

Scenario Analysis in Line with the TCFD Recommendations

Initiatives

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

► [Climate Change](#) (P.53)

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

1997	Kyoto Protocol adopted at COP3 in Kyoto
2008	JISF’s Voluntary Action Plan launched
2013	JISF’s Commitment to a Low Carbon Society launched
2015	Paris Agreement adopted at COP21
2017	TCFD published the final report of its recommendations
2018	JISF announced the Long-term Vision for Climate Change Mitigation, Zero Carbon Steel
2019	<u>JFE Group announced its endorsement for the final report of the TCFD recommendations</u> <u>JFE Group published a scenario analysis in line with the TCFD recommendations</u>
2020	Keidanren launched the Challenge Zero initiative Ministry of Economy, Trade and Industry published a list entitled Companies Taking on the Zero-Emission Challenge <u>JFE Group published its targets in its medium- to long-term vision (target for 2030 and achieving carbon neutrality by 2050)</u>
2021	Prime Minister Suga declared Japan will achieve carbon neutrality by 2050 JISF announced the Basic Policy of the Japan Steel Industry on 2050 Carbon Neutrality Aimed by the Japanese Government <u>JFE Group published its roadmap for achieving carbon neutrality in 2050 in the JFE Group Environmental Vision for 2050</u>
2022	Japanese government formulated the Green Growth Strategy Through Achieving Carbon Neutrality in 2050 <u>JFE Group announced that the CO₂ emissions reduction target for FY2030 for JFE Steel has been revised upward to 30% or more compared to FY2013</u> JISF published the “Evaluation of the Phase I Target (FY2020 Target)” and Phase II (FY2030 target) of reducing the total volume of energy-related CO ₂ emissions by 30% in its “Activities to Combat Global Warming—Report of JISF’s Carbon Neutrality Action Plan (Commitment to a Low Carbon Society) (March 2022).”
2023	The Act Concerning the Promotion of a Smooth Transition to a Decarbonized Economic Structure (the “GX Promotion Act”) was enacted.

The Challenge Zero (Innovation Challenges Toward a Net Zero Carbon Society) is a new joint initiative by Keidanren (Japan Business Federation) and the Japanese government for proactively publicizing and supporting companies and organizations that pursue innovative actions toward realizing a decarbonized society as the long-term goal of the Paris Agreement. The JFE Group endorses the Challenge Zero declaration and will rise to the challenge of pursuing innovation. The Ministry of Economy, Trade and Industry (METI), in collaboration with Keidanren and the New Energy and Industrial Technology Development Organization (NEDO), has been tackling a project called the Zero-Emission Challenge. The project is preparing a list of companies generating innovation toward realizing a decarbonized society and providing investors and other stakeholders with useful information on them. At the TCFD Summit 2021 on October 5, 2021, approximately 600 companies, both listed and unlisted, were announced as Zero Emissions Challenge Companies. These organizations are boldly accepting the challenge of innovation to realize a decarbonized society, and the JFE Group was selected as one of them.

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

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

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

Scenario Analysis

Tools and Methods

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

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

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

*1 Source: IEA's World Energy Outlook 2018

*2 Source: IEA's Energy Technology Perspectives 2017

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

*4 Source: IPCC Fifth Assessment Report

*5 When carbon pricing differs from country to country, a gap opens in international competitiveness between countries that impose strict CO₂ emissions regulations and those with less strict regulations. This will result in carbon leakage where CO₂ emissions of a strict climate policy country are reduced as production and investment decline while production and investment increase in other countries with laxer emission constraints, thereby increasing their nations' CO₂ emissions. One reference scenario, SDS, assumes the implementation of carbon pricing in developed countries and some developing countries. We took this into account in formulating the 2°C scenario based on the assumption that uniform carbon pricing is introduced to major emitting countries to push toward achieving the 2°C scenario target.

Scope of Business and Period for Analysis

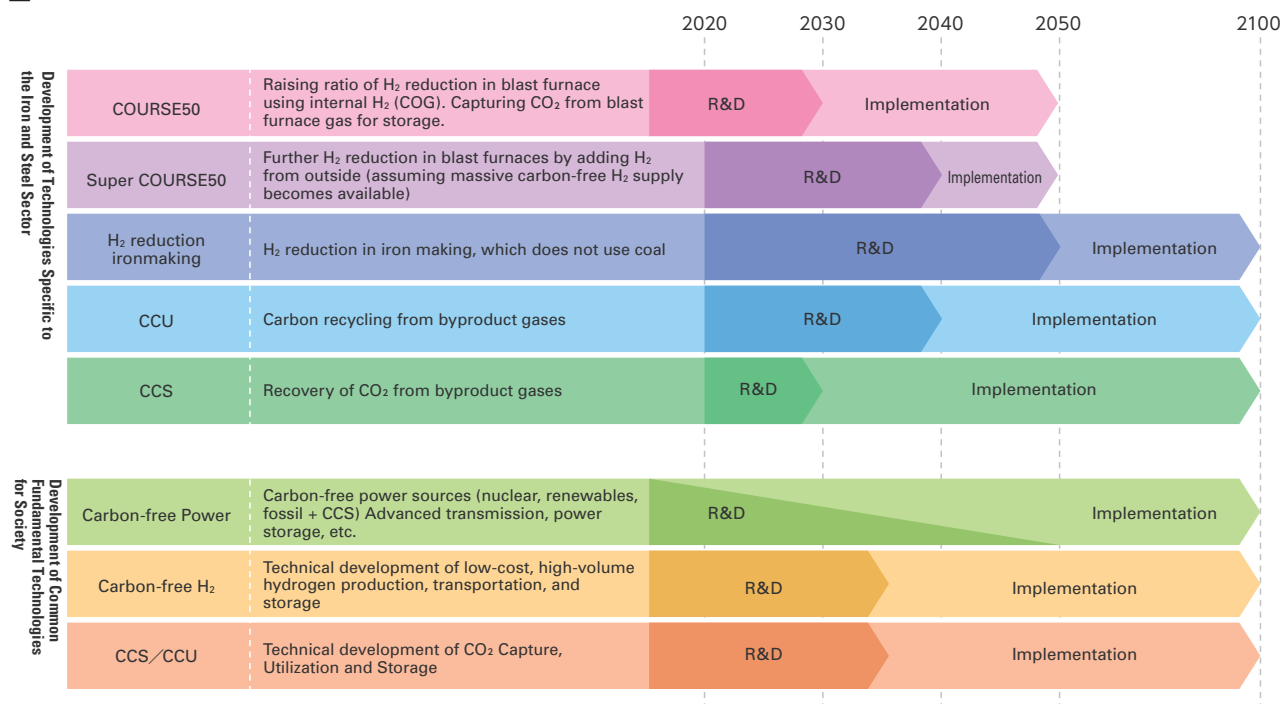
This analysis covers the following businesses: the steel business by JFE Steel, the engineering business by JFE Engineering, the trading business by JFE Shoji, and businesses carried out by some of the other Group companies. The period covered is up to 2050.

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

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

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

Efforts to Achieve Zero Carbon Steel



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

Process to Identify Key Factors that Impact the Business

STEP 1: Examine the entire value chain from a holistic perspective and sort out factors that impact the businesses under analysis (for more information on risks and opportunities in the value chain, refer to:

► [JFE Group Value Chain](#) (P. 30)

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

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

Level of Impact



Expectations and concerns of stakeholders



Axis for identifying key factors

Axis for identifying key factors:

- Level of impact (possibility of risks and opportunities arising × Level of impact if manifested)
- Expectations and concerns of stakeholders

Results of Scenario Analysis

Climate change is a critical concern from the perspective of business continuity for JFE Group management. Our steel business, which emits 99.9% of the Group's total CO₂ emissions, has been developing technologies for saving energy and reducing CO₂ emissions. We have actively addressed the risks by applying these technologies to steel manufacturing. We will continue to develop processes to further reduce environmental impact while at the same time seeking to turn this challenge into an opportunity for addressing climate change by deploying the technologies we have fostered across the globe.

The JFE Group has developed and maintained a variety of eco-friendly products and technologies, including high-performance steel materials that help save energy when customers use them, as well as renewable energy power generation. We view the current challenges as an opportunity and are contributing to addressing climate change. As automobiles in general become lighter in weight along with the broader adoption of electric vehicles, we will support the transition by improving the functions of the JFE Group's high tensile strength steel sheets and electrical steel sheets. In addition, we will help reduce CO₂ emissions in society by further disseminating renewable energies and implementing recycling initiatives as well as energy conservation.

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

Analysis Results

	Changes in Society and Response		Stakeholder Expectations and Concerns for the JFE Group	Results of Assessment
1.5/2°C Scenario Key Factor ① Decarbonization of Iron and Steelmaking Process	Increasing social demand for decarbonized iron and steelmaking process	Implement innovative technology to realize decarbonation at a large scale	<ul style="list-style-type: none"> Significantly contribute through innovative technologies Increase in investment to implement innovative technologies Increase in operating costs due to the introduction of carbon pricing 	Opportunity ↗ Develop and put into practical use innovative technologies in addition to existing ones
		Introduction of carbon pricing		Risk → Investment into implementing innovative technologies is feasible ↘ Need to accelerate R&D and implementation under 1.5°C scenario → The Group's cost competitiveness will remain the same if uniform carbon pricing is implemented across all countries. ↘ Operating cost increases (if carbon pricing is not properly introduced)
1.5/2°C Scenario Key Factor ② Increased Needs for Effective Utilization of Steel Scrap	Increasing interest for electric arc furnace method for its lower CO ₂ emissions	Increasing expectations for electric arc furnace steel Increasing volume of scraps generated	<ul style="list-style-type: none"> Electric arc furnace as an alternative to converter furnace Expanding electric arc furnace steelmaking within the JFE Group 	Opportunity ↗ Converter furnace steelmaking is increasing due to constraint on the supply of scrap ↗ Expansion in electric arc furnace steelmaking and electric arc furnace engineering ↗ Expansion in scrap logistics business
1.5/2°C Scenario Key Factor ③ Change in Demand for Automotive Steel	Shift in demand for automobiles	Increasing demand for EV motors	<ul style="list-style-type: none"> Increase in demand for electrical steel sheets for EV motors Decrease in demand for special steel due to decreased demand for internal-combustion engines Alternative steel material for automobiles to meet the trend of using multimaterials Demand to improve decarbonization and recyclability of steel 	Opportunity ↗ Increase in demand for electrical steel sheets due to rising popularity of electric vehicles ↗ Increase in demand for special steel due to higher car sales ↗ Increase in demand for high tensile strength automotive steel sheets ↗ Recyclability of steel regains attention ↗ Increase in demand for low-CO ₂ steel products
		Decreasing demand for internal-combustion engines Cars are lighter in weight and use multimaterials		Demand for decarbonization and high recyclability
1.5/2°C Scenario Key Factor ④ Increase in Demand for Solutions to Enhance Decarbonization	Transition to decarbonized society	Increasing demand for solutions to promote the transition Overseas expansion of energy-saving technologies	<ul style="list-style-type: none"> Renewable energy power generation plant Promote low-carbon business, or eco solutions, in developing countries using best available technologies (BAT) developed and put into practical use in Japan 	Opportunity ↗ Entire construction and operation of renewable energy plants (biomass, geothermal, and solar power generation) ↗ Entire construction and operation of incinerators and plastic recycling plants ↗ Entire construction of CCU/CCS facilities ↗ Overseas expansion of low-carbon business
4°C Scenario Key Factor ⑤ Unstable Raw Materials Procurement due to Increased Occurrence of Climatic Hazards	Increasingly devastating climate hazards caused by temperature rise	Raw materials procurement becomes unstable	<ul style="list-style-type: none"> Raw material procurement becomes unstable 	Risk → Ongoing specific measures: Diversify supply sources, strengthen capabilities of facilities
4°C Scenario Key Factor ⑥ Damage to Production Bases and Offices Caused by Climatic Hazards	Increasingly devastating climate hazards caused by temperature rise		<ul style="list-style-type: none"> Increase in damage caused by typhoons and heavy rain Increase in damage caused by drought Flooding caused by sea level rise 	Risk → Measures against flood and drought are already in progress → Impact of flooding caused by sea level rise can be addressed with current countermeasures
4°C Scenario Key Factor ⑦ National Resilience	Increasingly devastating climate hazards caused by temperature rise	Increasing the importance of enhancing infrastructure Increasing demand for disaster mitigation products	<ul style="list-style-type: none"> Contribute to reinforcing infrastructure with steel and other relevant products 	Opportunity ↗ Reinforce infrastructure with steel and other relevant products

Overview of a Scenario Analysis Assessment

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

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

We are developing innovative technologies to emerge as the pioneer in realizing a decarbonized society. With a strong financial base to meet investments for implementing innovative technologies, we are significantly contributing to the transition to a decarbonized society.

Short term (2024)

Medium term (2030)

JFE Steel has been committed to developing energy-saving technologies toward increasing the efficiency of the iron and steelmaking process and decarbonization. These initiatives have helped JFE Steel acquire technologies that realize the world's top energy efficiency in iron and steelmaking. To further push ahead with decarbonization, the Company will enhance the development of innovative ironmaking processes such as COURSE50 and ferro-coke, which are expected to reduce the carbon footprint through hydrogen reduction and CCS.

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.

Short term (2024)

Medium term (2030)

Long term (2050)

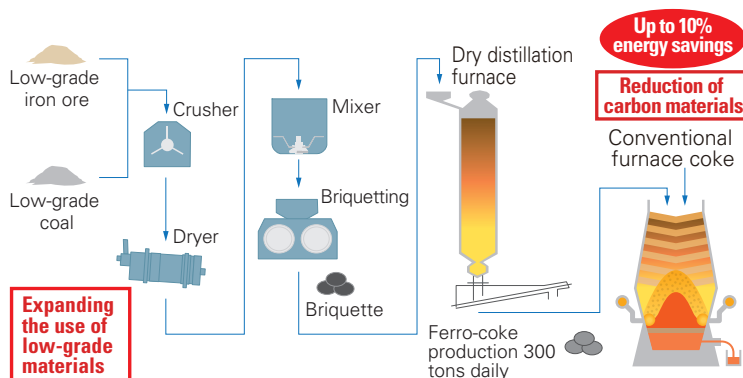
COURSE50 applies hydrogen reduction technology and CCS to reduce CO₂ emissions by about 10% and 20%, respectively, through each technology, for a total reduction of about 30%. The first facility is expected to come online by 2030, followed by the implementation of other plants by 2050, corresponding with the timing for upgrading blast furnace facilities. Ferro-coke is a technology for significantly reducing CO₂ emissions by improving the reduction rate of iron ore put into blast furnaces. In addition to these technologies, we will push forward to establish a hydrogen reduction ironmaking technology which we will aim to put it into practice after 2030 in order to realize the ultimate goal of creating zero-carbon steel.

We consider implementing innovative technologies as critical and will advance with this strategy together with the government. Furthermore, we have a sufficient financial base to meet necessary investments.

For the six-year period from FY2017 to FY2022, JFE Steel worked on the New Energy and Industrial Technology Development Organization (NEDO) project: "Development of Environmental Technology for Steelmaking Process/ Development of Ferro-Coke-Utilization Process Technologies." In the project's final year, we conducted tests to assess the effect of using ferro-coke produced in a medium-scale facility in a blast furnace at the West Japan Works in Fukuyama and confirmed that it lowered the reducing agent rate. The ultimate goal of this technology is to reduce energy consumption in the ironmaking process by approximately 10%. In the future, we will work on identifying issues and researching the operating conditions for achieving this goal by using the mass/energy balance model we have developed for the model steelworks and the general-purpose high-functional blast furnace simulator* that reflects the above test results.

*Developed by Nippon Steel Corporation during the project

■ Example of Developing an Innovative Technology: Ferro-Coke Production Process



Long term (2050)

In the long term, we will develop carbon-recycling blast furnaces (CR blast furnaces), hydrogen steelmaking, and electric arc furnaces while striving to achieve carbon neutrality by 2050, as stated in the JFE Group Environmental Vision for 2050. In particular, we have been focusing on a technology that combines a CR blast furnace with CCU. This is an ultra-innovative technology that targets net zero CO₂ emissions by drastically reducing CO₂ emissions from the blast furnace process, maximizing its ability to efficiently produce high-grade steel in mass volume, and enabling CO₂ reuse in the blast furnace. The remaining CO₂ that cannot be fully reused in the furnace will be further reduced by manufacturing basic chemicals such as methanol.

Long term (2050)

International expectations have been rising for organizations to seek pathways for achieving the 1.5°C scenario. We believe the necessary actions are not significantly different from the 2°C scenario. In the 1.5°C scenario, however, the development and implementation of decarbonizing technologies would need to further accelerate, requiring significantly more R&D costs and capital investment. A public infrastructure capable of supplying cheap and ample green hydrogen and electricity would also need to be in place. We believe that addressing these issues will require more support from the government and collaboration across society, including a mechanism for broadly sharing the financial burden and a long-term government strategy for supplying green hydrogen and electricity. The JFE Group has been actively advancing decarbonization initiatives, including commissioning NEDO's Green Innovation Fund project*¹, issuing transition bonds*², and participating in the GX League*³.

▶ ***1 NEDO's Green Innovation Fund project (Japanese only)** (<https://www.jfe-steel.co.jp/release/2022/01/220107.html>)

▶ ***2 Issue Transition Bonds** (<https://www.jfe-holdings.co.jp/en/release/2022/01/220120.html>)

▶ ***3 GX League (Japanese only)** (<https://gx-league.go.jp/>), **GX League members (Japanese only)** (<https://gx-league.go.jp/member/>)

The Group's cost competitiveness will remain the same if uniform carbon pricing is implemented across all countries.

Short term (2024)**Medium term (2030)**

Various approaches to carbon pricing have been introduced around the world, and in Japan, emissions trading and the introduction of growth-oriented carbon pricing are being discussed in line with the GX Promotion Law for achieving carbon neutrality by 2050. In Europe, a border adjustment tax is also being discussed.

If uniform carbon pricing is introduced to major emitting countries, the increase in operating cost will be reflected reasonably on the price of steel products both in Japan and overseas, thus maintaining the Company's cost competitiveness. In addition, since CO₂ emissions per unit of steel production is the lowest of all competing materials, steel retains its superior position in cost competitiveness.

On the other hand, the introduction of carbon pricing in a manner that is biased toward certain regions, industries, or countries such as Japan would have a major impact on the JFE Group and particularly on its steel business, as this would further increase the current price of electricity, which is already higher in Japan than in other countries. It may cause the Company to lose its cost competitiveness and may even inhibit innovation and hinder the realization of carbon neutrality. As carbon pricing is introduced, we will need to closely monitor emerging trends to confirm that it will truly contribute to growth.

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

To achieve carbon neutrality, we are focusing on high-grade steel manufacturing and raising efficiency by applying our industry-leading electric arc furnace technology. Furthermore, we will open up opportunities for the entire JFE Group by expanding the use of our electric arc furnaces, increasing the use of our electric arc furnace construction technology, and expanding scrap logistics.

Short term (2024)

Medium term (2030)

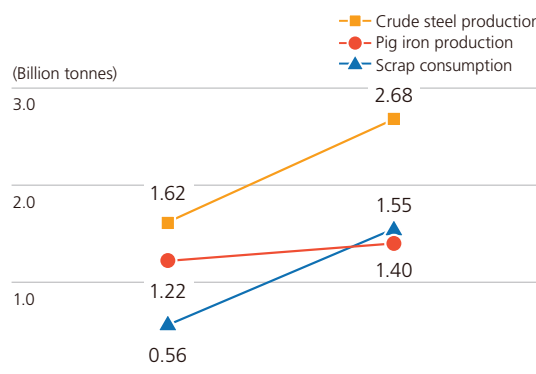
Long term (2050)

The JISF predicts that the demand for crude steel will continue rise along with growth of the global population and economic development and that both the blast furnace and electric arc furnace methods will emerge as major, indispensable steelmaking processes (JISF's Long-term Vision for Climate Change Mitigation). To achieve carbon neutrality, we need to expand the production of steel products using the electric arc furnace method, which emits less CO₂. For this to happen, we need to explore technologies that improve the productivity of electric arc furnaces and address the constraints in producing high-grade steel products. Additional technologies are required for increasing the volume of scrap used in converter furnaces.

The JFE Group is viewing increased demand for electric arc furnace steel as well as the worldwide increase in the amount of scrap generated as an opportunity, and it will enhance its electric arc furnace steel production while applying its engineering technology for constructing an entirely cutting-edge, energy-saving electric arc furnace facility with the ultimate goal of opening up additional business opportunities. In regard to expanding the use of electric arc furnaces, we have decided to strengthen the electric furnace at the Sendai Works and introduce an electric furnace in the stainless steel manufacturing process in the Chiba district (total investment: approx. 15 billion yen). We are also considering the introduction of a high-efficiency, large-scale electric furnace in the Kurashiki district. Moreover, the Group will advance the development of technologies to utilize scrap and boost industry-wide use of this material.

Meanwhile, securing a stable supply of scrap needed for steel production using electric arc furnaces is another vital issue we must address. Expanding the use of scrap will also generate greater demand for distribution options, which will in turn provide an opportunity for JFE Shoji to expand its logistics business.

■ Estimated Supply and Demand for Steel Production and Scrap Use



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

The shift to EVs is accelerating as new and stricter environmental regulations are being introduced globally at a faster pace. Demand for electrical steel sheets for EV motors as well as special steel is increasing as global car sales rise. The increase in the intensity of high tensile strength automotive steel sheets contributes to further weight reductions.

Short term (2024)

Medium term (2030)

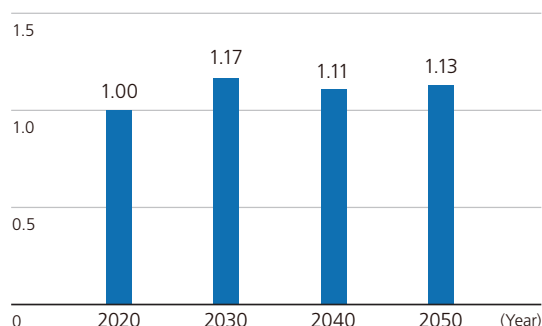
Long term (2050)

The increasing popularity of electric vehicles (EVs) has given rise to rapidly expanding demand for electrical steel sheets used in EV motors. JFE Steel has already commercialized the JNE series of non-oriented electrical steel sheets for automotive applications, as part of its eco-product lineup, and has gained a major market share. In the Kurashiki district, we have decided to triple the production capacity of high-grade, non-oriented electrical steel sheets for EV main motors, compared to the current capacity (total investment: approx. 95 billion yen).

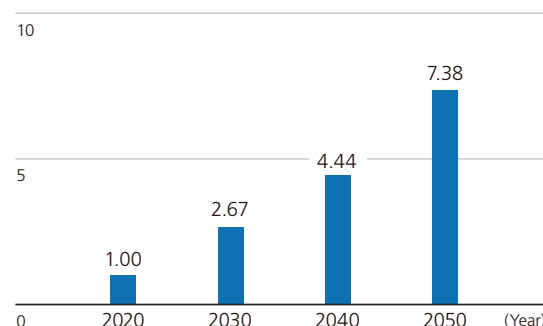
On the other hand, it has been pointed out that an increase in EVs may lead to a decline in the amount of special steel used in engine components. The amount of this type of steel, used in hybrid vehicles and electric vehicles, is 80% and 60% of gasoline cars, respectively. We believe that the risk level for this matter, however, is low since car sales are expected to increase even under the 1.5°C/2°C scenarios and total demand for special steel for cars is increasing.

Nonetheless, the situation for EV remains the same in terms of strong demand for lighter-weight body structures. JFE Steel has developed a cold-rolled steel sheet boasting 1.5 GPa-grade tensile strength as an eco-product and has put it into practical use as an automotive steel sheet. With its high strength, the product can significantly reduce the weight of a car frame. In response to customer demand for more environmentally sound options, we intend to expand its application and further increase its strength, thus dramatically reducing CO2 emissions from cars in motion.

■ Estimated World Demand for Automotive Special Steel



■ Estimated World Demand for Automotive Electrical Steel Sheets



Vertical axis: Steel demand (comparison by year with the year 2020 as 1.00)

Source: Estimated by JFE Holdings based on the reports from METI's Strategic Commission for the New Era of Automobiles

Steel demand will increase due to renewed interest in its highly recyclable quality, essential for decarbonization.

Short term (2024)

Medium term (2030)

Long term (2050)

Steel is a highly recyclable material that can be reborn as many different products over and over again with no loss in its intrinsic quality. In the future, public resource recycling is expected to increase toward establishing a decarbonized society. We believe that the high recyclability of steel will gain attention once again in light of this transition.

Managing emissions throughout the supply chain (Scope 3) has attracted increasing attention, and this will increase demand for low-CO₂ emission steel products.

Short term (2024)

Medium term (2030)

Long term (2050)

The rising worldwide support for decarbonization is expected to drive greater demand for low-CO₂ emission steel products, such as in the automobile industry, where CO₂ emissions must be managed throughout the supply chain. In the IEA's Net Zero Emissions by 2050 Scenario (NZE), the share of steel production using electric arc furnaces is expected to increase to 37% by 2030 and 53% by 2050. Since steel production using electric arc furnaces emits less CO₂ than using blast furnaces, customer demand may shift to products manufactured using the former.

The JFE Group considers the growing demand for low-CO₂ emission steel products as an opportunity. We will therefore actively advance the development of ultra-innovative technologies and, during the transition phase, explore other means for supplying products with low environmental impact. 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 and then supplied as green steel products. Reduction of CO₂ throughout the supply chain is rapidly progressing and JFE Steel will contribute to the decarbonization of society by expanding its capacity for supplying JGreeX™ and further reducing CO₂ emissions through the use of advanced low-carbon technologies as well as energy-saving, high-efficiency technologies.

Effect of trend to use multi-materials is limited.

Short term (2024)

Medium term (2030)

Long term (2050)

Aluminum and carbon fiber reinforced plastic are potential alternative materials for reducing the weight of cars. It has been pointed out, however, that the production cost of these materials and the amount of CO₂ emitted throughout their life cycles is higher than those of steel. Therefore, under the 2°C scenario, which assumes the introduction of a carbon pricing whereby the price differential between steel and alternative materials will be larger. Under this scenario, while the trend of using multi-materials may show some progress for luxury cars, their use would be limited for economy cars. Moreover, considering a situation in which all panels used for doors and other parts of a luxury car were changed to aluminum, the effect on weight reduction could be expected to be 5% of all materials used in luxury and economy cars together.

Multiplied by the number of cars produced, the impact over the total demand for automotive steel can be assumed to be limited.

In the meantime, JFE Steel has developed a multi-material structure that uses a small amount of fiber resin to maximize steel quality. In this new structure, a highly ductile, strong adhesive resin is sandwiched between a body part made of an ultra-high strength steel plate and a part made of a thin steel plate. This structure is capable of further reducing the weight of automobile frame parts and also improving collision safety performance.

We will continue developing and proposing various products and technologies that meet customer needs.

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

Providing solutions: renewable energy power generation, Multisite Energy Total Service, recycling business, carbon-recycling technologies, and energy-saving steel technologies

Renewable Energy Power Generation

Short term (2024)

Medium term (2030)

Long term (2050)

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

We will also focus on offshore wind power generation, which the Japanese government has positioned as one pillar of its Green Growth Strategy to achieve carbon neutrality by 2050. Specifically, we plan to manufacture and market monopiles and other seabed-fixed structures with JFE Engineering as the main driver. JFE Engineering has started constructing Japan's first monopile-foundation manufacturing plant, scheduled to start production in April 2024*⁴. JFE Steel will contribute by increasing the supply of large and heavy steel plates, and JFE Shoji will assist by establishing SCM, which includes information sharing with Taiwan, a leader in offshore wind power generation, and East and Southeast Asian countries, where demand is expected to expand. We will also focus on O&M*⁵ to fully deploy Group resources.

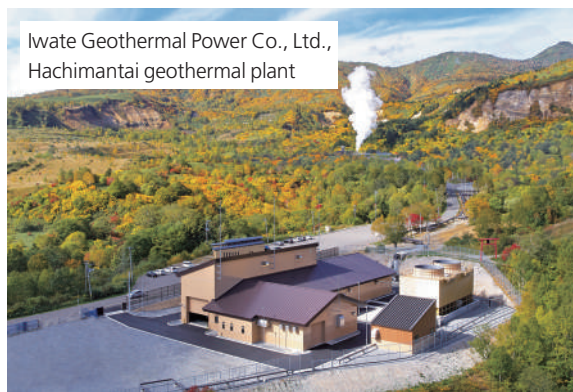
Furthermore, from the perspectives of the effective use and recycling of resources, we are taking action to increase power output at waste processing facilities. JFE Engineering is developing a fully automated operation*⁶ to facilitate higher power output at waste incinerators (introduced to 12 facilities by FY2022, and will be gradually expanded to 16 facilities).

Moreover, we are utilizing renewable energy as the main power source for our retail electricity business*⁷, and in helping to establish and operate regional electricity retail companies*⁸, we focus on local production and consumption of electricity based on renewable energy. In FY2020, we helped 8 locations establish and operate their regional electricity companies. In FY2024, we plan to do the same for around 10 locations, and in FY2030, for around 20.

(Contribution to CO₂ reduction resulting from renewable energy power generation: FY2020: 9.65 million tonnes per year → FY2024: 12 million tonnes per year → FY2030: 20 million tonnes per year)



Waste-to-energy power generation plant



Geothermal power generation plant

▶ ***1 The JFE Engineering Corporation's biomass power generation (Japanese only)** (<https://www.jfe-eng.co.jp/products/power/ele07.html>)

▶ ***2 The JFE Engineering Corporation's geothermal power generation plant** (<https://www.jfe-eng.co.jp/en/products/power/gene01.html>)

▶ ***3 The JFE Engineering's solar power generation (Japanese only)** (<https://www.jfe-eng.co.jp/products/power/ele05.html>)

The JFE Technos Corporation's solar power generation (Japanese only) (<https://www.jfe-technos.co.jp/products/solar/>)

▶ ***4 JFE Engineering invests in constructing a new monopile foundation factory** (<https://www.jfe-eng.co.jp/en/news/2021/20210720.html>)

*5 Operation and maintenance business

▶ ***6 JFE Engineering's BRA-ING Pre-release (Japanese only)** (<https://www.jfe-eng.co.jp/news/2020/20200727.html>)

▶ ***7 Urban Energy Corporation's electricity retail business (Japanese only)** (<https://u-energy.jp/service/retail.html>)

▶ ***8 Urban Energy Corporation's regional electric power support business, targeting local governments (Japanese only)** (<https://u-energy.jp/service/municipality.html>)

Establishing regional electricity retail companies in partnership with local municipal governments (CSR Report 2022, P. 116) (<https://www.jfe-holdings.co.jp/en/csr/pdf/csr2022e.pdf>)

Multisite Energy Total Service

Short term (2024)

Medium term (2030)

Long term (2050)

In addition to the conventional service of optimizing energy use for single sites, JFE Engineering offers the Multisite Energy Total Service (JFE-METS)*, which optimizes energy use for multiple sites through centralized management. We realize overall energy savings and CO₂ reduction by analyzing energy consumption at multiple sites and achieving total optimization by installing and operating energy-related equipment at each site to circulate energy throughout the network, including remote locations.

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

Recycling Business

Short term (2024)

Medium term (2030)

Long term (2050)

We are striving to reduce the use of new fossil fuel-derived materials by recycling waste plastic and food waste. In waste plastic recycling, in addition to the conventional recycling of plastic containers and packaging, we are actively engaged in the so-called bottle-to-bottle business, in which used PET bottles are recycled into new ones. We have completed the construction of the PET bottle recycling raw material manufacturing plant (West Japan PET Bottle MR center), and full commercial operation has begun. The plant recycles approximately 10% of the total number of PET bottles shipped nationwide, demonstrating a complete resource recycling model for reducing CO₂ emissions. In food recycling, we generate methane gas from disposed food wastes to create renewable energy (fuel gas and electricity). JFE Engineering manages the engineering, procurement, and construction of recycling plants, while J&T Recycling Corporation manages the operation and business development of the plants*.

Industry-wide decarbonization cannot be achieved through technical developments in manufacturing alone. We therefore believe that demand for CCU and CCS facilities will increase as they facilitate the efficient use and storage of CO₂. JFE Engineering is able to undertake the entire process of building CCU and CCS facilities from design and procurement to construction.

▶ [*JFE Engineering and J&T Recycling Corporation's Recycling \(Japanese only\)](https://www.jfe-eng.co.jp/products/recycle/) (https://www.jfe-eng.co.jp/products/recycle/)

Energy-Saving Steel Technologies

Short term (2024)

Medium term (2030)

From the perspective of the steel industry, there is room for disseminating eco solutions (energy-saving steel technologies) in nations such as China, where close to 50% of the world's crude steel is produced, and India and ASEAN countries, where further growth in production is expected. The potential CO₂ reduction achieved by internationally transferring and disseminating advanced energy-saving technologies widely used in Japan will exceed 400 million t-CO₂ worldwide (Japan is estimated to contribute to the reduction of approximately 80 million t-CO₂ in FY2030 through these technologies).

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

Ongoing initiatives to address the issue, such as alternative procurement and dispersed supplier bases, and increasing plant capacity.

Short term (2024)

Medium term (2030)

In Australia, our major source country for raw materials, the frequency of typhoons is predicted to double. If production and shipments are disrupted in Australia for too long, we may not be able to continue production and would therefore suffer a loss. To address this, we are promoting alternative procurement and dispersed supplier bases.

Alternative procurement and dispersed supplier bases:

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

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

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

Measures against flood and drought in progress; impact of flooding caused by rising sea levels can be addressed with current countermeasures.

Short term (2024)

Medium term (2030)

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

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

FOCUS Key Factor (7) National Resilience

Contribute to infrastructure enhancement with products such as high-strength H-shaped steel and steel pipe piles, hybrid tide embankments, and permeable steel slit dams.

Short term (2024)

Medium term (2030)

The JFE Group takes seriously the increased frequency and severity of recent climatic hazards in Japan. Also, the daily life of the Japanese citizenry is being exposed to a heightened risk of danger. The JFE Group defines its mission as promoting disaster prevention and mitigation as well as national resilience to maintain vital infrastructure that is essential to daily life and economic activities.

The JFE Group will gather its collective energy to protect key structures from earthquakes using structural steel such as high-strength H-shaped steel and steel pipe piles as well as steel sheet piles. It will also help to reinforce embankments that are prone to bursting and provide disaster prevention products such as hybrid tide embankments and permeable steel slit dams, in addition to reconstructing infrastructure.

➤ [Hybrid Tide Embankments](#) (P.81)

➤ [Permeable Steel Slit Dams](#) (P.82)

➤ [Terre Armée Method](#) (P.82)

Links to information about the JFE Group Environmental Vision for 2050 and Climate Change Scenario Analysis

Commitment to a Low Carbon Society: ➤ [Steel Industry Initiatives](#) (P.104)

Targets and Results Related to Climate Change: ➤ [Material Issues of Corporate Management and KPIs](#) (P.20)

Initiatives on Climate Change: ➤ [Climate Change](#) (P.53)

Technologies and Products Related to Reducing ➤ [Development and Provision of Eco-friendly Processes and Products](#) (P.108)