

Climate Change

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 CO₂ 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 CO₂ 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 CO₂ emissions in FY2030 in the steel business, which accounts for most of the Group's CO₂ 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 CO₂ 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.

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 CO₂ 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 CO₂ emissions by 18% from FY2013 levels by the end of FY2024.** In addition, we announced that **the target of reducing CO₂ 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 CO₂ 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 CO₂ emissions reduction across society.**
- **The principles of TCFD will be reflected in our business strategies and systematically deployed.**

The Target of Reducing CO₂ Emissions in FY2024 (Seventh Medium-term Business Plan Initiatives)

- ▶ Reduce steel-business CO₂ emissions in FY2024 by 18%, compared to FY2013 (steel business)

The Target of Reducing CO₂ Emissions in FY2030

- ▶ Reduce steel-business CO₂ emissions in FY2030 by 30% or more, compared to FY2013 (steel business)

Initiatives for Carbon Neutrality by 2050

(1) Reduce steel-business CO₂ 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 CO₂ emissions reduction in society

- ▶ JFE Engineering: Expand and develop renewable energy power generation and carbon-recycling technologies. (Reduce CO₂ 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.

- Carbon-recycling blast furnace: A technology that converts CO₂ from the blast furnace into methane, which is then used as reducing material in the blast furnace
- CCU: Carbon dioxide capture and utilization
- Transitional technologies: Technologies that advance the transition to carbon neutrality
- Ferro coke: Innovative blast furnace raw material that improves the reduction efficiency of iron ore and reduces CO₂ generation from the blast furnace

▶ [Seventh Medium-term Business Plan](#) (P.12)

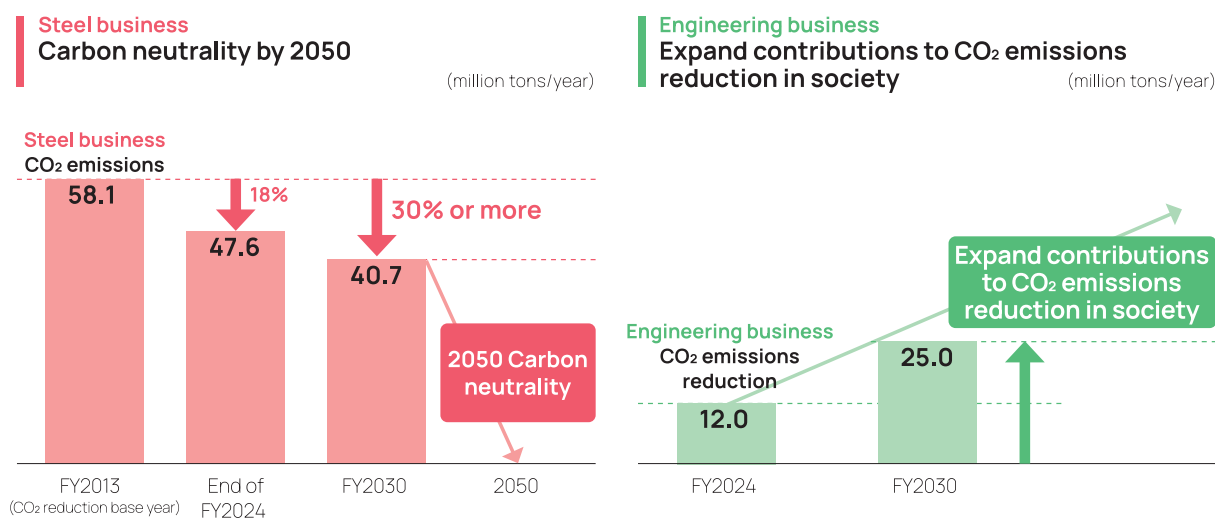
▶ [JFE Group Environmental Vision for 2050, Presentation Material](#)

(<https://www.jfe-holdings.co.jp/en/investor/zaimu/g-data/2020/May2021-210525-release01.pdf>)

Developing processes to mass produce high-quality, high-performance steel with zero CO₂ 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



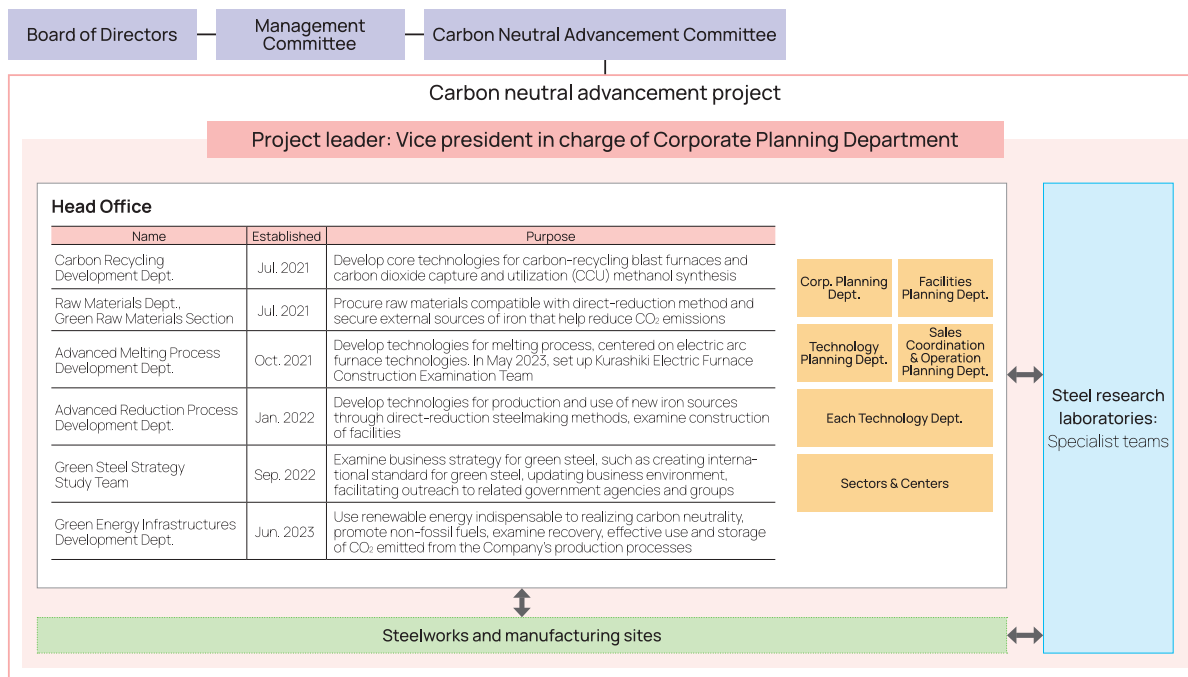
Management Structure

JFE Steel's Management Structure to Promote Carbon Neutrality

In May 2023, JFE Steel established the Kurashiki Electric Furnace Construction Examination Team within the Advanced Melting Process Development Department to quickly and efficiently introduce a new high-efficiency, large-scale electric furnace at the West Japan Works (Kurashiki district). In addition, we dissolved the CCUS* & Green Infrastructure Study Team and established the Green Energy Infrastructures Development Department in June 2023 to promote the use of renewable energy and non-fossil fuels toward achieving carbon neutrality by 2050 and to rapidly promote the capture, effective use, and storage of CO₂ emitted from our production processes.

*Carbon dioxide capture, utilization and storage

JFE Steel's Management Structure to Promote 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)*.



*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. 268)

Governance

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 CO₂ 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 CO₂ emissions and contribution to CO₂ 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 CSR Council**, supervises and guides these initiatives by deliberating goals, monitoring progress, and improving the Group's overall environmental performance.

The JFE Group Environmental Committee, chaired by the president of JFE Holdings and operating under the JFE Group Sustainability Council, supervises and guides these initiatives by deliberating goals, monitoring progress, and improving the Group's overall environmental performance.

Key managerial issues such as climate change and other environmental challenges are deliberated at **the Group Management Strategy Committee** as well and reported to **the Board of Directors**. The board discusses and makes decisions on the matters reported.

■ 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 CO₂ emissions reduction target for FY2030
- Use of climate-related metrics to determine executive remuneration

➤ [Corporate Governance System](#) (P.205)

➤ [Framework for Environmental Management](#) (P.47)

Addressing Climate Change Issues

Contribute to the realization of a carbon-neutral society by developing decarbonization processes, supplying green steel products, and expanding technologies that reduce CO₂ emissions

Having positioned climate change as a top management concern, JFE Group formulated the JFE Group Environmental Vision for 2050 and presented an actionable roadmap for achieving carbon neutrality by 2050. We have positioned the timeframe up to 2030 as the transition phase for shifting to low-carbon manufacturing processes and up to 2050 as the innovation phase in which to establish and implement our ultra-innovative technologies and achieve carbon neutrality. We have accordingly developed a concrete CO₂ reduction plan and are working on initiatives for achieving it. In the steel business, we have decided to strengthen the operation of the electric furnace at the Sendai Works and introduce an electric furnace in the stainless steel manufacturing process in the Chiba district to achieve a reduction by 30% or more by FY2030 (compared to FY2013), in addition to introducing a process that increases the volume of scrap for use in converters at all sites. We are also considering the introduction of a high-efficiency, large-scale electric furnace in the Kurashiki district, and we will continue to steadfastly make the necessary capital investments to achieve our 2030 target. To advance our multi-track development of technologies for a carbon recycling blast furnace, hydrogen steelmaking (direct reduction), and a high-efficiency, large-scale electric furnace, we started constructing test furnaces for verifying each technology in the Chiba district in FY2023. These test furnaces are important first steps in the long-term development of carbon-neutral ironmaking and will boost the efficiency of developing ultra-innovative technologies and help to quickly realize applications.

In addition, as the demand for decarbonization accelerates throughout the supply chain, the demand for green products that emit less CO₂ in the manufacturing process is also rising. In the first half of FY2023, JFE Steel began supplying JGreeX™, a brand of green steel products that significantly reduce CO₂ emissions in the steel manufacturing process compared to conventional products. JGreeX™ products have already been adopted for a variety of applications. In the initiative to use JGreeX™ for the construction of dry bulk carriers (large cargo ships), we constructed the world's first business model for sharing the associated cost of reducing CO₂ emissions across the supply chain, and we are allowed to charge a green premium of about 40% for the product. The widespread recognition of the environmental value of green steel products is important for helping us obtain the necessary funding for the capital investment and development of ultra-innovative technologies for achieving carbon neutrality. We will strive to create a market for green steel products that can contribute to realizing a carbon-neutral society.

Another area of focus in the JFE Group Environmental Vision for 2050 is to expand our contribution to reducing CO₂ emissions in society as a whole. In the engineering business, in addition to expanding our renewable power generation plant businesses, we have started the commercial operation of the PET bottle recycling raw material manufacturing plant (West Japan PET Bottle MR center). This is a bottle-to-bottle business initiative, and the plant has the capacity to recycle approximately 10% of the total number of PET bottles shipped nationwide. In the steel business, we have decided to bolster the manufacturing capacity at the West Japan Works (Kurashiki district) for high-grade, non-oriented electromagnetic steel sheets, for which demand is expected to expand for electric vehicles. In the trading business as well, we will reinforce our supply system for electromagnetic steel sheets to ensure that we capture the growing demand. We consider this as a fresh business opportunity for applying our advanced technologies to contribute to creating a sustainable society, and we will take advantage of these opportunities to grow our businesses and enhance our corporate value.

Furthermore, we are working on an initiative for contributing to the offshore wind-power generation business by applying the strengths of the Group. With JFE Engineering as the main driver, we started constructing the manufacturing plant for monopiles and other seabed-fixed structures and plan to start production in 2024. Offshore wind-power generation business can take full advantage of the capabilities of all our operating companies, and so we will continue to make a Group-wide effort to accelerate this business.

Our key strategies for achieving carbon neutrality by 2050 are to reduce CO₂ emissions at JFE Steel and expand contributions to CO₂ reduction for society as a whole. We view society's shift toward decarbonization as a business opportunity and are committed to playing our part in realizing a sustainable society developing and quickly implementing decarbonizing technologies and creating products and services that contribute to a decarbonized society.



Seiya Kitajima
Senior Executive Officer,
JFE Holdings, Inc.

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.91)
- ▶ [JFE Group Environmental Vision for 2050, Presentation Material](https://www.jfe-holdings.co.jp/en/investor/zaimu/g-data/2020/May2021-210525-release01.pdf)
(<https://www.jfe-holdings.co.jp/en/investor/zaimu/g-data/2020/May2021-210525-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 CO₂ 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 CO₂ 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.

Reduce CO₂ Emissions at JFE Steel

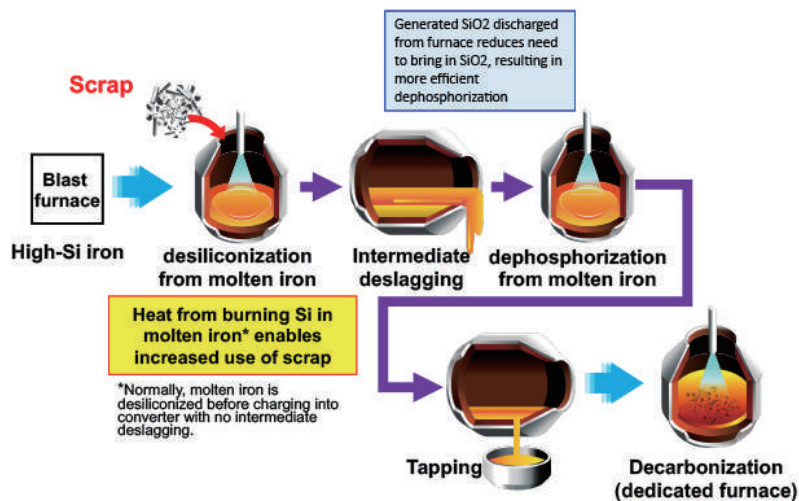
The JFE Group has adopted a multipronged approach, including the development of ultra-innovative technologies, to achieve carbon neutrality by 2050. In the steel business, we have set a target for reducing CO₂ emissions by 18% as of the end of FY2024 and by 30% or more by FY2030, compared to FY2013. 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 CO₂ 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 CO₂ 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.

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 CO₂ 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 CO₂ emissions by approximately 0.17 million tons per year in FY2021. 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 CO₂ emissions by about 2 million tons per year by FY2030.

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

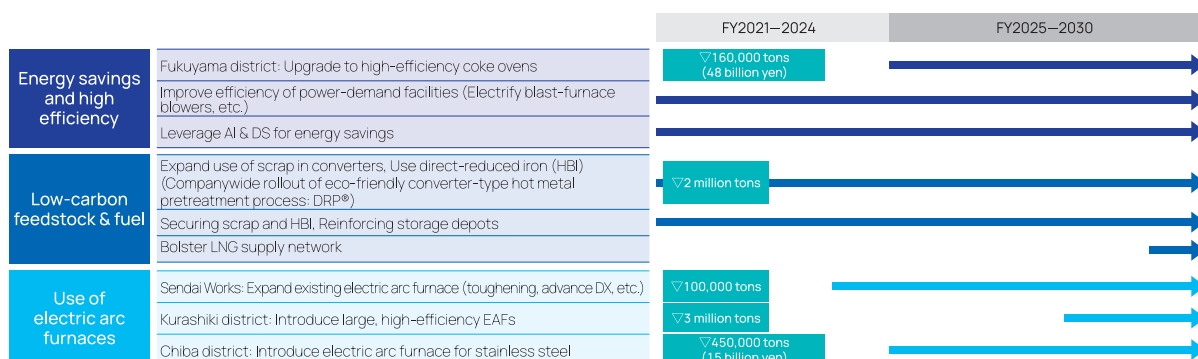


East Japan Works (Chiba District) to Produce Stainless Steel with Electric-Arc Furnace

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 CO₂ 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 CO₂ emissions. Looking ahead, we will continue to develop ultra-innovative technologies in a multi-pronged approach and make steady progress toward realizing carbon neutrality.

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 CO₂ reduction target for FY2030 may require investments and loans of around one trillion yen, and approximately 110 billion yen has been approved by FY2022. We intend to steadily advance toward obtaining the necessary investments and loans to achieve the reduction target.



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 CO₂ 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 specific steel products by applying the mass balance method*1 and then supplied as green steel products. With regard to the amount of CO₂ emission reductions and the emission intensity of each product, we have obtained a third-party certification from Nippon Kaiji Kyokai (ClassNK), which verified 520,000 tonnes of CO₂ emission reduction in FY2022.

JGreeX™ green steel products have been selected by Tsuneishi Shipbuilding Co., Ltd. for the planned construction of tugboats fitted with hydrogen co-combustion engines. JFE Steel will start supplying JGreeX™ products to Tsuneishi from September 2023.

In addition, JGreeX™ green steel products have been selected for constructing new dry bulk carriers*2, a joint initiative with eight participating companies: NYK Bulk & Projects Carriers, Ltd., MOL Drybulk Ltd., Toko Kaiun Kaisha, Ltd., Kawasaki Kisen Kaisha, Ltd., Kawasaki Kinkai Kisen Kaisha, Ltd., Daiichi Chuo Kisen Kaisha, Ltd., Daiichi Chuo Kinkai Kaisha, Ltd., and Eastern Car Liner, Ltd .

All of the steel materials*3 to be used in the construction of these ships will be exclusively JGreeX™, which generates net zero CO₂ emissions in the manufacturing process, making these ships the first in the world to use only green steel materials. This is also the first time that shipping companies and JFE Steel, which also engages in shipping activities, have jointly established a new business model (see diagram below) in which the costs of CO₂ reduction are shared across the entire supply chain.

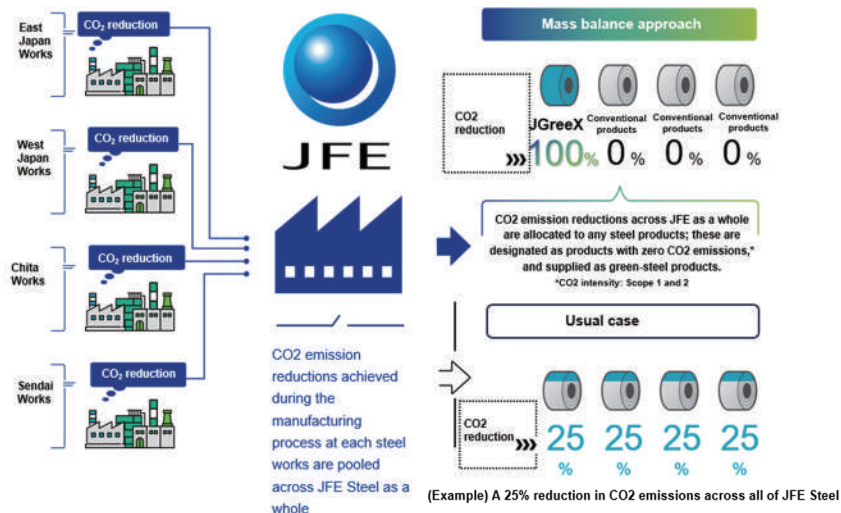
In FY2023, JFE Steel expects to deliver 14,000 tons of JGreeX™ products to two shipbuilders, Onomichi Dockyard Co., Ltd and Higaki Shipbuilding Co., Ltd., for use in four vessels to be commissioned between September 2024 and January 2025 by shippers NYK Bulk & Projects Carriers, MOL Drybulk, and Toko Kaiun.

Reduction of CO₂ 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 CO₂ emissions through the use of advanced low-carbon technologies as well as energy-saving, high-efficiency technologies.

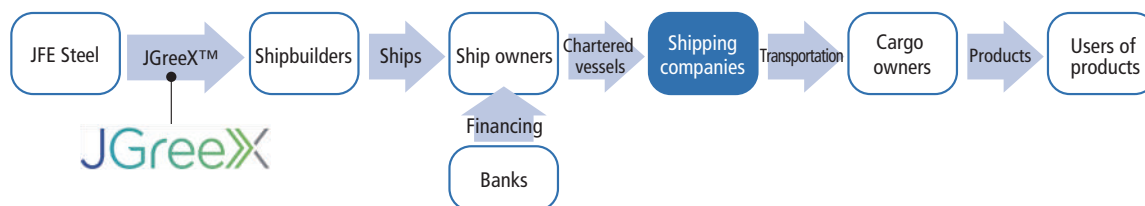
■ JGreeX™ supply overview

Start of supply	First half of fiscal 2023
Supply capacity in fiscal 2023	Approximately 200,000 tons
Applicable products	All steel products manufactured by JFE
Certification organization	Nippon Kaiji Kyokai

■ Concept of Green Steel JGreeX™



■ JGreeX™ supply overview



*1 Consolidate the environmental value of CO₂ emission reduction from the entire product manufacturing process, allocate the value to some steel products, and regard them as having low CO₂ emission intensity.

*2 Cargo ships that transport large quantities of dry cargo

*3 Steel products purchased directly by shipbuilding companies

Demonstration Tests for NEDO Project: Hydrogen Utilization in Iron and Steelmaking Processes

In preparation for the innovation phase, we are researching and developing ultra-innovative technologies such as carbon-recycling blast furnaces and hydrogen steelmaking (direct reduction), for achieving carbon neutrality by 2050.

To this end, the company formed a consortium with Nippon Steel Corporation, Kobe Steel, Ltd., and the Japan Research and Development Center for Metals and jointly commissioned the New Energy and Industrial Technology Development Organization's (NEDO's) Green Innovation Fund Project: Hydrogen Utilization in Iron and Steelmaking Processes.

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 2024, complete demonstration tests by 2026
- **Pilot electric arc furnace (10 t pilot furnace)**
Start construction in 2023, start demonstration tests in 2024, complete demonstration tests by 2025

Details for each are as follows.

Carbon-Recycling Blast Furnaces (CR Blast Furnace)

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) while also striving 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 CO₂ in the blast furnace. This technology is focused on achieving virtually zero emissions by using the remaining CO₂, which cannot be fully reused to manufacture basic chemicals such as methanol.

*Carbon dioxide capture and utilization

Technical Features of a CR Blast Furnace

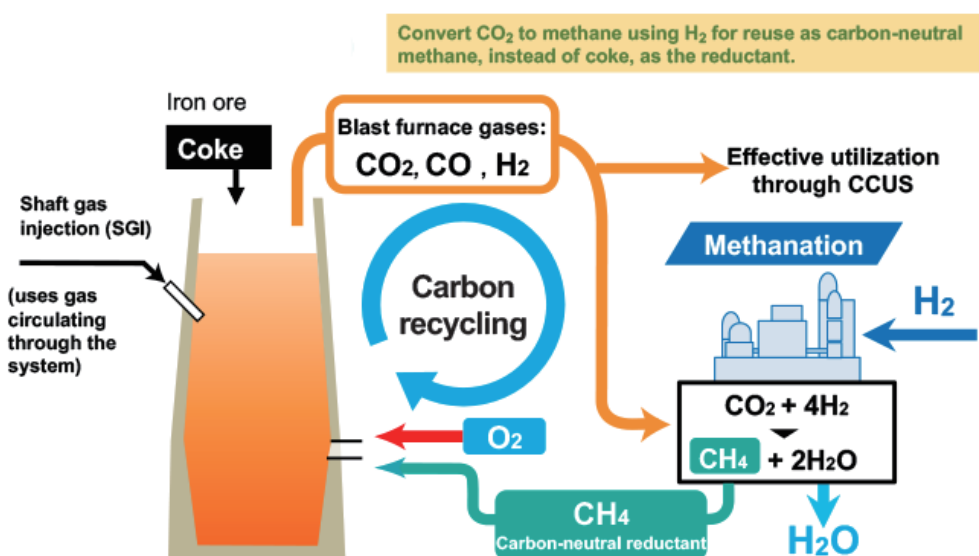
The CR blast furnace incorporates an ultra-innovative technology that converts CO₂ in the furnace exhaust gas into carbon-neutral methane through methanation, which is then reused as reducing material in the furnace. The technology is expected to reduce CO₂ by 50% in the blast furnace process and to 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 CO₂, so the equipment necessary to separate CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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

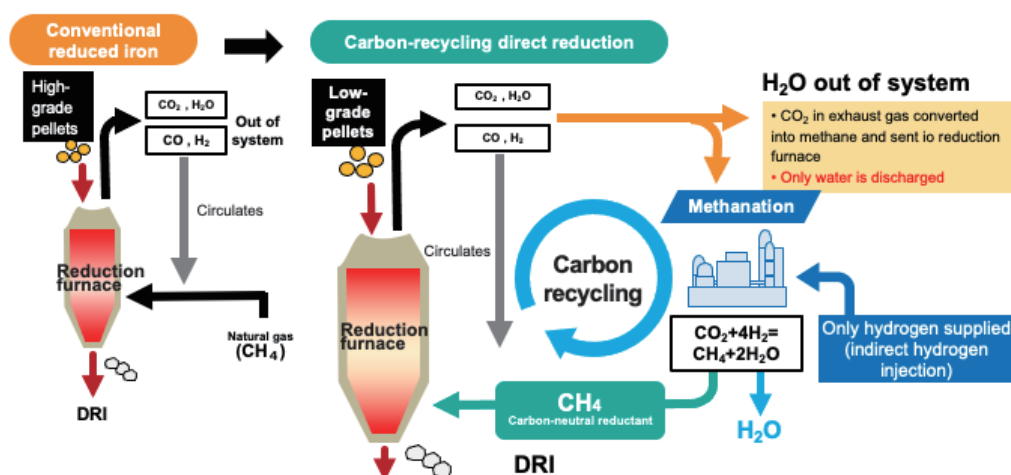
One challenge of hydrogen reduction is that the reduction of iron ore by hydrogen is an endothermic reaction, which means that heat must be applied externally for the reaction to proceed. A sufficient reduction reaction may not take place if there is not enough heat. Thus, technologies for heating raw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

Overview of the Demonstration Tests

We are developing a process to convert the CO₂ 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 CO₂ emissions. We will verify the following during demonstration tests.

- Optimal methods for recycling CO₂ through methanation
- Methods for using low-grade ores

Carbon-Recycling Direct Reduction Process



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 CO₂ emissions from this steelmaking process down to one-quarter of that of the blast furnace-converter method. We are striving to eliminate CO₂ emissions generated by the electric arc furnace process in the future by using the aforementioned hydrogen-reduced iron as the raw material and green electricity.

Although the electric arc furnace process has the advantage of reducing CO₂ 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 and striving to establish technologies that will enable the production of high-quality, high-performance steel with high productivity using the electric arc furnace process.

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 CO₂ 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 CO₂ emissions. This could increase by up to six times the volume of scrap used, and we expect to reduce CO₂ 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 CO₂ emissions from blast furnaces.

JFE Steel has agreed with Emirates Steel Arkan (Emirates Steel), 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.

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

JFE Steel has signed a memorandum of understanding (MOU) with ITOCHU, Emirates Steel, 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. The four companies exchanged their MOU in the presence of Japanese Prime Minister Fumio Kishida at the Japan-UAE Business Forum that was held on July 17.

We view Direct Reduced Iron as a key initiative for CO₂ emissions reduction and are participating with Emirates Steel and Itochu as core members in the establishment of a supply chain of Green Ferrous Material. The companies are jointly promoting a detailed feasibility study at the planned project site in Abu Dhabi.

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 550km² 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.

*Enhanced oil recovery

- Overview of Emirates Steel
Company name: Emirates Steel Arkan
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.

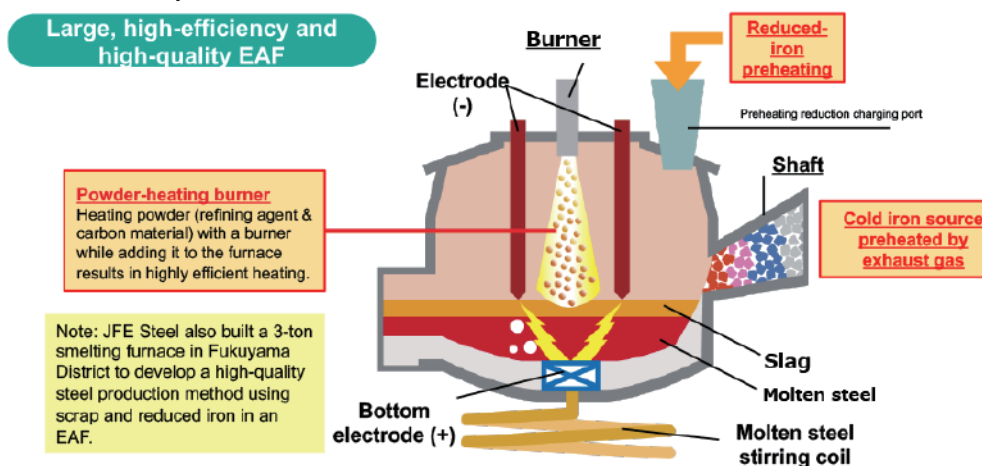
The Group already has achieved industry-leading productivity and energy (electricity) efficiency with these technologies, but we are working to raise productivity even further.

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-grade steel products such as steel sheets for automobiles and electrical steel sheets.

Practical Applications of CO₂ Utilization Technologies

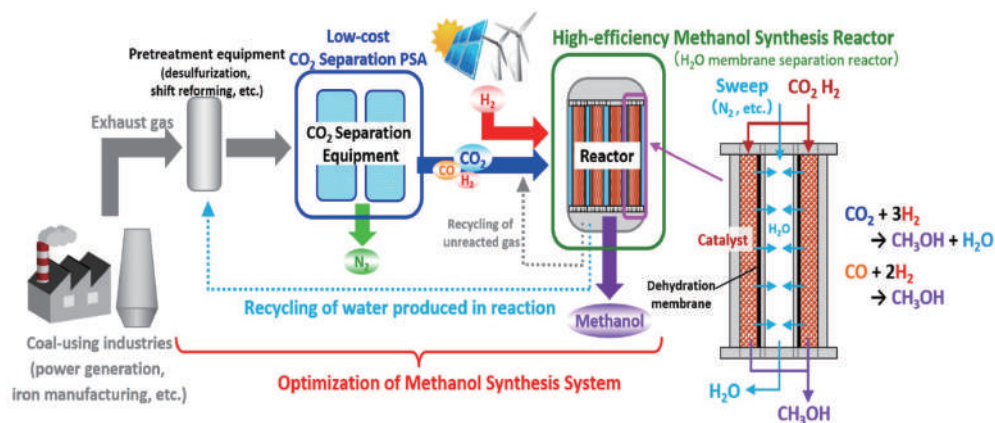
JFE Steel is working on the Optimum System for Methanol Synthesis Using CO₂, an R&D project, in collaboration with the Research Institute of Innovative Technology for the Earth (RITE) (Figure 1). On-site construction of a test facility commenced in FY2022 in the Fukuyama district of the West Japan Works, 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 CO₂ 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 CO₂ 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 CO₂ 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.

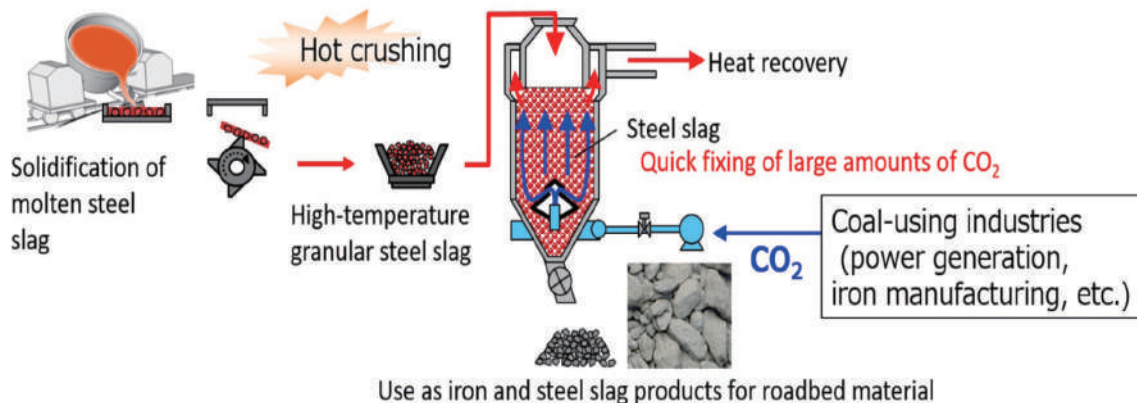
Furthermore, JFE Steel, Japan Petroleum Exploration Co., Ltd., JGC Holdings Corporation (JGC HD), and Kawasaki Kisen Kaisha, Ltd. ("K" LINE) have agreed to conduct a joint evaluation for establishing a CCS value chain originated from Japan, aligned with the joint study on CCS in Malaysia with Petroliaam Nasional Berhad (PETRONAS). Under this joint effort, the four companies will conduct evaluations to establish a CCS value chain, from CO₂ separation and capture at JFE's steelworks, to

marine transportation of liquefied CO₂ to the receiving points in Malaysia, including estimation of required facilities and costs. These evaluations will also be appropriately aligned with the study of CO₂ receipt and storage in Malaysia within the scope of the Study with PETRONAS. By establishing an international CCS value chain through this joint effort, JFE Steel, JAPEX, JGC Holdings, and "K" LINE aim to contribute to realizing carbon neutrality by 2050, including the realization of de-carbonized society in Asia targeted by Asia Energy Transition Initiative *.

■ Figure 1



■ Figure 2



*The Japanese Government's initiative announced in May 2021 for simultaneously achieving sustainable economic growth and carbon neutrality in Asia.

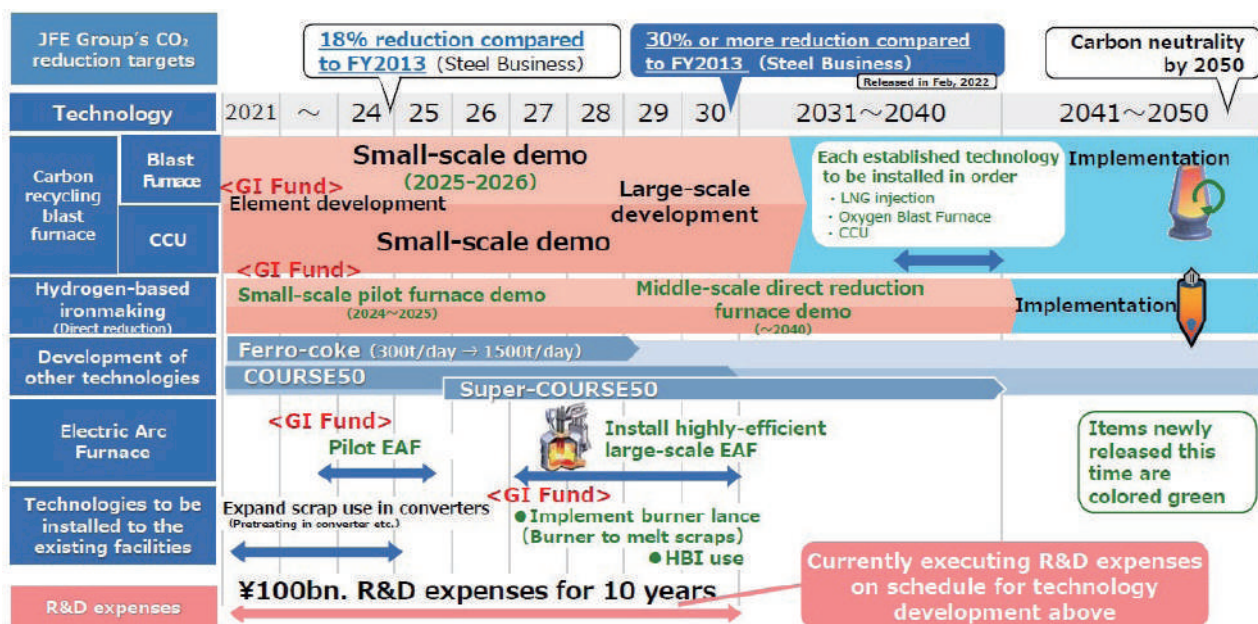
► **Development and Provision of Eco-friendly Processes and Products** (P.108)

■ Related Products and Technologies

Reduce CO ₂ Emissions at JFE Steel		
Carbon neutrality	Key Initiatives	<p>JFE Steel Carbon Neutrality Strategy Briefing (https://www.jfe-steel.co.jp/en/company/pdf/carbon-neutral-strategy_220901_1.pdf)</p> <p>JFE Steel Challenge to Achieve Carbon Neutrality through Green Transformation (https://www.jfe-steel.co.jp/en/movie/#movie-gx)</p>
	Demonstration tests	<p>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)</p>
Green steel products	Begin supplying green steel products	<p>JFE Steel to Begin Supplying JGreeX™ Green Steel (https://www.jfe-steel.co.jp/en/release/2023/230508-2.html)</p>
	Adoption of green steel products	<p>JFE Steel's JGreeX™ Green Steel Selected by Tsuneishi Shipbuilding for Construction of Hydrogen-fueled Tugboats (https://www.jfe-steel.co.jp/en/release/2023/230620-1.html)</p> <p>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)</p>
Carbon-recycling blast furnace	Carbon-recycling blast furnace technology	<p>JFE Steel Carbon Neutrality Strategy Briefing: Reducing CO₂ via CR Blast Furnaces (https://www.jfe-steel.co.jp/en/company/pdf/carbon-neutral-strategy_220901_1.pdf)</p> <p>Challenge Zero: Challenge for development of super-innovative technologies focusing on Carbon-recycling Blast Furnace+CCU (https://www.challenge-zero.jp/en/casestudy/812)</p>
	CCU/CCUS	<p>Challenge Zero: Technology of CO₂ utilization (https://www.challenge-zero.jp/en/casestudy/391)</p>
New technology to process raw materials for hydrogen reduction ironmaking	Development of technology for direct hydrogen reduction	<p>JFE Steel Carbon Neutrality Strategy Briefing: Direct Hydrogen Reduction (https://www.jfe-steel.co.jp/en/company/pdf/carbon-neutral-strategy_220901_1.pdf)</p>
	Collaboration with a material supplier	<p>JFE Steels and BHP to address decarbonization in steelmaking process (https://www.jfe-steel.co.jp/en/release/2021/210210.html)</p>
Expanded use of scrap and reduced iron	Eco-friendly converter-type molten iron pretreatment process DRP®	<p>Increased Use of Scrap Iron in Steelmaking Process to Reduce CO₂ Emissions (https://www.jfe-steel.co.jp/en/release/2022/220621.html)</p>
	Feasibility study on new venture business to secure reduced iron supply	<p>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)</p> <p>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)</p>

Reduce CO ₂ Emissions at JFE Steel		
Expanded use of scrap and reduced iron	Development of electric arc furnace process technology	JFE Steel Carbon Neutrality Strategy Briefing: Large, High-efficiency EAFs
	Adoption of electric arc furnace process technology	JFE Steel's Chiba District Facility to Produce Stainless Steel with Electric-arc Furnace
CO ₂ utilization and storage technology	CO ₂ utilization technology	Novel Processes for Manufacturing Valuable Materials Using Coal-Derived CO₂ Selected for NEDO Projects
	Testing for practical use	JFE Steel Moves Ahead with Testing CO₂-utilization Technologies Aimed at Achieving Carbon Neutrality
	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

■ Related Products and Technologies



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

➤ [Seventh Medium-term Business Plan](#) (P.12)

➤ [JFE Group Environmental Vision for 2050, Presentation Material](https://www.jfe-holdings.co.jp/en/investor/zaimu/g-data/2020/May2021-210525-release01.pdf)

JFE Group Initiatives Aligned 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 CO₂ 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)

(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_jfeh_eng.pdf)

(https://www.meti.go.jp/policy/energy_environment/global_warming/transition/transition_finance_case_study_jfeh_eng.pdf)

Expand Contributions to CO₂ Emissions Reduction in Society

Contribution to CO₂ 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 CO₂, and working on demonstrating a process that separates and collects CO₂ 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 CO₂ emissions in society by 12 million tonnes by FY2024 and 25 million tonnes by FY2030.

The following key initiatives contributed to CO₂ reduction in FY2022.

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 operation 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 Kankyō 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 17 sites across 8 group companies, driving CO₂ 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 17 sites across eight companies in the House Foods Group nationwide. The service is expected to reduce CO₂ emissions by approximately 12% and energy consumption by approximately 17% (compared to FY2020) at these sites. Operation is scheduled to commence in April 2024.

CCUS

Contract received for the construction of CO₂ liquefaction, storage and loading/unloading facilities, a large-scale, long-distance, lower cost transportation system for liquid CO₂ to realize a CCUS society.

JFE Engineering has received an order from Japan CCS Co., Ltd. to construct its CO₂ liquefaction, storage, and loading/unloading facilities (EPC project). The project will construct 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 CO₂ Transportation. We will be involved in the design and construction of onshore facilities capable of liquefying and storing 10,000 tonnes per year of CO₂ 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 commercial operation 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 CO₂ than the production of crude oil-derived pellets.

Electrical Steel Sheets

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 CO₂ emissions on a global scale by supplying high-performance electrical steel sheets.

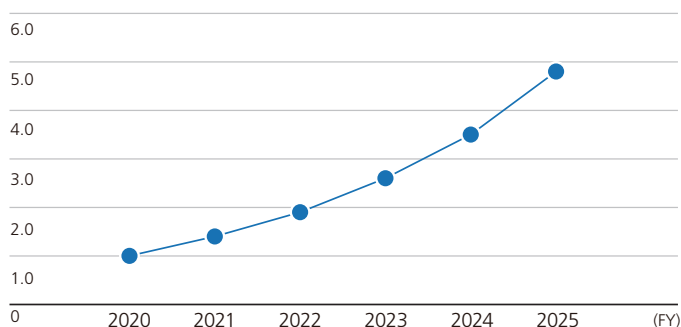
Non-Oriented Electrical Steel Sheets

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)



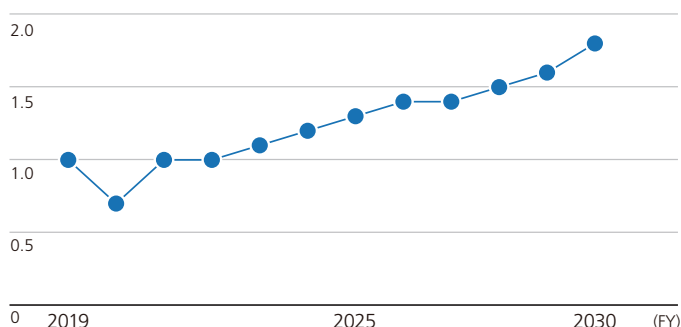
Grain-Oriented Electrical Steel Sheets

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)





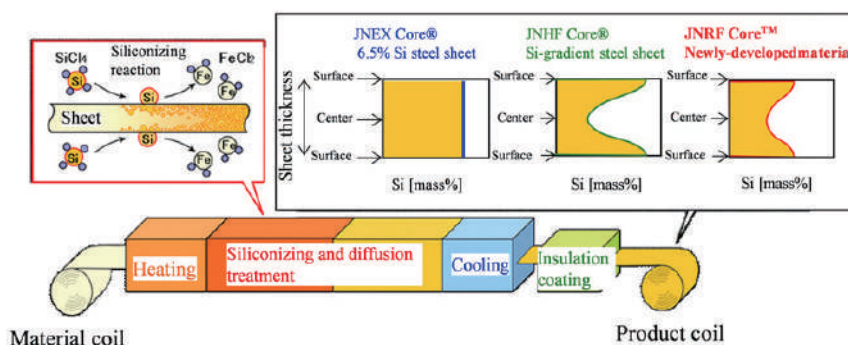
Signed an agreement to establish a grain-oriented electrical steel sheet manufacturing joint venture company

Super Core

Motors are becoming ever smaller and faster for EVs, home appliances, drones, and other applications, and consequently require higher output and efficiency. At the same time, demand is growing to reduce high-frequency iron loss*1 and increase magnetic flux density*2 for the electrical steel sheets used as iron core materials for these products. Since silicon boosts the electrical resistance of steel, increasing the amount of silicon helps to realize these properties. Using our proprietary technology for CVD continuous siliconizing*3, we worked on controlling silicon concentration distribution in the through-thickness direction by optimizing the siliconizing amount and diffusion conditions and controlling crystal orientation. These efforts have resulted in the development of a JNRF™ silicon-gradient steel sheet for high-speed motors, and JNRF™ helps to significantly increase motor efficiency to conserve energy while maintaining magnetic flux density (torque) equivalent to conventional non-oriented electrical steel sheets (3% silicon steel sheets).

- *1 Iron loss refers to energy, mainly heat, lost when an iron core is excited by an alternating current. The energy loss that occurs when the iron core is excited at high frequency is called a high-frequency iron loss. The efficiency of high-speed motors increases as high-frequency iron loss is reduced.
- *2 Magnetic flux density, which indicates a material's ease of magnetization, raises electromagnetic strength as density increases. In motors, larger torque (power) can be achieved with materials that offer high magnetic flux density.
- *3 The chemical vapor deposition (CVD) process technology increases silicon concentration in steel. CVD, performed in a steel strip annealing line, causes a reaction between steel strips and silicon tetrachloride (SiCl4) gas in a furnace while continuously passing the steel strips through the furnace.

Super Core Manufacturing Process



High Tensile Strength Steel Sheets (HITEN) for Automobiles

Higher strength steel sheets are needed for automobile bodies in order to improve fuel efficiency, vehicle safety and, more recently, the cruising range of EVs. Generally, increasing the strength of steel sheets decreases their formability and, in some cases, limits how they can be applied. JFE Steel offers the JEFORMA® series, a lineup of cold-rolled and galvanized steel sheets in strength grades 590, 780, 980, and 1,180 MPa, each with distinct formability characteristics. The series facilitates selection of the optimal steel sheet based on body part shape and forming method. More recently, the Company has also worked on the following development initiatives for high tensile strength steel sheets for automobiles.

Joint Development with thyssenkrupp Steel Europe

JFE Steel and thyssenkrupp Steel Europe jointly launched new 980-1,180 MPa-class cold-forming, high-tensile steel sheets by designing a new steel composition and microstructure with an emphasis on local ductility and establishing a new heat treatment method. Compared to conventional high-tensile steel sheets, these products achieve higher yield strength and ductility with excellent local ductility, characteristics that will contribute to lighter-weight automobile body frames and better crash safety performance. In addition, they can be formed into parts with complicated shapes, using conventional cold forming rather than hot stamping, and thereby helping to improve productivity, lower manufacturing cost, and save energy during parts manufacturing.

1.5 GPa-Grade High Tensile Strength Cold-Rolled Steel Sheets

In 2020, JFE Steel's 1.5 GPa-grade high tensile strength cold-rolled steel sheets were adopted for the first time in the world* for cold press forming applications in vehicle body structural parts, representing the highest strength vehicle body structural parts obtained through cold press forming. Until then, the adoption of high tensile strength cold-rolled steel sheets for complex-shaped vehicle body structural parts had been limited to 1.3 GPa grade because increasing sheet strength can result in decreased cold press formability and delayed fracture resistance. Consequently, 1.5 GPa-grade high tensile strength steel sheets manufactured through a hot press forming process were more commonly adopted to meet these challenges. JFE Steel achieved both high yield strength and delayed fracture resistance even with the 1.5 GPa-grade high tensile strength steel sheets while maintaining cold press formability equivalent to 1.3 GPa-grade sheets by using a proprietary WQ (water quenching) method-based continuous annealing process to control the steel sheet's microstructure. This enabled the adoption of 1.5 GPa-grade high tensile strength steel sheets for vehicle body structural parts through a cold forming method, thus reducing environmental impact and cost.

In addition, we received the Minister of Economy, Trade and Industry Award in the FY2023 National Invention Awards, for inventing ultra-high tensile strength thin steel sheet that improves fuel efficiency and collision safety of automobiles. This invention relates to cold-rolled steel sheets for automobiles with ultra-high tensile strength of over 1,320 MPa and dramatically improved delayed fracture resistance. It is therefore used in the ultra-high tensile strength cold-rolled steel sheets described above.

*According to our research

JFE Steel develops and manufactures steel sheet products that are easy to use, with full consideration for environmental impact and contribution to reducing energy and resources. The company will contribute to reducing CO₂ emissions in society in general through the use of its products for automobile parts.

■ 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/csr/pdf/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 CO₂ 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/csr/pdf/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)		

Expand contributions to CO ₂ emissions reduction in society		
Contribution to CO ₂ reduction through the engineering business	Carbon-neutral world	Contribution to Creating a Carbon-Neutral World Through the Transport of Hydrogen and CO₂ (FY2022 CSR, P. 114) (https://www.jfe-holdings.co.jp/en/csr/pdf/csr2022e.pdf)
		Contract Received for the Construction of CO₂ Liquefaction, Storage and Loading/Unloading Facilities—a Large-Scale, Long-Distance, Lower Cost Transportation System for Liquid CO₂ 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 Commercial Operation (Japanese only) (https://www.jfe-eng.co.jp/news/2022/20220421.html)
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 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)		

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.

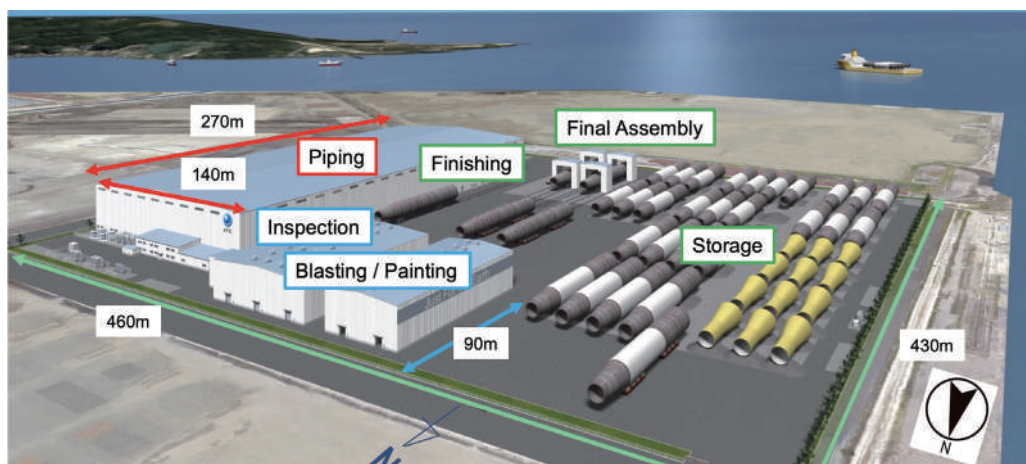
*Operation and maintenance

Construction of a Monopile Manufacturing Plant

JFE Engineering is constructing a manufacturing plant for monopiles, which are the foundational structural components for offshore wind power generation, in Kasaoka, Okayama Prefecture. Monopiles are extremely large steel structures, approximately 10 m in diameter, 100 mm thick, and 100 m long. When completed, the plant will be the only one in Japan capable of manufacturing such large structures. It is 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. Production is scheduled to start in April 2024, with an annual capacity of up to 100,000 tonnes, and 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





Construction work of the monopile manufacturing plant, as of May 2023

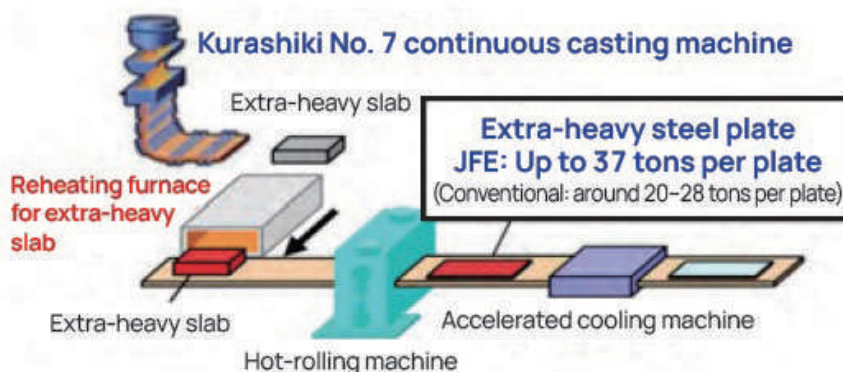
Large and Heavy Steel Plates for Offshore Wind Power Generation

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.

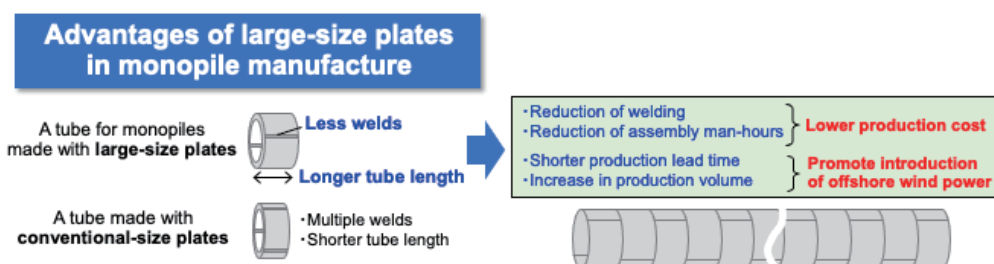
Offshore wind turbines have recently grown in size, requiring larger monopiles and other foundational structures to support them. The monopiles are manufactured by welding ultra-thick steel plates, resulting in increased welding workloads that require monopile manufacturers to improve the efficiency 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

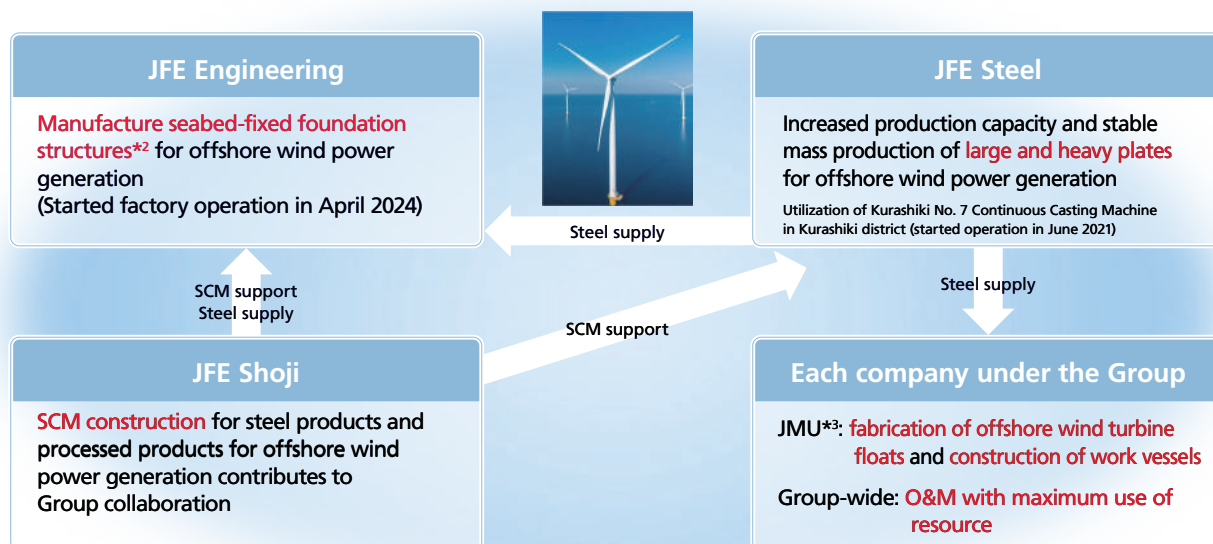


Advantages of Using Large and Heavy Steel Plates for Monopiles



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

Initiatives for Achieving Carbon Neutrality in the Keihin Waterfront Areas

The JFE Group is partnering with Kawasaki City to devise options for repurposing land in the Keihin district of the Japan East Works after the operation of blast furnaces and other facilities are suspended. One key vision for land use is to play a leading role in achieving carbon neutrality. Public-private partnerships are also underway to accelerate the government's plan to create a carbon-neutral port in the Keihin waterfront area, including the land belonging to the Japan East Works.

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 utilizing the deep-water wharves and adjacent land areas of Ogishima, an island in the Keihin district. Furthermore, 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., Iwatani Corporation, and ENEOS Corporation that is part of NEDO's Green Innovation Fund Project: Large-scale Hydrogen Supply Chain Establishment. We are actively exchanging information with these companies.

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



Aerial view of the Keihin waterfront area (courtesy of Kawasaki City)

Adapting to Climate Change (Contribution to Achieving Societal Resilience)

Contributions to Disaster Prevention and Mitigation and Increased National Resilience

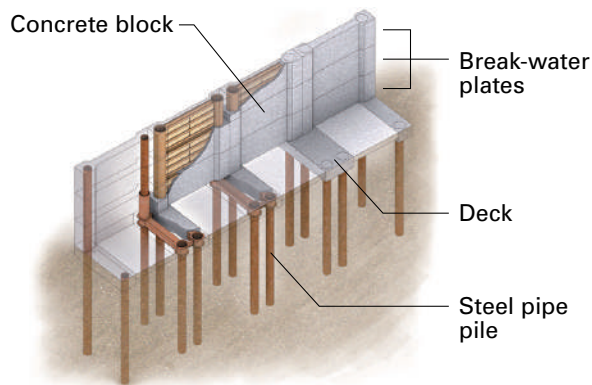
The JFE Group is not only focused on reducing CO₂ emissions (climate change mitigation); we also intend to contribute to the resilience of society in general by adapting to climate change.

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)

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.24)
- ▶ [Risk Management](#) (P.220)
- ▶ [Environmental Management](#) (P.47)

Metrics and Targets (Medium- and Long Term Targets and Results in FY2022)

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-CO₂. 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ emissions by incorporating the TCFD's principles in its management strategies.

JFE Group's Initiatives to Reduce CO₂ (JFE Group Environmental Vision for 2050)

Seventh Medium-term Business Plan Initiatives

- Reduce steel-business CO₂ emissions in FY2024 by 18%, compared to FY2013 (JFE Steel).
Furthermore, JFE Steel's major group companies have also set their own CO₂ reduction targets for FY2024 to ensure that these targets are achieved. With this, more than 99% of the total CO₂ emissions of the entire JFE Steel Group is accounted for.
- The target of reducing CO₂ in FY2030: 30% or more, compared to FY2013 (JFE Steel)

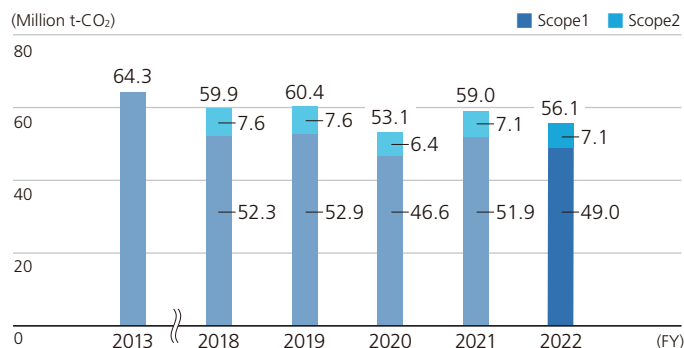
Initiatives for Carbon Neutrality by 2050

- Reduce CO₂ 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 CO₂ emissions reduction in society
 - Reduce CO₂ 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/investor/zaimu/g-data/2020/May2021-210525-release01.pdf)
(<https://www.jfe-holdings.co.jp/en/investor/zaimu/g-data/2020/May2021-210525-release01.pdf>)

CO₂ Emissions of the JFE Group

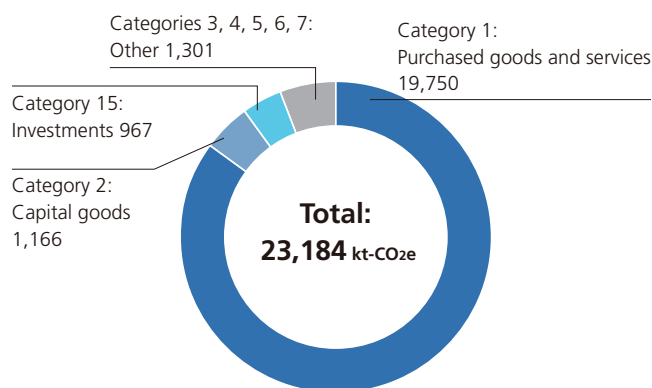
CO₂ Emissions of the JFE Group



Notes:

- Data cover 76 companies
 JFE Steel and 26 major domestic and overseas subsidiaries
 JFE Engineering and 12 major domestic and overseas subsidiaries
 JFE Shoji and 35 major domestic and overseas subsidiaries
- Data for JFE Steel include CO₂ emissions from non-energy sources.
- Starting with FY2018, data for JFE Steel's subsidiaries and JFE Engineering's subsidiary include CO₂ 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 (FY2022)



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, 15 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 CO₂ emissions, refer to the following information.

➤ [Environmental Data](#) (P.225)

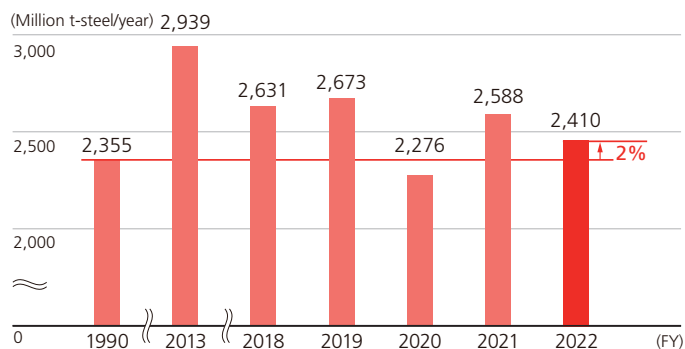


Initiatives to Save Energy and Reduce CO₂

JFE Steel has always aggressively pursued CO₂ reduction and energy savings, including the introduction of energy-saving equipment.

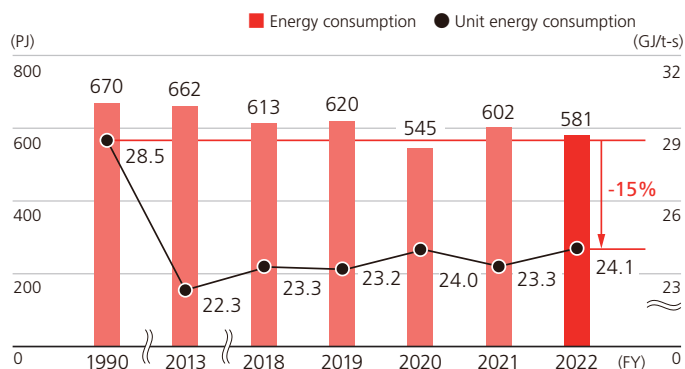
Energy Consumption and CO₂ Emissions in FY2022

■ Production of Crude Steel of JFE Steel



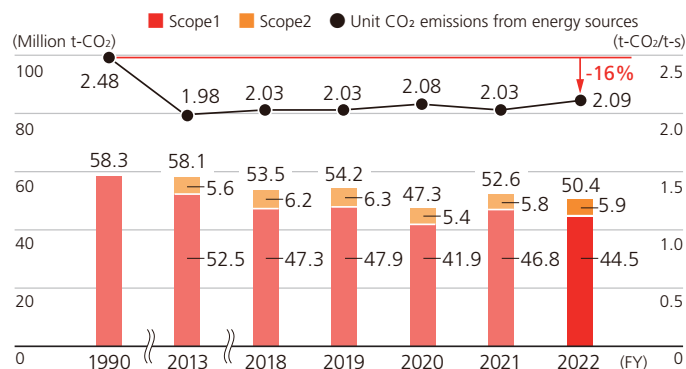
Note: FY2013 figure includes data for the Sendai Works of JFE Bars & Shapes Corporation.

■ Energy Consumption and Unit Energy Consumption of JFE Steel



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

CO₂ Emissions from Energy Sources and Unit CO₂ Emissions of JFE Steel



Notes:

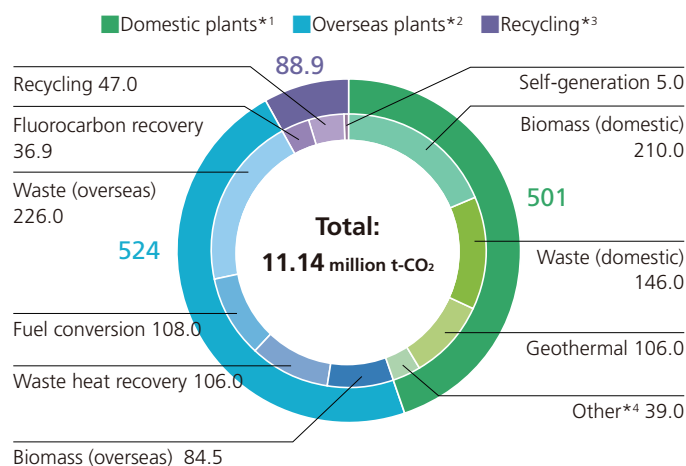
- The CO₂ emissions and emission intensity in FY2022 are calculated using the CO₂ emission factor for electricity purchased in FY2021, adopted by the Japan Iron and Steel Federation’s Commitment to a Low Carbon Society.
- FY2021 data was revised by applying the CO₂ emission factor for electricity purchased in FY2021, 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

JFE Engineering contributes to CO₂ 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 FY2022, the Company contributed to reducing 11.14 million tonnes of CO₂ emissions (a 5% increase compared to FY2021) across society. JFE Engineering will further expand its business and contribute to CO₂ 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 FY2022 we have achieved a 50% reduction in CO₂ 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 CO₂ Emissions Reductions (FY2022)



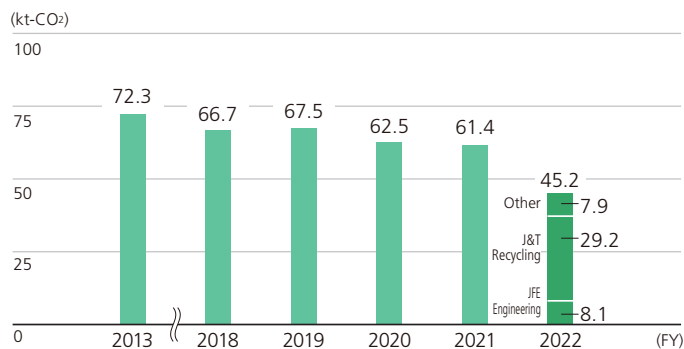
*1 Data cover JFE Engineering.

*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 solar, wind, digestion gas, sludge incineration, PPA, and energy service

JFE Engineering Group's CO₂ Emissions from Energy Sources



Notes:

- Data cover JFE Engineering and 13 major domestic and overseas subsidiaries.
- FY2021 figure includes data for an expanded list of JFE Engineering major subsidiaries.

JFE Shoji

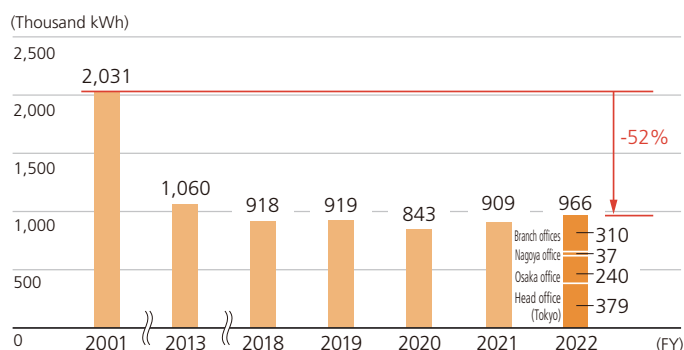
Under the environmental strategies formulated in 2001, JFE Shoji is continuously implementing initiatives to reduce paper and electricity consumption and strictly manage waste separation as part of its energy reduction efforts.

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 strongly 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.

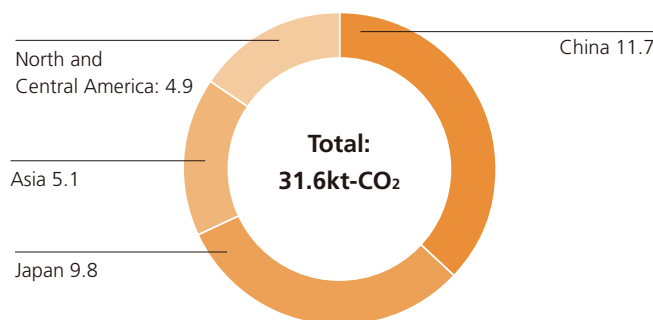
In addition, the company has established a new goal in the domestic operating companies to reduce CO₂ emissions by installing solar panels and purchasing electricity derived from renewable energy sources. In February 2023, we completed a project at JFE Shoji Coil Center Corporation in Shizuoka that achieved virtually zero CO₂ emissions in steel processing, the first time* this has been achieved in the steel distribution industry. As a result of this and other ongoing efforts to reduce the amount of electricity consumed, CO₂ emissions in FY2022 in the domestic operating companies were reduced by 11.2%, compared to FY2019.

*According to our research

Electric Power Consumption by JFE Shoji



■ CO₂ Emissions of the JFE Shoji Group (FY2022)



Notes: Data cover CO₂ emissions from electricity use by JFE Shoji and 35 major domestic and overseas subsidiaries (steel-processing companies).

Endorsing and Participating in External Initiatives

The JFE Group expresses its views and opinions on various public policies and external initiatives related to climate change and environmental conservation through Keidanren (Japan Business Federation) and the Japan Iron and Steel Federation (JISF), and it proactively participates in these activities.

The Group also endorses the Challenge Zero declaration and will rise to the challenge in pursuit of innovation. Challenge Zero (Innovation Challenges Towards a Net Zero Carbon Society) is a new joint initiative by Keidanren and the Japanese government for proactively publicizing and supporting companies and organizations that pursue innovative actions to realize a decarbonized society, which is the long-term goal of the Paris Agreement.

The Japan Iron and Steel Federation (JISF) is actively working toward achieving its Carbon Neutrality Action Plan (formerly the Commitment to a Low Carbon Society), with the target year of FY2030. In November 2018, the JISF also formulated and published the Long-term Vision for Climate Change Mitigation for 2030 and beyond, which represents the industry's challenge for realizing zero-carbon steel. In February 2021, the JISF announced the "Basic Policy of the Japan steel industry on 2050 Carbon Neutrality aimed by the Japanese government," declaring that the Japanese iron and steel industry will boldly take on the challenge of realizing zero-carbon steel. As a member of the JISF, JFE Steel will be an active participant in these medium- and long-term climate change initiatives. In addition, the Ministry of Economy, Trade, and Industry (METI) has announced its intention to establish 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. The Group participates in the GX League because it believes that its goal is aligned with the JFE Group's overall objective for climate change initiatives. JFE Steel is also participating in activities outside of Japan such as the Japan India Public and Private Collaborative Meeting, Japan-ASEAN Steel Initiative, and Japan-China Steel Industries Exchange. Furthermore, it is a member of the World Steel Association (WSA)'s Climate Action data collection program, which uses ISO 14404 as the standard for measurement and calculation.

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. Furthermore, with the GX League, established and promoted by METI, becoming fully operational in April 2023, JFE Engineering has decided to officially participate in the league starting in FY2023. Through the league, we will promote co-creation with various stakeholders and contribute to the realization of carbon neutrality and the transformation of economic and social systems.

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. In FY2022, we participated in subcommittees on supply chains, human rights due diligence, human rights education, and other topics, learning about global trends and exchanging information between companies for connecting to our own SDG promotion efforts.

For more details, refer to the following.

▶ [Steel Industry Initiatives](#) (P.104)

Initiatives by industry groups

▶ [The Japan Iron and Steel Federation: Climate Change Policy](https://www.jisf.or.jp/en/activity/climate/index.html) (https://www.jisf.or.jp/en/activity/climate/index.html)

▶ [The Japan Iron and Steel Federation: Challenges towards Carbon Neutrality](https://www.carbon-neutral-steel.com/en/)
(https://www.carbon-neutral-steel.com/en/)

▶ [Keidanren \(Japan Business Federation\): Challenge Zero](https://www.challenge-zero.jp/en/) (https://www.challenge-zero.jp/en/)

▶ [The Ministry of Economy, Trade, and Industry: GX League \(Japanese only\)](https://gx-league.go.jp/) (https://gx-league.go.jp/)

▶ [WSA: Climate Action data collection programme](https://worldsteel.org/climate-action/climate-action-data-collection/data-providers/)
(https://worldsteel.org/climate-action/climate-action-data-collection/data-providers/)

▶ [Japan Climate Leaders' Partnership \(JCLP\)](https://japan-clp.jp/en) (https://japan-clp.jp/en)

▶ [United Nations Global Compact](https://www.unglobalcompact.org/) (https://www.unglobalcompact.org/)

▶ [Global Compact Network Japan \(Japanese only\)](https://www.ungcjin.org/) (https://www.ungcjin.org/)