC Fifth Assessment Report

*5 When carbon pricing differs from country to country, a gap opens in international competitiveness between countries that impose strict CO_2 emissions regulations and those with less strict regulations. This will result in carbon leakage where CO_2 emissions of a strict climate policy country are reduced as production and investment decline while production and investment increase in other countries with laxer emission constraints, thereby increasing their nations' CO_2 emissions. One reference scenario, SDS, assumes the implementation of carbon pricing in developed countries and some developing countries. We took this into account in formulating the 2°C scenario based on the assumption that uniform carbon pricing is introduced to major emitting countries to push toward achieving the 2°C scenario target.

Scope of Business and Period for Analysis

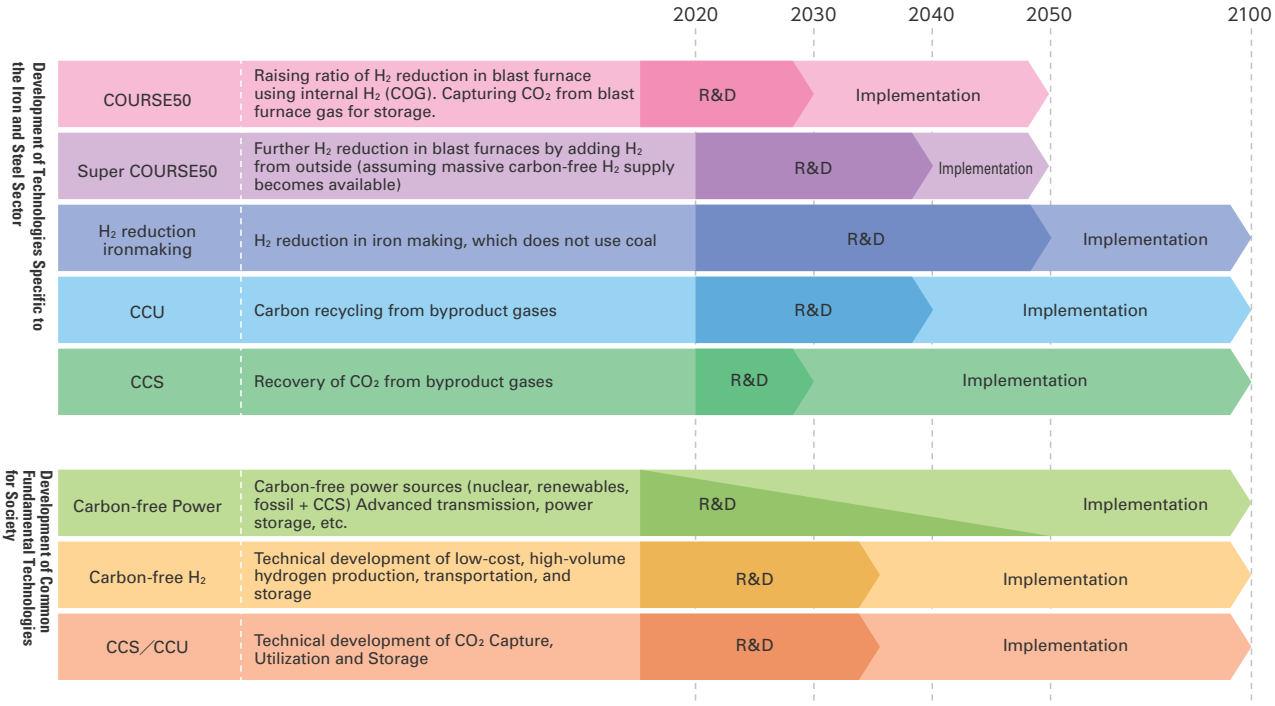
This analysis covers the following businesses: the steel business by JFE Steel, the engineering business by JFE Engineering, the trading business by JFE Shoji, and businesses carried out by some of the other Group companies. The period covered is up to 2050.

Relevance with the JISF's Long-term Vision for Climate Change Mitigation

The Japan Iron and Steel Federation (JISF) has been working toward its Commitment to a Low Carbon Society, and Phase I of this initiative ended in FY2020. From FY2021, the effort was rebranded as the Carbon Neutrality Action Plan, and the Phase II target (FY2030 target) was revised. In November 2018, the JISF also formulated and published the Long-term Vision for Climate Change Mitigation for 2030 and beyond. JFE Steel played a central role in the formulation of this long-term vision. The vision represents the industry's challenge toward realizing zero-carbon steel and lays out the prospect of achieving the 2°C scenario for steelmaking and necessity of ultra-innovative technologies to achieve the 1.5°C scenario. Furthermore, on February 15, 2021, the JISF announced the "Basic Policy of the Japan Steel Industry on 2050 Carbon Neutrality Aimed by the Japanese Government," which declares that the Japanese iron and steel industry will boldly accept the challenge of realizing zero-carbon steel.

The JFE Group's scenario analysis is intended to ensure resiliency in our Group's business strategy during the intermediate stages of these long-term challenges.

■ **Efforts to Achieve Zero Carbon Steel**



➤ JIFS: Challenges towards Carbon Neutrality (https://www.carbon-neutral-steel.com/en/)

Process to Identify Key Factors that Impact the Business

STEP 1: Examine the entire value chain from a holistic perspective and sort out factors that impact the businesses under analysis (for more information on risks and opportunities in the value chain, refer to:
➤ JFE Group Value Chain (P. 26)

STEP 2: Examine all factors at an overview level and identify key factors by taking into account the level of impact and stakeholder expectations and concerns

	1.5/2°C Scenario	4°C Scenario
Impact on Procurement		5. Unstable raw materials procurement due to increased occurrence of climatic hazards
Impact on Direct Operation	1. Decarbonization of iron and steelmaking process 2. Increased needs for effective utilization of steel scrap	6. Damage to production bases and offices caused by climatic hazards
Impact on Product and Service Demand	3. Change in demand for automotive steel, etc. 4. Increase in demand for solutions to enhance decarbonization	7. National resilience

Level of Impact × **Expectations and concerns of stakeholders** → **Axis for identifying key factors**

Axis for identifying key factors:
- Level of impact (possibility of risks and opportunities arising × Level of impact if manifested)
- Expectations and concerns of stakeholders

Results of Scenario Analysis

Climate change is a critical concern from the perspective of business continuity for JFE Group management. Our steel business, which emits 99.9% of the Group's total CO_2 emissions, has been developing technologies for saving energy and reducing CO_2 emissions. We have actively addressed the risks by applying these technologies to steel manufacturing. We will continue to develop processes to further reduce environmental impact while at the same time seeking to turn this challenge into an opportunity for addressing climate change by deploying the technologies we have fostered across the globe.

The JFE Group has developed and maintained a variety of eco-friendly products and technologies, including high-performance steel materials that help save energy when customers use them, as well as renewable energy power generation. We view the current challenges as an opportunity and are contributing to addressing climate change. As automobiles in general become lighter in weight along with the broader adoption of electric vehicles, we will support the transition by improving the functions of the JFE Group's high tensile strength steel sheets and electrical steel sheets. In addition, we will help reduce CO_2 emissions in society by further disseminating renewable energies and implementing recycling initiatives as well as energy conservation.

To achieve the long-term goal of the Paris Agreement of keeping the global average temperature increase well below 2°C compared to pre-industrial levels and to strive to limit it more strictly to 1.5°C, the Group will continue to develop and disseminate innovative technologies and contribute to the prevention of global warming. We will also support national resilience by providing steel for social infrastructure and construction to address the emerging risks associated with the growing severity of meteorological disasters.

Analysis Results

	Changes in Society	Risks/Opportunities		Expectations and Concerns of Stakeholders for the JFE Group	Strategies/Initiatives	Financial Impact (Estimate for 2030)*	
						Details	Amount/Scale
1.5/2°C Scenario Key Factor ❶ **Decarbonization of Iron and Steelmaking Process**	Increasing social demand for decarbonized iron and steelmaking process	Implement innovative technology to realize decarbonization at a large scale	Opportunity	JFE will lead in the business of supplying steel materials with high environmental value by implementing innovative technologies such as electric arc furnaces	• Deploy existing low-carbon technologies • Introduce large-scale electric arc furnaces capable of manufacturing high-quality steel • Increase use of low-carbon direct reduced iron • Develop and implement innovative technologies • Conduct studies for the practical application of CCUS • Expand supply capacity for JGreeX™ • Lobby to create demand for steel materials with high environmental value • Collaborate with companies in the JISF to promote steel materials with high environmental value	Increased sales of steel materials for their environmental added value	+120 to 150 billion yen per year
			Transition risk	More investment will be needed to implement innovative technologies	• Strengthen the revenue base • Secure funds for investment/technological development • Lobby for government support • Expand sales of JGreeX™	GX-related investment amount between 2023–2030	Approx. −700 billion yen
		Introduction of carbon pricing	Transition risk	• Financial burden will increase due to carbon pricing • Emission reduction targets will be more aggressive and stricter due to environmental changes	• Establish reliable CN technologies • Engage with policymakers to achieve CN	Increased carbon pricing burden	For every 1% reduction in emissions not achieved −10 billion yen per year
1.5/2°C Scenario Key Factor ❷ **Increased Needs for Effective Utilization of Steel Scrap**	Increasing interest for electric arc furnace method for its lower CO_2 emissions	Higher competition and prices for cold iron sources (scrap and reduced iron)	Transition risk	The cost of purchasing cold iron sources will increase	• Collaborate with customers/users to collect scraps • Establish technologies for using low-grade/difficult-to-use scrap • Participate in the reduced iron supply chain project • Expand scrap trading volume • Reduce manufacturing cost • Pass the cost to steel product prices	Increased cost of purchasing cold iron sources	Up to approx. −50 billion yen per year
		Increased electricity demand due to switching from blast furnace process to electric arc furnace process	Transition risk	Manufacturing cost will rise due to increased electricity usage (using more electricity and generating less by-product gas)	• Reduce manufacturing cost • Pass the cost to sale prices • Secure a stable supply of electricity • Lobby for steel product prices	Increased manufacturing cost due to switching processes (increase in electricity usage is equivalent to 0.5 nuclear power plant output)	Confidential for business reasons
1.5/2°C Scenario Key Factor ❸ **Change in Demand for Automotive Steel**	Shift in demand for automobiles	Changes in the product mix due to EV production, etc.	Opportunity	Sales will increase for electrical steel sheets used in EV motors	• Strengthen production capacity for electrical steel sheets • Establish processing bases and supply chain structure for steel sheets globally	Increased sales of electrical steel sheets	Confidential for business reasons
			Opportunity	Sales will increase for high-tensile steel due to improved collision safety performance	• Increase production capacity for high-tensile steel sheets	Increased sales of high-tensile steel sheets	
			Transition risk	Sales will decrease for steel materials due to a shift away from internal combustion engines and a shift toward using multi materials	• Develop high-performance products	Decreased sales of steel sheets for automobiles	Minimal impact
1.5/2°C Scenario Key Factor ❹ **Increase in Demand for Solutions to Enhance Decarbonization**	Transition to decarbonized society	Increase in demand for decarbonization solutions businesses	Opportunity	Renewable energy-related businesses will expand	• Expand the business undertaking the entire construction and operation of renewable energy power plants (biomass, geothermal, solar, offshore wind, etc.)	Sales of JFE Engineering's CN-related business	Approx. 200 billion yen per year
			Opportunity	Business of disseminating eco solutions (advanced energy-saving technologies developed and applied in Japan) to developing countries will expand	• Solutions business for low-carbon steelmaking technologies	Increased sales of overseas solutions business	Under assessment
4°C Scenario Key Factor ❺ **Unstable Raw Materials Procurement due to Increased Occurrence of Climatic Hazards**	Increasingly devastating climate hazards caused by temperature rise	Raw materials procurement becomes unstable	Physical risk	• Sales will decrease due to reduced production • Raw material cost will increase	• Establish alternative procurement and dispersed supplier bases, engage in stockpiling • Acquire raw material rights	Decreased sales of steel materials due to raw material shortages	For every 1% decrease in annual sales volume Approx. −30 billion yen/year
4°C Scenario Key Factor ❻ **Damage to Production Bases and Offices Caused by Climatic Hazards**	Increasingly devastating climate hazards caused by temperature rise	Damage to manufacturing bases from typhoons, heavy rain, and droughts	Physical risk	Sales will decrease due to reduced production	• Implement measures against flood and drought damage at manufacturing bases	Decreased production and sales due to flood and drought	No impact, as measures have already been taken
4°C Scenario Key Factor ❼ **National Resilience**	Increasingly devastating climate hazards caused by temperature rise	Strengthen infrastructures and disaster resiliency	Opportunity	Infrastructure reinforcement orders will increase	• Strengthen infrastructure reinforcement-related businesses in Japan and overseas • Strengthen sales of infrastructure-related steel materials	Increased sales of JFE Engineering's infrastructure construction business	Difficult to calculate at this point

Note: Assessment results are estimated outcomes based on scenario analysis and do not represent actual performance.

Overview of Scenario Analysis Assessment and JFE Group's Focus

Timeframe: short term (2024) ⇒until 2024, medium term (2030) ⇒until 2030, long term (2050) ⇒until 2050 (final)

FOCUS Key Factor (1) Decarbonization of Iron and Steelmaking Process

Supply steel materials with high environmental value through implementation of innovative technologies such as electric arc furnaces

Short term (2024) Medium term (2030)

JFE Steel has been committed to developing energy-saving technologies toward increasing the efficiency of the iron and steelmaking process and decarbonization. These initiatives have helped JFE Steel acquire technologies that realize the world's top energy efficiency in iron and steelmaking. Taking advantage of the increasing public demand for decarbonized iron and steelmaking processes, we will deploy these low-carbon technologies at each of our steelworks and expand our capacity to supply steel products with high environmental value that are manufactured using these technologies. The rising worldwide support for decarbonization is expected to drive greater demand for low-CO_2 emission steel products, such as in the automobile industry, where CO_2 emissions must be managed throughout the supply chain. In the IEA's Net Zero Emissions by 2050 Scenario (NZE), the share of steel production using electric arc furnaces is expected to increase to 37% by 2030 and 53% by 2050. Since steel production using electric arc furnaces emits less CO_2 than using blast furnaces, customer demand may shift to products manufactured using the former. During the transition period, we are considering the introduction of large-scale electric arc furnaces capable of producing high-performance, high-quality steel materials that could only be made previously using the blast furnace process. In addition to meet customer needs for products that reduce environmental impact, in the first half of FY2023 JFE Steel began supplying JGreeX™, a brand of green steel products that significantly reduce CO_2 emissions in the steel manufacturing process compared to conventional products. At present, it is difficult to immediately supply green steel products with significantly lower or zero emissions, so the reductions created by our technologies are allocated to any steel products by applying the mass balance method and then supplied as green steel products. Reduction of CO_2 throughout the supply chain is rapidly progressing and JFE Steel will contribute to the decarbonization of society by expanding its capacity for supplying JGreeX™ and further reducing CO_2 emissions through the use of advanced low-carbon technologies as well as energy-saving, high-efficiency technologies.

Moreover, further progress in these initiatives will depend on gaining broader recognition of the environmental value of these steel materials. We are also actively lobbying to boost demand for steel materials with high environmental value.

Long term (2050)

In the long term, we will develop carbon-recycling blast furnaces (CR blast furnaces), hydrogen steelmaking, and electric arc furnaces while striving to achieve carbon neutrality by 2050, as stated in the JFE Group Environmental Vision for 2050. In particular, we have been focusing on a technology that combines a CR blast furnace with CCU. This is an ultra-innovative technology that targets net zero CO_2 emissions by drastically reducing CO_2 emissions from the blast furnace process, maximizing its ability to efficiently produce high-grade steel in mass volume, and enabling CO_2 reuse in the blast furnace. The remaining CO_2 that cannot be fully reused in the furnace will be further reduced by manufacturing basic chemicals such as methanol.

More investment needed to implement innovative technologies

Short term (2024) Medium term (2030)

The investment need to implement innovative technologies such as electric arc furnaces presents a risk. In order to achieve the CO_2 reduction target for FY2030, we are assuming that investment and financing on a scale of 1 trillion yen may be required, and we have approved approximately 300 billion yen from FY2021 to FY2023. We are working to strengthen our revenue base, carry out research and development using the Green Innovation Fund and other sources, lobby for government support, and expand sales of JGreeX™ to continue making these capital investments.

Long term (2050)

International expectations have been rising for organizations to seek pathways for achieving the 1.5°C scenario. We believe the necessary actions are not significantly different from the 2°C scenario. In the 1.5°C scenario, however, the development and implementation of decarbonizing technologies would need to further accelerate, requiring significantly more R&D costs and capital investment. A public infrastructure capable of supplying cheap and ample green hydrogen and electricity would also need to be in place. We believe that addressing these issues will require more support from the government and collaboration across society, including a mechanism for broadly sharing the financial burden and a long-term government strategy for supplying green hydrogen and electricity.

Financial burden will increase due to carbon pricing, and emission reductions targets will be more aggressive and stricter due to environmental changes

Short term (2024) Medium term (2030) Long term (2050)

Various approaches to carbon pricing have been introduced around the world, and in Japan, emissions trading and the introduction of growth-oriented carbon pricing are being discussed in line with the GX Promotion Law for achieving carbon neutrality by 2050. In Europe, the introduction of a border adjustment tax (CBAM regulation) is being discussed, and ahead of its full application from 2026, the transitional phase started on October 1, 2023, in which reporting obligations are imposed on importers of goods in scope. Countries are taking different approaches to pricing carbon, and the scope of the levies also differ. While carbon pricing still involves many moving parts, we need to closely monitor future trends and consider the impact of these changes. On the other hand, we also believe that carbon pricing could be an important system for ensuring that steel products with environmental value are properly evaluated worldwide. We are recommending that the government takes steps to ensure that the system is appropriately designed.

FOCUS Key Factor (2) Increased Need for Effective Utilization of Steel Scrap

Cost of purchasing cold iron sources (scrap/reduced iron) will increase

Short term (2024) Medium term (2030) Long term (2050)

There is a growing interest in the electric arc furnace process because of its low carbon footprint, and its adoption is progressing worldwide. Even as the JFE Group takes full advantage of its electric arc furnaces, it is installing these furnaces at the Chiba District of the East Japan Works and also considering installing a large electric arc furnace at the Kurashiki district of the West Japan Works. We expect that demand for cold iron sources (scrap and reduced iron) will increase, and there is a risk it will become difficult to procure the cold iron sources necessary to maintain the quality of steel and maintain production. To this end, we are working to ensure a stable supply by collecting high-grade scrap generated by our customers and developing technologies for using low-grade or difficult-to-use scrap. In addition, we are striving to ensure the stable procurement of direct reduced iron through our participation in the reduced iron supply chain project with Emirates Steel.

Manufacturing cost will increase due to converting from blast furnace process to electric arc furnace process

Short term (2024) Medium term (2030) Long term (2050)

Converting from the blast furnace process to an electric arc furnace requires a lot of electricity. In addition to the electricity needed to melt the cold iron source in the electric furnace, more will be needed to make up for the heat from the by-product gas of the blast furnace, which currently is the main source of heat for the reheat furnaces and other processes in the steelworks. Consequently, we need a power infrastructure that can stably provide a large amount of electricity at competitive prices. We are actively making recommendations to policymakers with the aim of meeting these needs.

FOCUS Key Factor (3) Change in Demand for Automotive Steel

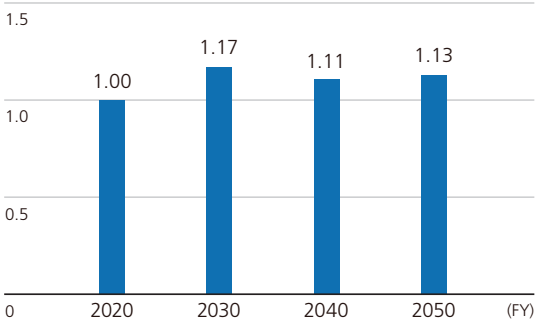
Changes in the product mix due to EV production and other factors

Short term (2024) Medium term (2030) Long term (2050)

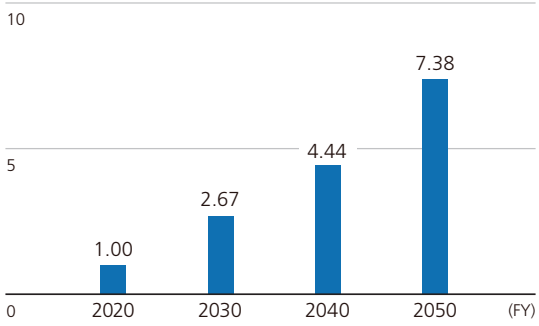
As electric vehicles become more widely adopted, we expect to see changes in the types of steel materials required for automobiles. Demand for electrical steel sheets used in EV motors is rapidly expanding, and we expect changes in the product mix of steel materials, such as materials to offset the increased weight of batteries and stronger frames to protect them. The JFE Group has decided to take advantage of this trend by strengthening our production capacity for electrical steel sheets, and we are currently tripling production capacity for non-oriented electrical steel sheets at the Kurashiki district of the West Japan Works. In addition, JFE Steel has developed a cold-rolled steel sheet boasting 1.5 GPa-grade tensile strength as an eco-product and has put it into practical use as an automotive steel sheet. Furthermore, it has developed a multi-material structure that uses a small amount of fiber resin to maximize steel quality. In this new structure, a highly ductile, strong adhesive resin is sandwiched between a body part made of an ultra-high strength steel plate and a part made of a thin steel plate. This structure is capable of further reducing the weight of automobile frame parts and also improving collision safety performance. We will continue developing and proposing various products and technologies that meet customer needs.

In the meantime, aluminum and carbon fiber reinforced plastic are potential alternative materials for reducing the weight of cars. It has been pointed out, however, that the production cost of these materials and the amount of CO_2 emitted throughout their life cycles is higher than those of steel. Therefore, under the 2°C scenario, which assumes the introduction of a carbon pricing whereby the price differential between steel and alternative materials will be larger. Under this scenario, while the trend of using multi-materials may show some progress for luxury cars, their use would be limited for economy cars. Moreover, considering a situation in which all panels used for doors and other parts of a luxury car were changed to aluminum, the effect on weight reduction could be expected to be 5% of all materials used in luxury and economy cars together.

■ Estimated World Demand for Automotive Special Steel



■ Estimated World Demand for Automotive Electrical Steel Sheets



Vertical axis: Steel demand (comparison by year with the year 2020 as 1.00)
Source: Estimated by JFE Holdings based on the reports from METI's Strategic Commission for the New Era of Automobiles

FOCUS Key Factor (4) Increase in Demand for Solutions to Enhance Decarbonization

Increase in demand for decarbonization solution businesses

Renewable Energy Power Generation Short term (2024) Medium term (2030) Long term (2050)

Demand for power generation plants using non-carbon emitting renewable energies is expected to increase. The JFE Group engages in designing, procuring, constructing, and operating biomass power generation*1, geothermal power generation*2, solar power generation*3, and onshore wind power generation plants in its engineering domain.

We will also focus on offshore wind power generation, which the Japanese government has positioned as one pillar of its Green Growth Strategy to achieve carbon neutrality by 2050. Specifically, we plan to manufacture and market monopiles and other seabed-fixed structures with JFE Engineering as the main driver. JFE Engineering has completed the construction of a

monopile manufacturing plant, where operations commenced in April 2024*4.

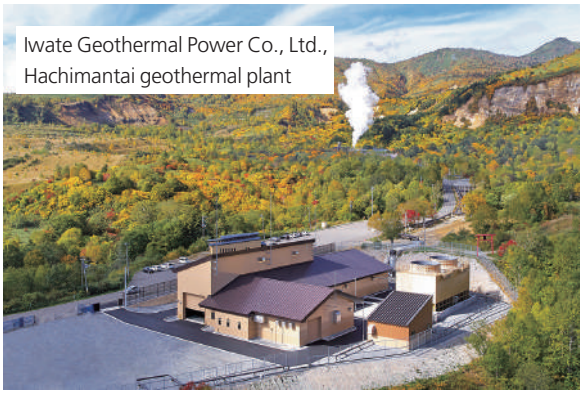
JFE Steel will contribute by increasing the supply of large and heavy steel plates, and JFE Shoji will assist by establishing SCM, which includes information sharing with Taiwan, a leader in offshore wind power generation, and East and Southeast Asian countries, where demand is expected to expand. We will also focus on O&M*5 to fully deploy Group resources.

Furthermore, from the perspectives of the effective use and recycling of resources, we are taking action to increase power output at waste processing facilities. JFE Engineering is developing a fully automated operation*6 to facilitate higher power output at waste incinerators (introduced to 12 facilities by FY2023, and will be gradually expanded to 16 facilities).

Moreover, we are utilizing renewable energy as the main power source for our retail electricity business*7, and in helping to establish and operate regional electricity retail companies*8, we focus on local production and consumption of electricity based on renewable energy. By FY2023, we have helped 8 locations establish and operate their regional electricity companies. In FY2024, we plan to do the same for 1 location, and in FY2030 for around 15 locations.

(Contribution to CO_2 reduction resulting from renewable energy power generation/recycling/etc.: FY2020: 9.65 million tonnes per year → FY2024: 12 million tonnes per year → FY2030: 20 million tonnes per year)

Waste-to-energy power generation plant



Geothermal power generation plant

➤ *1 The JFE Engineering Corporation's biomass power generation (Japanese only) (https://www.jfe-eng.co.jp/products/power/ele07.html)
➤ *2 The JFE Engineering Corporation's geothermal power generation plant (https://www.jfe-eng.co.jp/en/products/power/gene01.html)
➤ *3 The JFE Engineering's solar power generation (Japanese only) (https://www.jfe-eng.co.jp/products/power/ele05.html)
The JFE Technos Corporation's solar power generation (Japanese only) (https://www.jfe-technos.co.jp/products/solar/)
➤ *4 Completion of Japan's first manufacturing base of fixed-bottom foundation (monopile) for offshore wind turbines (https://www.jfe-eng.co.jp/en/news/2024/20240401.html)

*5 Operation and maintenance business

➤ *6 JFE Engineering's BRA-ING Pre-release (Japanese only) (https://www.jfe-eng.co.jp/news/2020/20200727.html)
➤ *7 Urban Energy Corporation's electricity retail business (Japanese only) (https://u-energy.jp/service/retail.html)
➤ *8 Urban Energy Corporation's regional electric power support business, targeting local governments (Japanese only) (https://u-energy.jp/service/municipality.html)
Establishing regional electricity retail companies in partnership with local municipal governments (CSR Report 2022, P. 116) (https://www.jfe-holdings.co.jp/en/common/pdf/sustainability/data/2022/csr2022e.pdf)

Multisite Energy Total Service

Short term (2024) Medium term (2030) Long term (2050)

In addition to the conventional service of optimizing energy use for single sites, JFE Engineering offers the Multisite Energy Total Service (JFE-METS)*, which optimizes energy use for multiple sites through centralized management. We realize overall energy savings and CO_2 reduction by analyzing energy consumption at multiple sites and achieving total optimization by installing and operating energy-related equipment at each site to circulate energy throughout the network, including remote locations.

➤ *The JFE Engineering Corporation's JFE-METS (Japanese only) (https://www.jfe-eng.co.jp/news/2019/PDF/20200130.pdf)

Recycling Business

Short term (2024) Medium term (2030) Long term (2050)

We are striving to reduce the use of new fossil fuel-derived materials by recycling waste plastic and food waste. In waste plastic recycling, in addition to the conventional recycling of plastic containers and packaging, we are actively engaged in the so-called bottle-to-bottle business, in which used PET bottles are recycled into new ones. We have completed the construction of the PET bottle recycling raw material manufacturing plant (West Japan PET Bottle MR center), and full-scale commercial operations have begun. The plant recycles approximately 10% of the total number of PET bottles shipped nationwide, demonstrating a complete resource recycling model for reducing CO_2 emissions. In food recycling, we generate methane gas from disposed food wastes to create renewable energy (fuel gas and electricity). JFE Engineering manages the engineering, procurement, and construction of recycling plants, while J&T Recycling Corporation manages the operation and business development of the plants*.

Industry-wide decarbonization cannot be achieved through technical developments in manufacturing alone. We therefore believe that demand for CCU and CCS facilities will increase as they facilitate the efficient use and storage of CO_2. JFE Engineering is able to undertake the entire process of building CCU and CCS facilities from design and procurement to construction.

➤ *JFE Engineering and J&T Recycling Corporation's Recycling (Japanese only) (https://www.jt-kankyo.co.jp/business/)

Solution Business for Low-Carbon Steelmaking Technologies

Short term (2024) Medium term (2030) Long term (2050)

From the perspective of the steel industry, there is room for disseminating eco solutions (energy-saving steel technologies) in nations such as China, where close to 50% of the world's crude steel is produced, and India and ASEAN countries, where further growth in production is expected. The potential CO_2 reduction achieved by internationally transferring and disseminating advanced energy-saving technologies widely used in Japan will exceed 400 million t-CO_2 worldwide (Japan is estimated to contribute to the reduction of approximately 80 million t-CO_2 in FY2030 through these technologies). JFE Steel launched a solutions-business brand, JFE Resolus™ , to provide solutions to a wide range of customers, including those outside the steel industry, based on manufacturing and operation technologies that JFE Steel has cultivated over many years in its steelmaking operations. Going forward, as the business environment and markets continue to undergo drastic change, JFE Steel will steadily enhance its proprietary technologies and, now under the JFE Resolus™ brand, offer customers the JFE Group's advanced technologies and know-how as solutions for mutual growth and development.

➤ JFE Steel's Solution Business (https://www.jfe-steel.co.jp/en/products/solution/)

FOCUS Key Factor (5) Unstable Raw Material Procurement due to Increased Occurrence of Climatic Hazards

Unstable material procurement

Short term (2024) Medium term (2030) Long term (2050)

In Australia, our major source country for raw materials, the frequency of typhoons is predicted to double. If production and shipments are disrupted in Australia for too long, there is no avoiding the impact on production, and depending on the situation, there is a risk that sales of steel materials will be impacted by a depletion of raw material stocks. To address this, we are promoting alternative procurement and dispersed supplier bases, stockpiling, and acquisition of raw material rights.

Alternative procurement, dispersed supplier bases, and stockpiling

Respond to disaster by carrying out spot procurement from China's port stocks, increasing procurement from closer source countries such as Indonesia and front-loading the purchase and/or increasing the purchase contract of different brands from outposts in unaffected regions of Australia. Also, use the stock and external yard of the Group company Philippine Sinter Corporation.

The decarbonization in the steelmaking process is expected to lead to a diversification of the required raw materials. We will take into account the risk of climate change for these materials as well and work to establish diversified procurement sources.

FOCUS Key Factor (6) Damage to Production Bases and Offices Caused by Climatic Hazards

Damage to manufacturing bases from typhoons, heavy rain, and drought

Short term (2024) Medium term (2030) Long term (2050)

We are taking action to minimize damage under the assumption that typhoons and heavy rains will become stronger and that the occurrence of disasters comparable to the torrential rain in western Japan in 2018 will rise. We have currently invested approximately 6.5 billion yen for disaster prevention at steelworks and strengthened drainage facilities and other assets. About 3.5 billion yen of separate investment has already been made to prepare for water shortages at steelworks by installing desalination facilities at some of them. Although no severe drought disaster has struck since 1994, we are preparing to minimize any damage, even if the frequency of occurrence should increase.

All steelworks are exposed to the risk of floods associated with rising sea levels because of their location in coastal areas. The estimated sea level rise by 2050 is 20 to 30 cm (70 cm by 2100 if the impact of climate change manifests itself at the highest level). We believe that current measures against storm surge, which generates more sea level rise, are sufficient to address the risk. However, we will continue analyzing climatic hazards going forward to prepare for the changing circumstances.

FOCUS Key Factor (7) National Resilience

Strengthened infrastructure and disaster measures

Short term (2024) Medium term (2030) Long term (2050)

The JFE Group takes seriously the increased frequency and severity of recent climatic hazards in Japan and overseas. Having one's daily life put in danger is a huge risk. It is our mission to promote disaster prevention and mitigation as well as national resilience to maintain vital infrastructure that is essential to daily life and economic activities.

Drawing upon its collective strengths, the JFE Group is able to contribute in many ways, such as by protecting key structures from earthquakes using structural steel such as high-strength H-shaped steel and steel pipe piles as well as steel sheet piles, reinforcing embankments that are prone to bursting, and providing disaster prevention products such as hybrid tide embankments and permeable steel slit dams. JFE Engineering is also able to handle a wide range of infrastructure construction projects, including bridges, gas, water and sewage, and pipelines.

➤ Hybrid Tide Embankments (P.81)
➤ Permeable Steel Slit Dams (P.82)
➤ Terre Armée Method (P.82)

Links to information about the JFE Group Environmental Vision for 2050 and Climate Change Scenario Analysis
Commitment to a Low Carbon Society: Policy Engagement (P. 90)
Targets and Results Related to Climate Change: Material Issues of Corporate Management and KPIs (P. 18)
Initiatives on Climate Change: Initiatives to Address Climate Change Issues (P. 52)
Technologies and Products Related to Reducing: Development and Provision of Eco-friendly Processes and Products (P. 135)

Realizing a Recycling-Oriented Society

Basic Policy

Economic growth in emerging countries is intensifying the need to conserve non-renewable resources. Iron can easily be separated and is thus highly recyclable. It can be recycled and reused to make other steel products infinite times (closed-loop recycling). The JFE Group is leveraging each Group company's strengths to enhance resource recycling through recycling co-products from iron and steelmaking, reducing waste at construction sites, and promoting the global recycling of steel scrap. We continue to pursue efficient uses of resources in both the production and product/service phases of its businesses, through steel scrap recycling, biomass fuel production and waste-to-energy power generation.

The JFE Group uses large quantities of fresh water for cooling and cleansing products and facilities in its core business of steel manufacturing. For this reason, the efficient use of water resources with due consideration to the source of the water and stakeholders in the area is a key challenge. In response, we have established a system for reducing water intake by maximizing the use of recycled water at our steelworks.

System

The JFE Group Environmental Committee, chaired by the president of JFE Holdings and operating under the JFE Group Sustainability Council, sets goals for environmental protection, monitors the progress of these initiatives and works to improve the Group's overall environmental performance. Key issues for corporate management such as climate change are deliberated at the Group Management Strategy Committee as well and reported to the Board of Directors. The board oversees environmental challenges by discussing the reported material. Additionally, specialized committees set up by JFE Group operating companies and affiliates implement specific activities.

➤ Framework for Environmental Management (P.46)

Targets and Results

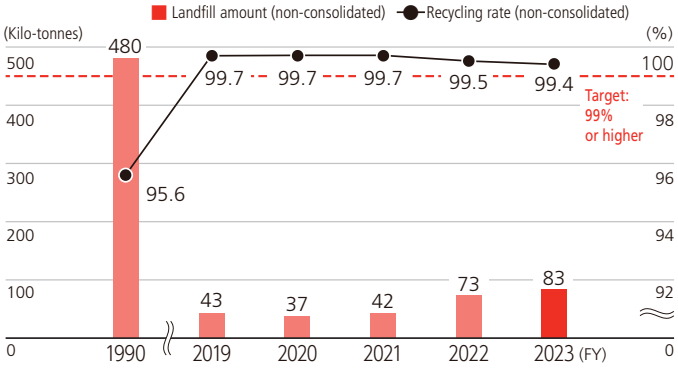
As we acknowledge that the efficient use of resources is a key environmental issue for manufacturers, we set high-level targets corresponding to the business of our Group companies and monitor the results. The Group companies have consistently fulfilled KPIs for material CSR issues every year up to FY2020 and established environmental practices. We continue to work on efficiently using resources toward the following high-level targets.

We also acknowledge the use of water resources as a key environmental issue for manufacturers. Because the JFE Group uses large quantities of water in its core business of steel manufacturing, the Group sets high goals for water resource recycling. We defined KPIs for material CSR issues and consistently met them every year up to FY2020. This effort helped us to establish environmental practices. We will maintain our efforts to reduce water consumption toward the following high-level targets.

■ Target and Result for FY2023 and Target for FY2024

Operating Company	FY2023 Targets	FY2023 Results and Initiatives	FY2024 Targets
JFE Steel	Recycling rate of co-products: 99% or higher	Recycling rate: 99.4%	Continue efforts to prevent and reduce the generation of dust and sludge in the recycling of co-products, to maintain the recycling rate of co-products at 90% or higher
	Maintain efficient use of water Recirculated water usage rate: 90% or higher	Recirculated usage rate: 93.1%	Continue the water resource recycling effort to maintain the recirculated usage rate at 90% or higher
JFE Engineering	Recycling rate at construction sites • Recycling rate of rubble: 99.5% or higher • Recycling rate of sludge: 95.0% or higher • Recycling rate of industrial waste: 85.0% or higher	Recycling rate at construction sites • Recycling rate of rubble: 97.8% • Recycling rate of sludge: 99.3% • Recycling rate of industrial waste: 87.1%	Recycling rate at construction sites • Recycling rate of rubble: 99.5% or higher • Recycling rate of sludge: 95.0% or higher • Recycling rate of industrial waste: 85.0% or higher
	Recycling rate of office recyclable waste (Yokohama head office): 98.0% or higher	Recycling rate of office recyclable waste (Yokohama head office): 97.7%	Recycling rate of office recyclable waste (Yokohama head office): 98.0% or higher
JFE Shoji	Global recycling of steel scrap • Exceed FY2020 scrap trade volume (FY2024 target: +5% from FY2020)	–5% from FY2020 While domestic trade volume increased, overseas sales decreased as a result of an overall decline in the export of scrap from Japan.	Global recycling of steel scrap: +5% from FY2020 Enhance domestic and overseas distribution network for scrap and increase the sales thereof to JFE Group companies and others that need it and outside the country toward achieving the target

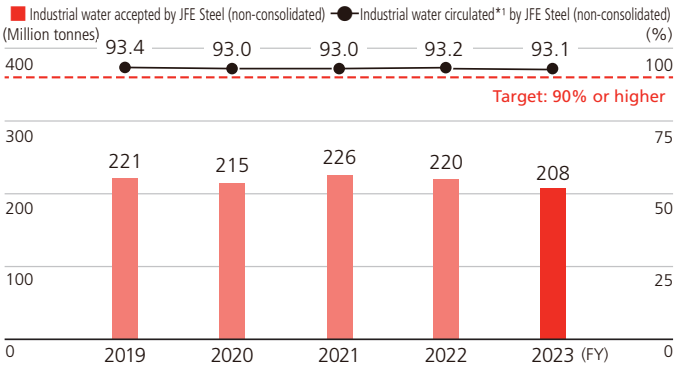
■ Landfill of Co-Products and Recycling Rates



		1990	2019	2020	2021	2022	2023	
Group companies*	Amount released	—	546	513	504	593	583	(Kilo-tonnes)
	Landfill amount	—	31	23	52	94	97	(Kilo-tonnes)

*22 JFE Steel consolidated subsidiaries in Japan.

Industrial Water Accepted/Circulated



JFE Steel

Total amount	3,323	3,066	3,207	3,242	3,053	(Million tonnes)
Industrial water accepted	221	215	226	220	208	(Million tonnes)

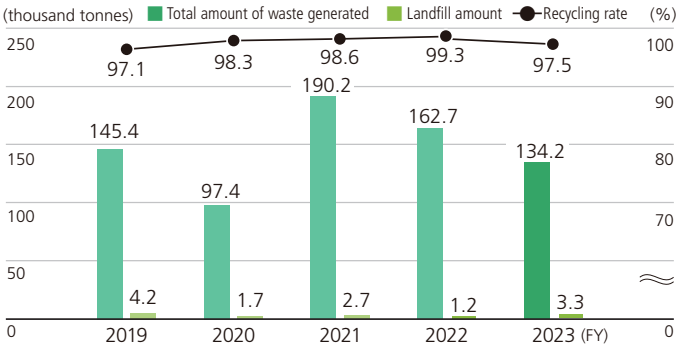
Group companies*2

Total amount	293	265	235	233	207	(Million tonnes)
Industrial water accepted	20	21	19	18	16	(Million tonnes)

*1 Industrial water circulated (%) = (Total amount used – industrial water accepted)/total amount used ×100

*2 22 JFE Steel consolidated subsidiaries in Japan.

Waste Generated at Construction Sites



For more on waste generated at the steelworks, please refer to the following information.

➤ Environmental Data (P.235)

Initiatives

Resource Recycling Solutions

The JFE Group is involved in establishing a recycling-oriented society through a variety of initiatives. Steelworks promote the efficient use of raw materials, water, and other resources in the process of iron and steelmaking in addition to encouraging the application of recycled resources such as used plastics for blast furnaces. Moreover, we are striving to more efficiently use

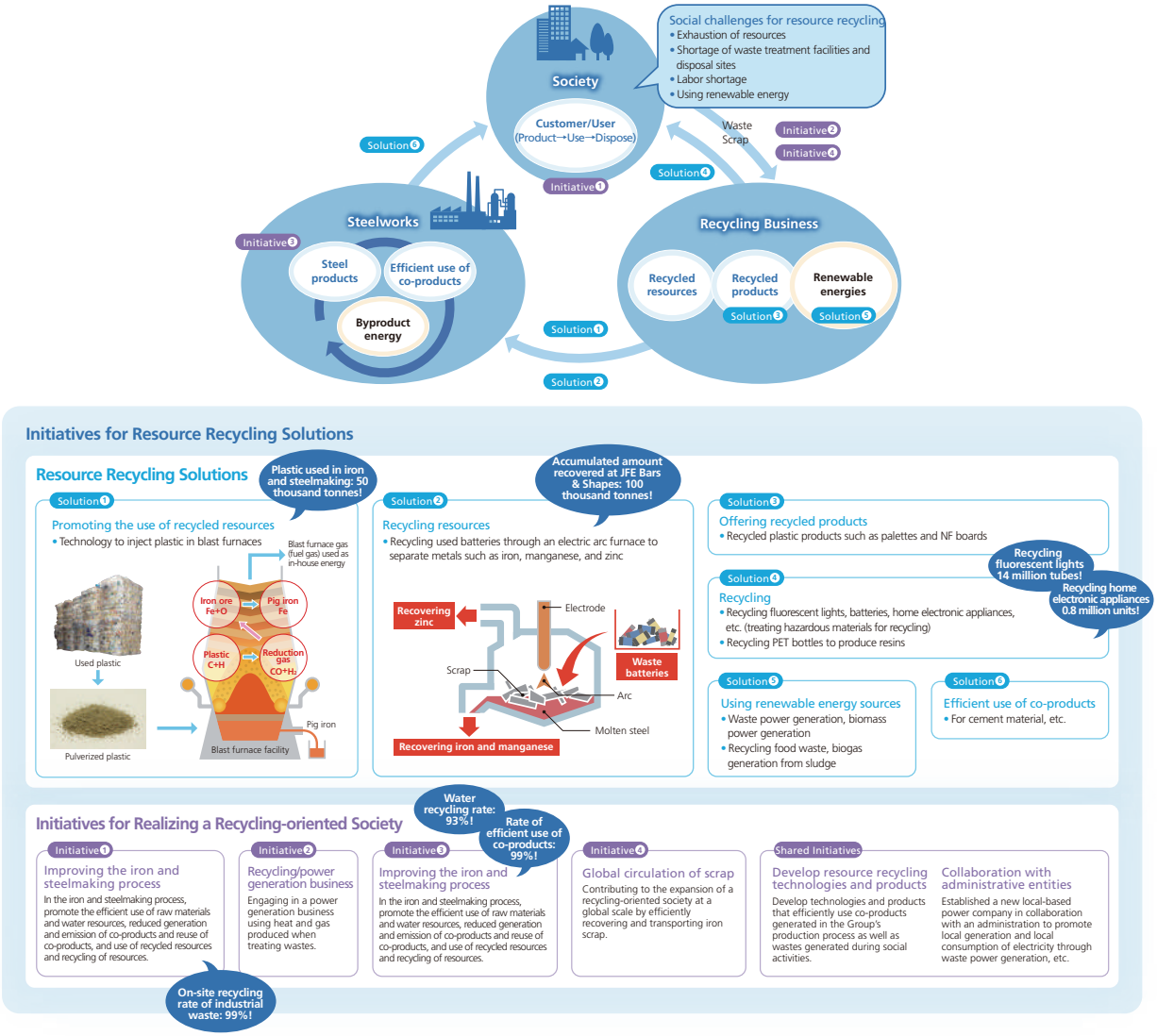
co-products generated in the iron and steelmaking process through initiatives such as the international recycling of steel scrap. By leveraging the highly recyclable quality of steel, we are also developing product that contribute to addressing the issue of plastic waste.

In the engineering field, we produce biomass fuel from food waste and sewage sludge, constructing plants, and other infrastructures for Waste-to-energy power generation and offer resource recycling solutions by operating these facilities directly or under contract. In addition, we are pursuing a circular economy by developing PET bottles and a plastics recycling business as well as an energy supplying business.

For JFE Steel and JFE Engineering's recycling businesses, please refer to the following information.

➤ **List of JFE Group's recycling businesses**
(https://www.jfe-holdings.co.jp/en/common/pdf/sustainability/environment/resource/resource01.pdf)

For more on this, please refer to the following information.
➤ **Development and Provision of Eco-Friendly Processes and Products** (P.38)
➤ **Stakeholder Engagement** (P.135)



JFE Steel Reducing Generation and Emission of Co-Products and Reusing Co-Products

JFE Steel carefully controls the generation and emission of iron and steelmaking slag (a co-product), iron dust from blast furnaces and converters, sludge from water treatment facilities, and other co-products by setting targets to improve recycling rates. Dust and sludge with high iron content are recycled as raw materials for steelmaking. Iron and steelmaking slag is effectively recycled for reuse in cement and other construction materials. The company is also promoting its use as environment recovery material such as Marine Stone™, which works effectively as a base for the adhesion of organisms and for improving the marine environment. As a result of these efforts, the company accomplished a 99.4% recycling rate for slag, dust, and sludge in FY2023, fulfilling the target of 90% or higher, and it is committed to consistently achieving the target.

For more quantitative data related to co-products, please refer to the following information.
➤ Environmental Data (P.235)

JFE Engineering Promoting Recycling

Most of JFE Engineering's waste is either rubble and sludge discharged from construction sites or industrial waste discharged by the Tsurumi and Tsu works and the Kasaoka monopile manufacturing plant. The company is seeking to reduce industrial waste while also resource recycling through various measures, such as setting environmental goals for recycling rates and properly separating waste on-site before sending it to disposal companies known for achieving high recycling rates. It also complies with the Plastics Resource Circulation Act, enforced in Japan in April 2022, by including initiatives for plastics recycling in its environmental target.

The Yokohama head office sets target recycling rates for office recyclable waste and maintains its efforts to reduce waste (encouraging double-sided copying), reuse (setting up collection boxes for plastic folders and plastic business card cases and recovering label printer cartridges), and recycle (thoroughly separating waste). The JFE Engineering Group is also helping to realize a recycling-oriented society through its PET bottle and food waste recycling initiatives.

For more on waste generated at the steelworks, please refer to the following information.
➤ Environmental Data (P.235)

Efficient Use of Water Resources

JFE Steel Goal-Setting for Recycling Use of Water

All of JFE Steel's seven production sites in Japan developed a water management plan and monitored water usage in seeking to increase the recirculation rate of water in order to reduce the volume of water intake and drainage and efficiently use water resources. The target water recycling rate at JFE Steel, which uses a large volume of water for cooling and other processes, is 90% or more, which is extremely high considering the amount evaporated when water is used. We are striving to improve the recycling rate by adopting purification processes such as biological and chemical wastewater treatments, and we have been successfully achieving the target. Our recycling rate of industrial water in FY2023 maintained a high level of 93.1%.

JFE Engineering Efficient Use of Water Resources

JFE Engineering and each Group company strive to use water efficiently at their business sites.

For more on quantitative data related to water, please refer to the following information.
➤ Environmental Data (P.235)

Key Initiatives in FY2023

JFE Steel

Reducing Plastic Waste by Manufacturing Cups from Highly Recyclable Steel

Under the logo Steelish™, a combination of "steel" and "stylish," JFE Steel is engaged in an initiative to expand the use of stylish, recyclable steel products that would introduce a change in daily lifestyles and help propel the global effort to tackle plastic pollution. For instance, JFE Steel proposes single-use steel cups as an alternative to disposable plastic cups. Steel cups are light and sturdy, with a thin rim that feels smooth against the lips, and they are able to keep drinks hot or cold for a long time, as well as being infinitely recyclable into other steel items and easier to recycle than plastic.

To this end, JFE Steel in 2021 launched the project BETTER RECYCLE Shonan and has since been involving customers in the development of disposable steel cups, the first time the company has adopted this approach. The project team, made up of members from IBLC Co., Ltd. and Shonan Style (a magazine published by EDITORS, Inc.) as well as JFE Steel, sought advice and cooperation from local governments and plastic disposable suppliers in the Shonan area and created a prototype for an eco-friendly disposable steel cup. The prototype and the Steelish™ initiative were presented at Carnival Shonan 2022, an event held at the Kanagawa Municipal Tsujido Kaihin Park in November 2022 to explore turning the Shonan beaches into the first zero-waste beaches in Japan.

In March 2023, steel cups were used at Nakame Challenge Cup 2023, an event hosted by Asahi YOU. US, Ltd. and the Nakame Area Management Association to eliminate disposable plastic bottles discarded by people viewing cherry blossoms in Nakameguro and raise awareness of plastic pollution, food loss, and other sustainability issues.

JFE Steel is committed to playing its part in fostering public awareness about climate change and plastic pollution issues and to achieving the SDGs by developing steel solutions that meet the needs of customers and society as a whole.

The Steelish™ logo

The recyclable steel cup

➤ **Website on recyclable steel cups (Japanese Only)** (https://www.jfe-steel.co.jp/products/can/use/scene09.html)
➤ **BETTER RECYCLE Shonan (Japanese Only)** (https://www.jfe-steel.co.jp/products/can/pr/better_recycle_shonan.html)

Products and Technologies (Realizing a Recycling-Oriented Society)

The JFE Group is determined to both efficiently use resources in its business activities and deliver products and technologies that will help realize a recycling-oriented society.

Apart from eco-friendly products and processes designed to reduce environmental impact, the steel business is developing technologies and products for the efficient use of co-products from manufacturing processes and waste from social activities. The engineering business is conducting research and development for new technologies and eagerly advancing its Waste-to-energy power generation and plastic recycling projects.

For more on products and technologies aimed at realizing a recycle-oriented society, please refer to the following information.

➤ **Development and Provision of Eco-Friendly Processes and Products** (P.135)

Preserving Biodiversity

Basic Policy

Recognizing that natural capital and biodiversity are foundational for realizing a sustainable society, the JFE Group has endorsed the Declaration of Biodiversity by Keidanren and Action Policy and conducts business in harmony with nature across the world. We particularly recognize the preservation of biodiversity as a key challenge and conduct assessments to minimize the ecological impact associated with our business activities. Our initiatives include cooperating with the community to monitor biodiversity and carry out preservation activities around the steelworks, the key facilities for our business, and in surrounding areas. We are also involved in developing iron and steelmaking slag products that can help restore the marine environment. Furthermore, beyond our business operations, we launched a joint research program with a local government and conduct environmental education for local communities.

Our core business of steel manufacturing uses large quantities of fresh water for cooling and cleansing products and facilities. For this reason, the efficient use of water resources with due consideration to the source of the water and stakeholders in the area is a key challenge.

And while we have always taken measures against meteorological disasters such as droughts and floods at our manufacturing sites in Japan, we are further reinforcing them in anticipation of the increased frequency and severity of weather events associated with climate change by securing alternative means and raising the height of embankments. We also seek to identify water-related risks throughout our business sites and supply chain in Japan and overseas, such as the risk of drought at the source of water intake and pollution at the point of discharge. In areas under water stress, we will respond appropriately through dialogue with stakeholders.

➤ Declaration of Biodiversity by Keidanren and Action Policy (Revised Edition)
(https://www.keidanren.or.jp/en/policy/2018/084.html)

System

The JFE Group recognizes the issue of water resources as a risk that may significantly impact operations, and we have taken action against meteorological disasters such as droughts and floods. In recent years, we have been seeking to adequately identify and manage water risks based on the assumption that disasters due to climate change will increase in frequency and severity.

With regard to Group risk management, the Group Sustainability Committee, under the leadership of the CEO, who heads the JFE Group CSR Council, discusses, supervises, and guides Group-wide environmental initiatives, including the proper use of water resources.

There were no violations of environmental laws or regulations related to water quality in FY2023, and no fines or penalties were imposed.

➤ Framework for Environmental Management (P.46)

Initiatives

Assessing Impacts on Natural Capital

Evaluating Dependencies and Impacts in Line with the LEAP Approach

The JFE Group began pilot testing the LEAP approach in line with the recommendations of the Taskforce on Nature-Related Financial Decisions (TNFD), starting with the steel business and focusing on JFE Steel's leading manufacturing sites and key raw materials such as iron ore and coking coal. We will increase our understanding of relationships between nature and the Group's other businesses toward the disclosure of material risks and opportunities in accordance with the TNFD framework.

■ Progress in pilot LEAP assessment

Locate

Locating the interface with nature
We used TNFD-recommended tools such as IBAT and Resource Watch to identify locations of major manufacturing sites of our steel business and the mining sites used by our major suppliers of raw materials such as iron ore and coking coal, and assessed natural capital in the areas surrounding them.

Evaluate

Evaluating dependencies and impacts
We applied ENCORE and other TNFD-recommended tools to identify and evaluate the dependencies and impacts of our steel business on important natural capital.

Assess

Assessing nature-related risks and opportunities
Based on the findings from the evaluation of the dependencies and impacts, we identified and as-sessed nature-related risks and opportunities for our steel business.

Prepare

Preparing to respond and report
We have been preparing to respond to the assessed risks and opportunities.

Reviewing Specific Categories of Findings on the Dependencies and Impacts of the Steel Business on Nature (General Findings Related to the Steel Business)

Regarding the dependencies and impacts of our steel business on nature, we reviewed the findings under the categories of manufacturing at our production sites, procurement from our upstream supply chain at iron ore and coking coal mining sites, and product disposal at our downstream supply chain. Our procurement and manufacturing operations depend on natural resources, particularly related to water supply, the control of water volume, and climate adjustments. Meanwhile, our manufacturing operations have an adverse impact on nature through the use of water resources and by contributing to air pollution. The iron core and coking coal mining conducted at the upstream of our supply chain also impact nature through the use of terrestrial land and water resources, the emission of greenhouse gases, and pollution.

	Dependencies on nature						Impacts on nature										
	Supply service	Adjustment service					Climate change	Use of terrestrial and aquatic land			Use or resources		Pollution				
	Water resources	Air purification	Water volume control	Climate adjustment	Disaster mitigation	Erosion control	GHG emissions	Land areas	Freshwater areas	Sea areas	Water resources	Other	Air	Water quality	Soil	Waste	Disturbance
Procurement	■		■	■		■	■	■	■		■		■	■	■	■	■
Manufacturing	■	■	■		■		■	■			■		■	■	■	■	■
Product disposal																■	

■ Very high ■ High ■ Moderate □ Low

Assessment of Leading Manufacturing Sites

Our assessment of leading manufacturing sites found that the East Japan Works and the West Japan Works are located in proximity to areas of high conservation significance such as Key Biodiversity Areas (KBAs). As a result, those sites have been identified priorities for evaluation and responses.

Manufacturing site	Criteria for priority locations				
	Conservation significance	Ecosystem integrity	Degradation in ecosystem integrity	Water-related physical risks	Importance of ecosystem services
East Japan Works, Chiba	Located in proximity				Not located in proximity
East Japan Works, Keihin	Not located in proximity				Not located in proximity
West Japan Works, Kurashiki	Located in proximity				Not located in proximity
West Japan Works, Fukuyama	Located in proximity				Not located in proximity
Chita Works	Located in proximity				Not located in proximity
Sendai Works	Located in proximity				Not located in proximity

■Very high ■High ■Moderate □Low

* Assessment based on the five criteria was performed by using the following indicators and tools.
- Conservation significance: Assessed with IBAT the proximity (within a 3-km radius) to areas of conservation significance, for example, protected areas and KBAs.
- Ecosystem integrity: Assessed based on the Biodiversity Intactness Index provided by Natural History Museum
- Rapid degradation in ecosystem integrity: Assessed based on the Pressure on Biodiversity indicator provided by WWF Biodiversity Risk Filter to measure at degree of influence on nature
- Water-related physical risks: Assessed based on the Baseline Water Stress indicator through the use of Aqueduct
- Importance of ecosystem services: Assessed with the Global Forest Watch tool the proximity (within a 3-km radius) to areas under the control of Indigenous Peoples and Local Communities (IPLCs)

Raw Material Suppliers

We located the interfaces of our major iron ore and coking coal suppliers in natural settings and assessed the state of nature at those sites (6 iron ore mines and 14 coking coal). The iron ore mines are in Australia and Brazil, and our assessment found that some of those in Brazil are located near areas of conservation significance and that those in Australia are exposed to high water stress and require responses to handle water-related risks. Our coking coal suppliers are mining in Australia, Canada and Indonesia. We learned from our assessment that their mines in Canada and Indonesia are located in areas with high ecosystem integrity and that some of their mines in Australia are in areas with degrading ecosystem integrity.

Raw material	Major supplier countries	Findings from the Assessment of the Areas in Proximity to the Mines*
Iron ore	Australia	Some of the mines are located in areas exposed to high water stress.
	Brazil	Some are located in areas of high conservation significance or areas with high ecosystem integrity.
Coking coal	Australia	Some are located in areas whose ecosystem integrity is degrading.
	Indonesia	Some are located in areas with high ecosystem integrity or in areas whose ecosystem integrity is degrading.
	Canada	Some are located in areas with high ecosystem integrity.

*Assessed using the same indicators and tools as those used for the assessment of our leading manufacturing sites

Assessment of Risks and Opportunities and JFE's Responses

We sorted out nature-related risks and opportunities currently deemed potential based on the aforementioned findings. The risks, some of which are recognized in our climate change scenario analysis, include physical risks that could be materialized due to a water shortage or natural disaster and potentially trigger a decrease in production at our manufacturing sites or a lack of procurement from suppliers, apart from transition risks that might occur if regulations concerning protected areas and pollution are tightened. The potential opportunities include an increase in demand for our eco-friendly products, processes and technologies as well as related developments and an increase in new orders for our engineering business.

Meanwhile, we ensured that JFE Steel's major iron ore and coking coal suppliers had performed their assessment concerning water resources and ecosystem and had publicly announced how to respond to their detected risks. We will keep monitoring the status of their response efforts as part of our supply chain management. We will also encourage more of our suppliers to adopt and observe the JFE Steel Procurement Guidelines.

As for our own material risks and opportunities, we will maintain the current measures taken for them and, while enhancing our assessment, we will keep a close watch on whether additional measures are necessary.

Category	Risks and Opportunities
Physical risks	Destabilization in raw material procurement due to a water shortage or natural disaster
	Decrease in production capabilities due to a water shortage or natural disaster
Transition risks	Destabilization in raw material procurement due to a protected area expansion, tighter regulation, or another issue
	Increase in operational costs due to a protected area expansion, tighter regulation, or another issue
Opportunities	Increase in demand for eco-friendly products, processes and technologies, and increase in development opportunities
	Increase in demand for recycled steel products
	Increase in new demand related to natural capital considerations in the engineering business

➤ Initiatives to Address Climate Change Issues (P.52)
➤ Realizing a Recycling-Oriented Society (P.115)
➤ Initiatives for Blue Carbon Using Steel Slag Products and Acquisition of J Blue Credit™ (P.154)
➤ Restoring Marine Ecosystems Using Steel Slag Products (P.162)

Analyzing and Responding to Water Risks

As part of overall risk management, we identify, analyze and evaluate water risks based on past incidents of droughts and floods in the JFE Group's businesses, forecast data from the Meteorological Agency and results of our scenario analysis. In particular, we consider as key risks the damages to business sites and disruption of the supply chain caused by restrictions on water intake due to droughts or increasing severity of meteorological disasters. In response, we are further reinforcing measures such as using recycled water, securing alternative means, and strengthening drainage facilities.

JFE Steel Water Risk Assessment and Measures

JFE Steel identifies and evaluates water-related risks based on past incidents of damage caused by droughts and floods, forecast data from the Meteorological Agency and results of scenario analysis. We conduct a further evaluation of water risks around each manufacturing site from different perspectives by also using the World Resource Institute (WRI)'s Aqueduct, a mapping tool for evaluating overall water risks from droughts and floods in each region around the world. According to the WRI's assessment in June 2024, water risks for all of Japan are not designated at a high level or above, but there will be risks of water shortages and flooding due to weather conditions in the future (2030s and 2040s). JFE Steel identifies steelworks under such weather risks and takes measures such as business continuity planning.

JFE Steel Raised Effluent Standards to Reduce Water Resource Pollution Risks in Iron and Steelmaking Processes

JFE Steel strives to reduce its environmental impact on waterways by thoroughly purifying water used in iron and steelmaking processes before releasing it into public waterways or sewers. The company has concluded agreements with the administrative entity in each area that set out more rigorous effluent standards, compared to those stipulated under the Water Pollution Prevention Act. It also established a strict voluntary control standard to improve water quality. For FY2023, COD*, the water-quality index for wastewater, was 2.3 tonnes per day.

*COD stands for chemical oxygen demand, an indicator for water pollution in seas, oceans, lakes, and ponds. It represents the amount of oxygen (mg/l) consumed when pollutants present in water, such as organic matter, are oxidized.

JFE Engineering Proper Management in Accordance with the Water Pollution Prevention Act and Sewerage Act

Wastewater from the JFE Engineering Yokohama head office, Tsurumi works, Tsu works, and the Kasaoka Monopile Factory is released into public waterways or sewer systems. Nitric oxide, phosphorus, and COD in the wastewater are measured on a regular basis and effectively managed in accordance with the Water Pollution Prevention Act and Sewerage Act.

For more on quantitative data related to water, please refer to the following information.
➤ Environmental Data (P.235)

Environmental Impact Assessment

To minimize the ecological impact of our business activities on surrounding areas, we are monitoring biodiversity around all of our business sites and planting trees while also preserving rare species in the compound. An environmental impact assessment is conducted in accordance with laws and regulations before launching construction of a new manufacturing site or business. We assess the biodiversity of the surrounding areas as well as our premises to fully understand the situation and to implement the necessary measures for preserving the ecosystem.

Key Initiatives in FY2023

JFE Steel

Replanted a Rare Species of Orchid Found at a Planned Construction Site

Plant No. 1 in the JFE Ohgishima Thermal Power Plant, an aging facility, was renovated and resumed operations in 2019. Before this construction, we conducted an environmental prediction and evaluation for the renovation, in accordance with the Environmental Impact Assessment Act and Electricity Business Act. As a result, the Kugenuma orchid, a plant listed in Japan's Ministry of Environment's fourth version of the Red List as an endangered species (Threatened II-Vulnerable, VU), was discovered at the planned construction site for power generation facilities. To preserve the orchids, we replanted them in a different location of the site that had a similar environment.

A Kugenuma orchid discovered at the planned construction site for the JFE Ohgishima Thermal Power Plant

JFE Steel

Contributing to Biodiversity and the Creation of an Attractive Seaside Town by Utilizing Steel Slag Products (Partnership Agreement with Yokohama City)

Silty sediment (sludge containing large amounts of organic matter) piles up at the ocean bed along the seaside frontage of Yamashita Park in Yokohama City, Kanagawa Prefecture, and significantly deteriorates water quality in summer. As a result, the ocean's ability to function as a spawning ground or environment for nurturing organisms has been lost.

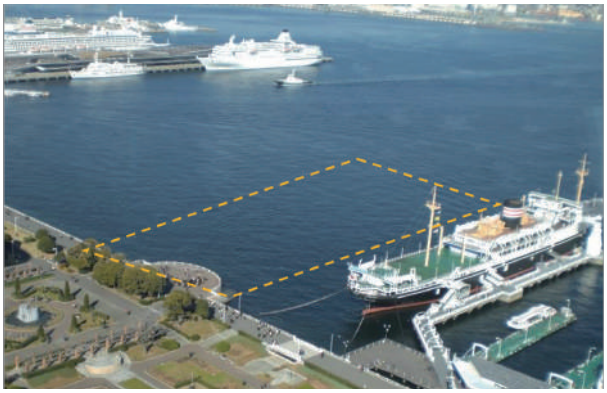
In a joint research project with Yokohama City, JFE Steel is restoring the intrinsic ability of the waters to purify seawater with the help of marine organisms by using carbonated steel slag products such as Marine Block™ to form shorelines as a base for the adhesion of organisms and assist in improving the marine environment. Immediately after an experiment, we observed an increase in the presence of marine organisms such as starfish and sea cucumbers around the area, and the populations continuing to grow. Moreover, we estimated that 8,400 kl of seawater (equivalent to seventeen 25-meter swimming pools) is filtered per day by filter-feeding marine creatures such as bivalves and sea squirt. We also estimated their impact on the removal of COD and the reduction of CO_2 in comparison to results obtained through water purification at sewage treatment plants.

The findings from the research project were presented at many exhibits and other events, helping to raise local awareness of environmental protection. This public-private research project for improving the marine environment has earned public recognition, with Yokohama City and JFE Steel jointly receiving the FY2021 Environmental Award (Group-2) of the Japan Society of Civil Engineering*1. In September 2022, JFE Steel won the Minister of Land, Infrastructure, Transport and Tourism Award of the 5th Eco Pro Awards*2, sponsored by the Sustainable Management Promotion Organization, a general incorporated association. A signboard commemorating these awards was installed next to the sea-facing balcony in Yamashita Koen Park, displaying research findings to visitors.

*1 The Japan Society of Civil Engineering Award is a prestigious award with a history of over 90 years. The Environmental Award (Group-2) is given to an innovative project that has contributed to any combination of environmental preservation, improvement, and creation activities by developing or operating civil engineering technology or systems.

*2 The award is given to goods, services, technology, solutions, or business models with specific and outstanding eco-friendly attributes that are widely recognized by businesses, consumers, investors, and market players in the Japanese market.

- FY2021 Environmental Award of the Japan Society of Civil Engineering (https://www.jsce-int.org/node/780)
- The 5th Eco Pro Award (Japanese only) (https://sumpo.or.jp/seminar/awards/5th_eco-pro_award_results.html)



The dotted line indicates the area in which slag products are being used at Yokohama Bay (photo taken by Yokohama City)

Colony of sea squirts on Frontier Rock™

Marine Block™ covered by marine bivalves (Yokohama Bay area)

Signboard commemorating the partnership project (installed in September 2023)

JFE Steel

Advancing Biodiversity Verification of Steel Slag Products in Collaboration with Venture Businesses

JFE Steel keeps a water tank containing the coral-covered steel slag product Marine Block™ at the exhibition area at the reception of the head office, offering visitors the opportunity to enjoy watching coral and tropical fish while learning about our initiative to preserve the ecosystem using steel slag products. We also intend to conduct experiments inside the tank. Innoqua Inc.* is providing technical support for the exhibition, which has been featured by several newspapers and TV programs as an example of business collaboration in the field of the environment.

*A venture company engaged in the development of systems for managing and nurturing corals and fish by combining its aquarist know-how with IoT and AI.

Healthy coral growth on Marine Block™ inside the water tank

JFE Steel

Firefly Festival

JFE Steel has opened its Environment Pond at the Chita Works to the community for a firefly viewing festival every year since 2014. Children at the event have the opportunity to release fireflies. The Company is nurturing an environment that preserves the ecosystem together with the local community by maintaining the watering holes and surrounding environment within the steel-works site and these firefly viewing events.

Releasing firefly larvae

Stream within the Chita Works site where fireflies are released

Firefly viewing party

JFE Steel

The Chita Works Certified as an Aichi Biodiversity Company

In November 2022, our Chita Works was recognized as a certified enterprise under the Aichi Biodiversity Company Certification Program in its first term launched by Aichi Prefecture based on the Aichi Biodiversity Strategy 2030. The program is intended to encourage more businesses in the prefecture to play a pivotal role in preserving local biodiversity by certifying those that have implemented outstanding initiatives to do so.

The Chita Works is using its Biotope Chita to release firefly larvae and hold firefly viewing festivals in collaboration with the local community and nursery schools/kindergartens. Since FY2022, the Chita Works has also exchanged information about the migration of the chestnut tiger butterfly, a species that travels more than 2,000 kilometers across Japan, with municipalities on the Chita Peninsula in Aichi Prefecture. Moreover, the Chita Works is protecting the Japanese rice fish (Oryzias latipes) and Japanese honeybee (Apis cerana japonica), both domestic species.

Certified
Aichi Biodiversity Company

Chestnut tiger butterfly

Japanese rice fish

JFE Steel The "Biotope Chita" Initiative to Reproduce the Local Ecosystem

With the "Biotope Chita" built on the property, the Chita Works is working on reproducing and protecting the ecosystem of plants and animals living on the Chita Peninsula, where the Chita Works is located. Fireflies have been released in the biotope by participant children since 2014, when the Chita Works started holding a firefly viewing festival for local residents.

In 2024, the Chita Works started growing rice in the biotope in collaboration with Aichi Prefectural Handa Agricultural High School. The management of the rice paddy is left in the hands of the high school students who learn the skills in the classroom. The iron-coating powder KONABIJIN™ (iron powder products suitable for direct seeded rice), developed and marketed by JFE Steel, is used to grow rice in the paddy.

Moreover, the Chita Works is using its biotope to protect the Japanese honeybee. The bees of this domestic species build their hives there and work as pollinators for plants in the biotope, supporting its biodiversity.

The biotope in full view

Rice planting

Rice paddy

JFE Engineering Initiatives in Relation to Construction Works

For large-scale construction or construction work carried out near watersheds or mountainsides, customers and/or the relevant authorities may conduct preliminary investigations depending on the importance of preserving the surrounding environment. Various preservation conditions may then be required, including the protection of living creatures.

JFE Engineering respect the proposed conditions and thoughtfully consider biodiversity preservation by keeping the impact of construction works at a minimum. For example, the company may propose a construction method that minimizes the impact of noise or drainage pollution. For its steelworks, the status of biodiversity on its premises and in surrounding areas are checked, and necessary measures are taken to ensure preservation.

JFE Engineering: Biotope for Children's Learning Experience

JFE Engineering has conducted some renovation work at the JFE Dragonfly Path in the Tsurumi Works, and since 2009 it has been inviting children in the community to learn about the ecosystem at a biotope, Dragonfly Pond, located along this path.

The JFE Dragonfly Path Fan Club, a group mainly composed of neighborhood residents, has organized a research event that involved capturing dragonflies in order to learn about their ecology and the local environment.

Furthermore, JFE Engineering has been a cosponsor of the How Far Do Dragonflies Fly since FY2020, with the aim of improving the quality of green spaces in the Keihin coastal areas and contributing to biodiversity. The forum brings together companies, residents, governments, and experts and conducts research activities such as capturing dragonflies that fly in 15 green spaces and biotopes scattered throughout the Keihin Coastal Area and inland areas, tagging them, releasing them, and tracking their movements. The JFE Dragonfly Path also serves as one of the research sites.

Dragonfly Pond serving as biotope

JFE Engineering Participation in Kanagawa Prefecture's Reforestation Partner Program

In March 2023, the JFE Engineering Group's J&T Recycling Corporation expressed its support for the Kanagawa Reforestation 50 Year Plan and signed a memorandum of understanding with Kanagawa Prefecture on the Reforestation Partner Program*, an initiative launched by the prefecture.

The company's intent is to use the program as part of its environmental protection and harmony activities while supporting the prefecture's vision. Under the partnership, the company's employees volunteer to help thin trees and take part in other efforts for conserving forests, a valuable source of water for future generations.

The Reforestation Partner Program grants naming rights to participants for parts of the prefecture-owned forests, one of which is now called the J&T Kankyo Miracle Forest (with the word "miracle" expressed in kanji, meaning the "future is coming"). J&T Recycling Corporation is constantly enhancing its ESG initiatives to improve the environment.

New employees pruned trees in a volunteer activity

J&T Kankyo Miracle Forest

Valuation report on CO_2 absorption by the forest

*For details about the Reforestation Partner Program, please refer to:

➤ **Website for Kanagawa Prefecture (Japanese Only)** (https://www.pref.kanagawa.jp/docs/pb5/partner.html)

Endorsing and Participating in External Initiatives

As a member of the Keidanren Committee on Nature Conservation, the JFE Group endorses the Declaration of Biodiversity by Keidanren and Action Policy and actively engages in the conservation of nature and biodiversity. In addition, the Group took part in the Business for GBF Project, launched by the Ministry of the Environment and Keidanren Committee on Nature Conservation. JFE Steel's steel slag product was selected by the Ministry and Keidanren and introduced as an example of an initiative that contributes to the conservation of biodiversity. Going forward, we will deepen our understanding of and contribute to the Post-2020 Global Biodiversity Framework and other global initiatives committed to preserving nature and biodiversity.

JFE Holdings has joined the 30by30 Alliance for Biodiversity, a platform launched by the Ministry of the Environment, business associations, nature conservation groups, and other organizations. The alliance is committed to effectively protecting at least 30% of Japan's land and sea as healthy ecosystems toward the Nature Positive goal of halting and reversing biodiversity loss by 2030. JFE is going to contribute to the protection of biodiversity by carrying out various activities, including the conservation of its biotope at the Chita Works.

For further details on external initiatives, please refer to:

- Business for GBF Project, Ministry of the Environment (https://www.biodic.go.jp/biodiversity/private_participation/business/en/
- Ministry of the Environment's 30by30 Alliance (https://policies.env.go.jp/nature/biodiversity/30by30alliance/)

Products and Technologies (Preserving Biodiversity)

The JFE Group endorses and participates in the Challenge Zero initiative that is being jointly sponsored by Keidanren and the Japanese government. And we are collaborating with Yokohama City on a project that uses steel slag to improve the marine environment while also developing various products aimed at conserving biodiversity.

For more on products and technologies related to environmental protection, please refer to the following information.

- Development and Provision of Eco-friendly Processes and Products (P. 135)
- Challenge Zero (https://www.challenge-zero.jp/en/member/37)

Development and Provision of Eco-Friendly Processes and Products

Basic Policy

In accordance with its corporate philosophy of contributing to society with the world's most innovative technology, the JFE Group develops and provides processes and products for addressing climate change and reducing environmental impact. In the JFE Group Environmental Vision for 2050, we announced our initiatives for reducing the CO_2 emissions of the Group and expanding our contribution to reducing CO_2 emissions in society as a whole. Apart from these initiatives, we also strive to enhance our corporate value and play our part in realizing a sustainable society through **the development and provision of various processes and products related to preserving the global environment.**

In the steel business, the Steel Research Laboratory is engaged in research and development under the Environmental Management System (environmental strategies) to create a recycling-oriented society capable of sustainable development by providing the world's best technologies and sparking innovation. In the engineering business, the Research Center of Engineering Innovation conducts research and development of new technologies to support the society of the future, including the creation of next-generation energy and solutions to environmental problems.

➤ JFE Steel: Research and Technological Development (https://www.jfe-steel.co.jp/en/research/index.html)
➤ JFE Engineering: Technological Development (https://www.jfe-eng.co.jp/en/rd/)

For further details on the JFE Group Environmental Vision for 2050, refer to the following resources.

➤ The JFE Group Environmental Vision for 2050 (P.52)
➤ The JFE Group Environmental Vision for 2050, presentation material on May 25, 2021
(https://www.jfe-holdings.co.jp/en/investor/climate/presentation/index.html)

Initiatives

Each operating company of the JFE Group leverages its respective strengths to develop and provide a variety of eco-friendly products and technologies.

Eco-Friendly Processes, Products, and Technologies in FY2023

JFE Steel

Development of High-Efficiency Autonomous Cleaning Robot "GAZMASTER™-S"—Reduced Work Burden and Improved Safety and Productivity

Environmental Benefit: Environmental conservation
Status: Development stage

Steelmaking uses facilities for handling iron ore, coal, and other raw materials, and they are usually cleaned by workers. To meet the strong demand automation, JFE Steel developed "GAZMASTER™-S"*, a high-efficiency, autonomous cleaning robot that can clean the floors of these facilities containing piles of raw materials in lumps and powder forms. The robot is now being used by the West Japan Works (Fukuyama District) (Photo 1).

GAZMASTER™-S gets the job done even in narrow spaces and on stepped surfaces, requiring only a simple replacement of accessories depending on the space to be cleaned (Photo 2). This robot estimates its progress in cleaning a room by comparing its learned occupancy map with real-time information it obtains from its laser range scanner (Figure 1). It is capable of preventing its wheels from getting stuck and coping with low battery levels, and these functions and status conditions can be monitored and controlled using a tablet. Durability has already been assured through tests conducted at the steel

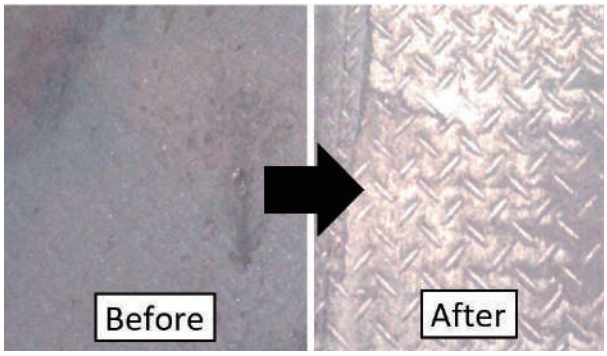
manufacturing plant in Fukuyama. JFE Steel plans to deploy GAZMASTER™-S at its other steelworks across the country to ease the burden of labor, improve safety and performance, and keep the workplaces cleaner and more pleasant.

With the launch of the JFE Digital Transformation Center (JDXC™), JFE Steel is promoting DX, including the implementation of a cyber-physical system (CPS) for manufacturing as an innovation in productivity and a means for addressing resolve safety and related issues associated with manufacturing operations, ultimately contributing to a sustainable future.

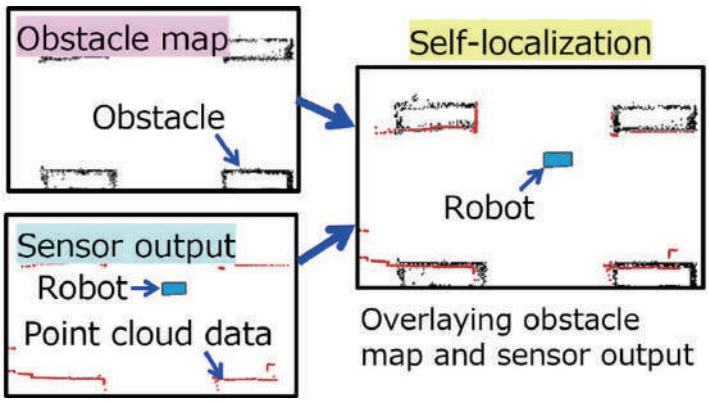
*GAZMASTAR: Coined from "Gather (dust)" and "Master".

■ **Photo 1：High-efficiency, autonomous GAZMASTAR-S™ robot**

■ **Photo 2：Before and after cleaning**



■ **Figure 1: How robot calculates its position**



JFE Steel

Receiving the 70th (FY2023) Okochi Memorial Technology Award for the Automation of Blast Furnace Operations through the Use of a Cyber-Physical System

Environmental Benefit: Reduce CO_2 emissions
Status: Development stage

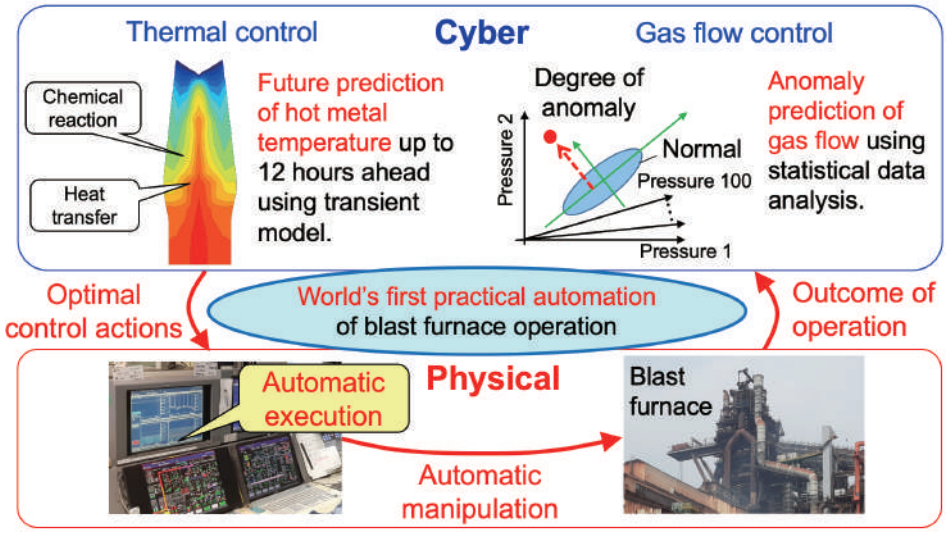
JFE Steel's data science technology progress toward establishing a cyber-physical system in furnace operations was awarded the 70th (FY2023) Okochi Memorial Technology Award, a prize granted for a unique accomplishment in the fields of industrial engineering and production engineering that significantly contributes to academic progress and industrial advancement.

Reducing CO_2 emissions from steelmaking requires increasing the efficiency and stability of blast furnace operations. While blast furnaces have high thermal efficiency, they must be handled by highly skilled operators with special knowledge and experience due to the difficulty of estimating internal conditions that are vulnerable to significant variances in the properties of raw materials and other factors. Furthermore, recently rising demand to reduce CO_2 emissions is increasing the urgency of realizing furnace operations that can be controlled more precisely and reliably than conventional ones.

JFE Steel developed a cyber-physical system that controls and optimizes hot metal temperatures and ventilation inside a blast furnace in real time. The system uses a unique model based on real-time sensor data collected from a blast furnace and estimates hot metal temperatures up to 12 hours in advance while also controlling ventilation using an anomaly detection technology. The system is already in use at JFE Steel's furnace operations, helping the company to boost labor productivity and reduce CO_2 emissions. JFE Steel plans to implement the system across its entire steelmaking operations as a productivity innovation and to increase operational safety.

Award ceremony (Mr. Kawamura, Mr. Yamazaki, Mr. Hashimoto, Mr. Hasegawa and Mr. Yamamoto, from left to right)

■ **Cyber Physical System of Blast Furnace**



JFE Steel

Verification of the Feasibility of Making Motors 48% Thinner Using Insulated Pure-Iron Powder Denjiro™

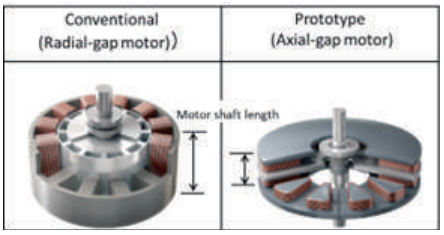
Environmental Benefit: Recycle resources and reduce CO_2 emissions
Status: Commercialized

In a project with JFE Techno-Research Corporation and a venture company launched by Shizuoka University and named ARMIS CORPORATION, JFE Steel designed and prototyped a motor using Denjiro™, the company's insulated pure-iron powder. The demonstration, also conducted by the three, established the feasibility of making motors 48% thinner and 40% lighter than existing ones while maintaining the same level of horsepower by using this powder.

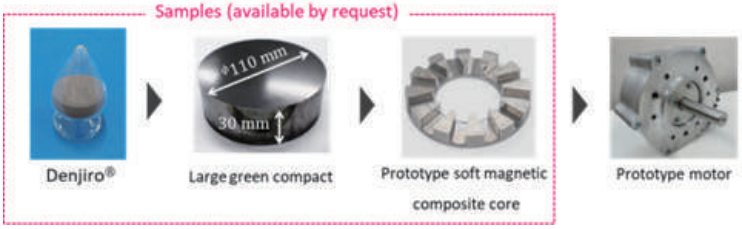
Demand continues to rise for smaller but higher-performing electric motors for industrial equipment and vehicles. Axial-gap motors, which are thinner than general radial-gap motors, can deliver high power (Figure 1). Unlike radial-gap motors, however, axial-gap motors pose a significant manufacturing challenge by requiring a three-dimensional magnetic core that cannot be made by laminating electrical steel sheets. Meanwhile, a powder magnetic core made by pressure-forming insulated magnetic powder exhibits a magnetic property that is three-dimensionally uniform and can withstand complex shapes. Denjiro™ is an insulated pure-iron powder product developed and marketed by JFE Steel. The aforementioned three parties designed and prototyped an axial-gap motor using a powder magnetic core made from Denjiro™ and tested the motor's performance (Figure 2). The test results showed that motors can be 48% thinner in height and 40% lighter compared to existing units while maintaining the same or higher level of performance (table and Figure 3). In response to these test results, JFE Steel and JFE Techno-Research Corporation launched a new service to support customers with the design of motor parts with a powder magnetic core. At the same time, the companies are now shipping samples of large green compacts for cutting and machining soft magnetic composite cores, as well as prototype soft magnetic composite cores that conform to specific designs.

In addition to developing products to meet customer demand, JFE Steel is going to increase its eco-friendly product lines to assist customers with reducing CO_2 emissions while also promoting technological exchanges with customers, including consultation on the use of technologies and support for prototype production and testing, under the goal of contributing to a sustainable future.

■ **Figure 1: Types of motors**



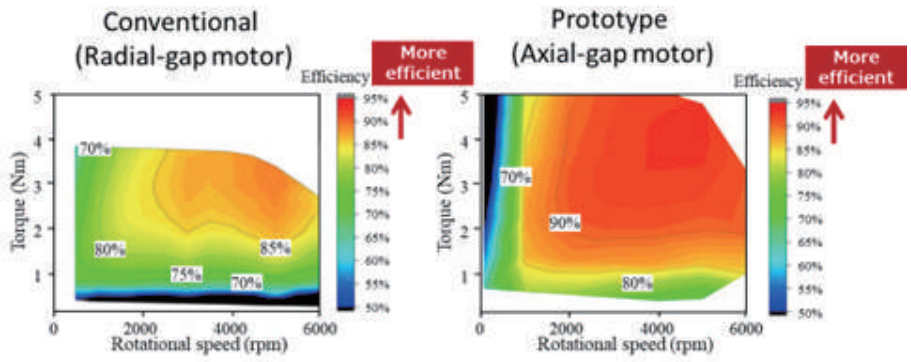
■ **Figure 2: From powder to prototypes**



■ **Conventional vs. prototype motor (test results)**

	Conventional (Radial-gap motor)		Prototype (Axial-gap motor)
Motor shaft length (mm)	90		110
Core weight (g)	1270	Thinner, Lighter	760
Core diameter (mm)	62		32
Max. efficiency (%)	89		93
Max. torque (Nm)	3.7		5.4

■ **Figure 3: Efficiency of conventional vs. prototype motor**



JFE Steel's New Insulated Pure-iron Powder for Soft Magnetic Composites Enables Prototype Axial-gap Motor to be Slimmed Down by 48% (https://www.jfe-steel.co.jp/en/release/2024/01/240116.html)

JFE Steel

Introduction of a Test Facility to Develop a Steel Product for Liquid Ammonia Tank Containers

Environmental Benefit: Recycle resources and reduce CO_2 emissions
Status: Development stage

JFE Steel started operating a test facility at the Steel Research Laboratory (Kurashiki District) at the end of October 2023, to evaluate the risk of stress corrosion cracking in steel products that can occur when exposed to liquid ammonia.

Amid growing worldwide initiatives for a decarbonized society, ammonia is expected to serve as an alternative fuel for thermal power generation and shipping, further increasing the importance of establishing supply chains for liquid ammonia, and the demand is rising for high strength steel required for the manufacture of larger liquid ammonia storage tanks.

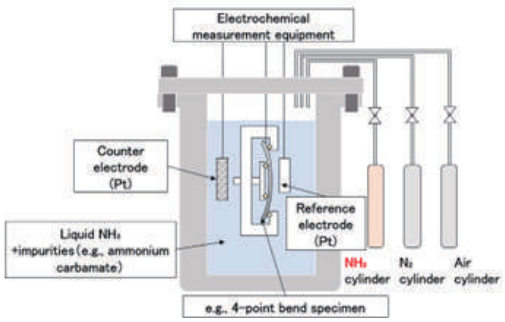
Liquid ammonia carries the risk of causing stress corrosion cracking (SCC*) in steel. Generally, higher strength carbon steel is more vulnerable to SCC when exposed to liquid ammonia. Therefore, the risk needs to be properly evaluated during the development of a high-strength steel sheet product. Since liquid ammonia is a toxic and combustible liquefied gas, JFE Steel constructed a new building (Photo 1) for housing the test facility (Figure 1) in accordance with the High Pressure Gas Safety Act, enabling the Steel Research Laboratory to perform electrical and chemical measurements in the building, in addition to evaluating the durability of raw materials against SCC through the use of test pieces soaked in the gas (Figure 2).

JFE Steel plans to make good use of this test facility to both propel the development of steel for ammonia tanks and proactively respond to other social needs, including the standardization of test methods and raw materials. The company will thereby support efforts for increasing green energy sources for a decarbonized society.

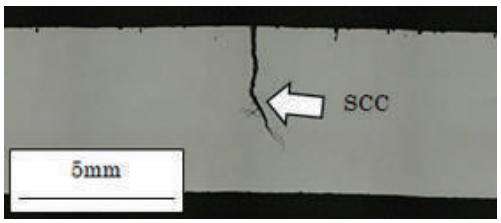
*Stress Corrosion Cracking: Occurs when metal materials are under tensile pressure and exposed to a corrosive environment.

■ **Photo 1：Example of stress corrosion cracking that occurred during test.**

■ **Figure 1: Building for testing stress corrosion cracking that occurs in liquid ammonia.**



■ **Figure 2:Overview of test equipment**



JFE Steel

Receiving the National Commendation for Invention for an Anti-Weatherability Steel Product that Does Not Require a Paint Finish Even Under Coastal Environmental Conditions

Environmental Benefit: Recycle resources and reduce CO_2 emissions
Status: Development stage

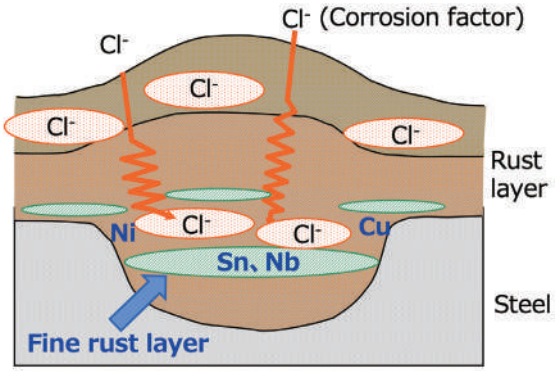
JFE Steel received the FY2024 National Commendation for Invention*1 for developing an anti-weatherability steel product that does not require a paint finish even for use in coastal settings. In addition to outstanding cost-performance, this product has weatherability nearly as high as the company's anti-weatherability nickel steel, which is popular as a material for bridges in high-salinity environments. The newly developed steel technology was applied to LALAC™-HS*2, an all-weather steel sheet product designed for use in high-salinity environments. LALAC™-HS already boasts a record of being selected as a material for five bridges in and outside Japan.

The company's anti-weatherability nickel steel is made with 1–3% additional nickel to achieve the prominent all-weather property, which has however made the product rather expensive. Instead of nickel, this award-winning invention adds a combination of tin and niobium. These elements thicken locally in the bottom layer of rust and form fine rust just as the anti-weatherability nickel steel would do, thereby controlling the permeation of chloride ions, which accelerates corrosion, into the steel (Figure 1). The anti-weather property of tin and niobium performs well even in small amounts thanks to their local thickening and allows a significantly reduced use of nickel, making this invention more affordable than anti-weatherability nickel steel, while exhibiting nearly the same level of weatherability (Figure 2). This newly-developed steel product with high weatherability and outstanding cost performance is expected to significantly reduce life cycle costs for structures by eliminating the need for painting or repainting.

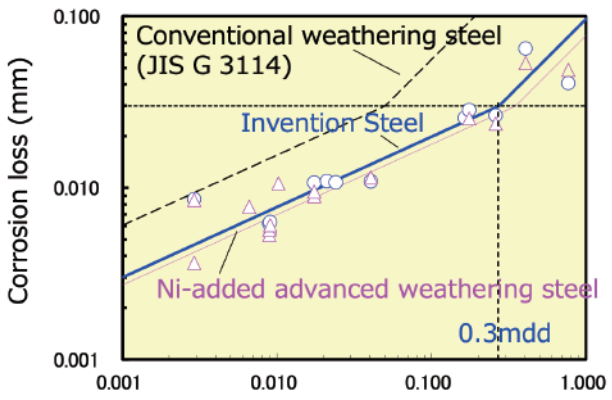
JFE Steel intends to further expand the applications for this new product and develop other steel products with high functionality and quality, thereby increasing the safety and durability of steel bridges and contributing to a sustainable future.

*1 Sponsored by the Japan Institute of Invention and Innovation (Chairman: Takeshi Uchiyamada). This commendation, which is intended to encourage the advance of science and technology in Japan and support the nation's industrial development, is given to an invention, idea, or design that has delivered or is expected to deliver significant benefits due to its excellence.
*2 LALAC™-HS: Abbreviation for Low Alloyed & Low Atmospheric Corrosion Steel – High Salinity.

■ Figure 1: Pattern Diagram Showing the Distribution of Elements in Rust Layers



■ Figure 2: Exposure Test in Real-Life Environments



JFE Steel

Receiving the FY2023 Ministry of the Environment Commendation for Action for Climate Change for the Development of an Ultra-Hydraulic Hydrogen Accumulator Using Steel and Carbon Fiber-Reinforced Resin Layers in Combination

Environmental Benefit: Recycle resources and reduce CO_2 emissions
Status: Development stage

JFE Steel's and JFE Container's joint "Development of Ultra-Hydraulic Hydrogen Accumulator Using Steel and Carbon Fiber-reinforced Resin Layers in Combination" received the FY2023 Ministry of the Environment Commendation for Action for Climate Change in the Development and Productization (the Mitigation domain) category.

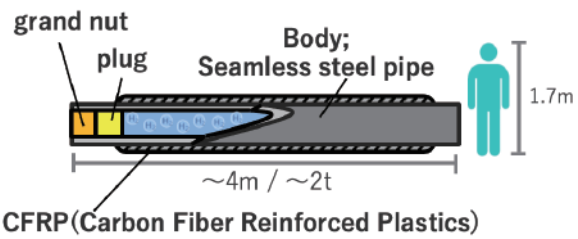
Hydrogen is being studied as a source of energy in a number of fields worldwide because it does not emit CO_2 during combustion. For example, hydrogen stations represent a key component for popularizing its use as a green fuel for vehicles. The incorporation of a hydrogen accumulator for high-pressure storage enables these stations to essentially serve as stationary, large-capacity reservoirs that can quickly fill hydrogen into a vehicle.

This award-winning hydrogen accumulator was designed and is now manufactured by JFE Container using JFE Steel's ultra-thick seamless steel pipe with high resistance to hydrogen embrittlement. The Carbon Fiber Reinforced Plastic (CFRP) of Mitsubishi Chemical Group Corporation is also used for the body of the accumulator to support a wide pressure range up to the highest levels in the industry. The accumulator was developed under a project of NEDO (New Energy and Industrial Technology Development Organization) and has been marketed by JFE Steel since FY2019, after having been authorized by the High Pressure Gas Institute of Japan and specially approved by the Minister of Economy, Trade and Industry in FY2018. The product is in use by multiple hydrogen stations around the country and has been recognized for its outstanding performance. It is also used for medium-pressure hydrogen accumulators, high-pressure hydrogen accumulators, and mock containers of the Fukushima Hydrogen Filling Research Center. The research facility was built under another NEDO project and mainly uses hydrogen produced by the adjacent processing facility, Fukushima Hydrogen Energy Research Field (FH2R). It facilitates the development and verification of filling and measurement technologies for large-flow-rate hydrogen for heavy-duty fuel-cell vehicles.

To further popularize the Ultra-Hydraulic Hydrogen Accumulator, JFE Steel is seeking to increase its manufacturing capacity and further developing the product to increase its internal volume, pressure range, and amplitude cycles to meet specifications likely to be requested as hydrogen stations become more popular for filling up fuel cell buses and trucks.

Award Ceremony (Dr. Takagi, JFE Steel Co., Mr. Yagi, State Minister of Environment, Mr. Takano, JFE Container Co.)

■ **High-pressure hydrogen accumulator**



JFE Steel

The Company's Proprietary Wall Bending and Restrike Method Selected for Production of Parts Supplied to a Major Japanese Automaker—Development of a Forming Method to Suppress the Springback of Ultra-High Tensile Steel Sheets

Environmental Benefit: Reduce CO_2 emissions
Status: Development stage

JFE Steel's Wall Bending and Restrike Method has been adopted and used to produce inner rockers, a body frame component, for use in vehicles manufactured and sold by a major Japanese automaker. The Wall Bending and Restrike Method, a press-forming method, is applied to suppress the springback of 1,180 MPa class, ultra-high tensile steel sheets. JFE Steel has provided customers with these steel sheets to meet increasing demand due to the need for lighter-weight vehicles to reduce CO_2 emissions and boosting fuel efficiency. Since pressed steel sheets are subject to springback—that is, returning to their original shape when removed from a mold—springback conditions must be corrected. Press-formed ultra-high tensile steel sheets generate greater stress than ordinary steel sheets and are therefore more susceptible to higher levels of springback. The resulting challenge of controlling deformation from the intended shape and the increased difficulty of bonding with other component parts has been a bottleneck to the wider application of ultra-high tensile steel sheets.

The Wall Bending and Restrike Method provides a solution for reducing springback by applying an offsetting force to springback-induced stress, particularly through the optimization of sheet shape prior to press-forming. The inner rockers, a structural component at the bottom of a vehicle door, for which the Wall Bending and Restrike Method is used, are manufactured by Kyoho Machine Works, Ltd., and the application of this method to mass-production molds was achieved through a joint development by this company and JFE Steel.

JFE Steel is actively working on what it calls Early Vendor Involvement (EVI), an activity beyond the supply of raw materials, to provide customers with solutions to help them develop new products and increase the performance of existing ones. JFE Steel is developing various steel application technologies to offer comprehensive solutions, including a systematized solution called JESOLVA™, which is short for JFE Excellent Solution for Vehicle Application. JFE Steel strives to broaden the application of its ultra-high tensile steel sheets and help customers boost the performance and trim the weight of their vehicles to contribute to a sustainable future.

■ **Inner rocker made with the Wall Bending and Restrike Method**

JFE Steel

The Company's Proprietary Forming Technologies for Ultra-High Tensile Steel Sheets Adopted and Used for the Production of Parts for Suzuki Swift— An Inflow Control Method for Reducing Wrinkles around Pressed Areas and the Stress Reverse Forming™ Method for Reducing Variation in Dimensional Accuracies

Environmental Benefit: Reduce CO_2 emissions
Status: Development stage

JFE Steel's inflow control method and the Stress Reverse Forming™ Method were adopted and have been used for the production of three front bumper parts for Suzuki Swift to reduce the formation of wrinkles at pressed areas of 980–1,180 MPa class, ultra-high tensile steel sheets and reduce variation in dimensional accuracies.

JFE Steel has provided customers with ultra-high tensile steel sheets to meet rising demand due to the need for lighter weight vehicles to reduce CO_2 emissions and raise fuel efficiency. When press-formed into a curvature shape, press wrinkles form on the steel sheets and the sheets tend to springback to their original shape; both conditions need to be corrected.

While contributing to vehicle weight reduction, ultra-high tensile steel sheets are susceptible to press wrinkles, mold damage, and shape variation, and all these issues are more likely to occur with thicker, stronger steel sheets, a factor that has inhibited the wider application of ultra-high tensile steel sheets. JFE Steel's inflow control method is capable of reducing the

formation of press wrinkles, particularly those around the flanges of pressed areas, by optimizing the inflow of materials at multiple press-forming processes.

The Stress Reverse Forming™ Method is designed to reduce variation in the scale of springback (or variation in dimensional accuracies), which increases as ultra-high tensile steel sheets have higher levels of strength. When press-formed, ultra-high tensile steel sheets are more susceptible to springback and to large variation in strength intensities than regular steel sheets. The Stress Reverse Forming™ Method uses the Bauschinger Effect, or the mechanical phenomenon in which deformation stress in steel sheets decreases immediately after the direction of the deformation is reversed. This method enables customers to stabilize their production of press parts even if there are changes in the intensities of steel sheets.

The front bumper parts for which these two methods are used are manufactured by Okamoto Press Industry, Co., Ltd. In fact, both the inflow control method and the Stress Reverse Forming™ Method were jointly developed by Okamoto and JFE Steel.

JFE Steel is actively working on what it calls Early Vendor Involvement (EVI), an activity beyond the supply of raw materials, to provide customers with solutions to help them develop new products and increase the performance of existing ones. JFE Steel is developing various steel application technologies to offer comprehensive solutions, including a systematized solution called JESOLVA™, which is short for JFE Excellent Solution for Vehicle Application. JFE Steel strives to broaden the application of its ultra-high tensile steel sheets and help customers boost the performance and trim the weight of their vehicles to contribute to a sustainable future.

JFE Steel Ultra-High Tensile Steel Sheet Product Adopted for the First time as a Material for a Hybrid EV Battery Module Component

Environmental Benefit: Reduce CO_2 emissions
Status: Development stage

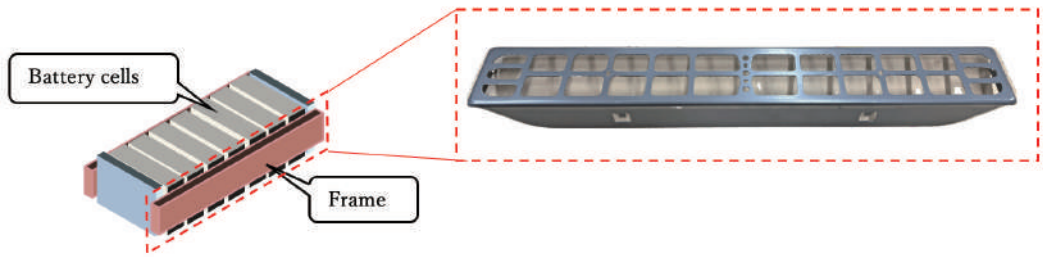
The 980 MPa class galvanized steel sheet was the first of JFE Steel's ultra-high tensile steel sheet products to be selected and used as a material for a lithium-ion battery module frame used in hybrid EVs.

A vehicle battery pack is comprised of multiple battery cells and bound with a steel frame to achieve a high power output. The frame must have a high bonding force to prevent the battery from swelling and from losing performance due to heat during use, and thus there has been demand for a high strength steel sheet. However, high-strength steel sheets are known to be susceptible to fracture when formed by bending. This process is required to minimize the curvature of the folding area of the frame to almost a 90-degree angle and thereby shrink the size of the battery module.

This issue can now be resolved with the use of a press-forming method using CAE* and product specs developed by J-MAX Co., Ltd., both of which have enabled the use of JFE Steel's 980 MPa class, galvanized steel sheet that has the high processability suitable for a battery module frame on hybrid EVs. This galvanized steel sheet is a product of the JEFORMA™ series, a lineup of steel sheets with high strength and high bending formability, properties achieved by optimizing the metallographic structure of the steel sheet through intricate temperature control at the continuous galvanizing facility of the West Japan Works (Fukuyama District). JFE Steel is seeking to expand the application of this galvanized steel sheet and will develop products and methods that will also satisfy customer needs. JFE Steel will contribute to a sustainable future by supporting customers in their development of safe, eco-friendly vehicles with lower CO_2 emissions and higher performance.

*Computer-Aided Engineering. A design tool using computer simulation.

■ **Ultra-High Tensile Steel Sheet Product Adopted for a Hybrid EV Battery Module Component**



JFE Engineering JFE Engineering's Commitment through Its Business

With the corporate purpose "Foundation of Life—Just For the Earth" in mind, JFE Engineering is committed to achieving the SDGs in five areas: waste to resources, carbon neutrality, combined utility services, infrastructure, and digital transformation (DX).

Waste to resources businesses include food recycling, plastic recycling, and waste incineration/power generation. Businesses related to carbon neutrality focus on renewable energies, such as offshore wind, solar, biomass, geothermal, and hydroelectric power generation. Combined utility services offered by the company include utility services (e.g., water, electricity, gas) that address regional concerns by launching new local electric power companies and offering heat supply services. The company's infrastructure business constructs bridges, gas plants, waterworks plants, pipelines, and other infrastructure by identifying needs such as robustness and longer service life. The DX project involves improving the efficiency of daily work as well as providing products and services that leverage digital technologies such as AI and IoT.

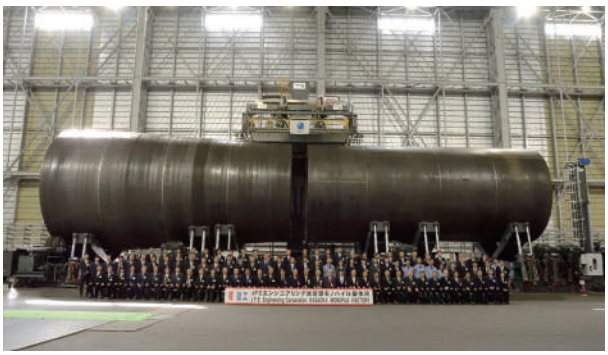
- JFE GROUP REPORT 2021 (PP. 43–44) (https://www.jfe-holdings.co.jp/en/common/pdf/investor/library/group-report/2021/all.pdf)
- JFE Engineering's Five Fields in the Medium- to Long-term Strategy (https://www.jfe-eng.co.jp/en/information/vision.html)
- JFE Engineering DX Strategy (https://www.jfe-eng.co.jp/dx/en/index.html)

JFE Engineering Offshore Wind Power: Launch of Operation at the Kasaoka Monopile Factory

Environmental Benefit: Renewable energy and reduce CO_2 emissions
Status: Business expansion
Feature: Production of monopile foundations for offshore wind turbines

Amid growing expectations for offshore wind power as a source of green power production, an increasing number of projects are being introduced, as is seen in the public tender launched by the Japanese government in 2020 to select offshore wind power generation operators under the Act on Promoting the Utilization of Sea Areas for the Development of Marine Renewable Energy Power Generation Facilities. Foundation structures supporting offshore wind turbines are roughly categorized as seabed-fixed and floating. Seabed-fixed generators that can be installed in shallow sea areas are called monopile foundations. These are also the most economical option.

JFE Engineering built Japan's first factory for monopiles on the premises of JFE Steel's West Japan Works (Fukuyama District) Kasaoka City, Okayama Prefecture, and started operating the factory in April 2024. The Kasaoka Monopile Factory uses large, heavy steel plates supplied by JFE Steel's West Japan Works (Kurashiki District) and is therefore reducing the amount of welding and streamlining assembly. The factory has an annual manufacturing capacity of around 100,000 tonnes of monopiles, with each unit having a diameter of up to 12 m, a plate thickness of 130 mm, a length of around 100 m, and weighing around 2,500 tonnes. The factory is also capable of manufacturing transition pieces for joining monopiles with wind turbine towers as well as large-scale steel pipes for building the columns of floating foundation structures.



Ceremony inaugurating the Kasaoka Monopile Factory

- Offshore Wind Turbine Foundations (Efforts for the Offshore Wind-Power Business) (Japanese only) (https://www.jfe-eng.co.jp/products/life/owp02.html)
- Completion of Japan's first manufacturing base of fixed-bottom foundation (monopile) for offshore wind turbines -Kasaoka Monopile Factory begins operations on April 1st!- (https://www.jfe-eng.co.jp/en/news/2024/20240401.html)

JFE Engineering

Offshore Wind Power, a Foray into O&M through a Remote Integrated Management System

Environmental Benefit: Renewable energy and reduce CO_2 emissions
Status: Business expansion
Feature: Remote management of offshore wind power plants through the use of digital technology

For more than 25 years since 1996, JFE Engineering has been involved in EPC for onshore wind-power stations (131 generators at 25 sites) in addition to equipment supply and associated maintenance services. JFE Engineering will fully leverage its deep, extensive expertise in onshore wind power generation as well as technologies owned by other JFE Group companies to grow and advance its O&M services for offshore wind power plants.

In October 2023, JFE Engineering launched a 20-year O&M contract for offshore wind power facilities (three generators with the max output of 7,495 kW) off the coast of Nyuzen in Toyama Prefecture. These facilities were built under Japan's first offshore wind energy project in a general sea area. JFE Engineering adopted a remote integrated management system for this project, the first of its kind in the nation for an offshore wind power project. The use of the system is allowing the company to provide systematic and preventive maintenance services and facilitate sensor management and data analysis for failure detection and diagnosis.

Nyuzen offshore wind power station (Photo by VENTI JAPAN, Inc.)

JFE Engineering

Contributing the Company's Horizontal Directional Drilling Method to Japan's First Installation of Telecommunication Optical Fiber Cables across Tokyo Bay

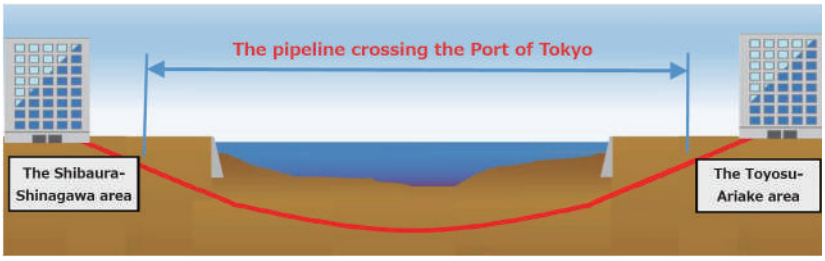
Environmental Benefit: Reduce environmental impact
Status: Commercialized
Feature: Telecommunication cable installation with the company's Horizontal Directional Drilling Method

JFE Engineering has completed the construction of a transmission channel across Tokyo Bay as a project ordered from Nippon COMSYS Corporation. The ongoing advance of information and telecommunication technologies have made telecommunication networks indispensable in daily life, and the growing volume of telecommunication traffic requires an increasing number of optical communications facilities.

Construction involved laying a pipeline for installing telecommunication optical fiber cables between Tokyo's Shibaura and Shinagawa areas, where many tech companies are located, and between the city's Toyosu and Ariake areas, thereby establishing a network with the shortest route. The challenging work required laying the pipeline deep undersea to prevent damaging seawalls and other protection structures around Tokyo Bay as well as handling nearly 2,000 meters of pipeline, one of the longest in Japan. The construction was completed successfully without accident within just two months, thanks to the use of the JFE-RAPID™ method, a pipeline technology developed by JFE Engineering to facilitate quick, low-cost construction.

The JFE-RAPID™ method makes it possible to bring down construction cost and shorten the work period by drilling at the sea bottom and moving the pipeline forward through a circular boring method instead of installing vertical shafts. This is an effective method for installing telecommunication cable and a promising technique for laying power cable pipelines for offshore wind-power stations.

■ **The pipeline (for illustrative purpose only)**



Propulsion machine

➤ JFE Engineering Completes the Construction of a Pipeline Crossing Tokyo Bay—Contributing with the Company's Horizonal Directional Drilling Method to Japan's First Installation of Telecommunication Optical Fiber Cables across the Bay (Japanese only)
(https://www.jfe-eng.co.jp/news/2024/20240523.html)

JFE Engineering

Aqua Connect Namie Corporation Launches Hydroelectric Power Generation Business at the Ukedogawa Hydro Power Plant

Environmental Benefit: Recycle resources and reduce CO_2 Emissions
Status: Commercialized
Feature: Matching local social needs and JFE Engineering Group's technologies

Aqua Connect Namie Corporation, a company established through the joint investment of JFE Engineering with The Tokyo Electric Generation Co., Ltd. and the Ukedogawa Land Improvement District (the town of Namie in the district of Futaba, Fukushima Prefecture), launched its power generation business at the Ukedogawa Hydro Power Station, becoming the first hydrogen power generation business for JFE Engineering. The business was established to take advantage of the agricultural water supplied from the Ogaki Dam to the ward of Odaka in the city of Minamisoma and to the towns of Namie and Futaba in the district of Futaba.

The Ukedogawa Hydro Power Station, with its waterwheel and power generator located at the foot of the Ogaki Dam, generates power by using the energy produced from the difference in water levels. All the power generated at this station is sold through the Feed-in Tariff System. Aqua Connect Namie Corporation is committed to operating the station safely and stably while supporting farmers in the Ukedogawa area. The company will thereby contribute to carbon neutrality and a sustainable future.

Celebrating the completed construction of the Ukedogawa Hydro Power Station

➤ Aqua Connect Namie Corporation Launches Power Generation Business at the Ukedogawa Hydro Power Station (Japanese only)
(https://www.jfe-eng.co.jp/news/2024/20240521.html)

JFE Engineering | Provision of Combined Utility Services

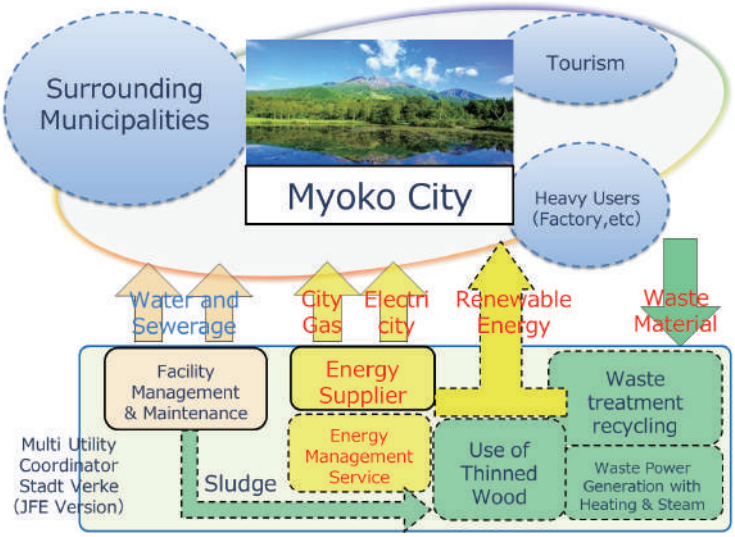
Environmental Benefit: Electric renewable energy and reduce CO_2 emissions
Status: Commercialized
Feature: Matching local social needs and JFE Engineering Group technologies

Myoko Green Energy Co., Ltd. was established through co-funding by JFE Engineering, Hokuriku Gas Co., Ltd., and INPEX Corporation under a basic agreement with the city of Myoko concerning the transfer of the municipal gas business and the delegation of the water and sewage services from the city to the private sector. The company has been providing utility gas, supplying water, and managing sewage for Myoko City, Niigata Prefecture, since April 1, 2022, to establish an urban infrastructure that ensures stable utility services for the citizens.

Myoko City, where the company is located, announced the Myoko Zero-carbon City Declaration in June 2020 and enacted an ordinance promoting it in April 2021. Because of the project's focus on carbon neutrality, Myoko was selected by the central government as a SDGs Future City in May 2021 and has been working on the project plan. To contribute to this initiative, Myoko Green Energy entered into a partnership for realizing a zero-carbon society with Myoko on March 14, 2022. One of the goals of the partnership focuses on the local production and consumption of electricity. To that end, the company started a local effort to collect and recycle renewable energy sources and has since distributed approximately 3,000 kW of zero-carbon electricity to 20 establishments belonging to the city.

Myoko Green Energy aspires to serve as a utility coordinator for local communities and is acquiring the required capabilities for handling infrastructure projects and services like those conducted and provided by Stadtwerke in Germany (See the diagram below).

■ **Myoko Green Energy's vision for itself in the future—Serving as an infrastructure company**



➤ Myoko Green Energy Receives the Award of Excellence in the "1st Commendation of Outstanding PPP/PFI Business Practices" from the Cabinet Office (Japanese only)
(https://www.myoko-green-e.co.jp/information/内閣府 第1回ppp-pfi事業優良事例表彰「優秀賞」を受/)

JFE Engineering

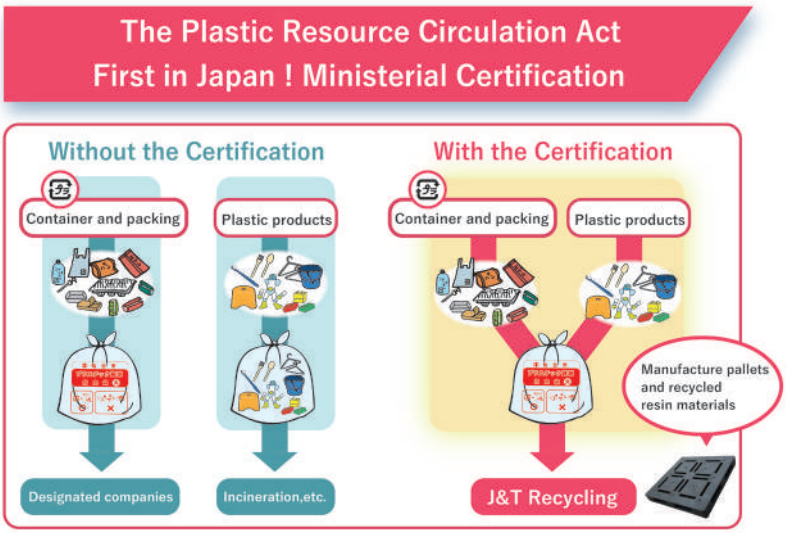
Promoting Plastic Recycling

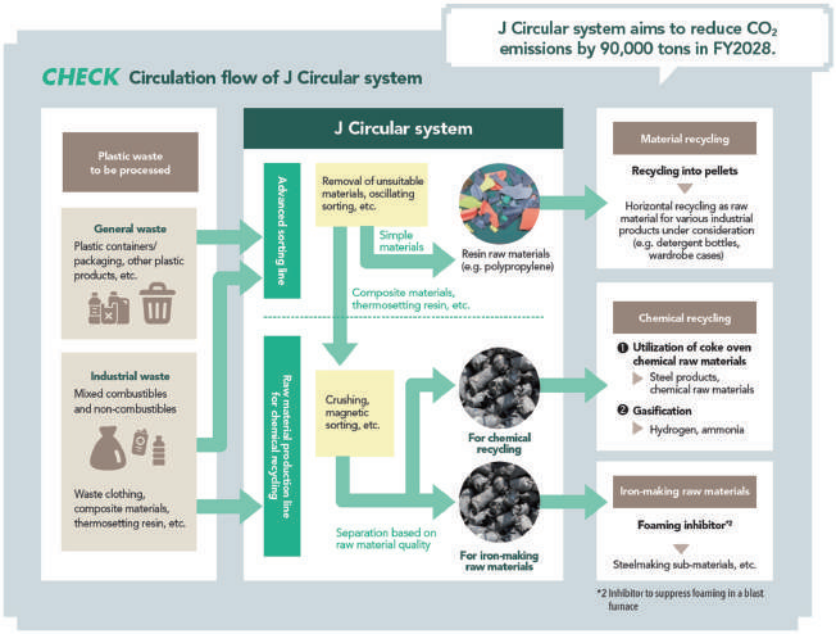
Environmental Benefit: Recycle resources
Status: Commercialized
Feature: Matching local social needs and JFE Engineering Group technologies

J&T Recycling Corporation joined Sendai City's plastic recycling project, the first of its kind authorized by the Minister of the Environment and the Minister of Economy, Trade and Industry. The project was launched under the renewed Act on Promotion of Resource Circulation in September 2022 and subsequently started a service in April 2023 to recover waste plastic products and containers in the city. Waste plastic products previously had been disposed of by incineration, and the service launched by J&T Recycling to recover waste plastic products and containers has boosted the efficiency of the city's plastic recycling efforts.

Moreover, J&T Recycling partnered with the JR East Japan Group and established J Circular System Co., Ltd., in Kawasaki, Kanagawa Prefecture in July 2023 to promote the recycling of plastic items across the country. The company's facilities are capable of processing 200 tons of waste plastic a day as one of the largest recycling operations in the Tokyo metropolitan area. J Circular System is expected to launch full-scale operations in April 2025, to include segregating waste plastic items by type beyond simply recovering them, and recycling the goods into raw materials for other plastic items or converting them into chemicals.

In cooperation with the city of Kawasaki and its neighboring municipalities, J Circular System is developing a plastic recycling plant based on the aforementioned renewed act and seeking to obtain a national license to operate its integrated plastic-recycling business. This will help make the conventional intermediate treatment process for waste plastic simpler and more rational.





- J&T Recycling Corporation Joins the Municipal Waste Plastic Recycling Project of Sendai as Japan's First Private-Sector Recycling Operator
- J&T Recycling Corporation Establishes J Circular System Co., Ltd.—Its Plastic Recycling Facilities on the Kawasaki Waterfront Have the Largest Scale in the Tokyo Metropolitan Area

JFE Engineering

Renewal of the Chugoku Expressway, the Company's Largest-Scale Project

Environmental Benefit: Reduce environmental impact
Status: Commercialized
Feature: Proprietary technology for streamlining bridge construction

Large-scale construction to renew aging express highways are either underway or about to be launched around Japan. The Chugoku Expressway, western Japan's traffic aorta opened in 1970 to coincide with the Japan World Exposition Osaka 1970, is one of these aging highways, with the renewal under way between Suita JCT and Chugoku-Ikeda IC toward completion in October 2024. This project involves replacing a total length of 10.8 km of bridges and using about 17,300 tonnes of steel. JFE Engineering represents a joint venture established for this project at the largest scale JFE Engineering has ever undertaken.

In March 2023, the work requiring all-day closures, one of the larger construction components of this project, was completed. The work was carried out in six separate 90-day sessions to ease public impact, because the bridges stand along the Osaka Central Loop Motorway and intersect with railways. During periods of heavy traffic, however, the closures had to be suspended, limiting the available time for this work. Several new methods and technologies proposed by JFE Engineering, including the company's jack-up method, were adopted to facilitate these all-day closures.

The JFE Engineering's jack-up method allows for construction preparation regardless of weather conditions while maintaining a constant workload. This method, in which new beams are built below older ones, also reduces the costs of scaffolding and the need to transport new beams while streamlining construction.

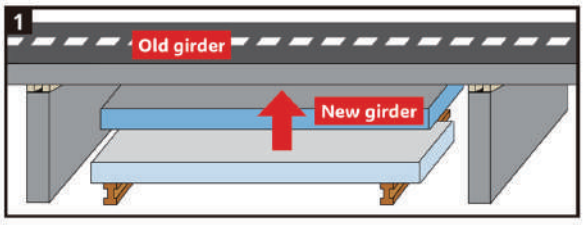
JFE Engineering will deploy its latest technologies and rich expertise to minimize the disruptive impact of bridge renewal work on traffic and society.

Installing a beam with the Jack-up Method

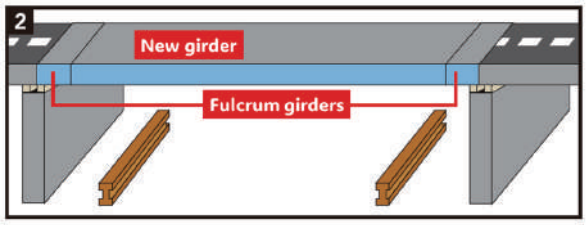
Replacing an old beam with a new one

JFE Engineering's Jack-up Method

This is a method for assembling new bridge beams in advance and thereby enabling them to immediately replace old ones after a highway has been closed off. New beams are used as the scaffolding for removing old ones. The method allows operators to arrange workers and machines in advance while maintaining a constant workload during a highway closure.



New girder jacked up under the old girder (used as scaffolding for new girder)



The old girders are removed by crane, and the new ones are jacked up to the same level. The fulcrum girders are also installed by crane

JFE Dayori (April 1–September 30, 2023) (P. 6) (Japanese only)
(https://www.jfe-holdings.co.jp/common/pdf/investor/stock/for_investors/2023/2023cyu-jigyou.pdf)

JFE Engineering

Development of a Waste Chemical Recycling Technology (C-PhoeniX Process™) through the Use of the Green Innovation Fund

Environmental Benefit: Recycle resources
Status: Development and verification stage
Feature: Participating in a national technology development project

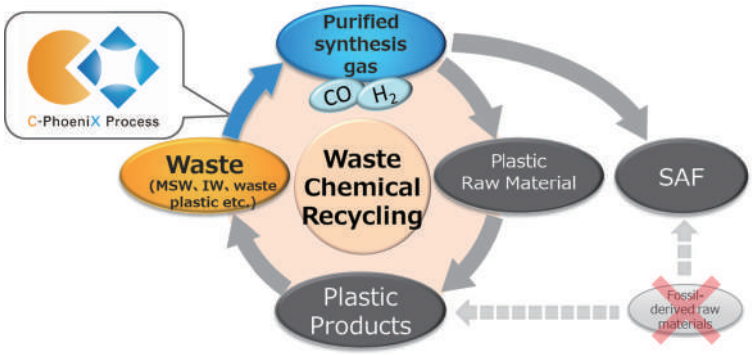
JFE Engineering responded to a public invitation to participate in a Green Innovation Fund Project issued by NEDO (New Energy and Industrial Technology Development Organization) in February 2024 and was selected*1. Following more than two decades of trial and error, JFE Engineering established a technology to convert domestic and other kinds of waste into processable gases. The company's unique gasification furnace has the longest running record in the world. The company is currently developing a new gasification technology, C-PhoeniX Process™ (or CX Process™), to improve and ultimately replace the current technology for carbon neutrality.

The C-PhoeniX Process™, based on the company's accumulated technological expertise, exhibits an advanced capability to constantly produce high-quality, purified synthesis gases, consisting primarily of hydrogen and carbon monoxide, from a wide range of waste materials. Once established, this technology will be applicable to the waste-to-chemical (WtC) process, enabling many types of waste to be recycled for different purposes, including the production of plastic, sustainable aviation fuel (SAF), and hydrogen.

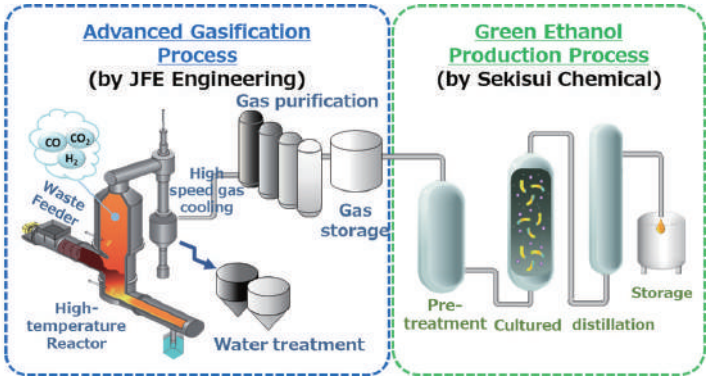
Through the use of the national Green Innovation Fund, JFE Engineering is set to develop a waste chemical recycling technology in cooperation with SEKISUI CHEMICAL Co., Ltd., which owns a technology for converting waste-originated purified synthesis gases into ethanol. In the meantime, JFE Engineering will accelerate the development of its C-PhoeniX Process™ for the advancement and social implementation of WtC. Development under the Green Innovation Projects is scheduled to be completed by the end of FY2030. JFE Engineering will deploy these two technologies, once established, overseas as well as in Japan, and will thereby contribute to the achievement of carbon neutrality by 2050.

*1 NEDO launches its Green Innovation Fund Projects to Achieve Carbon Neutrality in Waste and Resource Circulation

■ Overview of Waste Chemical Recycling



■ Entire Process and Development Domains



- Developing the Advanced Waste-to-Chemical Gasification Process, the "C-PhoeniX Process™" Toward Practical Use in Society
  (https://www.jfe-eng.co.jp/en/news/2024/20240207.html)
- "Waste-to-Chemical Technology Development for Green Ethanol Production by Integrating Advanced Gasification and Biochemical Conversion Technologies" adopted for the NEDO Green Innovation Fund project
  (https://www.jfe-eng.co.jp/en/news/2024/20240215.html)

JFE Engineering

The Energy Forest Project (Demonstration Project for Creating Stable and Effective Supply Systems of Woody Biomass Fuel)

Environmental Benefit: Renewable energy and reduce CO_2 emissions
Status: Development and verification stage
Feature: Participating in a national technology development project

The town of Yuni, located in Hokkaido, and JFE Engineering are jointly carrying out an Energy Forest Project, which will continue until the end of FY2028. This project, named JFE Forest NEXTAGE Project and drawn up by JFE Engineering, was selected by NEDO (New Energy and Industrial Technology Development Organization), a national research and development agency, for inclusion in the FY2023 Demonstration Project on Development of New Fuel Sources Such as Fast-growing Trees on August 3, 2023. JFE Engineering is specifically engaged in pioneering research for creating a large "energy forest," involving the silviculture of trees that grow well and fast in a subarctic climate (clean larch and Sakhalin willow) on land owned by the town of Yuni.

The town of Yuni is seeking to nullify CO_2 emissions by 2050 under the Unicho Zero Carbon City declaration. JFE Engineering is working with the town of Yuni to contribute to carbon neutrality and prevent global warming, thereby fulfilling its corporate purpose, "Foundation of Life—Just For the Earth."

Signing the Agreement Concerning the Energy Forest Demonstration Project with the town of Uni

- The Town of Uni and JFE Engineering Enter into an Agreement Concerning the Energy Forest Demonstration Project

Eco-friendly Processes, Products, and Technologies that Were Upgraded

JFE Steel Certification by SuMPO's EcoLeaf Environmental Labeling Program

Environmental Benefit: Reduce environmental impact
Status: Commercialized

JFE Steel has acquired certification for EcoLeaf, a Japanese environmental product declaration (EPD) program managed by the Sustainable Management Promotion Organization (SuMPO) in Japan for three types of steel sheets for cans: tinplate, JFE Universal Brite (laminated steel sheet), and tin-free steel; five types of building materials: H-beams, JFE Super HISLEND-H beams, extra- thick H beams, construction steel plates, and construction steel columns; and three types of steel plate products: for offshore structures and wind power generating equipment, ship building, and UOE steel pipes; and three types of steel pipes: welded steel pipes, seamless steel pipes, and Kakuhot™ construction seamless square steel pipes.

EcoLeaf is a Type III EPD program managed by SuMPO for quantitatively disclosing the environmental impact of products and services throughout their life cycle, from raw material procurement to disposal and recycling in accordance with ISO 14025:2006 (environmental labels and declarations, Type III Environmental Declarations, Principles and Procedures). The environmental impact of our products is presented as graphic representations of data to increase transparency. The disclosure of environmental impact data with fairness and reliability assured by third-party review and verification enables customers to quantitatively and objectively evaluate the environmental impact of the products they use.

EcoLeaf was renamed SuMPO EPD in April 2024. Going forward, JFE Steel will actively promote the acquisition and publication of SuMPO EPD for its products.

➤ SuMPO Environmental Labeling Program (https://ecoleaf-label.jp/en/)

JFE Steel Ferro-Coke

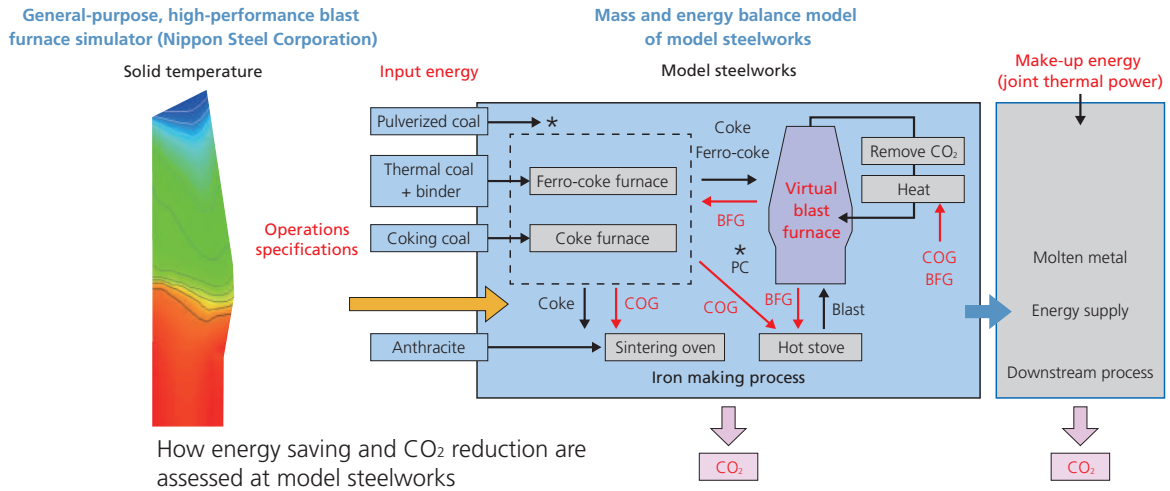
Environmental Benefit: Save energy and reduce CO_2 emissions
Status: Experimental operation

Ferro-coke is an innovative raw material for blast furnaces made by mixing low-grade coke and iron ore. In this energy-saving technology, metallic iron contained acts as a catalyst, reducing the amount of coke required in the furnace and thus significantly reducing CO_2 emissions in the iron making process.

In the six years from FY2017 to FY2022, JFE Steel engaged in a project to develop environmental technology for the steelmaking process, and technological development of the iron making process using ferro-coke, a project by the New Energy and Industrial Technology Development Organization. In 2022, the company conducted a test using ferro-coke made from affordable iron core at a facility with a daily capacity of 300 tonnes. In the test, the company used 30 kg/t of the ferro-coke at a furnace of the West Japan Works (Fukuyama District) and observed a 10 kg/t reduction in the reducing agent ratio. In 2023, the company produced ferro-coke from a mixture of even more economical iron core with fuel coal for use in pulverized coal injection and tested the ferro-coke at a furnace.

JFE Steel plans to conduct a laboratory test to clarify the materials for ferro-coke production that can reduce both material cost and the agency ratio before moving on to a pilot experiment.

■ How energy saving and CO_2 reduction are assessed at model steelworks



How energy saving and CO_2 reduction are assessed at model steelworks

JFE Steel

R&D into Line Pipe for Transporting High-Pressure Hydrogen Gas (Selected for Inclusion in the Nippon Foundation), and DeepStar Joint Research & Development Program Phase II

Environmental Benefit: Recycle resources and reduce CO_2 emissions
Status: Development stage

JFE Steel conducted research and development into the property evaluation of line pipe for transporting high-pressure hydrogen gas in a hydrogen-related technical development Phase-I under The Nippon Foundation*1—DeepStar*2 Joint Research & Development Program on Offshore Oil and Natural Gas*3 ("the Project"), which is being conducted in cooperation with major oil companies. Recognition of Phase-I results led to the selection of the R&D project for inclusion in the program's Phase II. In this phase, JFE Steel will expand the scope of the research to include thick, high-strength UOE steel pipes*4 intended for seabed pipelines, and it will continue to work with DeepStar consortium members ExxonMobil and Chevron of the U.S.A. and TotalEnergies of France to establish evaluation criteria and methods using the company's Mighty Seam™ electric-resistance-welded steel pipe*5 to transport high-pressure hydrogen for realizing the world's first commercial high-pressure hydrogen pipeline.

Since hydrogen does not emit CO_2 during combustion, the large-scale use of hydrogen for various purposes, such as fuel for power generation, is being widely considered for achieving carbon neutrality by 2050. The use of a pipeline similar to the current supply chain for natural gas is being explored for transporting hydrogen in bulk from its production plant and receiving terminal to where it is needed. Meanwhile, hydrogen causes steel materials to become brittle (reducing ductility). Consequently, methods for evaluating the performance of materials are being established in countries other than Japan to support safety standards and quality inspections. As in Phase I, JFE Steel's Steel Research Laboratory in Chiba, Japan, will research properties required for high-pressure hydrogen pipelines, particularly through the application of the Engineering Critical Assessment*6 . The company will also evaluate performance under high-pressure hydrogen environments using a steel pipe specimen as well as welded area samples to verify safety.

The JFE Group will continue to promote research and development that will contribute to the realization of a hydrogen society. By meeting the needs of customers who are working on the supply and wider application of hydrogen, the JFE Group will help realize carbon neutrality.

*1 A public interest incorporated association designated as a ship promotion organization by the Ministry of Land, Infrastructure, Transport and Tourism of Japan. Funding for its activities is drawn from the proceeds of motorboat racing held by local governments throughout Japan, to primarily support maritime shipping-related business, engage in public services/welfare business, and international cooperation.

*2 An offshore technology development consortium consisting of businesses that engage in globally exploring, developing, and producing offshore oil and natural gas, such as Chevron, Shell, and Equinor, as companies that carry out offshore oil field development and production, and other businesses, universities, and research institutions that offer products and services to those businesses.

➤ *3 A joint grant program of the Nippon Foundation and DeepStar for research and development projects for advancing decarbonization in offshore oil and natural gas areas.(Japanese only) (https://www.nippon-foundation.or.jp/who/news/information/2023/20230113-83742.html)

➤ *4 Made by forming a steel plate through cold-pressing in two steps, first into a U shape and then an O shape, and then, after arc-welding the joint, expanding the tube while adjusting the shape. (https://www.jfe-steel.co.jp/en/products/pipes/linepipe.php)

*5 An electric-resistance-welded steel pipe for line pipe, with excellent weld quality.

*6 A technology for evaluating safety from a mechanical standpoint, by comparing the forces acting on a structure with material toughness obtained from material testing.

JFE Steel

Steel Slag Hydrated Matrix

Environmental Benefit: Recycle resources and reduce CO_2 emissions
Status: Commercialized

Steel slag hydrated matrix is a steel slag product that can be used as a substitute for concrete but uses ground granulated blast furnace slag instead of cement, and steel slag instead of natural gravel and sand aggregate, as its ingredients. It effectively uses steel slag and does not rely on natural aggregate, thereby reducing environmental impact, and uses less cement, in turn reducing CO_2 emissions.

There are many examples of blocks and artificial stones made from steel slag hydrated matrix being used as a substitute for concrete blocks and natural stones in harbor works, apart from the expected application for scour-prevention at the growing number of offshore wind-power stations to be constructed in the near future. In addition, we are conducting on-site monitoring in the Katsunan Central Zone of Chiba Port with the help of a local fishing association to assess the impact of these blocks on marine biodiversity.

Wave-dissipating and foot protection block

Artificial stones made from steel slag hydrated matrix

JFE Steel

Initiatives for Blue Carbon Using Steel Slag Products and Acquisition of J Blue Credit™

Environmental Benefit: Recycle resources, preserve biodiversity, and absorb and secure CO_2
Status: Commercialized

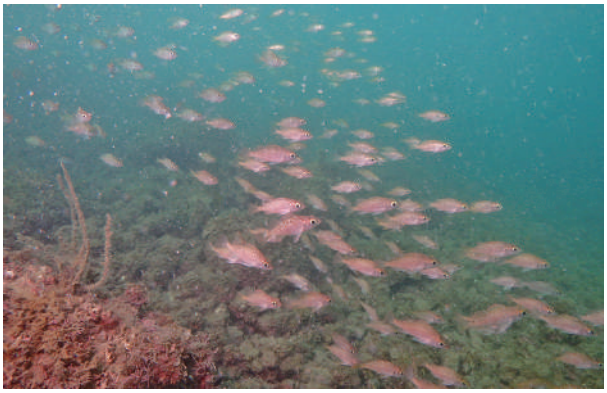
In recent years, research on blue carbon (carbon absorbed and stored by living organisms in the ocean) has been advancing. JFE Steel has been participating in the research by creating a seaweed bed using steel slag products and measuring the amount of carbon captured by the entire bed.

The company has been collaborating with Koujiro Fisheries Cooperative (Iwakuni City, Yamaguchi) and the National Institute of Technology, Ube College (Ube City, Yamaguchi) on a project to create a seaweed bed and ecosystem using recycled materials at areas around Shinto, Iwakuni City, since FY2012. The initiative involves creating a seaweed bed with rich biodiversity using Marine Stone™, a grain-size-adjusted steel slag, and other steel slag products, and measuring CO_2 absorption of the created beds. The cumulative amount of CO_2 absorbed and stored from 2018 to 2022, which totaled 80.7 tonnes, received J Blue Credit™ certification by the Japan Blue Economy Association. This was the first certification ever given to a three-party joint project by the Fisheries Cooperative, academia, and private business. The seaweed bed created through the project had the co-benefits of offering a gathering place for diverse fish. The sea area is also useful for education and research.

This initiative was highly regarded, and its members and JFE Steel received the Ministry of Agriculture, Forestry and Fisheries Prize for the 32nd Global Environment Award*, sponsored by the Fujisankei Communications Group in 2024.

*The Global Environment Award recognizes environmental preservation and related efforts that will help establish a circular society for a "harmonic coexistence between industrial development and the environment of the Earth."

➤ The 32nd Global Environment Award (Japanese only) (https://www.sankei-award.jp/eco/jusyou/)



School of rockfish gathered around the steel slag seaweed bed

Excellent place for education and research (photo from the National Institute of Technology, Ube College)

JFE Shoji

Building a Supply Chain for the Offshore Wind Power Generation Industry

Environmental Benefit: Renewable energy
Status: Sales expansion

Initiatives toward carbon neutrality are expanding around the world to tackle the shared issue of climate change. Japan has set its goal to achieve carbon neutrality by 2050 and formulated the Sixth Strategic Energy Plan in 2021 to lay out strategies to that end. These ambitious strategies include reducing greenhouse gas emissions by 46% in FY2030, boosting renewable energy in its electricity mix to 36–38%, and increasing the ratio of wind in the renewable energy mix to 5% (generating capacity of 23.6 GW) compared to the 0.9% (generating capacity of 4.5 GW) in FY2019.

As for offshore wind power generation, the industry is expected to expand, as targets were set to accept proposals to build 10 GW capacity by 2030 and 30–45 GW by 2040, and the commercialization of those proposals is in progress. Moreover, as is seen in the selection of a demonstration project for floating offshore wind-power generation as a Green Innovation Fund Project, efforts are underway to adopt many internationally competitive technologies.

JFE Shoji is collaborating with a local enterprise that manufactures the wind turbine foundations in Taiwan, which is leading in the offshore wind power generation market, and have been achieving progress regarding supply chain of steel materials for foundation structures. Looking ahead, the company will capitalize on the knowledge acquired and contribute to the realization of carbon neutrality by establishing a supply chain that supports the domestic production of goods and the local economy while also meeting customer demand in the offshore wind power generation industry in Japan.

Major Eco-Friendly Processes, Products, and Technologies in the Past

JFE Steel

Technology for Optimized Combustion of a Coke Furnace

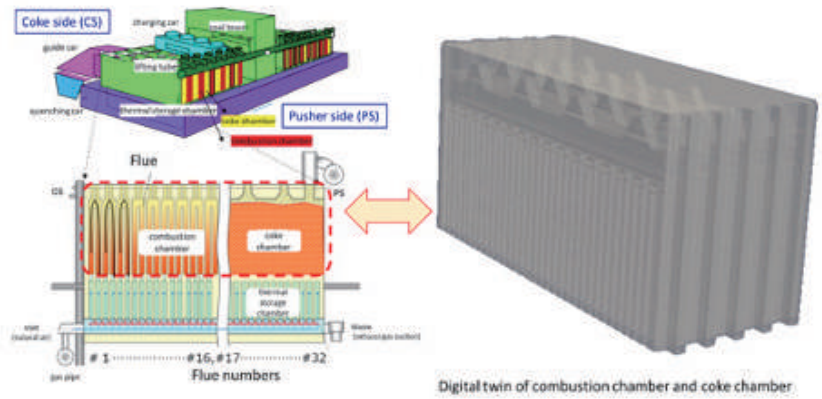
Environmental Benefit: Save energy and reduce CO_2 Emissions
Status: Operation in production process

JFE Steel has completed technological development of a new facility at the coke furnace in the West Japan Works (Fukuyama District), which is capable of saving energy and cutting CO_2 emissions, by using digital-twin technology, and has started the operation of the process.

We intend to transform into an intelligent steel works through the deployment of cyber physical systems (CPSs) as part of our digital transformation (DX) strategy. Digital twins are a core CPS technology in which physical systems and processes in the real world are replicated with equivalent properties in a digital model ("twin") in a virtual space, allowing for an accurate simulation of the real world. These digital models make it possible to visualize highly inaccessible internal areas of facilities to optimize the design and operation of manufacturing processes for which internal conditions have conventionally been difficult to confirm via sensors or direct observation. The use of the digital twin also makes it possible to predict the effects of major changes to facilities or operations.

The technology was applied to process improvements for the operation of the Number 5, D Group coke furnace in the Fukuyama District of the West Japan Works. The information obtained from the digital twin of coke furnace constructed in virtual space confirmed that a mechanism for partially controlling air supply will achieve greater operational efficiency, information that the company can use for calculating the amount of supplemental air needed to optimize combustion. JFE Steel then applied these learnings in developing the new facility, which is now in commercial operation. The company has achieved an approximately 5% reduction in the amount of fuel used and has reduced its CO_2 emissions by 6,600 tonnes a year, compared to the level with the furnace's previous design. This project was chosen for the Japanese government's Sustainable Open Innovation Initiative funding.

■ **Architecture of the coke furnace and the digital twin model**



JFE Steel

Fuel and Power Operation Guidance System for Steelworks

Environmental Benefit: Save energy and reduce CO_2 emissions
Status: Development stage

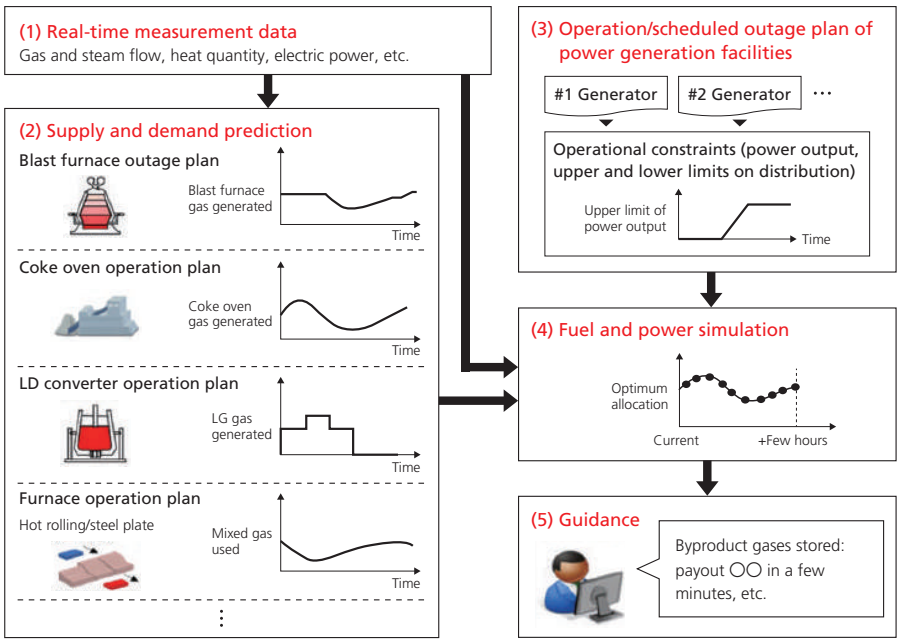
JFE Steel developed a fuel and power operation guidance system for steelworks and succeeded in saving energy and reducing CO_2 as well as fuel and power by optimizing the fuel, steam, and electric power used in the steelmaking process.

Previously, operators determined various factors such as the distribution of byproduct gas to each process, amount of fuel (heavy oil, city gas, etc.) and electricity to purchase, and the amount of byproduct gas stored, taking into account energy demand and supply (amount generated and used) as well as the operating conditions of power generation facilities, to minimize cost and energy loss. However, it was difficult to use this method to accurately estimate the change in energy demand and supply. The guidance system (diagram 1) developed by JFE Steel uses voluminous real-time measurement data (1) obtained through a cyber physical system (CPS)* and the precise production plans of each factory to predict future demand and supply with high accuracy (2), and by taking into account information such as in-house power generation capacity (3), fuel and power simulation allows for the calculation of the optimal operating conditions with the lowest possible purchase from external sources (4), and the results are fed back to guide the operator (5).

The system's development was awarded the Academic Award (Technical Division) of the 2022 Japan Institute of Energy Award. JFE Steel established the JFE Digital Transformation Center (JDXC™) to promote CPS within the manufacturing process and other digital transformation initiatives to achieve innovative production improvements as well as stable operations. We remain committed to realizing a sustainable society by adopting digital transformation to address the various issues identified at production sites.

*A system that brings together a vast amount of sensor information about physical space as big data in cyberspace and generates value by feeding back in real time the results analyzed by various measures for application in the physical space.

■ **Guidance System Overview**



➤ JFE Steel receives Academic Award (Technical Division) of the 2022 Japan Institute of Energy Award (Japanese only)
(https://www.jfe-steel.co.jp/release/2023/03/230301.html)

JFE Steel

Resource Saving Silicon-Gradient Steel Sheet

Environmental Benefit: Save energy and reduce CO_2 emissions
Status: Commercialized

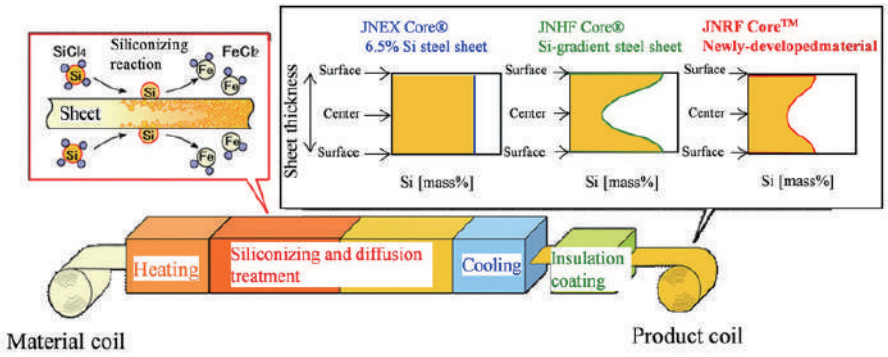
The recent trend toward increasing driving frequency due to the downsizing of electrical equipment has intensified the need to reduce iron loss*1 in the high-frequency range for electrical steel sheets*2, widely used as iron core material for electrical equipment such as motors and transformers. Meeting this demand depends upon increasing the concentration of silicon (Si), an element that strengthens electrical resistance. However, increasing concentration also causes magnetic flux density to decrease at the same time.

To overcome this, JFE Steel developed JNHF™, JNSF™, and JNRF™ using its proprietary chemical vapor deposition (CVD) continuous siliconizing process technology for controlling Si concentration distribution. These products exhibit low iron loss at high frequencies and high magnetic flux density, significantly contributing to greater efficiency while downsizing electrical equipment, and they are used as an iron core material for reactors for solar power generation and high-speed motors.

In recognition of the positive social impact of this development, we received the 2022 Award for Science and Technology from the Minister of Education, Culture, Sports, Science and Technology under the development category of the science and technology field. JFE Steel will continue to contribute to improving electrical equipment by raising efficiency, reducing size, and saving energy by providing high-performance, high-grade electrical steel sheets.

*1 The loss of energy, primarily as heat, that occurs when the iron core is excited by an alternating current. The less iron lost, the higher the efficiency of electrical equipment.
*2 Electrical steel sheets are obtained by adding silicon to iron and are widely used as iron core materials in equipment such as motors and transformers.

■ CVD Continuous Siliconizing Process and Si Concentration Distribution Control



➤ Received the 2022 Award for Science and Technology from the Minister of Education, Culture, Sports, Science and Technology under the science and technology field (development category). (Japanese only)
(https://www.jfe-steel.co.jp/release/2022/04/220408.html)

➤ External Awards (P.269)

JFE Steel

Anti-Fatigue-Damage Steel for Increased Bridge Safety (AFD™ Steel)

Environmental Benefit: Recycle resources and reduce CO_2 emissions
Status: Development stage

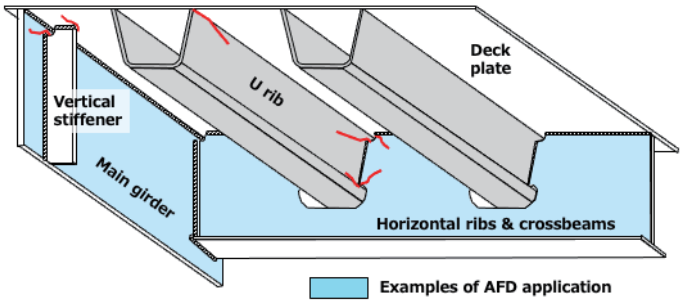
JFE Steel has developed a thin version of its anti-fatigue-damage steel (AFD™ steel) with improved fatigue resistance. The steel plate, produced by a plate mill at the East Japan Works (Keihin District) using the Super-RQ system with advanced cooling control, has a minimum thickness of 9 mm and retains the mechanical properties of conventional plates while offering improved fatigue resistance. Compared to AFD™ steel, the thin-walled version is expected to be deployed in a wider range of applications, including bridge structural members that are prone to cracking over time.

Ensuring low maintenance and renewal costs associated with aging is crucial for steel structures purposed for long-duration use. Thin-walled members of bridges are susceptible to fatigue cracking over time, and the cracks may increase in size between inspections and maintenance. The newly developed AFD™ steel increases the durability of steel structures because it can be used in places prone to fatigue cracking. Compared to ordinary steel, AFD™ steel reduces the fatigue-crack growth rate*1 to half or less of the upper limit of ordinary steel and roughly doubles product life, thereby reducing life cycle costs associated with long service life.

Looking ahead, JFE Steel will continue to improve the performance and quality of steel to achieve superior durability, safety, and economy in steel structures, including bridges, ships, construction machinery, and industrial machinery, thereby contributing to a more sustainable world.

Note: AFD is the abbreviation for Anti-Fatigue Damage.
*1 Fatigue damage is caused by small, repeated forces that create cracks that gradually grow until the material fails. Since these cracks propagate incrementally with the repeated application of force, the length over which the cracks propagate per repetition is called the fatigue crack growth rate.

■ **Examples of Thin AFD Steel Application**



➤ Developed thin, fatigue-resistant steel for steel structures (https://www.jfe-steel.co.jp/en/release/2023/230330.html)

JFE Steel Extra-Thick, High-Strength Steel Plate for the Materialization of Large Container Ships

Environmental Benefit: Recycle resources and reduce CO_2 emissions
Status: Commercialized

The world's thickest crack arrest steel plate*1, developed by JFE Steel, is applicable to large container ships, with its 460 MPa class yield strength and a thickness of 100 mm. The technology is the first in the world to satisfy two different properties in the extra-thick steel plate: weldability and crack arrestability. Container ships are designed with wide open areas at the top of the deck. Since the hull is exposed to heavy wave force throughout the voyage, the top of the deck and the side of the hull (hatch side coaming) must be built with steel that is thick with high strength. In response to the recent trend of upsizing container ships for more efficient transportation, the thickness of steel plates has increased from 50 mm to 100 mm, with an expected yield strength of 460 MPa. At the same time, an excellent crack-arrest property is required to prevent the propagation of brittle crack. To ensure the safety of hulls that are rapidly becoming larger, the International Association of Classification Societies mandated that all 80 mm to 100 mm class thickness steel used in hatch side coaming must have at least 8,000 $N/mm^{3/2}$ arrest toughness (Kca). Using TMCP technology*2, JFE Steel precisely controlled the heating and rolling temperatures and established a proprietary technology that increases the crystallization ratio in the central part of the steel plate's thickness, helping ensure high brittle crack arrestability in the world's thickest, 100 mm, high-strength steel plate.

The development of this technology received the 2023 Award for Science and Technology from the Minister of Education, Culture, Sports, Science and Technology under the development category of the science and technology field for significantly contributing to the materialization of ultra-large container ships. It has been awarded many other prizes including the 2018 Invention Prize of National Commendation for Invention and the 2019 Okochi Memorial Prize. We will continue to improve the economic efficiency, safety, and reliability of vessels by providing high-performance, high-quality steel material while meeting the diversified needs of customers and also addressing global environmental concerns, and contributing to the realization of a sustainable society.

*1 A steel plate with excellent performance in minimizing vessel damage by stopping brittle crack propagation in the event of weld cracking.
*2 A thermo-mechanical control process technology that improves the strength and toughness of steel material in an online process using controlled rolling and accelerated cooling systems.

➤ Received the Award for Science and Technology from the Minister of Education, Culture, Sports, Science and Technology under the science and technology field (development category)(Japanese only) (https://www.jfe-steel.co.jp/release/2023/04/230407.html)

JFE Steel Calcia Improvement Material

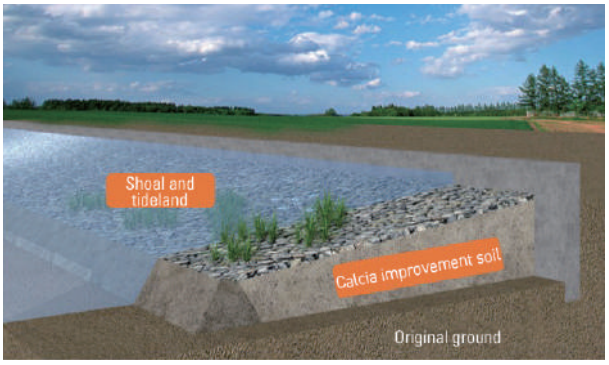
Environmental Benefit: Recycle resources and preserve biodiversity
Status: Commercialized

Calcia improvement material is a slag product that uses converter-type steelmaking slag as raw material and is manufactured by controlling the composition and adjusting particle size. Dredged soil mixed with calcia improvement material is called calcia improvement soil, which is stronger than the original weak dredged soil and is therefore able to prevent dredged soil from dissipating into the surrounding area and having a negative environmental impact placed in water.

This enables the effective use of weak dredged soil in land reclamation, shoal and tideland construction, and refilling former dredging sites. Calcia improvement soil has been used to construct a mid-section submerged breakwater* (Shin Honmoku Pier, Port of Yokohama), the main embankment material for creating a shallow area (incidental facilities at the sediment disposal site, Tokuyama-Kudamatsu Port) and backfilling material for an earthquake-resistant quay wall in the Mino offshore area, Fukuyama Port.

*An embankment built under the water surface on the inside of a perimeter wall to divide the land into sections for reclamation.

■ Calcia Improvement Material and Calcia Improvement Soil



Example of calcia improvement soil application (shoal and tideland construction material)

JFE Steel Precast Concrete Products Mixed with Finely Ground Blast Furnace Slag

Environmental Benefit: Recycle resources and reduce CO_2 emissions
Status: Commercialized

Finely ground blast furnace slag can be used as a cementing material in concrete. This type of concrete exhibits significantly higher durability under harsh conditions such as applications in sewers and exposure to anti-freeze agents. Its effectiveness in reducing environmental impact is widely understood, although there has recently been growing interest in its practical applications for concrete constructions that require higher durability.

As one of the deliverables for the Japanese government's Strategic Innovation Promotion Program, the Japan Society of Civil Engineers published a draft guideline in March 2019 on the application of finely ground blast furnace slag to precast concrete product, and its application now includes precast concrete slabs installed in highways and piers. With the application of finely ground blast furnace slag in concrete, the durability of precast products is expected to be greater and more consistent, allowing them to contribute to building national resilience.

Precast concrete slabs mixed with finely ground blast furnace slag installed in piers

JFE Steel Use of Granulated Blast Furnace Slag to Reduce CO_2 Emissions

Environmental Benefit: Recycle resources, preserve biodiversity, and reduce CO_2 emissions
Status: Commercialized

Granulated blast furnace slag in crushed and powdered form can be mixed with cement and used as a substitute for cement for making concrete. This leads to reducing the production of cement, thus lowering CO_2 emissions. For example, producing 1 tonne of blast furnace slag cement with 45% of its content substituted with granulated blast furnace slag emits 42% less CO_2 than conventional cement. In FY2023, JFE Steel supplied approximately 5.94 million tonnes of granulated blast furnace slag to cement production, equivalent to a reduction of approximately 4.21 million tonnes of CO_2 emissions.

■ CO_2 Emissions for Producing 1 Tonne of Cement (Unit: kg-CO_2/ton)

CO_2 Emissions Source	Regular Cement	Blast Furnace Slag Cement
Limestone	478	270
Electricity/energy	278	168
Total	756	437

Source: Data published by the Japan Cement Association (compiled from the actual FY2022 data)

JFE Steel

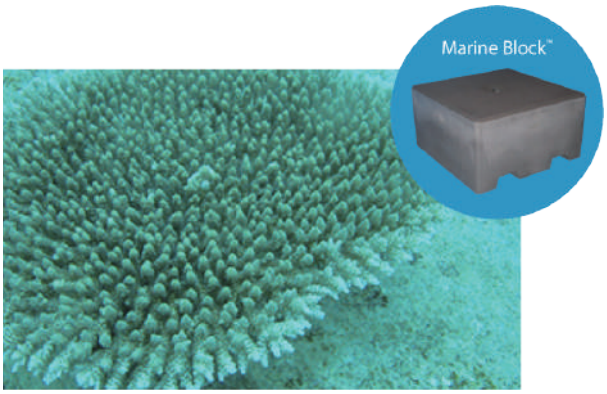
Restoring Marine Ecosystems Using Steel Slag Products

Environmental Benefit: Recycle resources, preserve biodiversity, and absorb and secure CO_2
Status: Commercialized

Marine Stone™ is a grain-size-adjusted steel slag that controls the generation of hydrogen sulfide from the silty sediment in enclosed coastal seas and improves the environment in which organisms can live. Its effectiveness in improving marine environments is widely recognized, and the joint project with Hiroshima University has received external commendations.

Frontier Rock™ is another steel slag product that consists of artificial stones made from steel slag hydrated matrix and provides an excellent base for seaweed beds and fishing reefs. A submerged bank built on the seabed off the coast of Minami - Izu Town, Shizuoka Prefecture, has become a gathering place for large perennial seaweeds as well as useful fishery resources such as lobsters, turban shells, and a wide variety of fish. We are also testing the effects of Marine Block™ as beds for corals.

School of fish attracted to the submerged bank made of Frontier Rock™



Coral growing on Marine Block™

JFE Steel

JFE Steel and Tohoku University's Collaborative Research Laboratory for Green Steel

Environmental Benefit: Reduce CO_2 emissions
Status: Development stage

In February 2022, JFE Steel and Tohoku University jointly established the Collaborative Research Laboratory for Green Steel within the university's Graduate School of Engineering to research eco-friendly steel materials and production methods for the carbon-neutral era. The Collaborative Research Laboratory is managed under a cross-divisional system and develops collaborations across a wide range of fields, including the development of steelmaking processes and materials. This will facilitate a multifaceted approach to resolving issues related to low-carbon steelmaking processes and to discover innovative development themes from new perspectives. Furthermore, we will dispatch young researchers to nurture highly specialized human resources who will lead the next generation of the steelmaking industry.

Collaborative Research Wing, Materials Development, Graduate School of Engineering, Tohoku University

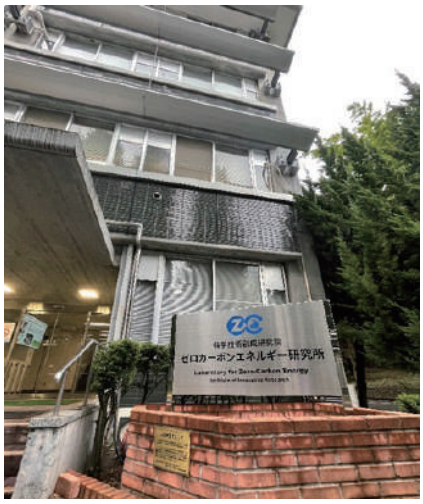
➤ JFE Steel and Tohoku Univ. Establish Collaborative Research Lab for Green Steel (https://www.jfe-steel.co.jp/en/release/2022/220203.html)

JFE Engineering Carbon Neutrality Collaborative Research Center Established with the Tokyo Institute of Technology

JFE Engineering and the Tokyo Institute of Technology opened the JFE Engineering Carbon Neutrality Collaborative Research Center (CRC) at the Institute's Laboratory for Zero-Carbon Energy under the Institute of Innovative Research on July 1, 2022. The purpose of the CRC is to promote new technologies for realizing a carbon-neutral society. The two parties are comprehensively and jointly working on technical developments in carbon neutrality, transcending the boundaries of a typical individual joint research framework to pursue a multilayered approach and generate innovation across the wide range of fields required for realizing a carbon-neutral society.

The CRC will promote the development of new technologies to help realize a carbon-neutral society by combining JFE Engineering's engineering technologies related to plant and infrastructure construction in the fields of energy and the environment with the Tokyo Institute of Technology's advanced academic knowledge in a wide range of areas. The CRC will also continue collaborating with a variety of organizations through the Tokyo Tech GXI*, an industry-academia partnership project run by Tokyo Institute of Technology.

*Intended to promote research activities that will initiate a GX (green transformation) society, strengthen startups, and substantiate industry-society collaboration.



Laboratory for Zero-Carbon Energy, Institute of Innovative Research (Ookayama North No. 1 Campus)

➤ JFE Engineering and Tokyo Institute of Technology establishes JFE Engineering Carbon Neutrality Collaborative Research Center (Japanese only) (https://www.jfe-eng.co.jp/news/2022/20220629.html)

JFE Shoji

Expanding Business in Biomass Fuels

Environmental Benefit: Renewable energy and reduce CO_2 emissions
Status: Sales expansion

JFE Shoji imports fuels such as palm kernel shells (PKS) to Japan from Malaysia and Indonesia and wood pellets from Southeast Asian countries as fuel supplies for domestic biomass power plants.

PKS and wood pellets serve as carbon neutral fuel sources by absorbing CO_2 as they grow. JFE Shoji is working to procure biomass fuel through a process that is environmentally and socially sound, thereby maintaining a sustainable business model. Additionally, the company launched alternative fuel initiatives for exiting the use of coal as it strives to become an environmentally sound company.

PKS

Wood pellets

JFE Shoji

Expansion of Scrap Trading to Support the Development of a Recycling-Oriented Society

Environmental Benefit: Recycle resources and reduce CO_2 emissions
Status: Sales expansion

JFE Shoji engages in a recycling business for steel and aluminum scrap. Demand for steel scrap is particularly expected to grow in Japan and overseas as the global community advances toward carbon neutrality. JFE Shoji will contribute to building a recycling-oriented society by increasing scrap recycling across the globe.